Spectra Engineering Pty Ltd.

Technical Brief

Trade Name: **MX800F** Base Station / Repeater

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Addendum:

PDF MX800 Service Manual
PDF MX800 External & Internals photos
PDF MX800 Operation and Description
PDF Spectra Engineering Authorization Letter

Testing by: Spectra Engineering Pty Ltd.
Report Writing: Terry Urbanowski, C.E.T.
Report Date: May 23, 2007

1.0 Introduction

The MX800 product is presently Industry Canada certified for use in the VHF and UHF bands. Our objective is to certify the MX800 for the use of frequencies 217 – 218 MHz, 219 – 200 MHz and 220 – 222 MHz band as outlined in RSS-119 Issue 8 and RSS-Gen Issue 1.

For the 200-220 MHz section of the band, we have applied mask F using 12.5 kHz channel equipment, by superimposing three masks F on a 15 KHz bandwidth. The equipment complies with the attenuation slope of mask F near the edge of the 15 kHz channel as outlined in SRSP512e Section 4.1.5.

Mask I has been applied to 217 – 220 MHz for 12.5kHz channel spacing or an occupied bandwidth of 11.25kHz.

The power range of the MX800 is software adjustable and factory calibrated from 1 watt to 50 watts.

1.1 Product Description

The MX800 advanced design, uses the latest component technology to achieve superior performance in high RF environments. The sensitive receiver features a wide switching bandwidth and at the same time, maintains good blocking, Intermodulation and adjacent channel performance.

The broadband transmitter exciter module has very low spurious emission levels, and is followed by an efficient RF power amplifier. The optimized PA heatsink design results in lower transmitter temperature rise during continuous operation.

Features

• Complementing the wide RF switching bandwidth (greater than 10 MHz in all bands) the MX800 has an exceptional frequency coverage between 30 MHz and 960 MHz.

• An extended low frequency transmitter modulator response (DC to 3.4 kHz) permits the use of the MX800 in paging and other data applications.

• An extremely fast transmitter rise time with controlled soft start results in low transient emissions.

• Fast mute action, combined with fast TX, makes the MX800 suitable for many trunking and data systems.

• Functionally independent TX and RX mean that crossbanding is easily accomplished.

• A non-predictive CTCSS decoder will recognize any valid tone and transmit a user associated TX tone.

• Continuously rated at full operating power, the MX800 has a thermally controlled high MTBF fan ensuring cooler PA operation.

• Low current consumption on both TX and RX.

• 255 RF channel capability with operating channels optionally selectable from rear inputs.

• An automatic PA protection circuit reduces the output power at high VSWR and high temperature.

• Advanced fractional synthesizer design.

• Fully configurable by hardware and software for special applications.

Reliability

Reliability is designed into the MX800 and effective manufacturing quality control carries this into the finished product. Rugged machined module housing construction and extensive use of surface mount technology provides outstanding reliability under the harshest conditions.

Construction

The MX800 is a compact lightweight transceiver housed in a 2RU height (89 mm) fully welded steel case. The unit conforms to the 19” rack mounting standard and an optional slider rail kit can be fitted. The module construction has been designed for international EMC/EMI rules compliance and all RF modules are ndividually screened.

User Interface

RF, analog and digital signal line accessibility at the rear panel means that the MX800 is a versatile transceiver which can be used in systems configured to special requirements. For trunking applications, special system control functions are included. The base station is serially programmable on a per channel basis using MXTOOLS programming software. This software utility also permits remote monitoring, control and diagnostics of the MX800. Parameters such as PTT, Mute/squelch, Alarms, Digital I/O etc. can also be monitored or controlled independently. Real time measured analog parameters include: CTCSS decoded frequency, CTCSS encoded frequency, Forward and Reflected RF power, PA temperature, RSSI, RX and TX VCO volts, Discriminator output audio level and DC supply volts.

1.2 Product Applications

Typical applications for the MX800 include:

• Conventional private mobile radio base stations and repeaters.
A simplex option is available with an internally mounted changeover relay. In full duplex mode the MX800 is suitable for link applications.

• RF transceiver for trunked systems.
The DC modulator permits operation in a wide variety of trunking systems.

• RF transceiver for cellular systems
(analog).

• Paging transmitter.
The standard MX800 will accept a digital signal for transmission of POCSAG data.

• Mobile data systems.
Fast TX and RX response times reduce message overhead and increase data throughput. Low group delay distortion permits data rates to 19.2 kbps

Options

The following are standard options for the MX800:
• CTCSS encoder/decoder
• Simplex changeover relay
• –30°C temperature frequency stability
• 4 level FSK or 2 level FFSK modems
• Base station morse ID
• Full duplex DCS/DPL operation
• DSP/DDS based digital exciter

2.0 RSS-119 Issue 8 Testing

The transmitter and receiver test methods were followed as outlined in RSS-119 Issue 8, and RSS-Gen Issue 1 to include:

Output Power Test
Unwanted Emissions
Emission Mask I
Emission Mask D
Emission Mask F
Transient Frequency Behavior
FM Modulation Limiting and Audio Low Pass Filter
Frequency Stability
Receiver Spurious Emissions

2.10 Test Equipment

Manufacturer	Type	Model
HP	Communication Test Set	HP2920B
HP	Spectrum Analyzer	HP8595E
HP	Spectrum Analyzer	HP8562E
HP	Modulation Analyzer	HP8901B
HP	Signal Generator	HP8657B
HP	Oscilloscope	HP54600B
Lambda	Power Supply	ZUP20-20

2.12 Output Power Test

The output power is software adjustable from 1 Watt to 50 Watts. The EUT was tested unmodulated and measured at 1 Watt, 25 Watts and 50 Watts .

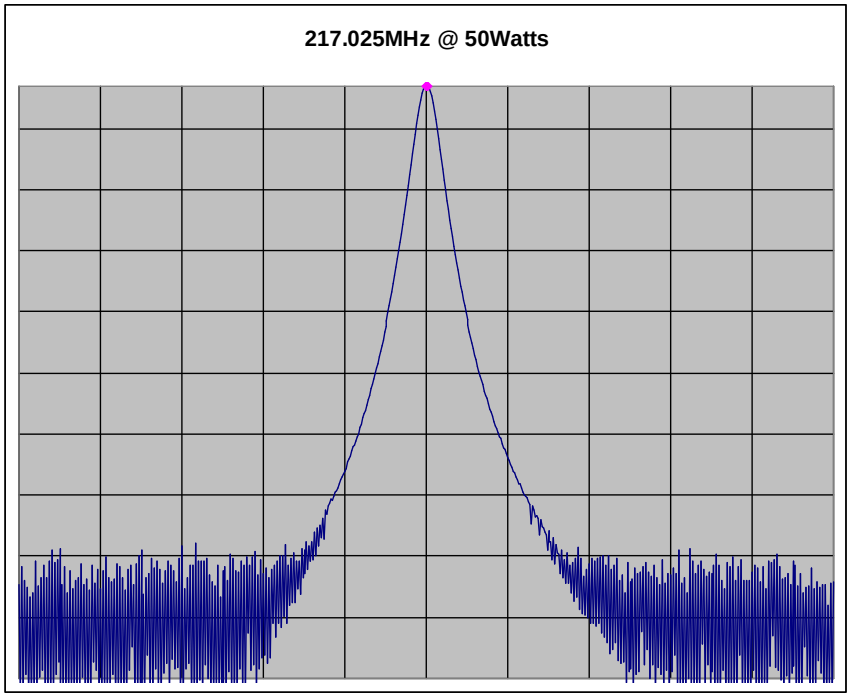
5.4 Output Power Test

The output power shall be within ±1.0 dB of the manufacturer's rated power.

Variable output power: 30dBm-->46.989dBm

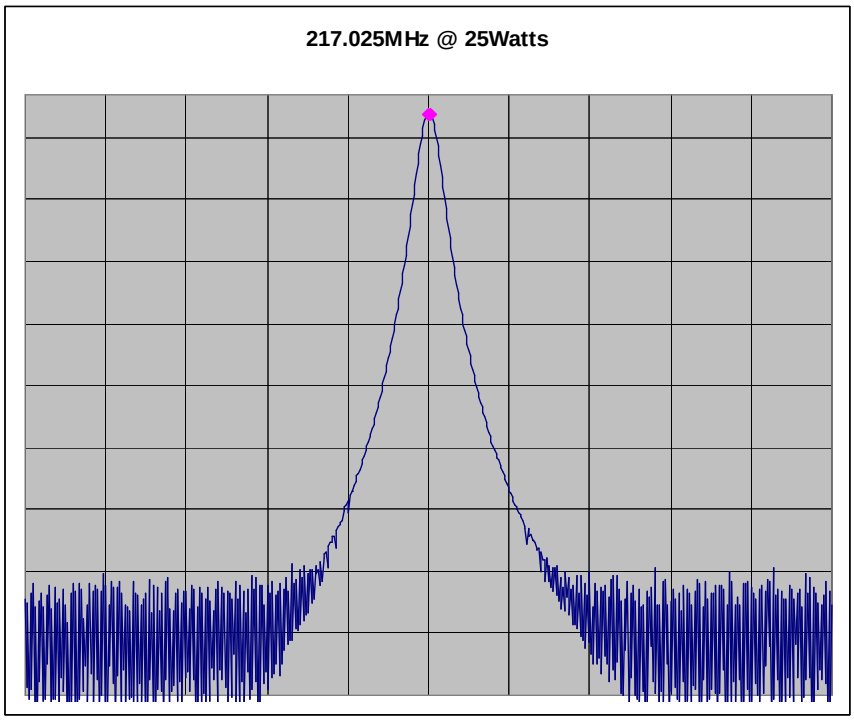
Variable Output Power: 1 to 50 Watts adjustable
Measured Maximum Power of 50Watts: 49.99 W
Measured Intermediate Power of 25Watts: 25.0610W
Measured Low Power of 1 Watt: .9616W
Frequency of Measurement: 217.0250 MHz
Conclusion: Meets RSS-119 Section 4.1 requirements.

9/05/2007
Centre Frequency:
217.025000 MHz
Resolution Bandwidth: 10KHz
Span: 2MHz
Video Bandwidth: 100KHz
Sweep Time: 50ms
Attenuation: 30 dB
Reference Level: 46.93 dBm
Mark Level: 46.93 dBm
Power: 49.991 Watts

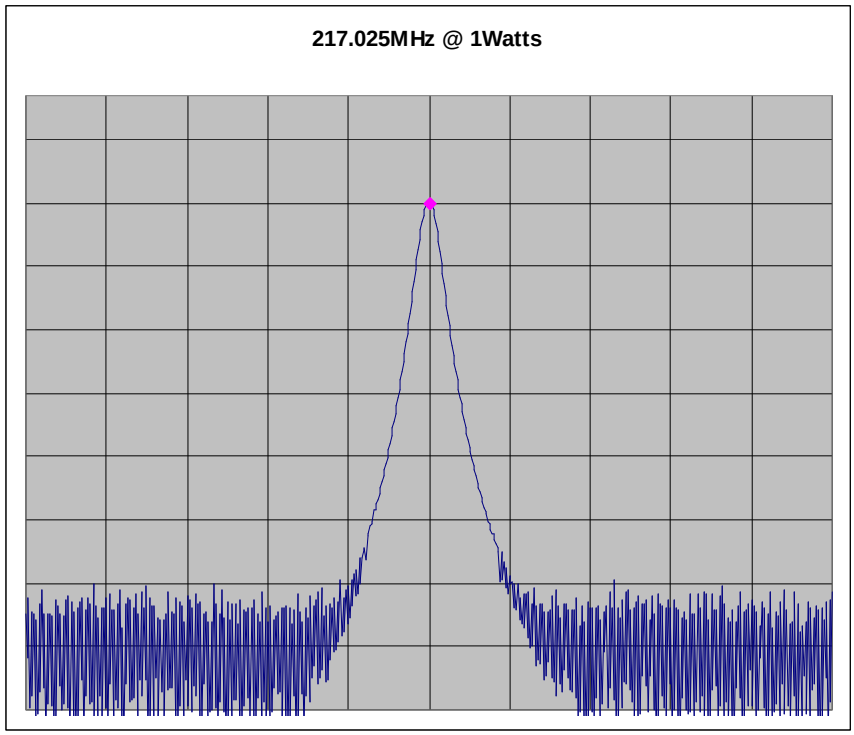


9/05/2007
Centre Frequency:
217.02500 MHz
Resolution Bandwidth: 30kHz
Span: 2MHz
Video Bandwidth: 100kHz
Sweep Time: 50 ms
Attenuation: 30 dB
Reference Level: 46.16 dBm

Marker Amplitude: 43.99 dBm
Power 25.0610 Watts



10/05/2007
Centre Frequency:
217.02500MHz
Resolution Bandwidth: 30kHz
Span: 2MHz
Video Bandwidth: 100kHz
Sweep Time: 50 ms
Attenuation: 30 dB
Reference Level: 46.16 dBm
Marker Amplitude: 29.83 dBm
Power: .9616 Watts



PASS

Testing Method
The testing method was followed as outlined in document RSS119 Section 4.1 and RssGen 4.6 . The EUT was measured conductively through a proper load impedance to match the transmitter and connected to the spectrum analyzer.

Test Results:

Frequency	Output Power in dBm	Output Power in Watts
217.0250 MHz	**46.93**	**49.991**
217.0250 MHz	**43.99**	**25.061**
217.0250 MHz	**29.83**	**.9616**

Base Station Model Number: MX800FFHPSZ2SD
Serial Number: 07044792
OFR: 195-225Mhz
SR: 30Mhz

2.13 - Unwanted Emissions

Name of Test: Unwanted Emissions
Test Results: Meets minimum standard

Test Method
The transmitter's unwanted emissions were tested as outlined in RssGen Section 4.7 and RSS119e Issue 8 Section 4.1 and 4.2.
Unwanted emissions were measured with the transmitter operating at the manufactures rated outputs. Due to the power output being adjustable, the transmitter's unwanted emissions were measured at 50 Watts and 1 Watt. The spectrum was scanned and recorded for each power level. Each scan was conducted from 0 Hz to at least the 5th harmonic of the highest generated frequency.

All unwanted emissions <100dBc @ all power levels between 1W-50W signals below spectrum analyzer noise floor

Carrier Output Power: 50Watts

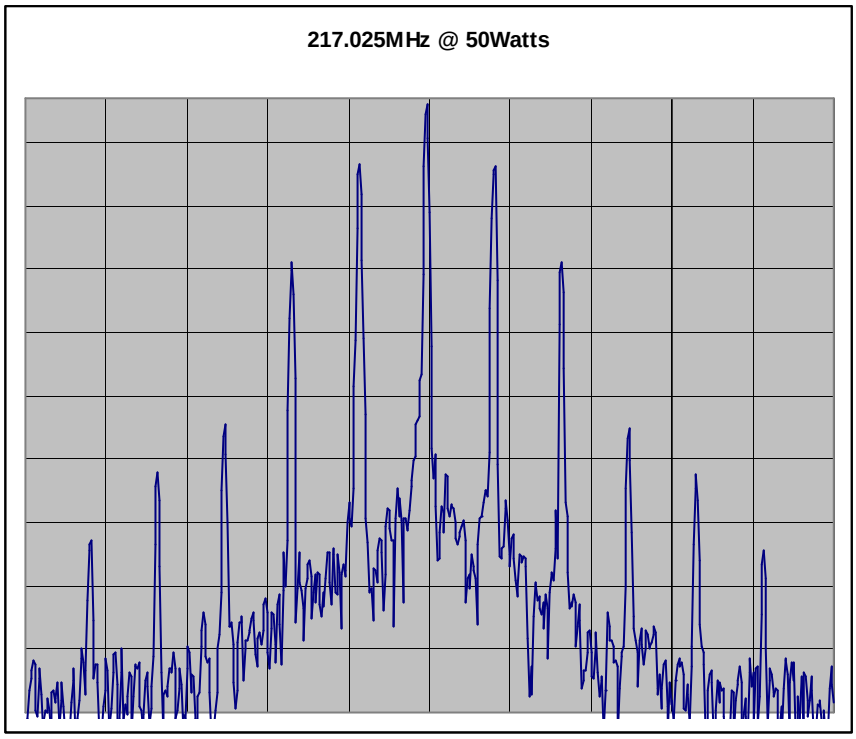
Channel Spacing, Authorized Bandwidth and Spectrum Masks

The permissible channel spacing **= 12.5kHz**
Authorized bandwidths= **11.25kHhz**
Spectrum Masks with Audio Filter = **D or I**

PASS

5.8 Transmitter Unwanted Emissions

9/05/2007 12:20
Centre Frequency: 217.025MHz
Resolution Bandwidth: 100Hz
Span: 30KHz
Video Bandwidth: 300Hz
Sweep Time: 2.4sec
Attenuation: 30
Reference Level: 46.16



MX800 F Band
Spectrum Emission Mask Plot
50Watts, 11.25kHz (Narrow band)

Unwanted Emissions

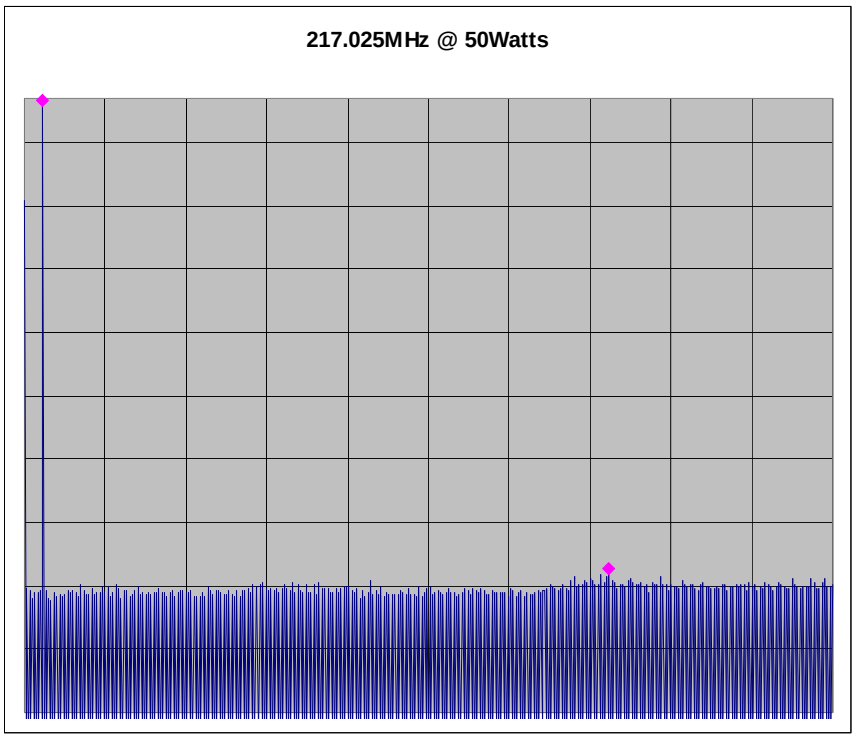
PASS

All unwanted emissions <100dBc @ all power levels between 1W-50W signals below spectrum analyzer noise floor.

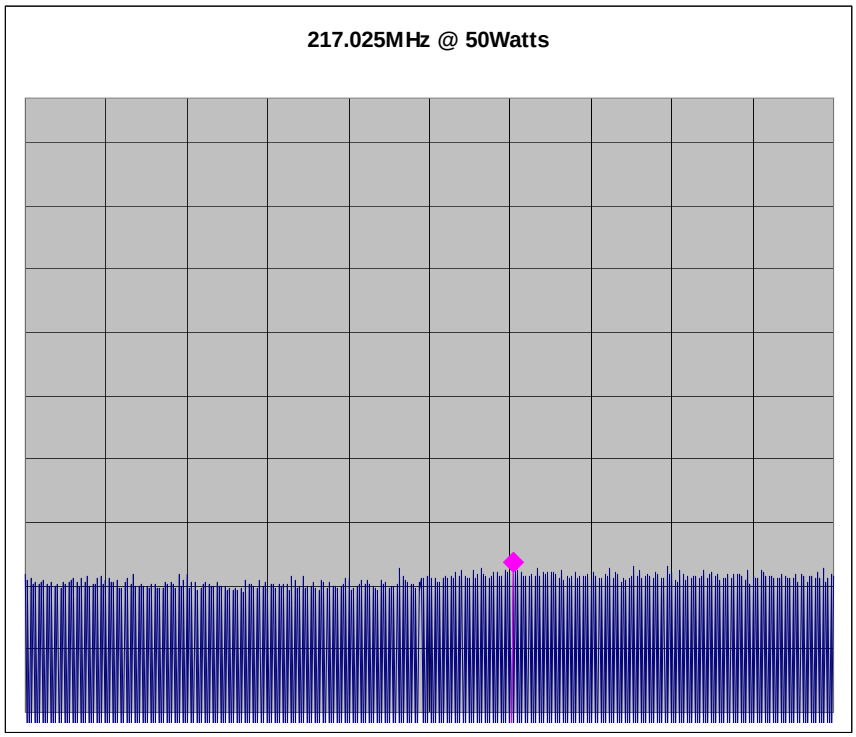
Minimum limit: 66.989dBc (-16.989dbm)

Carrier Output Power: 50Watts

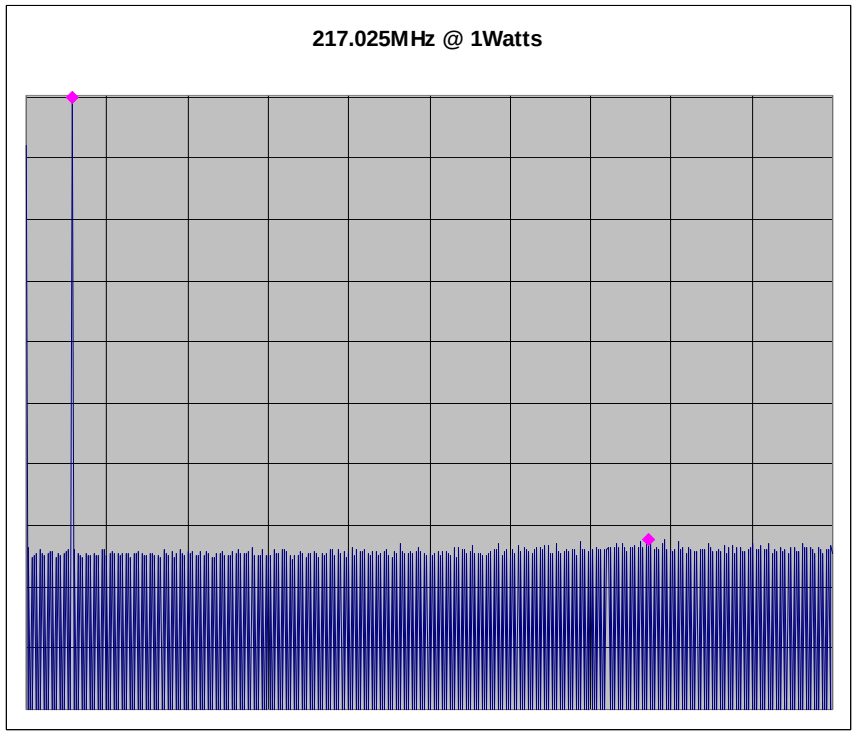
9/05/2007 12:53
Centre Frequency: 217.025MHz
Resolution Bandwidth: 30kHz
Span: 10GHz
Video Bandwidth: 100kHz
Sweep Time: 28sec
Attenuation: 30 dB
Reference Level: 47.3dbm
Marker Amplitude: -76.5dBc



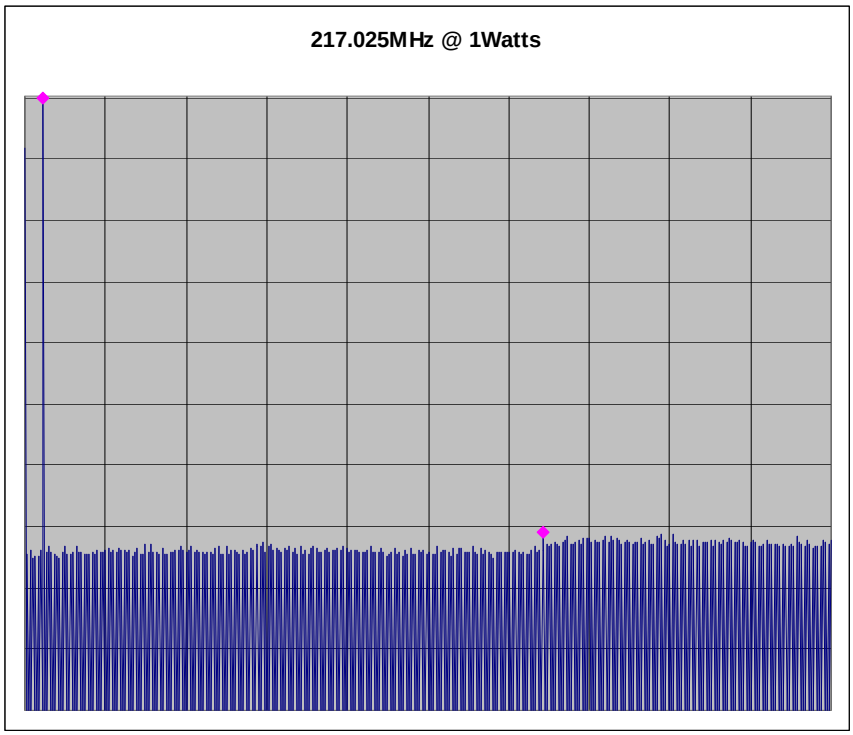
9/05/2007 12:53
Centre Frequency: 6.5GHz
Resolution Bandwidth: 30kHz
Span: 7GHz
Video Bandwidth: 100kHz
Sweep Time: 20sec
Attenuation: 30 dB
Reference Level: 46.16dbm
Marker Amplitude: -75.33dBc



10/05/2007 12:13
Centre Frequency: 2G
Resolution Bandwidth: 10KHz
Span: 4GHz
Video Bandwidth: 30kHz
Sweep Time: 100sec
Attenuation: 20
Reference Level: 30.16
Marker Amplitude: -73.67dBC



10/05/2007 12:32
Centre Frequency: 5 GHz
Resolution Bandwidth: 10kHz
Span: 10GHz
Video Bandwidth: 30kHz
Sweep Time: 250sec
Attenuation: 20
Reference Level: 30.16
Marker Amplitude: -71.9dBc



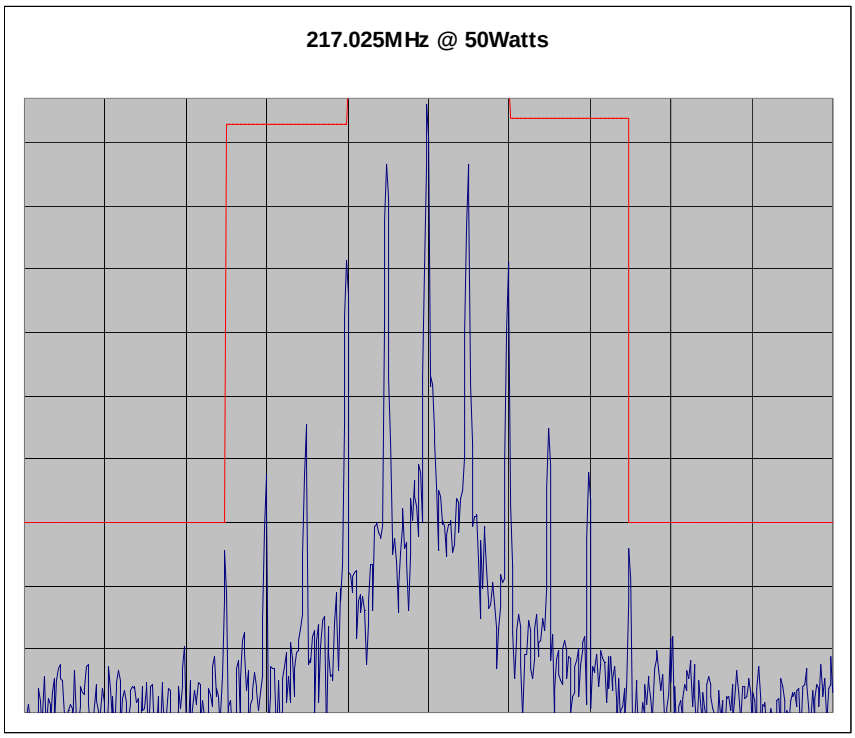
2.14 Emission Mask D

Name of Test: Transmitter Occupied Bandwidth 50 Watts with Mask D
Minimum Standard: Mask D

Authorized Bandwidth = 11.25kHz
From Fo to 5.625 kHz, down 0 dB
Greater than 5.625 to 12.5 kHz, down 7.25(Fd-2.88)dB
Greater than 12.5 kHz, down at least 50+Log10(P) or
70 dB, whichever is the lesser of the attenuation
P=50W
Attenuation: = 0 dB at Fo to 5.625 kHz
Attenuation: = 20 dB at 5.625
Attenuation: = 66.989 dB greater than 12.5kHz

Test Results: Mask meets Minimum Standards for Mask D.

9/05/2007 12:20
Centre Frequency: 217.025MHz
Resolution Bandwidth: 100Hz
Span: 50KHz
Video Bandwidth: 1kHz
Sweep Time: 4sec
Attenuation: 30
Reference Level: 46.16



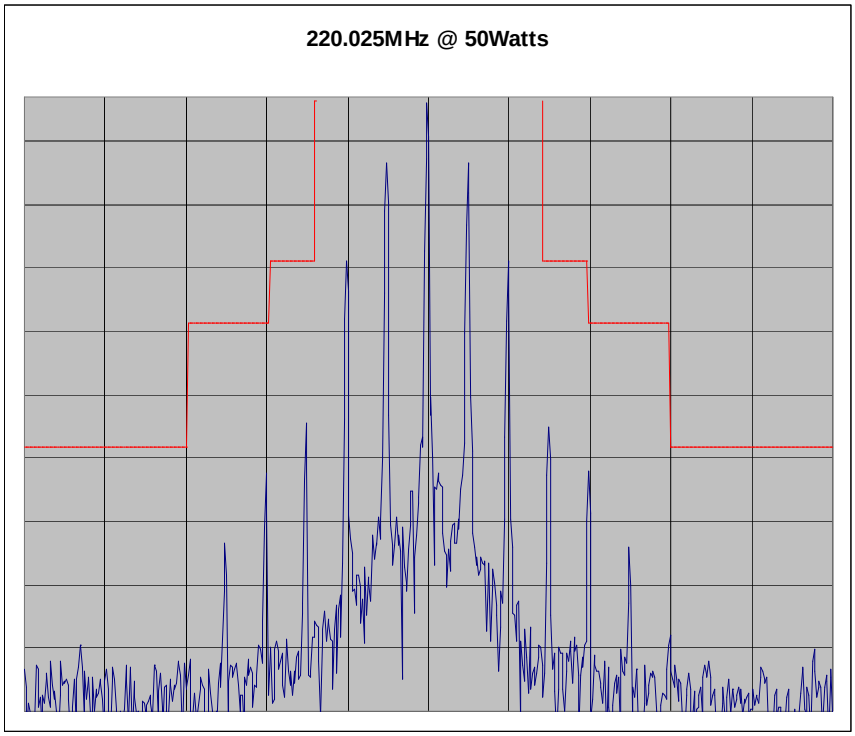
MX800 F Band
Spectrum Emission D Mask Plot
50Watts, 11.25kHz (Narrow band)

2.15 Emission Mask I
Name of Test: Transmitter Occupied Bandwidth 50 Watts with Mask I
Minimum Standard: Mask I

Authorized Bandwidth = 11.25kHz
From Fo to 6.0 kHz to 9.0 kHz down 25 dB @ 100 BW
Greater than 9.0 kHz to 15.0 kHz, down 35 dB
Greater than 15 kHz, down at least 43+Log10(P) or
70 dB, whichever is the lesser of the attenuation
P=50W
Attenuation: = 25 dB 6.0 kHz to 9.0 kHz
Attenuation: = 35 dB 9.0 kHz to 15 kHz
Attenuation: = 59.989 dB greater than 15 kHz

Test Results: Mask meets Minimum Standards for Mask I .

10/05/2007 10:20
Centre Frequency: 220.025MHz
Resolution Bandwidth: 100Hz
Span: 50KHz
Video Bandwidth: 1kHz
Sweep Time: 4sec
Attenuation: 30
Reference Level: 46.16



MX800 F Band
Spectrum Emission I Mask Plot

2.16 Emission Mask F

Name of Test: Transmitter Occupied Bandwidth 50 Watts with Mask F

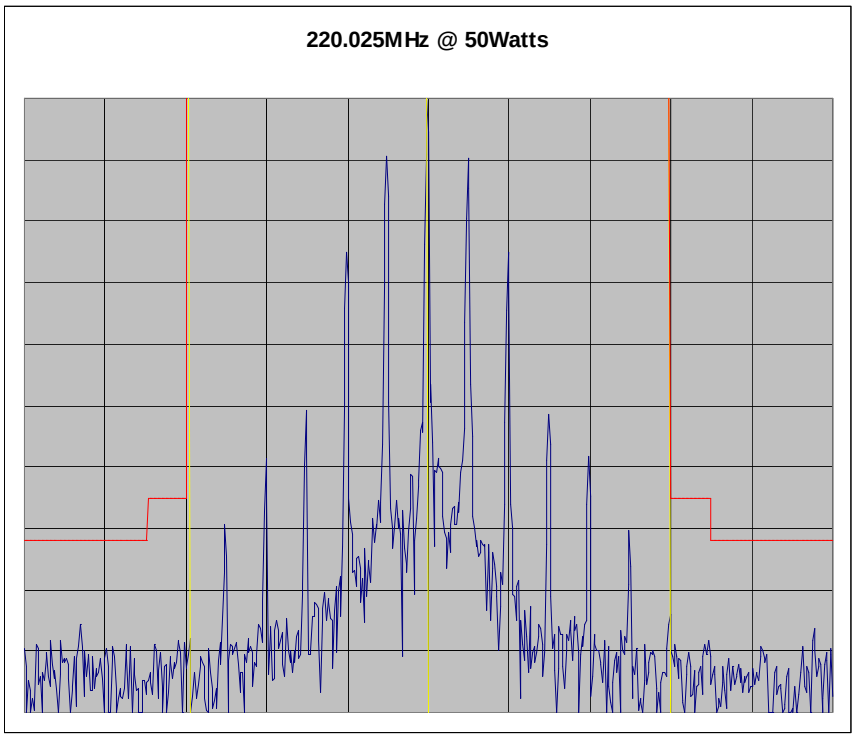
Minimum Standard: Mask F

Mask F for 220-22MHz as applied to 12.5 channel spacing

Methodology:

For the 200-220 MHz section of the band, we have applied mask F using 12.5 kHz channel equipment, by superimposing three masks F on a 15 KHz bandwidth. The equipment complies with the attenuation slope of mask F near the edge of the 15 kHz channel as outlined in SRSP512e Section 4.1.5.

10/05/2007 10:20
Centre Frequency: 220.025MHz
Resolution Bandwidth: 100Hz
Span: 50KHz
Video Bandwidth: 1kHz
Sweep Time: 4sec
Attenuation: 30
Reference Level: 46.16



MX800 F Band
Spectrum Emission F Mask Plot
3 X 3.75 Channel, 11.25kHz (narrow)

Yellow* Indicates the 3 Channel Centre frequencies

Red* Limit Markers

2.17 - Transient Frequency Behavior

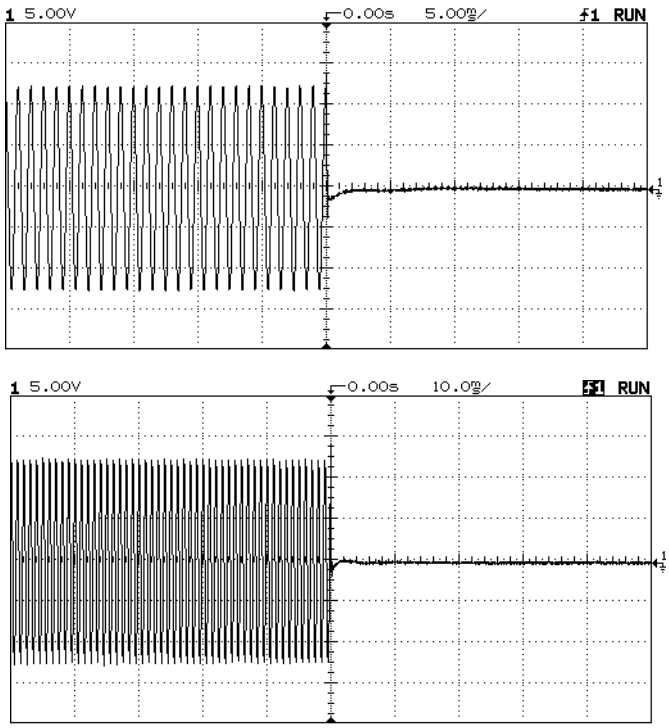
Test Method: EIA/TIA Standard 603 2.2.19
Test Results: Meets specification

5.9 Transient Frequency Behavior of Transmitter: PASS

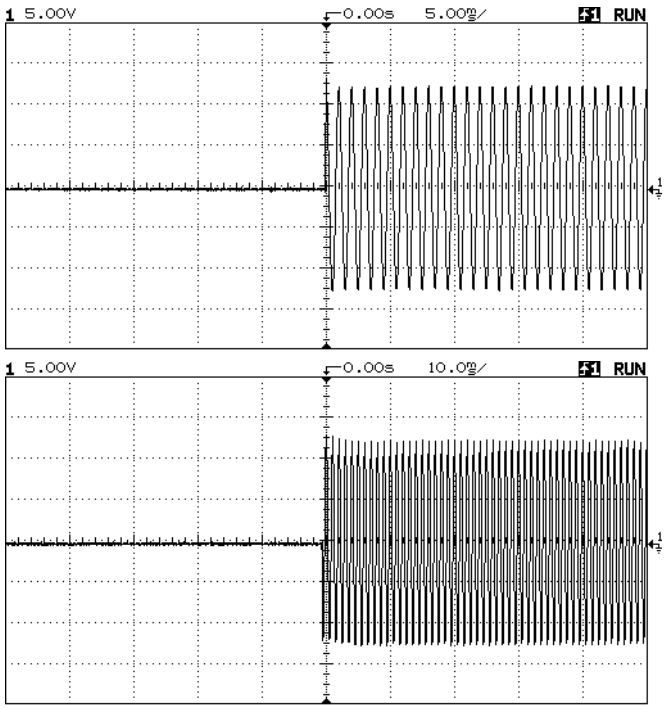
	138 Mhz-174 Mhz	406 Mhz 512 Mhz	Frequency Spec	Measured Period
T1	**5ms**	**10ms**	**< ±12.5kHz**	<1Ms
T2	**20ms**	**25ms**	**< ±6.25kHz**	<1Ms
T3	**5ms**	**25ms**	**< ±12.5kHz**	<1Ms

Test Freq.= 220.02500 MHz

TX ON



TX OFF



2.18 FM Modulation and Audio Low Pass Filter

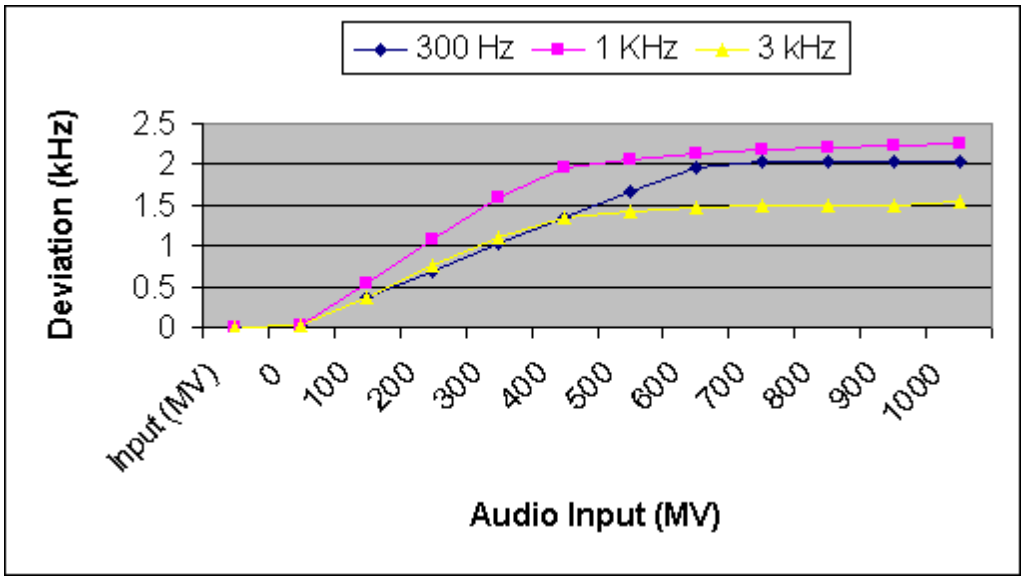
5.10 FM modulation limiting

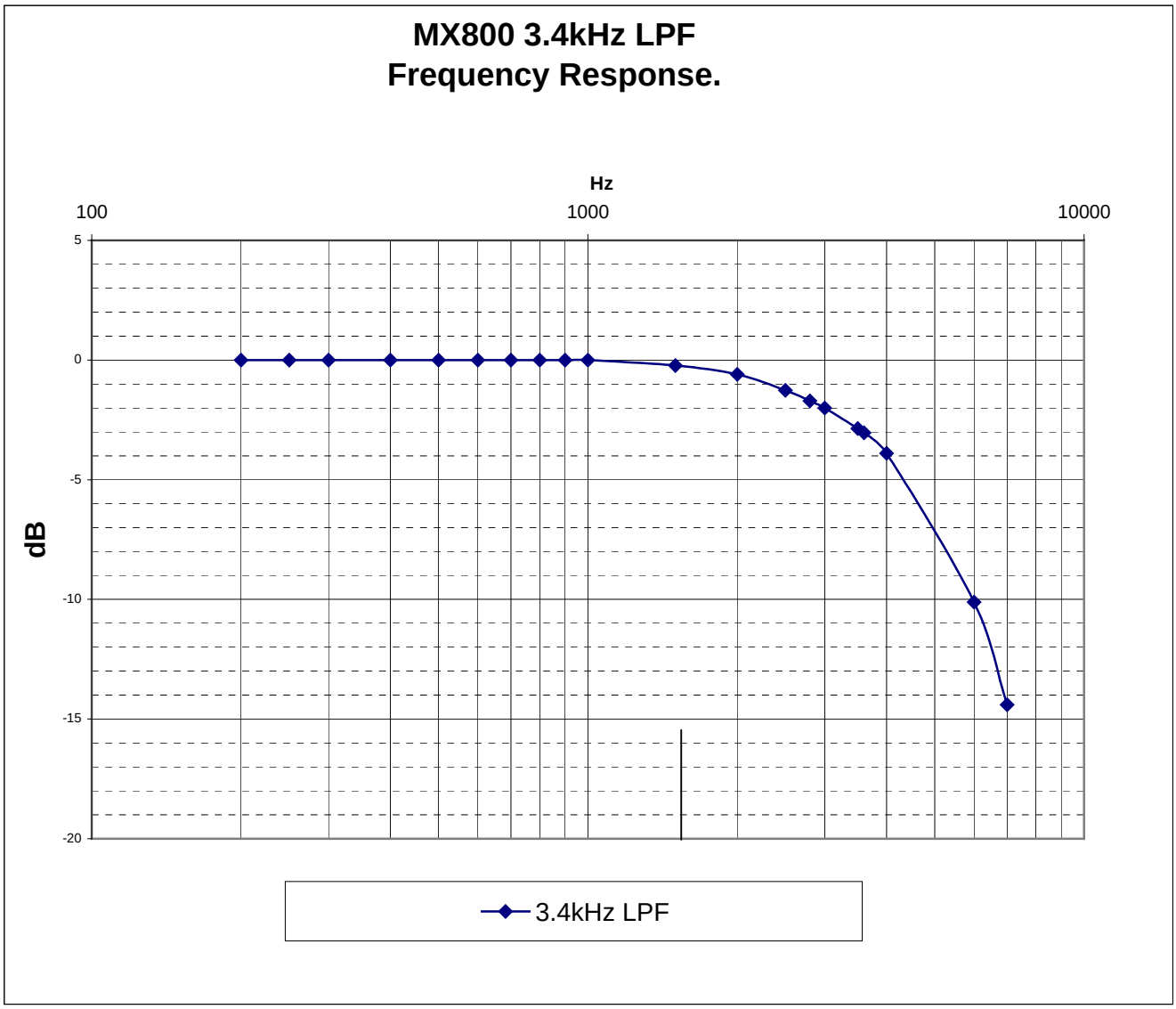
Method: A 3kHz audio signal was applied through the microphone circuit as below limiting. The audio signals were varied between 300, 1000 and 3000 Hz and resulting deviation recorded. The audio signal was increased in 100mV steps up to 1000mV and recorded at each 100 mV increment.

Test Results: The modulator/limiter meets the requirements of Table 17

MX800 Modulation Limit - 12.kHz

	300 Hz	1 KHz	3 kHz	
Input (MV)	Dev (kHz)	Dev (kHz)	Dev (kHz)	IC Limit
0	0.03	0.03	0.03	2.5
100	0.36	0.529	0.379	2.5
200	0.69	1.07	0.749	2.5
300	1.02	1.59	1.1	2.5
400	1.34	1.97	1.35	2.5
500	1.67	2.06	1.43	2.5
600	1.97	2.14	1.48	2.5
700	2.03	2.18	1.5	2.5
800	2.03	2.2	1.5	2.5
900	2.04	2.4	1.5	2.5
1000	2.04	2.26	1.54	2.5




MX800 3.4kHz LPF
Frequency Response.
Hz
100
1000
10000
5
0
-5
-10
-15
-20
dB
3.4kHz LPF

2.19 Frequency Stability

Frequency Stability vs Voltage Variation
Standard: EIA 4.2.2.3 Voltage variation
Voltage variation +-15%
Method:
The power supply voltage was varied from 85% to 115% of the nominal voltage of 13.8VDC as measured at the input to the MX800.

Test Results: Meets minimum requirements -PASS

Measurement Results

Ambient Temperature = +24oC

Limit, ppm = 2.5

Limit, Hz = 560

FR_C = 220.025000

STV, %	Vdc	Change in Frequency, Hz
85	11.7	-0.5
100	13.8	0.0
115	15.9	+0.5

Frequency Stability vs Temperature Variation
Standard: Standard: EIA 4.2.2.3 Temperature variation –30oC to +60oC

Method:

The MX800 was placed in a temperature chamber with the power supply voltage set at 13.8VDC as measured at the input to the MX800. The temperature set to +20oC and adjust to obtained reference error.

Measurement Results: PASS

Limit, ppm = 2.5
Limit, Hz = 560
FR_C = 220.025000
Reference Error @ +20Ć = 0Hz

Ć	Channel Frequency	Frequency Error in ppm
-30	220.025011	0.05
-20		
-10		
0		
10	220.025000	0
20		
25		
40		
50	220.025024	0.1
60		

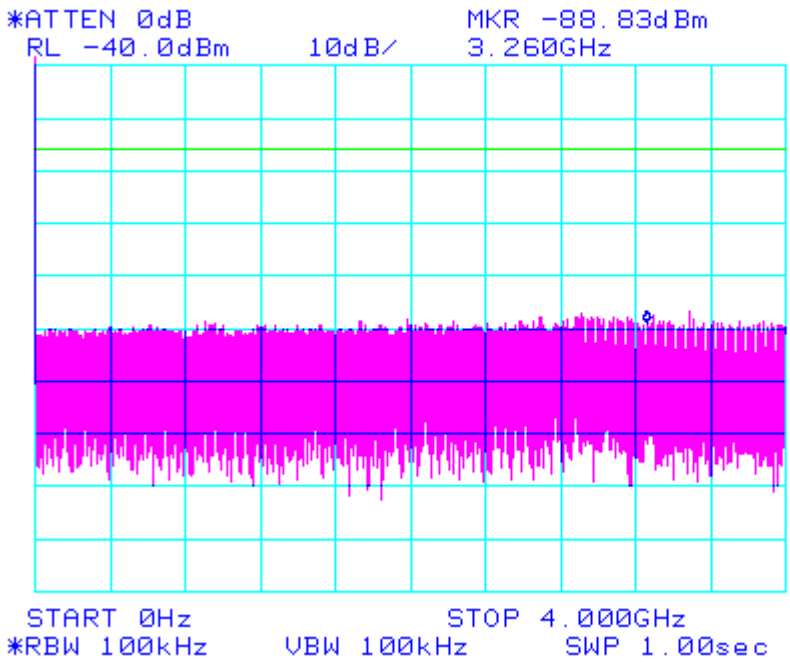
2.20 Receiver Spurious Emissions

Method: The receiver spurious signal was measured conductively by replacing the antenna with a spectrum analyzer of internal resistance equal to the impedance specified for the antenna.

5.12 Receiver Spurious Emissions **PASS**

Limits = <1GHz 2 nanowatts (-56.989dBm)
Limits = >1GHz 5 nanowatts (-53 dBm)

Signals below spectrum analyzer noise floor.



3.0 Exposure of Humans to RF Fields

Declaration of Compliance to RSS 102

In accordance with Section 6.2 of Industry Canada Specification RSS 102, we hereby declare that the _MX800F__ has been evaluated and found to comply with the RF exposure limits for humans, as specified in Health Canada's Safety Code 6 and reproduced in RSS 102.

This declaration is based on test data contained in _N/A_ and has been submitted with our application for certification.

Dated this 30st Day of May 20 07

By:  ***Terry Urbanowski***

Signature ***Printed***

Title: President, tuWolf Rf Designs Inc.

On behalf of :

Telephone: 250-260-1633

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Annex A – RF Technical Brief Cover Sheet

1. COMPANY NUMBER:	5605A
2. MODEL NUMBER:	MX800F
3. MANUFACTURER:	Spectra Engineering Pty Ltd.
4. TYPE OF EVALUATION:	Complete the applicable sections: (a) SAR Evaluation: Device Used in the Vicinity of the Human Head (b) SAR Evaluation: Body-worn Device (c) RF Evaluation Note: The worst-case scenario (i.e. highest measured value obtained) should be reported.
	(a) SAR Evaluation: Device Used in the Vicinity of the Human Head • Multiple transmitters: Yes ☐ No ☐ • Evaluated against exposure limits: General Public Use ☐ Controlled Use ☐ • Duty cycle used in evaluation: _____% • Standard used for evaluation: _____ • SAR value: _____W/kg Measured ☐ Computed ☐ Calculated ☐
	(b) SAR Evaluation: Body-worn Device • Multiple transmitters: Yes ☐ No ☐ • Evaluated against exposure limits: General Public Use ☐ Controlled Use ☐ • Duty cycle used in evaluation: _____% • Standard used for evaluation: _____ • SAR value: _____W/kg Measured ☐ Computed ☐ Calculated ☐
	(**c) RF Evaluation** • Evaluated against exposure limits: General Public Use ☐ Controlled Use x • Duty cycle used in evaluation: __50_____% • Standard used for evaluation: PME Limit Page 8 OET Bulletin 65, Edition 97-01 • Measurement distance: 140cm • RF Value: 0.405074 V/m ☐ A/m ☐ W/m^2 **X** Measured ☐ Computed ☐ Calculated **X**

Equation from page 18 of OET Bulletin 65, Edition 97-01

Annex B – Declaration of RF Exposure Compliance

ATTESTATION: I attest that the information provided in Annex A is correct; that a Technical Brief was prepared and the information it contains is correct; that the device evaluation was performed or supervised by me; that applicable measurement methods and evaluation methodologies have been followed and that the device meet the SAR and/or RF exposure limits of RSS-102
 Signature: Date: May 30, 2007
NAME: (Please print or type): Terry Urbanowski
TITLE: (Please print or type): President
COMPANY: (Please print or type): TU Wolf Rf Designs Inc.

Appendix I

Application and Agreement for Certification Services

APPLICANT & ADDRESS	CONTACT NAME: GARY JACOBS EMAIL ADDRESS gary@spectraeng.com.au	TELEPHONE NUMBER: +(61-8) 92482755 FACSIMILE NO: +(61-8) 92482756
SPECTRA ENGINEERING PTY LTD. 9 TRADE ROAD MALAGA, 6090 WESTERN AUSTRALIA		

CANADIAN REPRESENTATIVE	CONTACT NAME: TERRY URBANOWSKI, CET EMAIL ADDRESS terryurb@telus.net	TELEPHONE NUMBER: 250-260-1633 FACSIMILE NO: 250-260-1318
TU WOLF RF DESIGNS INC. 10730 PINECREST ROAD VERNON, B.C. V1H 2C1		

COMPANY NUMBER and UPN NUMBER: 5605A-MX800F

MODEL NUMBER**: MX800F**

SPECIFICATION STANDARD: RSS-119 ISSUE 8

TYPE OF SERVICE: SINGLE

If payment by cheque/amount:	CARD HOLDERS NAME: Terrance Urbanowski
CHEQUE Number:	CREDIT CARD TYPE: Visa
Card holder is: *Applicant * Test facility	CREDIT CARD NO. 4503 3528 1455 1015
AUTHORIZED AMOUNT: $945	EXPIRY DATE:07/09

CARD HOLDER'S

SIGNATURE:_____ _____

AGREEMENT

THE APPLICANT AGREES TO:

(i) Accept responsibility for all Departmental charges arising from this application;
(ii) Meet all the requirements in accordance with the Radio Standards Procedure 100 and other applicable procedures;
(iii) Warrant that the test results submitted are a true representation of the characteristics of the radio equipment type for which certification is requested.
(iv) Inform the Bureau of any changes to the information submitted.

NAME AND TITLE OF APPLICANT: (PRINT OR TYPE)

TERRY URBANOWSKI, CET, PRESIDENT

SIGNATURE OF APPLICANT:

DATE: May 30, 2007

Appendix II

Test Report Cover Page

COMPANYNUMBER: *5605A*
MODEL NUMBER: MX800F

MANUFACTURER: SPECTRA ENGINEERING PTY LTD

TEST TO RADIO STANDARDS SPECIFICATIONS (RSS) NO: RSS-119 ISSUE 8
0PEN AREA TEST SITE INDUSTRY CANADA NUMBER:
FREQUENCY RANGE (or fixed frequency): 217 – 222 MHz

R.F. POWER IN WATTS: 1 to 50 Watts

FIELD STRENGTH (at what distance): Conducted

OCCUPIED BANDWIDTH: 12.5 kHz
TYPE OF MODULATION: Frequency Modulation
EMISSION DESIGNATOR (TRC-43): 11K0F3E

TRANSMITTER SPURIOUS (worse case): -100 dBc Compliant
RECEIVER SPURIOUS (worse case): .0162 nW Compliant

ATTESTATION: I attest that the testing was performed or supervised by me; that the test measurements were made in accordance with the above mentioned departmental standard(s), and that the radio equipment identified in this application has been subject to all the applicable test conditions specified in the departmental standards and all the requirements of the standards have been met.

Signature:_____

Date: May 30, 2007

NAME AND TITLE: TERRY URBANOWSKI, CET PRESIDENT, TUWOLF RF DESIGNS INC.

Illustration of Equipment Label

Model MX800F

Base Station / Repeater

IC: 5605A-MX800F
Model: MX800F
S/N:
Rated Output: 1– 50 Watts
Spectra Engineering Pty Ltd.
Malaga, Australia