

EXHIBITS

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EXHIBIT 1: Letter Requesting Confidentiality under Sec. 0.457(d)

Thomas N. Cokenias *EMC & Radio Approvals*
Test & Consulting Services for Commercial, Military, International Compliance
P.O. Box 1086
El Granada, CA 94018

23 June 2000

FCC Laboratory
7435 Oakland Mills Road
Columbia, MD 21046

Attention: Application Examiner
 Reviewing Engineer

Re: Request for confidentiality per Section 0.459 of FCC Rules

Applicant: Watkins Johnson.

FCC ID: NTTSX1123

To whom it may concern,

Request is hereby submitted, on behalf of my client Watkins Johnson, to withhold from public review certain portions of the application for equipment certification for the referenced FCC identifier. In particular, the following sections of the application and report are requested to be kept confidential:

Schematics
Block diagrams
Theory of operation (P2MP Architecture)

Rationale for request for confidentiality:

Watkins Johnson has invested considerable time and materials in research and development to produce the referenced product. Disclosure of the confidential portions of this application to competitors would give them competitive advantage in developing similar products.

The \$135 fee for confidentiality has been submitted along with the fee for certification. If you have questions or need further information, please contact the undersigned.

Sincerely,

THOMAS N. COKENIAS
EMC Consultant/Agent for Watkins Johnson.

Tel 650 726 1263

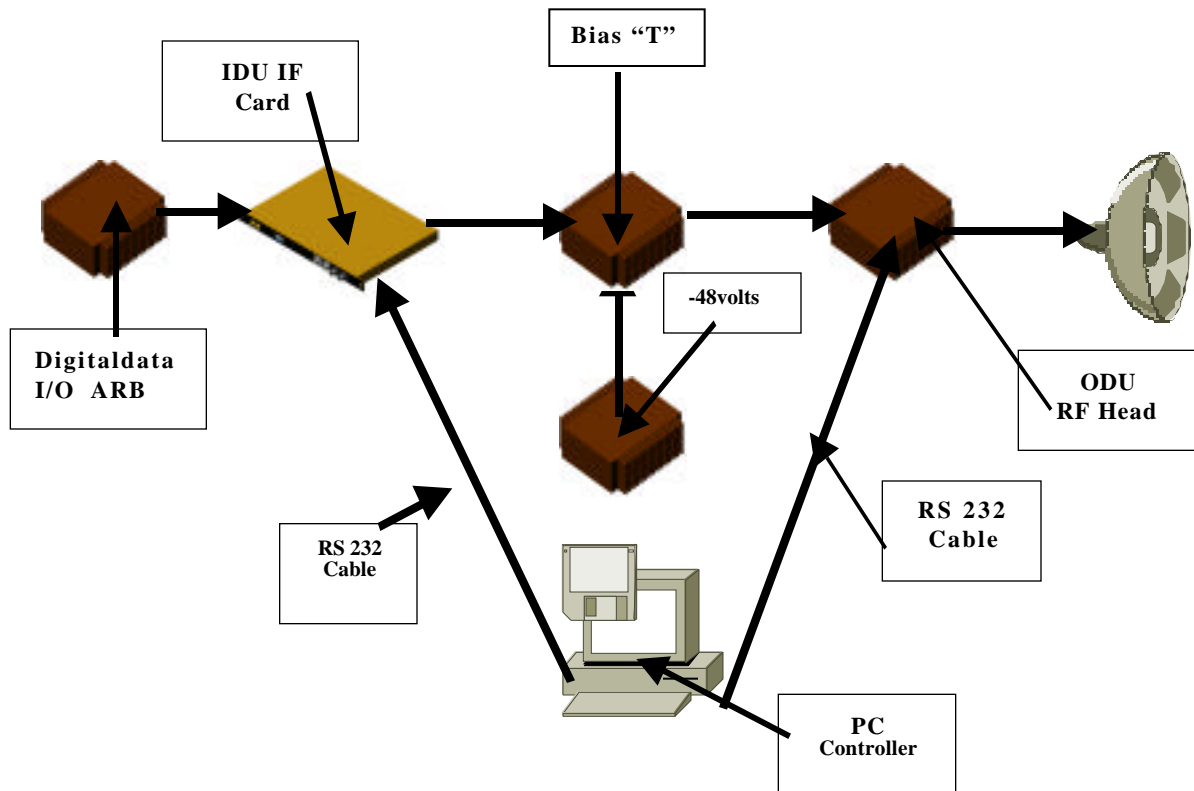
fax 650 726 1252

trephonc@macconnect.com

EXHIBIT 2: Product Description and Operation Overview

The Watkins Johnson FCC ID: NTTSX1123 is a MMDS transceiver operating under the provisions of Part 21 of the Rules. Model SX1123 is subscriber or customer premises equipment (CPE).

Refer to the system module diagram below:



Product development strategy is to follow a modular approach.

Digital data I/O for the initial version of the system will be a line card that will fit into a standard Cisco router chassis. For test purposes, a Tektronix arbitrary waveform generator will simulate the signal output of the router/line card combination.

The **IDU IF card** up-link performs the modulation functions of the system. A 330 MHz signal is modulated with the digital data stream using Orthogonal Frequency Division Multiplexing (OFDM) techniques. The system is capable of producing channel bandwidths in 1.5 MHz multiples. The system will be configurable for use with 1.5, 3, and 6 MHz channel bandwidths.

For the down-link signal, the IF card demodulates the receiver IF signal from the RF head and routes the demodulated digital information to the digital I/O card.

It is anticipated that the IDU IF card will be used with a number of different RF heads, but will provide the same kind of OFDM modulation, the same IF signals, and at the same channel spacing

as will be provided for the present application. The IDU output RF spectrum is shown for 6 MHz channels in Exhibit 10.

The **bias “T”** provides DC and the 330 MHz IF signal on a single coaxial cable for routing to the RF head.

The **ODU RF head** produces the RF transmit link at 2150-2162 MHz , and houses the receiver LNAs, receiver local oscillator, and the receiver IF bandpass filters and IF amplifiers. The RF head also houses the TX-RF diplexer.

The **PC controller** and **RS 232 cables** are for system control and set-up for testing purposes.

The antenna shown in the diagram is specified but not supplied by WJ. Antennas are available in integral or separate mount varieties, either 18 dBi or 24 dBi. The –48 VDC supply shown in the diagram is a customer provided supply.

SPECIFICATIONS

RF Head

Frequency range:	2150-2162 MHz
Power output:	26 dBm, 24 dBm, and 22 dBm
Channel Bandwidth:	1.5 MHz, 3 MHz, and 6 MHz configurable

IF Head

Frequency range:	24 MHz clock, 48 MHz blanking, 330 MHz modulated carriers
Power output:	-13 dBm nominal (programmable)

A detailed description of the theory of operation and product configuration is found in the attached document, *rf hea~1.doc*.

EXHIBIT 3: Information for which Confidentiality is Requested

Schematics

Block Diagrams

Theory of Operations

Schematics

- see separate attachment

Block Diagram

- see separate attachment

Theory of Operation

- see separate attachment:

rf head~1.doc

EXHIBIT 4: Product Photographs

- see separate attachments

EXHIBIT 5: User Manual and FCC ID Label

- see separate attachments

EXHIBIT 6: RF Hazard Information Per Sec. 1.1307

For transmitters operating in the 2.5-2.7 GHz frequency range, paragraph 1.1310 limits maximum permissible exposure (MPE) to 1 mW/cm² for uncontrolled environments, and 5 mW/cm² for controlled environments.

The maximum distance from the antenna at which MPE is met or exceeded is calculated from the equation relating field strength in V/m, transmit power in watts, transmit antenna gain, and separation distance in meters:

$$E, \text{V/m} = (30 \cdot P \cdot G) / d$$

$$\text{Power density, mW/m}^2 = E^2 / 3770$$

$$E \text{ for MPE } 1 \text{ mW/m}^2 = 61.4 \text{ V/m}$$

$$d, \text{meters} = (30 \cdot P \cdot G) / 61.4$$

Watkins Johnson does not provide an antenna with their MMDS radio system. The licensee is responsible for placing a label on the antenna providing adequate information regarding hazardous RF exposure (such as the maximum distance at which MPE is achieved) and including reference to the applicable FCC regulations. MPE are calculated for a typical 24 dBi antenna:

Watkins Johnson

FCC ID: NTTSX1123

RF Hazard Distance Calculation

Exposure, mW/cm²:		1.00
Max RF Power P, dBm	TX Antenna G, dBi	MPE Safe Distance, cm
26.0	24.0	89.2

Basis of Calculations:

$$E^2 / 3770 = S, \text{mW/cm}^2$$

$$E, \text{V/m} = (P_{\text{watts}} \cdot G_{\text{gain}} \cdot 30)^{0.5} / d, \text{meters}$$

$$d = ((P_{\text{watts}} \cdot G \cdot 30) / (3770 \cdot S))^{0.5}$$

$$P_{\text{watts}} \cdot G_{\text{gain}} = 10^{(P_{\text{dBm}} - 30 + G_{\text{dBi}}) / 10}$$

Refer to user manual RF Hazard information page for information to user and installer re FCC requirements concerning MPE, exposure from multiple sources, and other similar topics.

Draft version of the warning label is found in separate attachment *CPEwarning.doc*. In addition, the following wording will be placed on the ODU in plain legible text:

CAUTION: To comply with FCC RF exposure requirements, a minimum separation distance of 90 cm is required between this antenna and all persons.

EXHIBIT 7: Report of Measurements

FCC CERTIFICATION INFORMATION

The following information is in accordance with FCC Rules, 47CFR Part 2.

2.1033(c)1

Applicant: Watkins Johnson
3333 Hillview Avenue
Palo Alto, CA 94304-1233

2.1033(c)2 FCC ID: NTTSX1123**2.1033(c)3** Installation instructions are found in attached document.**2.1033(c)4** Emission type is OFDM in 1.5 MHz, 3 MHz, or 6 MHz channels
1M50W7D , 3M00W7D, and 6M00W7D**2.1033(c)5** Frequency range: 2150-2162 MHz**2.1033(c)6 Range of Operating Power**

0 – 26 dBm, TX attenuation settings via software

2.1033(c)7 Maximum Power Rating

Maximum allowed per 21.904: 33 dBw

Maximum rated output power of EUT:

26 dBm for 1.5 MHz channel
24 dBm for 3 MHz channel
22 dBm for 6 MHz channel

2.1033(c)8 Applied voltages and currents into the final transistor elements

Refer to electronic format schematics accompanying this application

2.1033(c)9 Tune-up procedure

Refer to electronic format file installation. for hardware configuration instructions. RF channel selection and RF power output of the ODU outdoor unit are selected via control and set-up PC software via GUI.

2.1033(c)10 Circuit and Functional Block Diagram, Description of Circuitry

Complete product schematics are attached as electronic files.
Circuit description and theory of operation are found in the attached electronic file *rf hea~1.doc*.

2.1033(c)11 FCC ID Label

Attached as electronic file *FCC label*

2.1033(c)12 Product Photographs

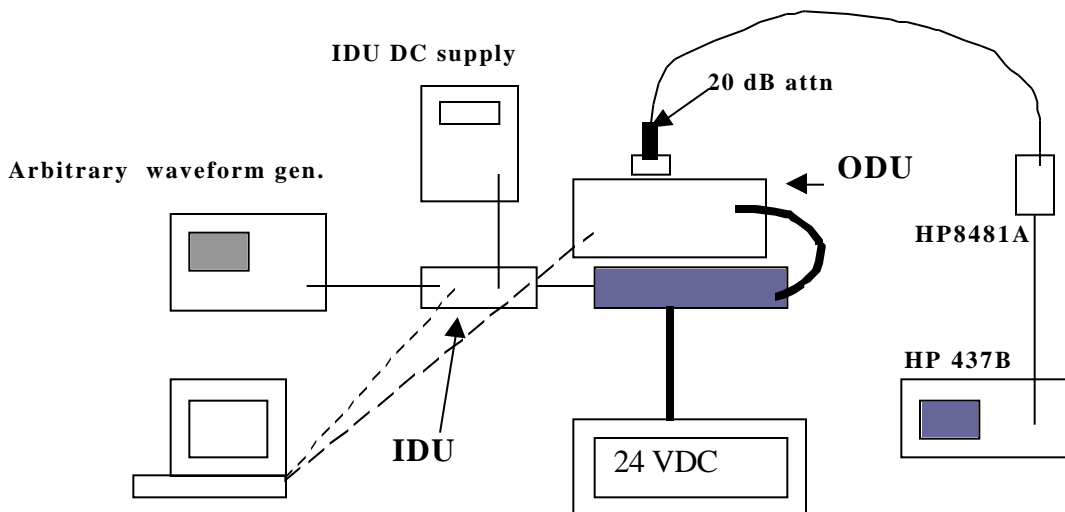
Attached as JPEG electronic files

2.1033(c)13 Description of Modulation System

Refer to appropriate chapters in attached electronic file P2P-Architecture.doc

2.1033(c)14 Test Data per 2.1046 – 2.1057**2.1055 RF Output Power Measurements****Measurement equipment used:**

HP EpM-441A Power meter
HP 8481A power sensor

Test set-up:**Test Procedures**

1. Set the IDU channel bandwidth parameters and output level to desired values. Output level is chosen to maximize RF output level from ODU while keeping spectral re-growth and spurious emissions from ODU at acceptably low levels.
2. Set ODU output power and channel bandwidth parameters as required.
3. Zero HP 437/HP8481A and enter HP8481A cal factors.
4. Connect HP8481A to 20 dB attenuator and record value.

Test Results

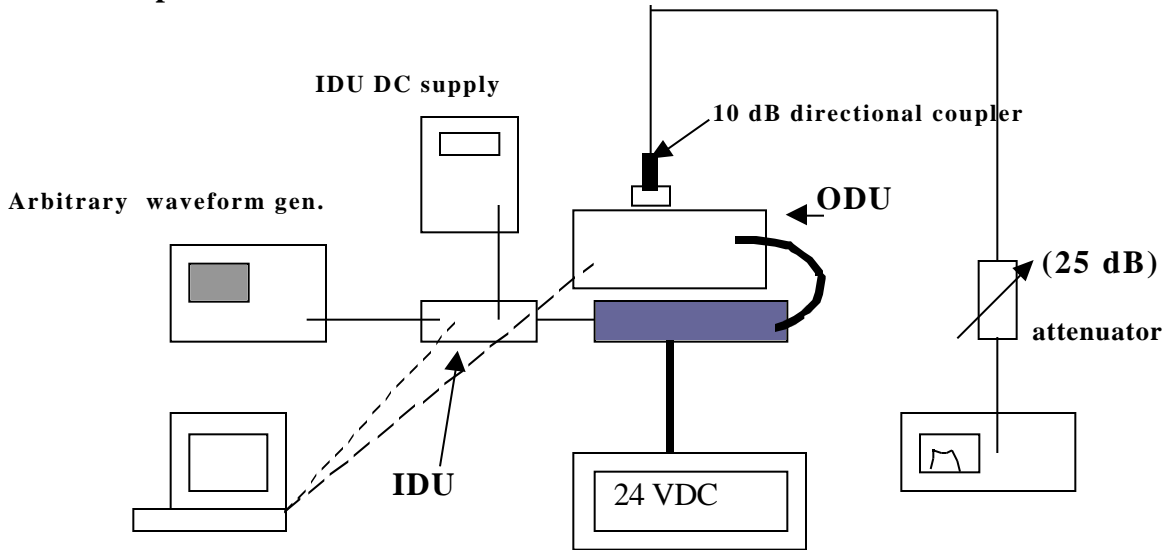
CH BW, MHz	Pout, dBm
1.5 LO	26.0
1.5 HI	26.0
3.0 LO	24.0
3.0HI	24.0
6.0	22.0

Section 2.1047 Modulation Characteristics

Measurement equipment used:

Rohde&Schwarz FSIQ3 spectrum analyzer
Directional coupler
Variable attenuator, 0-90 dB

Test set-up:



Test Procedures

1. Set transmitter output power and channel bandwidth parameters.
2. Set RES BW=50 or 100 kHz, VID BW = 100Hz. Adjust the variable attenuator to optimize analyzer dynamic range while minimizing analyzer spectral regrowth.
3. Plot/photograph resultant spectrum analyzer trace.

Test Results

PASS. Best dynamic range, minimum re-growth with attenuator set to 25 dB.

- refer to attached pfd electronic files

Section 2.1049 Occupied Bandwidth**Measurement Equipment Used:**

Rohde&Schwarz FSIQ3 spectrum analyzer
Directional coupler
Variable attenuator, 0-90 dB

Test Set-up

- Same as for 2.1047 above

Test Procedures and Results:

Using MKR DELTA function of the analyzer:

-26 dB Occupied Bandwidth: 1.5MHz, 3.0 MHz, and 6 MHz

Section 2.1051 Spurious and Harmonic Emissions at Antenna Terminals**Measurement Equipment Used:**

Rohde&Schwarz FSIQ3 spectrum analyzer

Test Set-up

- Same as for 2.1049 above

Test Procedures

Section 21.908(e) requires that for a 100 kHz measurement bandwidth, all emissions removed from the band edge by more than 3 MHz must be attenuated at least 60 dB below the channel emission flat top.

1. Set spectrum analyzer to TX output center frequency, RES BW = 100 kHz, VID BW = 100 Hz.
2. Use analyzer PEAK SEARCH to find flat top peak.
3. Set DISPLAY LINE to a level 60 dB below flat top peak
4. Record transmitter output spectrum from 1 MHz to 10th harmonic of TX output frequency
5. Plot/photograph spectrum analyzer data

Test Results

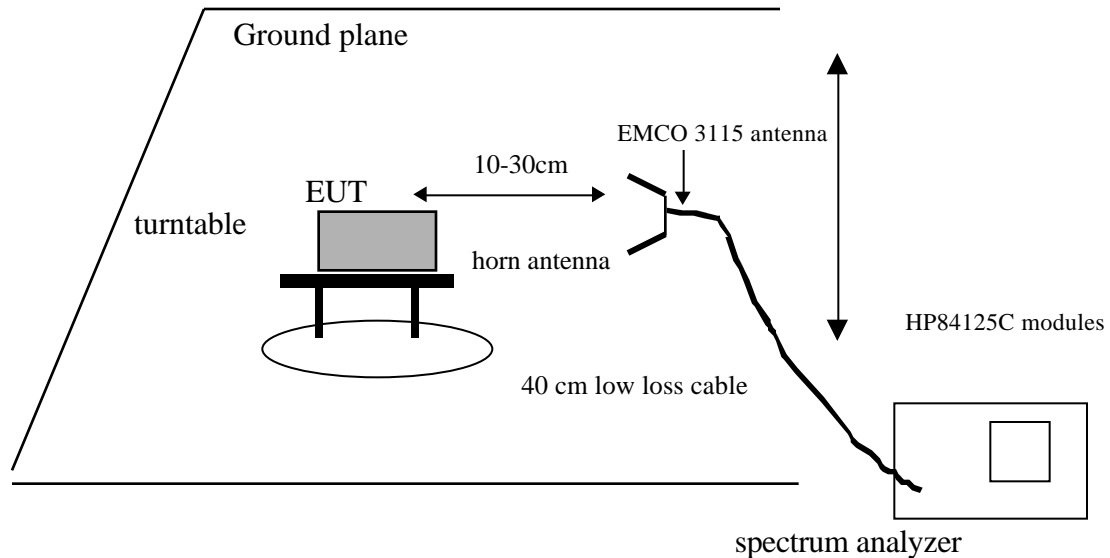
PASS. Refer to attached spectrum analyzer charts in Exhibit 10. Output emissions data is presented from 0 MHz to the 10th harmonic of the carrier frequency.

Section 2.1053 Field Strength of Spurious and Harmonic Radiation

Measurement Equipment Used:

HP 8565E Spectrum Analyzer
EMCO 3115 Horn antenna

Test Set-Up



Minimum Requirement

The magnitude of each spurious and harmonic emission detected as being radiated from the EUT must be at a level more than 60 dB below the emission flat top.

Resultant radiated field from an RF source feeding an isotropic antenna:

$$E@15\text{cm, dBuV/m} = (121.2 + P_{-60\text{dBm}}) \text{ dBuV/m, where } P_{-60\text{dBm}} \text{ is 60 dB below flat top.}$$

Test Method

The antenna output port of the EUT was terminated with a 50 ohm load. A CW signal was input to the ODU to produce full operating power. CW was chosen to overcome system losses and dynamic range limitations.

The EUT was rotated 360° and the search antenna was raised and lowered in both polarities, all in an attempt to maximize the levels of the received emission for each harmonic and spurious emission up to 10 fo.

Test Results

Maximum output, 2153 MHz: 26 dBm
26 - 60 = -34dBm, generating field strength of 87.2 dBuV/m at 15cm

No radiated harmonic or spurious emissions were detected at 15 cm. Noise floor of measurement system was at least 6 dB below radiated limit from $2f_0 - 10 f_0$.

2.1056 Frequency Stability

NOT APPLICABLE. Frequency stability tests are not meaningful for OFDM modulation systems.

Part 15 Digital Device Emissions

Tests were performed to measure radiated emissions per 15.109 of the Rules. A separate verification report is being held on file at Watkins Johnson.

Test Site

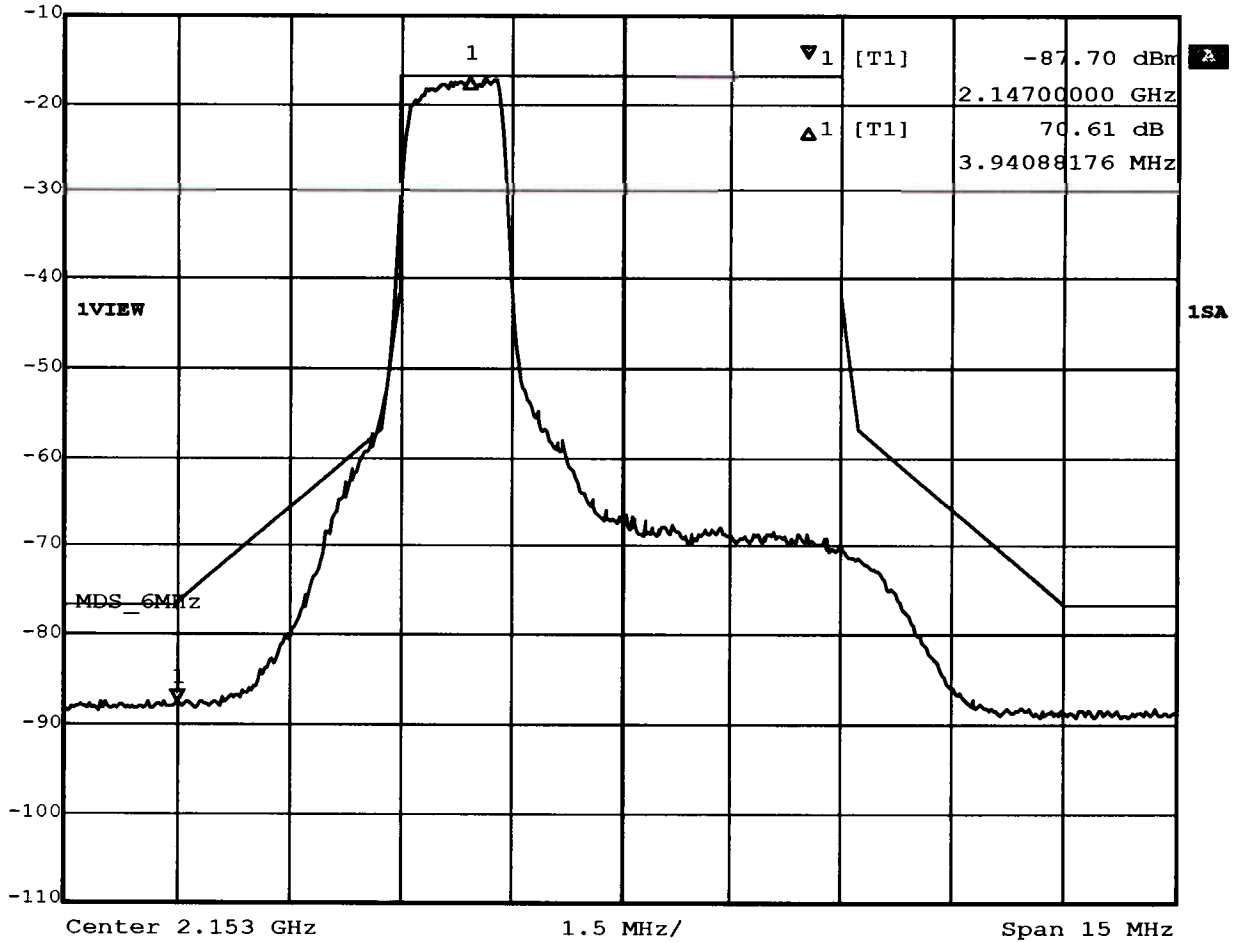
All testing was performed at Watkins Johnson by me or under my supervision. Conducted and radiated emissions were performed using test equipment with calibration traceable to NIST, and following test procedures accepted by the industry.

THOMAS N. COKENIAS
Consultant, EMC&Radio Type Approvals

EXHIBIT 8: Data Graphs: Emissions Masks



Marker 1 [T1] RBW 100 kHz RF Att 10 dB
Ref Lvl -87.70 dBm VBW 100 kHz
-10 dBm 2.14700000 GHz SWT 5 ms Unit dBm



Date: 14.JUN.2000 19:31:31

WJ5X1123

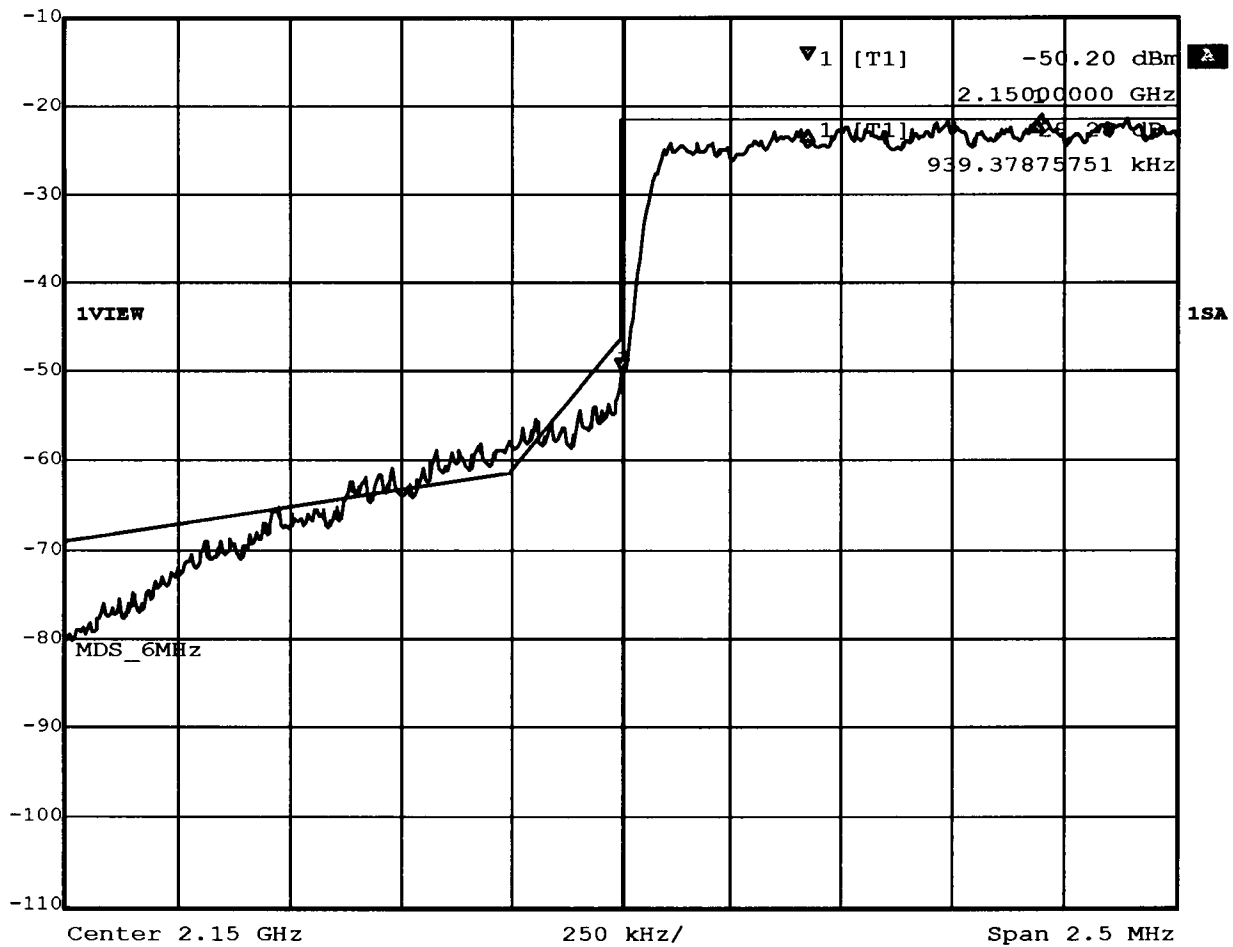
1.5 MHz LO

Power = 26 dBm

3/3



Delta 1 [T1] RBW 30 kHz RF Att 10 dB
Ref Lvl 28.28 dB VBW 30 kHz
-10 dBm 939.37875751 kHz SWT 7 ms Unit dBm



Date: 14.JUN.2000 18:01:40

WJSX1123

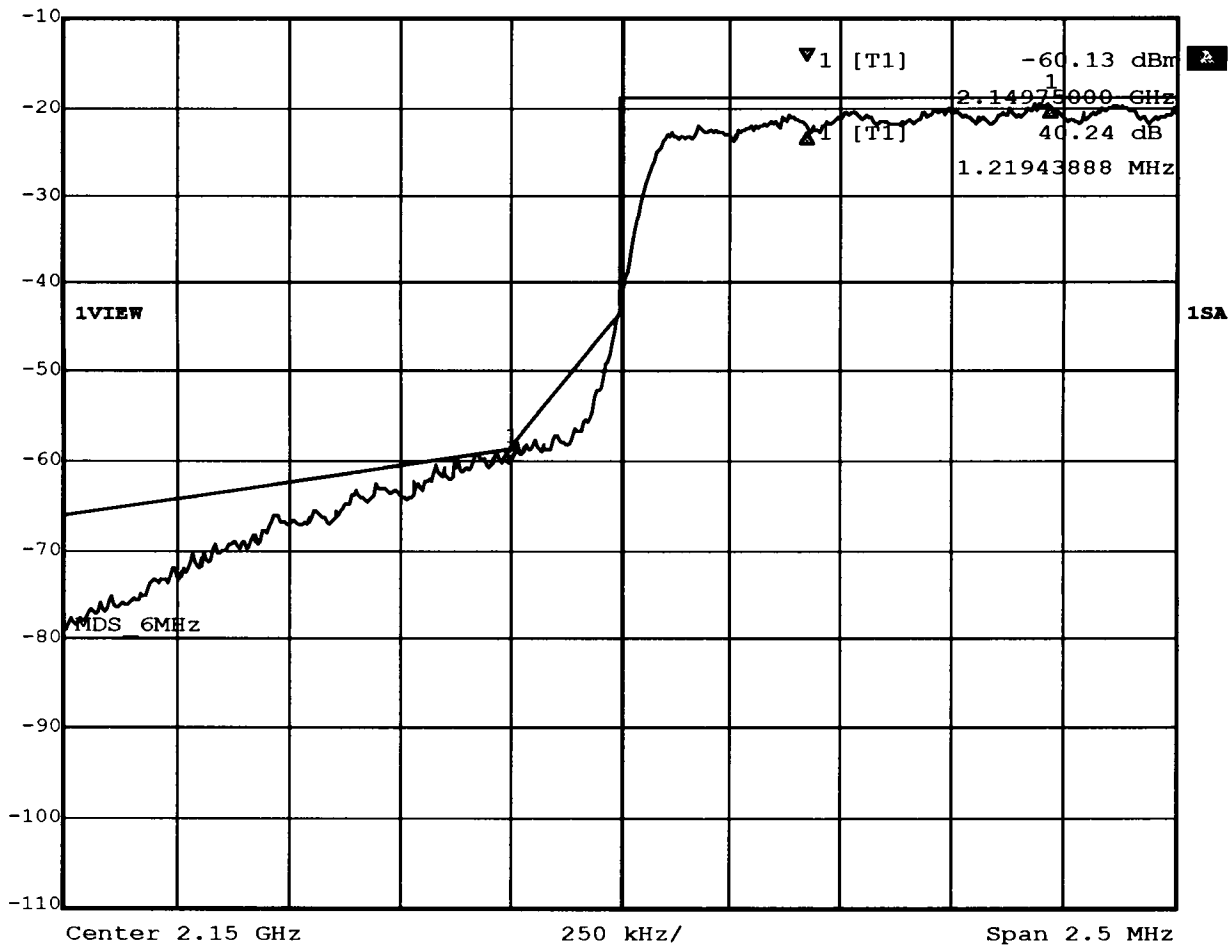
1.5 MHz LO

Power = 26 dBm

1/3



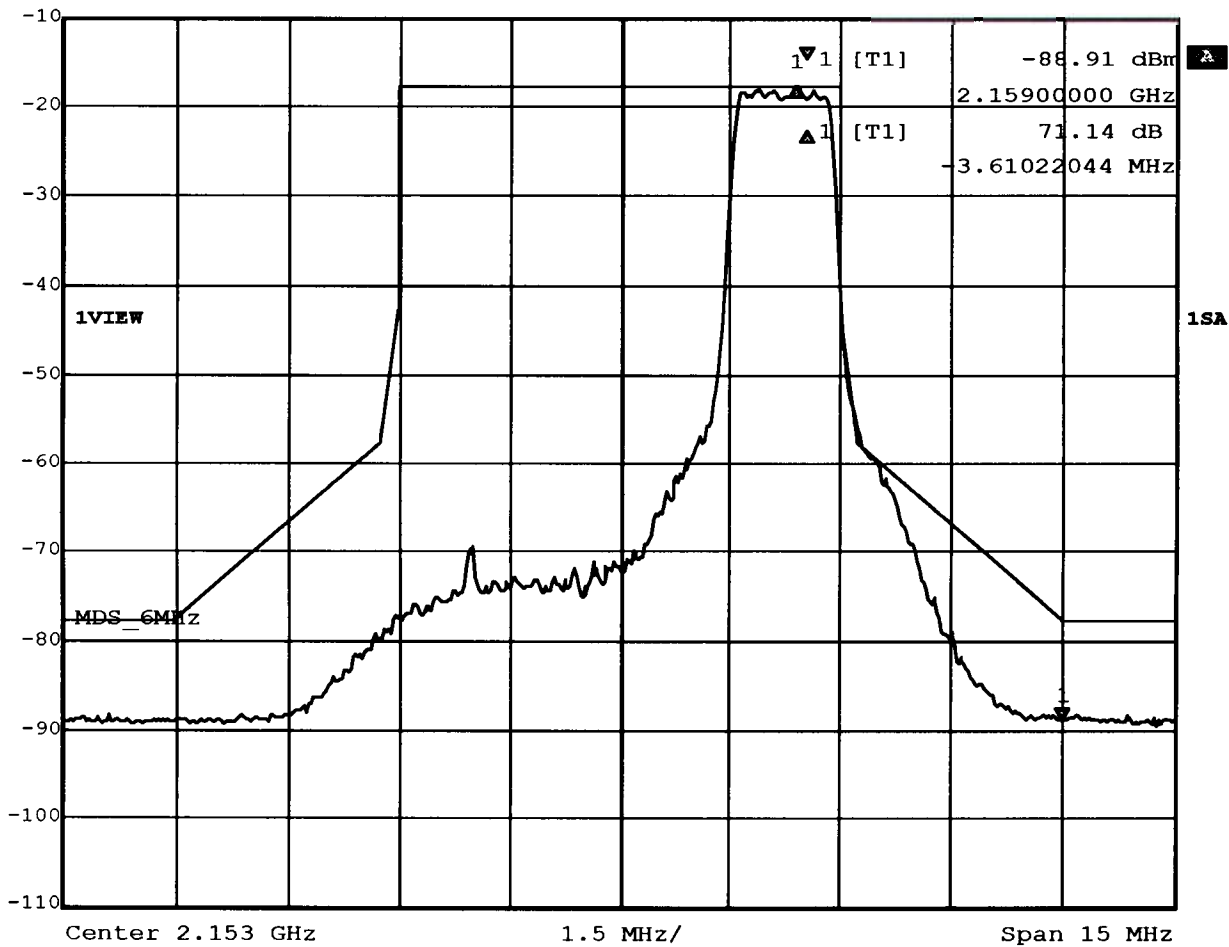
Delta 1 [T1] RBW 50 kHz RF Att 10 dB
Ref Lvl 40.24 dB VBW 50 kHz
-10 dBm 1.21943888 MHz SWT 5 ms Unit dBm



WT 5X1123
1.5 MHz LO
 $P_0 = 26 \text{ dBm}$
2/3



Delta 1 [T1] RBW 100 kHz RF Att 10 dB
Ref Lvl 71.14 dB VBW 100 kHz
-10 dBm -3.61022044 MHz SWT 5 ms Unit dBm

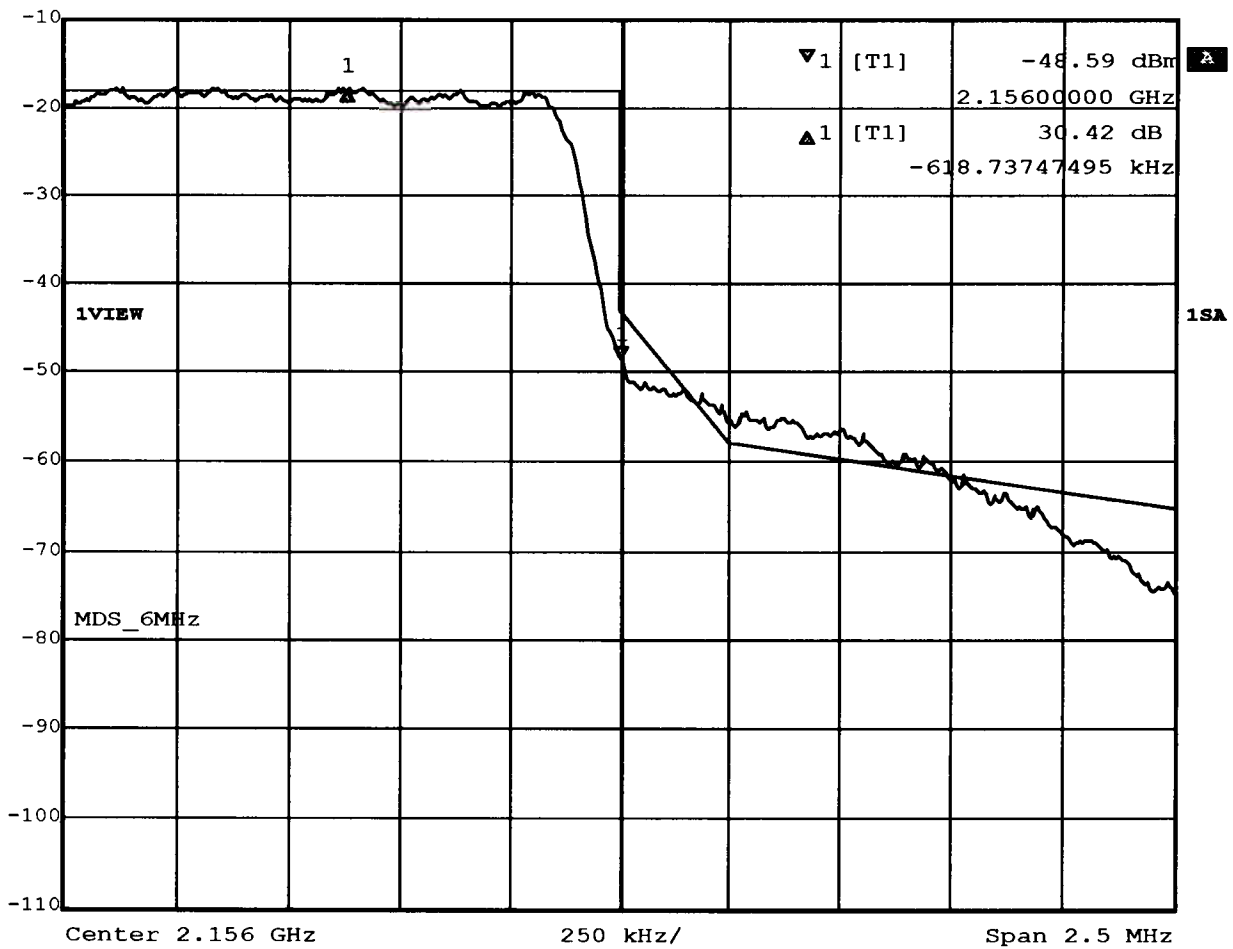


Date: 14.JUN.2000 03:54:11

WJSX1123
1.5 MHz HI
Pout = 26 dBm
3/3



Delta 1 [T1] RBW 50 kHz RF Att 10 dB
Ref Lvl 30.42 dB VBW 50 kHz
-10 dBm -618.73747495 kHz SWT 5 ms Unit dBm



Date: 14.JUN.2000 03:45:45

WJSX1123

1.5 MHz HI

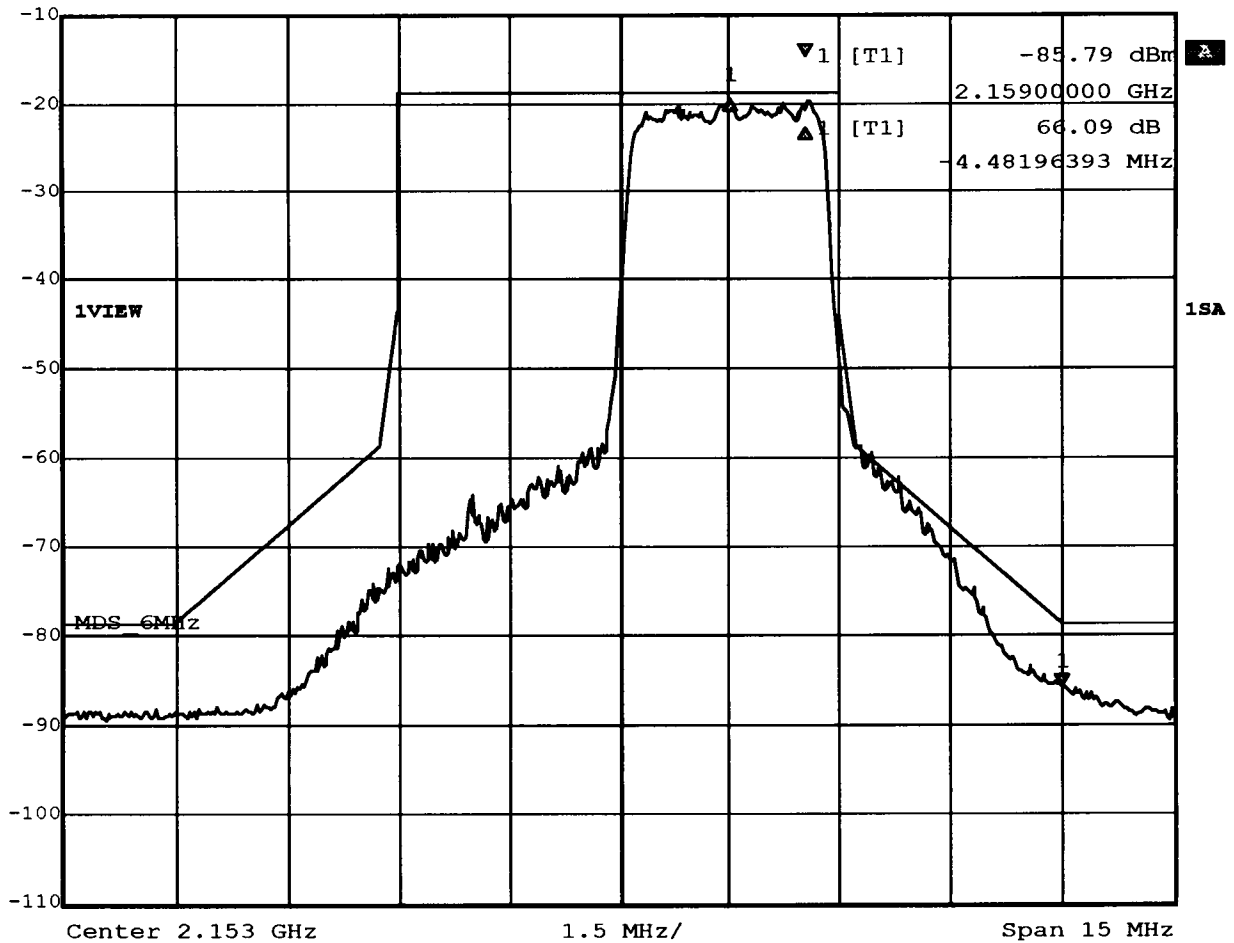
Power = 26 dBm

1/3


$$\frac{2}{3}$$



Delta 1 [T1] RBW 100 kHz RF Att 10 dB
Ref Lvl 66.09 dB VBW 100 kHz
-10 dBm -4.48196393 MHz SWT 5 ms Unit dBm



Date: 14.JUN.2000 03:29:59

WJSX1123

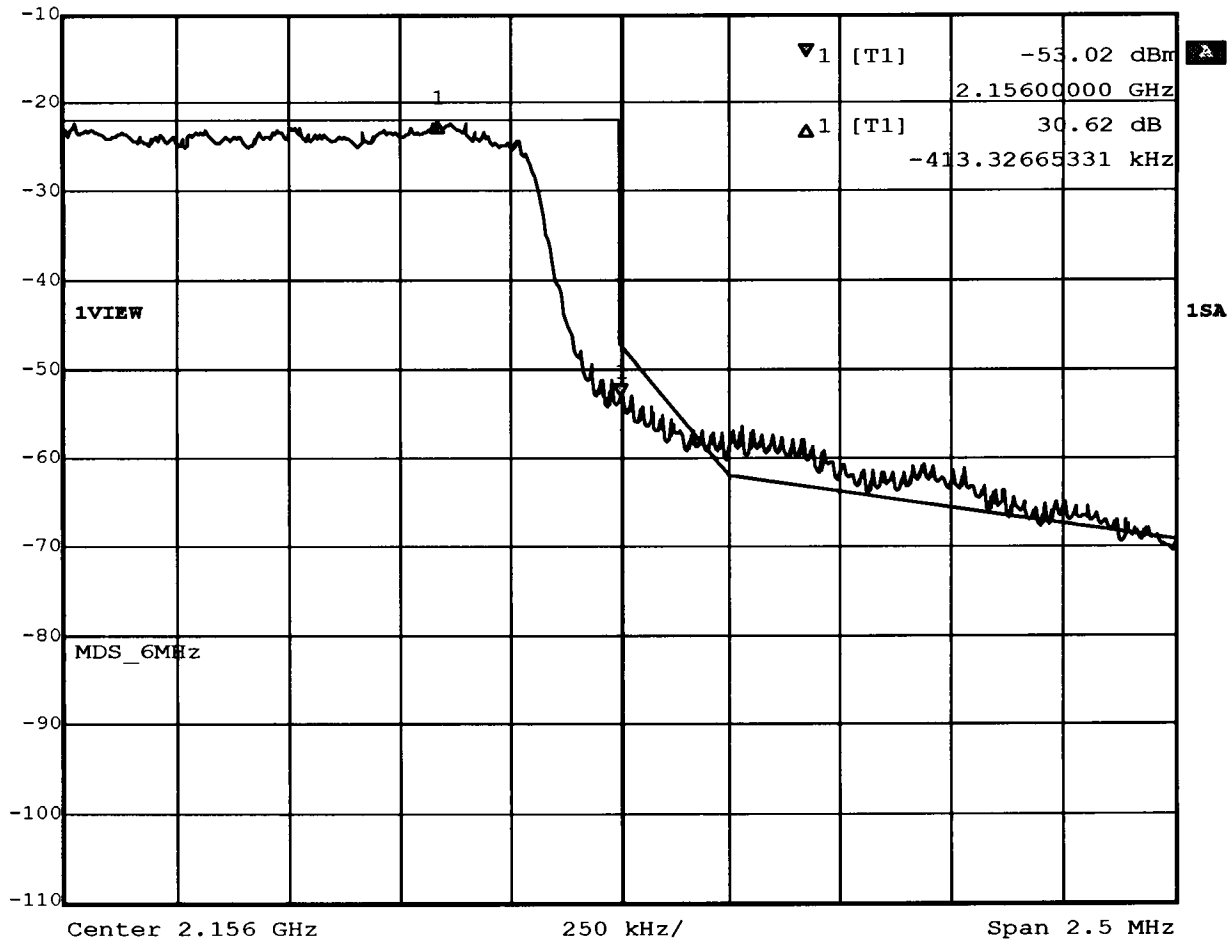
3MHz HI

POUT = 24 dBm

3/3



Marker 1 [T1] RBW 50 kHz RF Att 10 dB
Ref Lvl -53.02 dBm VBW 50 kHz
-10 dBm 2.1560000 GHz SWT 5 ms Unit dBm



Date: 14.JUN.2000 03:26:09

WJSX1123

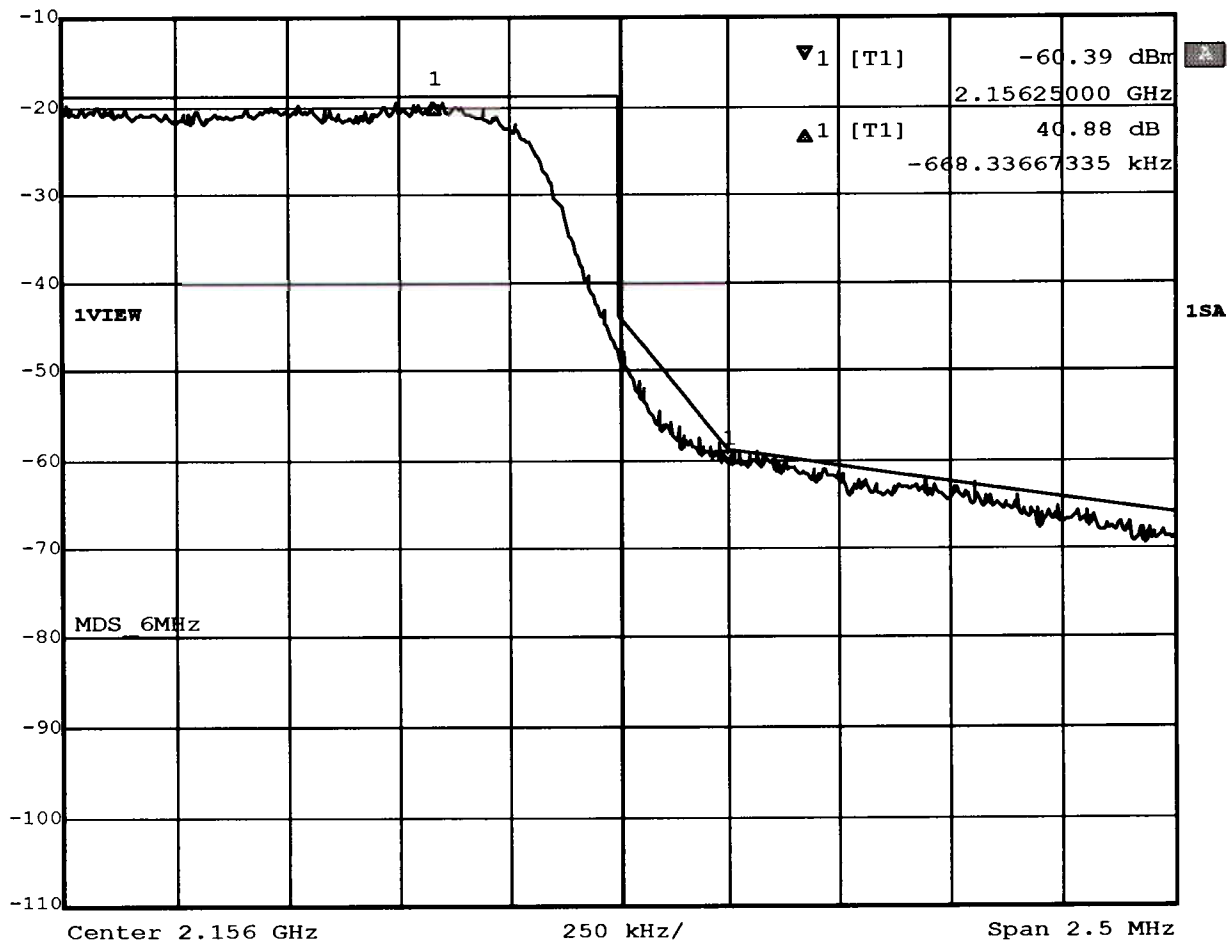
3MHz HI

Power = 24 dBm

2/3



Delta 1 [T1] RBW 100 kHz RF Att 10 dB
Ref Lvl 40.88 dB VBW 100 kHz
-10 dBm -668.33667335 kHz SWT 5 ms Unit dBm



Date: 14.JUN.2000 03:23:22

WJSX1123

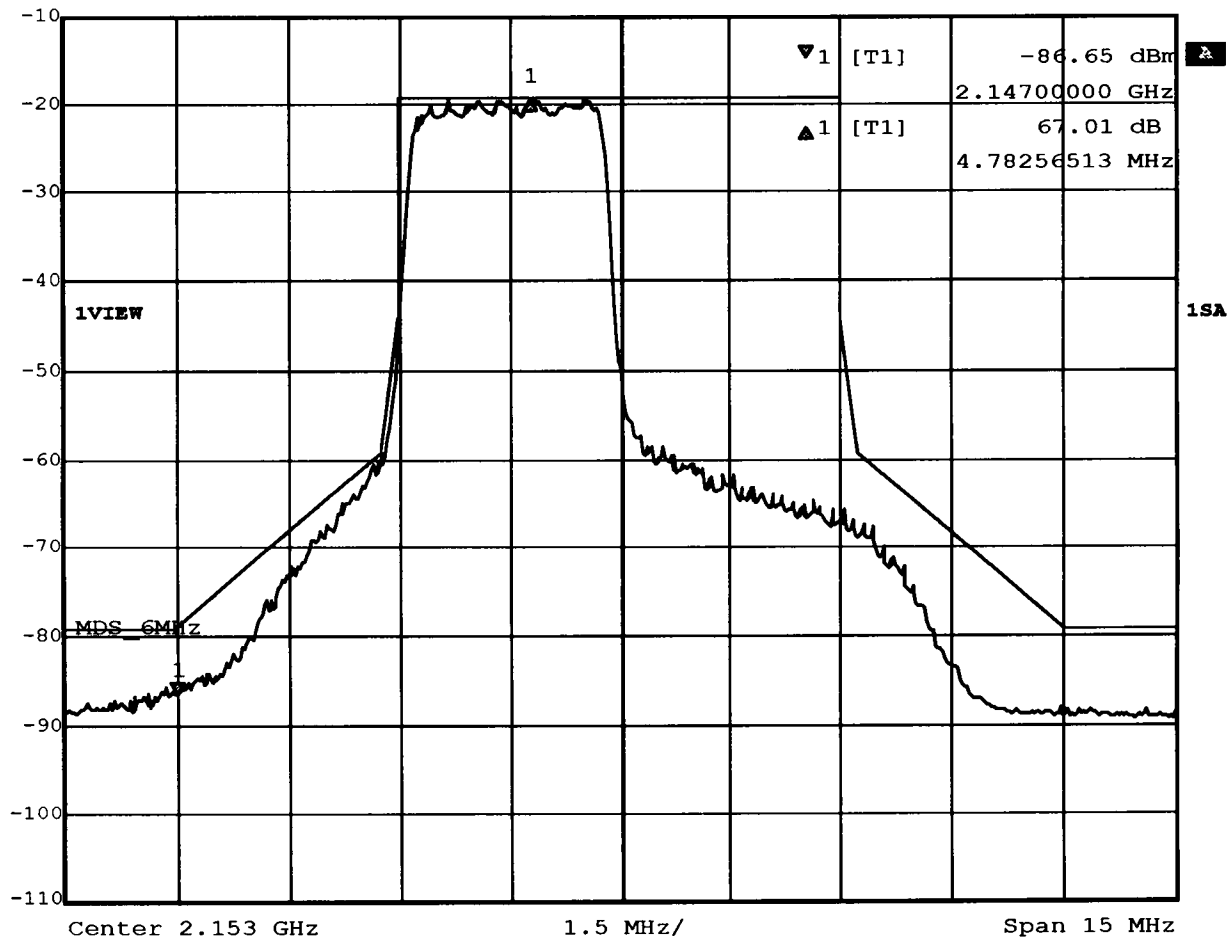
3MHz HI

Pat = 24 dBm

1/3



Delta 1 [T1] RBW 100 kHz RF Att 10 dB
Ref Lvl 67.01 dB VBW 100 kHz
-10 dBm 4.78256513 MHz SWT 5 ms Unit dBm



Date: 14.JUN.2000 03:14:37

WJSX1123

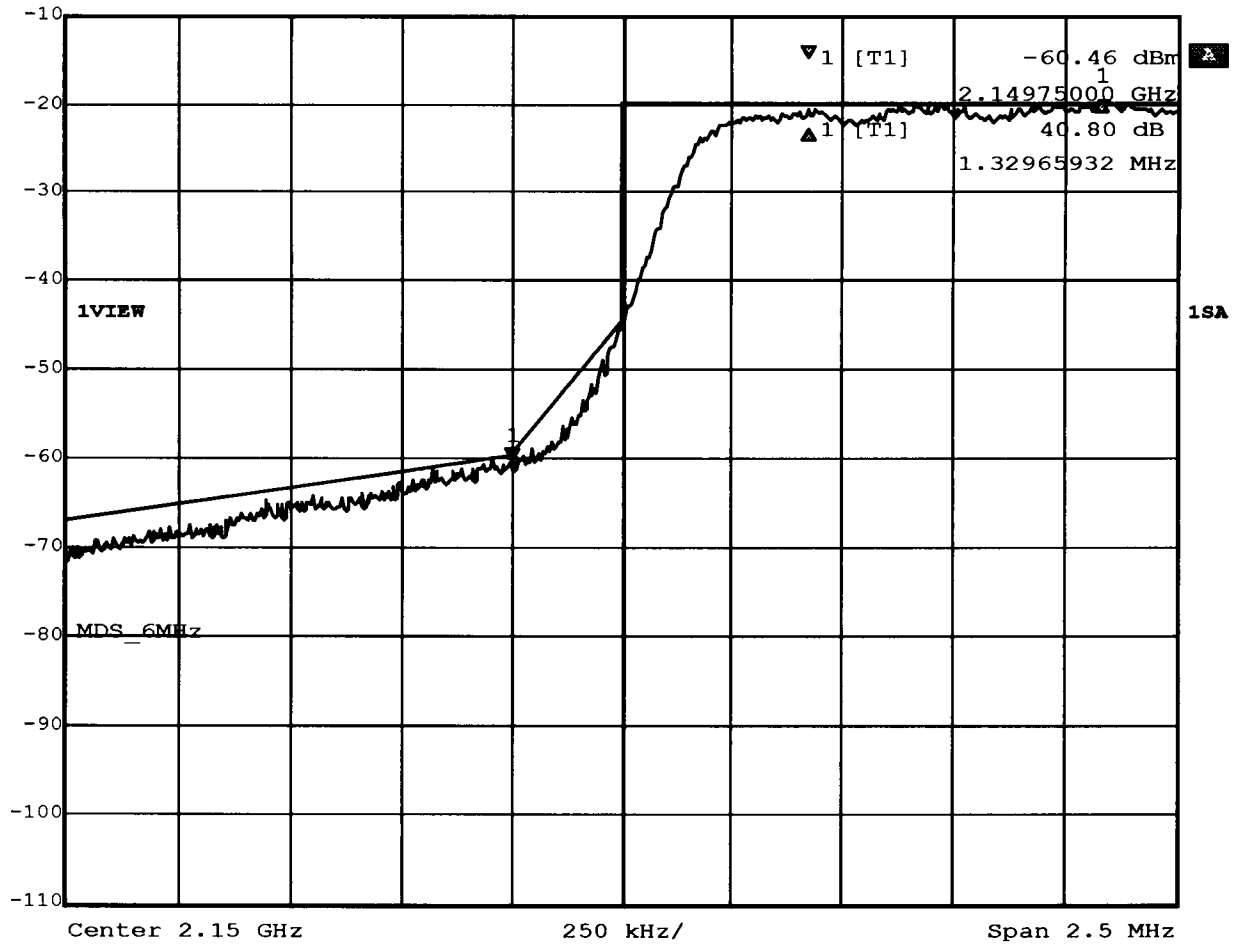
3MHz LO

Port = 24 dBm

3/3



Delta 1 [T1] RBW 100 kHz RF Att 10 dB
Ref Lvl 40.80 dB VBW 100 kHz
-10 dBm 1.32965932 MHz SWT 5 ms Unit dBm



Date: 14.JUN.2000 03:10:40

WJSX1123

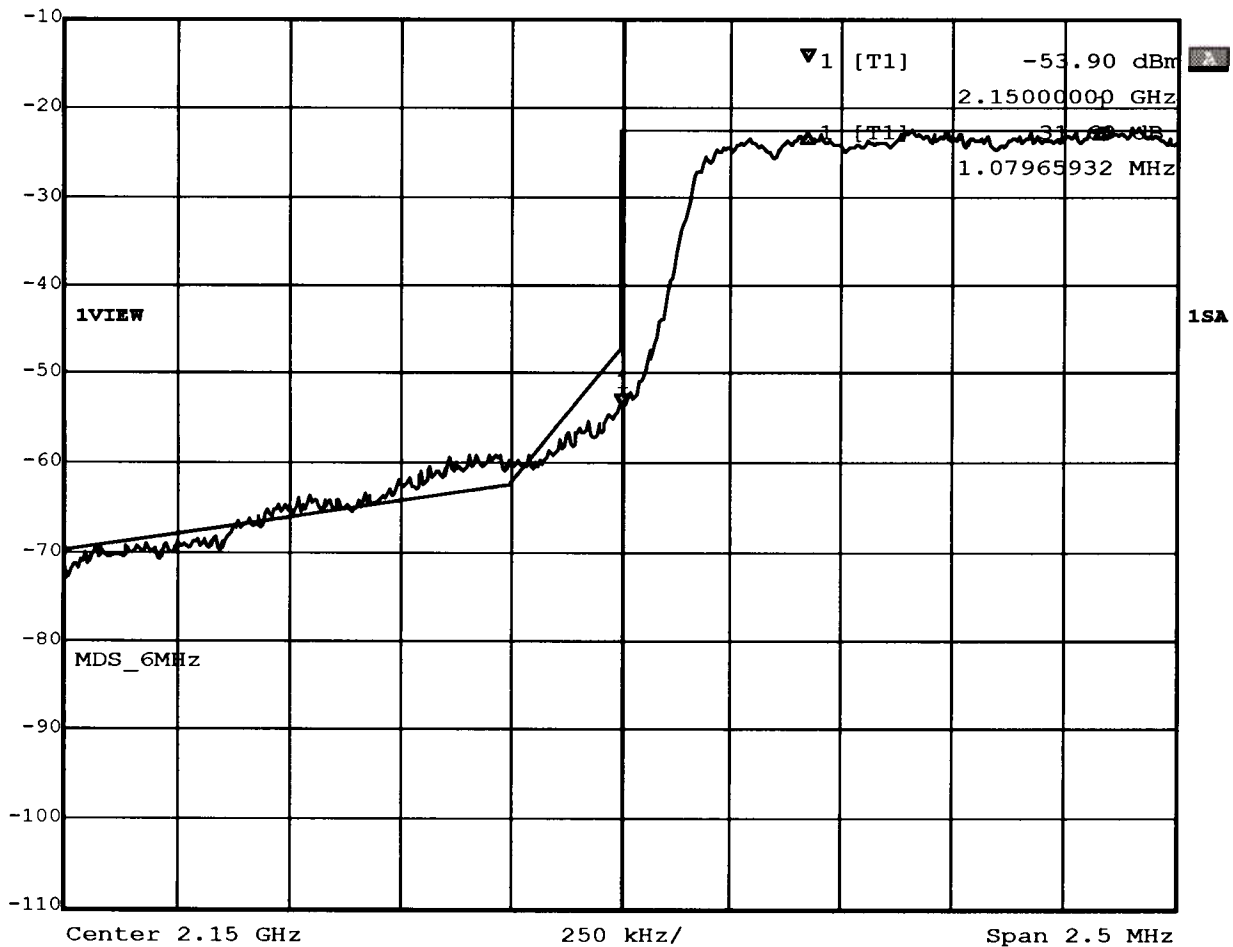
3MHz 10

Power = 24 dBm

2/3



Delta 1 [T1] RBW 50 kHz RF Att 10 dB
Ref Lvl 31.60 dB VBW 50 kHz
-10 dBm 1.07965932 MHz SWT 5 ms Unit dBm

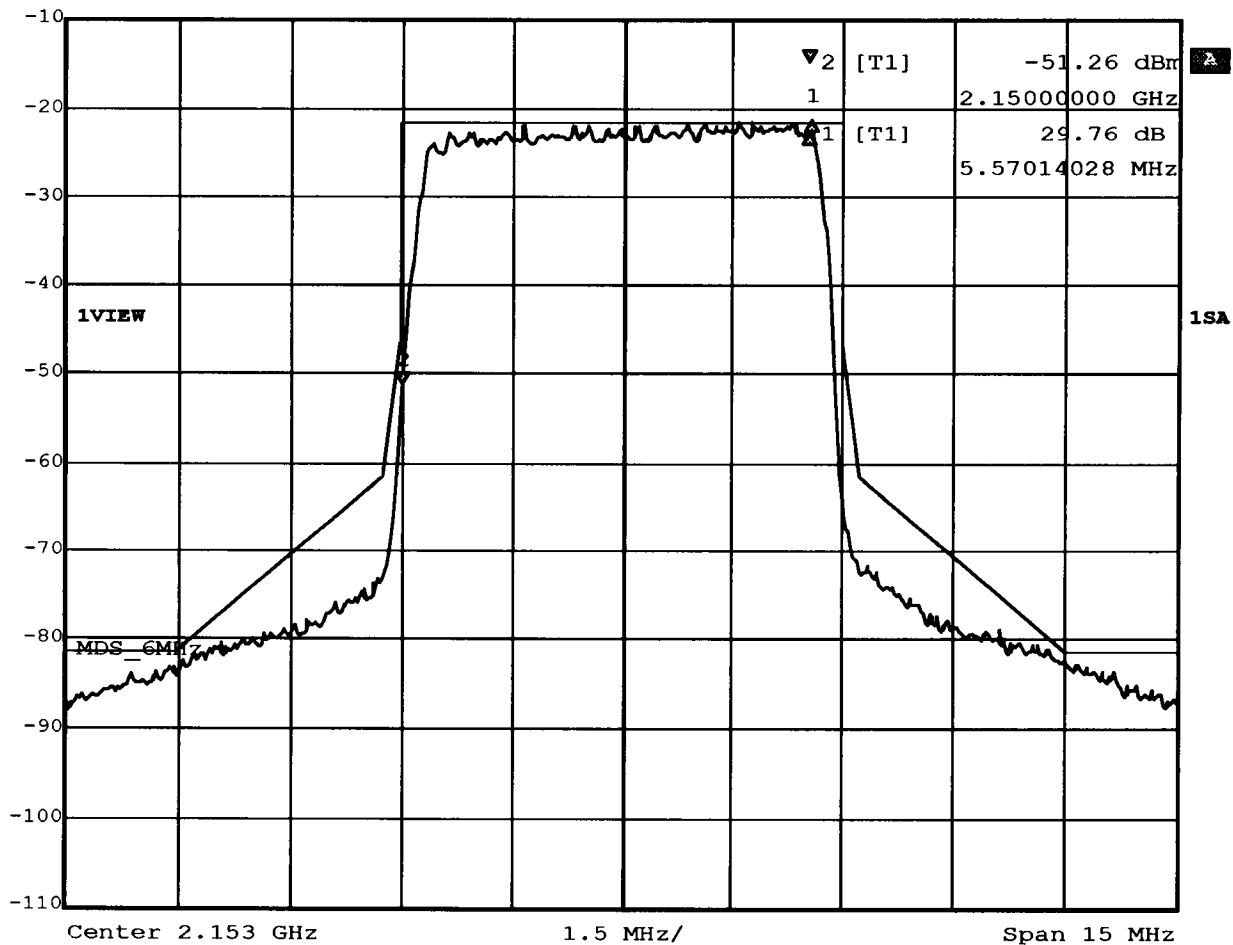


Date: 14.JUN.2000 03:07:44

WJSX1123
3MHz LO
Pout = 24 dBm
1/3



Delta 1 [T1] RBW 100 kHz RF Att 10 dB
Ref Lvl 29.76 dB VBW 100 kHz
-10 dBm 5.57014028 MHz SWT 5 ms Unit dBm

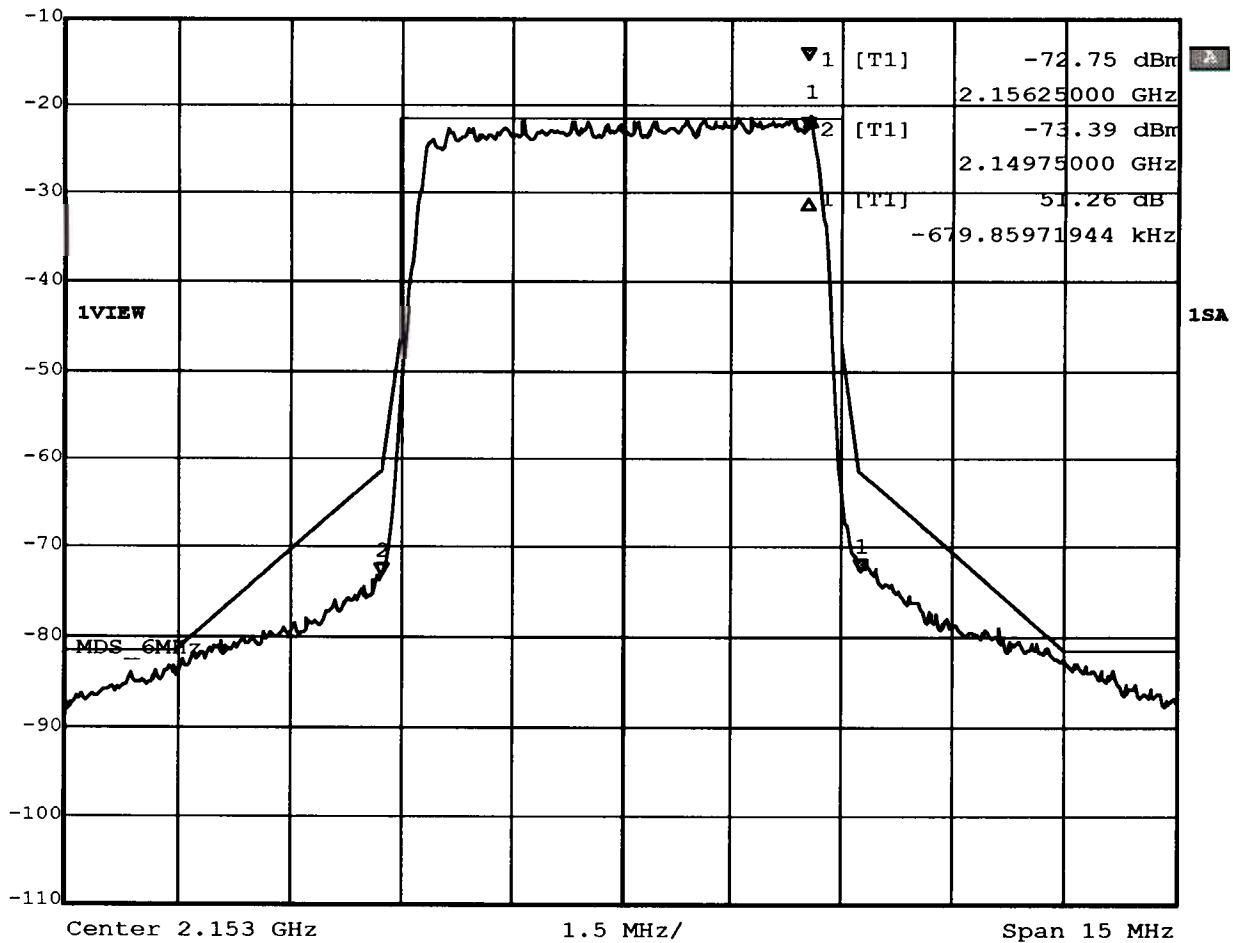


Date: 14.JUN.2000 01:40:30

WJSX1123
6 MHz
Pout = 22 dBm
3/3



Marker 1 [T1] RBW 100 kHz RF Att 10 dB
Ref Lvl -72.75 dBm VBW 100 kHz
-10 dBm 2.15625000 GHz SWT 5 ms Unit dBm



Date: 14 JUN 2000 01:38:28

WJSX1123

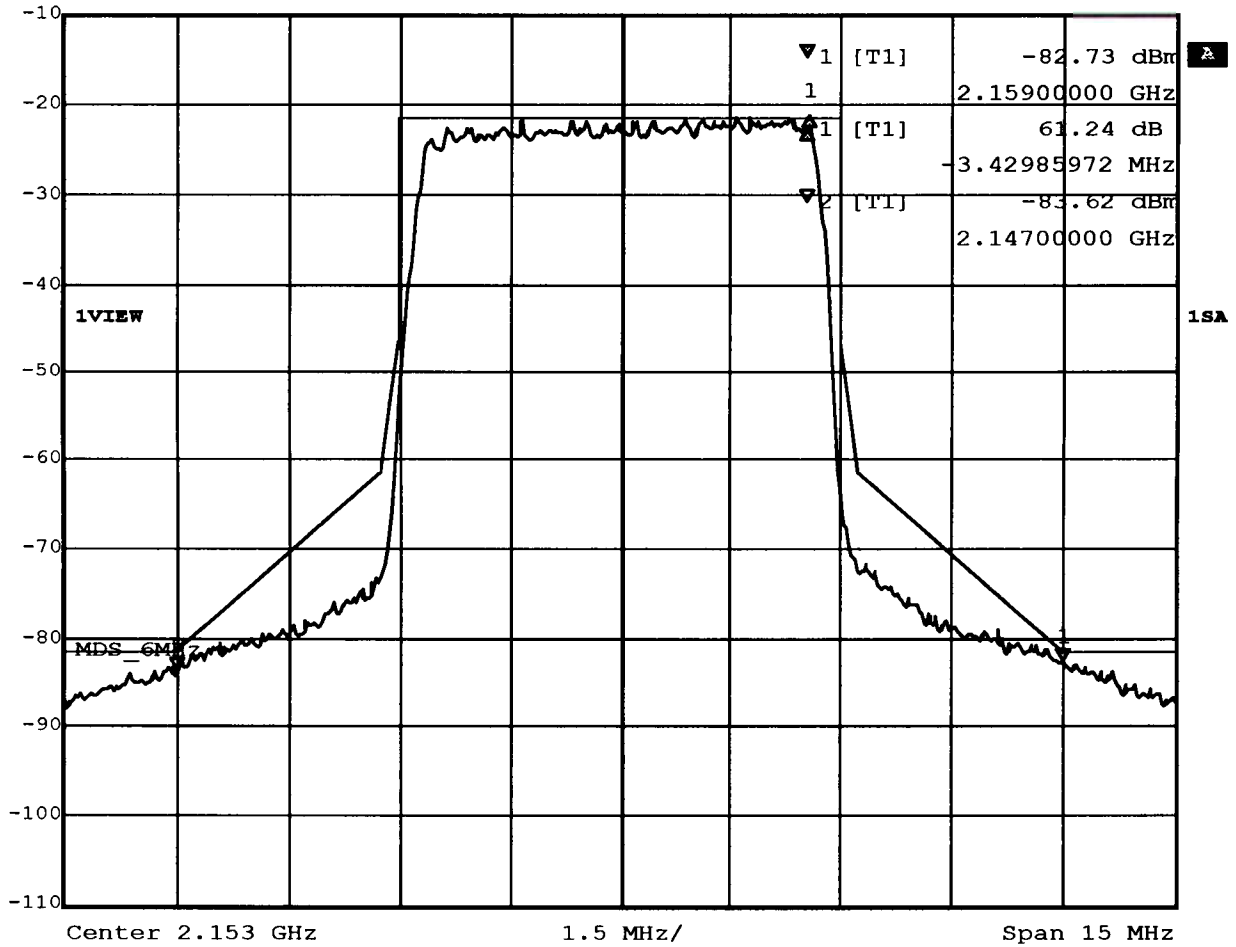
6 MHz

Power = 22 dBm

2/3



Delta 1 [T1] RBW 100 kHz RF Att 10 dB
Ref Lvl 61.24 dB VBW 100 kHz
-10 dBm -3.42985972 MHz SWT 5 ms Unit dBm



Date: 14.JUN.2000 01:32:43

WJ SX1123

60 MHz

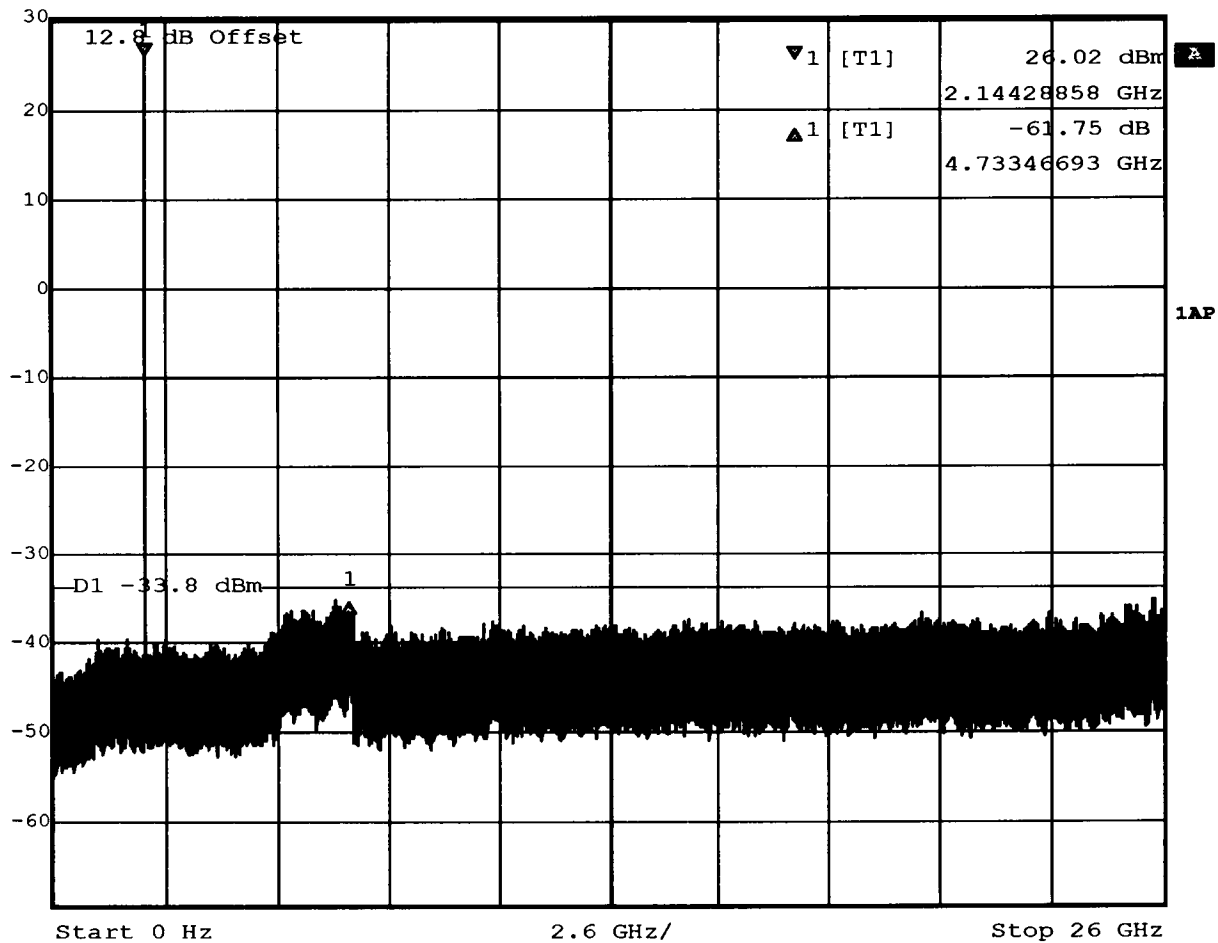
P_{OUT} = 22 dBm

1/3

EXHIBIT 9: Data Graph: Antenna Conducted Emissions

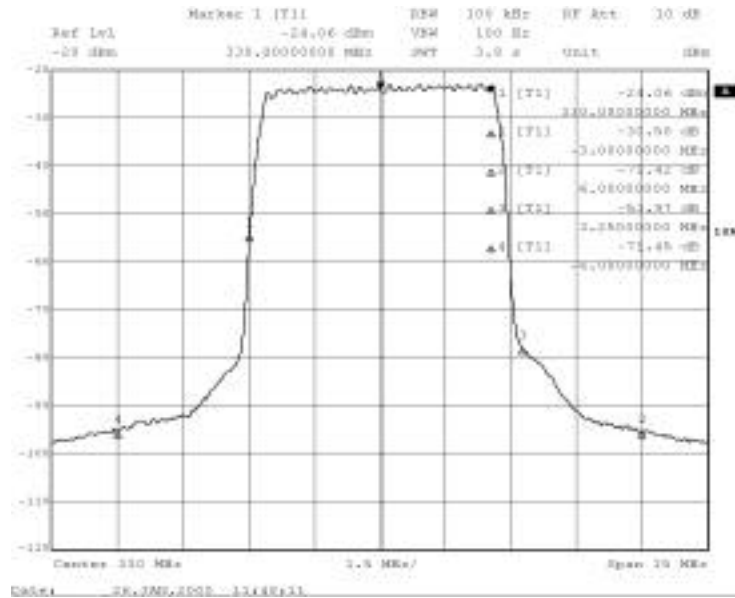


Delta 1 [T1] RBW 200 kHz RF Att 40 dB
Ref Lvl -61.75 dB VBW 10 kHz
30.4 dBm 4.73346693 GHz SWT 33 s Unit dBm



Date: 14 JUN 2000 19:41:53

WT SX1123
antenna out

EXHIBIT 10 IDU Signals to RF Module

BW=6 MHz input signal
 Input to ODU from IDU
 FCC ID: NTTSX1123