EXHIBITS

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EXHIBIT 2: Product Description and Operation Overview

EXHIBIT 3: Information for which Confidentiality is Requested

Schematics
Block Diagrams
Theory of Operation

EXHIBIT 4: Product Photographs

EXHIBIT 5: User Manual and FCC ID Label

EXHIBIT 6: RF Hazard Information per Sec. 1.1307

EXHIBIT 7: Report of Measurements

EXHIBIT 8: Data Graphs – Emissions Masks

EXHIBIT 9: IF Card TX Signals to RF Module

EXHIBIT 10: HP84125C Output Display, Noise Floor

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

21 July 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 Company

FCC ID: NTTSX1126

To whom it may concern,

Request is hereby submitted, on behalf of my client Watkins Johnson Co., 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 (P2P 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,

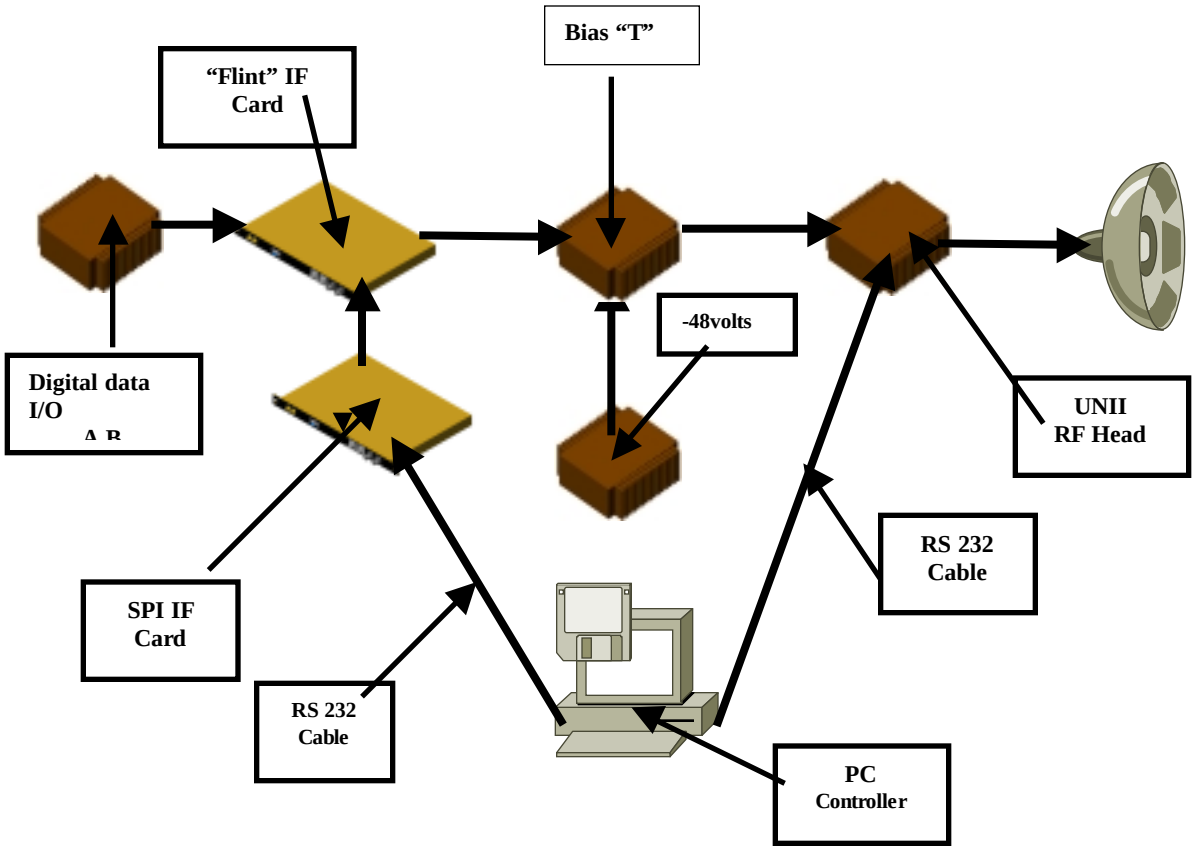
THOMAS N. COKENIAS
EMC Consultant/Agent for Watkins Johnson Co.

Tel 650 726 1263 *fax 650 726 1252* *trephonc@macconnect.com*

EXHIBIT 2: Product Description and Operation Overview

The Watkins Johnson FCC ID: NTTSX1126 is a UNII transceiver operating under the provisions of Part 15 of the Rules. The product functions as a point to point (P2P) wireless router.

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 router chassis. For test purposes, a Tektronix arbitrary waveform generator will simulate the signal output of the router/line card combination.

The **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 6 MHz multiples. The system will be configurable for use with 6 MHz and 12 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.

The **bias "T"** provides DC and the 324 MHz IF signal on a single coaxial cable for routing to the RF head.

The **RF head** produces the RF transmit link at 5.725 - 5.825 GHz , and houses the receiver LNAs, receiver local oscillator, and the receiver IF bandpass filters and IF amplifiers. The RF head also houses the TX-RX 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 Watkins-Johnson. The –48 VDC supply shown in the diagram is telephone central office (CO) power or a customer provided supply.

SPECIFICATIONS

RF Head

Frequency range:	5.725 - 5.825 GHz
Power output:	25 dBm maximum (5-25 dBm in 1 dB steps)
Channel Bandwidth:	1.5/3/6 MHz, configurable

IF Head

Frequency range:	330 MHz 24 MHz clock	
Power output:	330 MHz: 24 MHz:	-13 dBm nominal (programmable) -12 dBm nominal
Data transfer rate, air link:	22 Mbs (6 MHz channels)	
Modulation:	OFDM (Orthogonal Frequency Division Multiplexing)	
	6 MHz channel:	512 tones, 64 QAM

A description of the theory of operation and product configuration is found in an attachment to this application and report.

System Interconnection

- Refer to separate attachment

EXHIBIT 3: Information for which Confidentiality is requested

Schematics
Block Diagrams
Theory of Operations

EXHIBIT 4: Product Photographs

Refer to separate attachment

EXHIBIT 5: User Manual and FCC ID Label

-Refer to separate attachments

EXHIBIT 6: RF Hazard Information Per Sec. 1.1307

For transmitters operating in the 5725-5825 MHz frequency range, paragraph 1.1310 limits maximum permissible exposure (MPE) to 1 mW/cm2 for uncontrolled 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,V/m = (√(30*P*G))/d

Power density, mW/m2 = E^2/3770

E for MPE 1mW/m2 = 61.4 V/m

Simplifying and rearranging terms:

d = (√(30*P*G))/61.4 Converting to decibels:

20 log d = 10 log 30 + 10 log P watts + G dBi -35.8 dB

20 log d = 14.77 + PdBm - 30 dB -35.8 + GdBi

20 log d = P dBm + G dBi -51 ; **d = 10^(PdBm+GdBi-51)/20**

Antenna	**Power into antenna**	**MPE distance, cm**	**Comments**
22.5 dBi	18.8 dBm	33.5	max EIRP per 15.407

Instructions will be placed in the user manual instructing installers and users to maintain the MPE distances during operation of the EUT.

EXHIBIT 7: Report of Measurements

FCC CERTIFICATION INFORMATION

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

2.1033(b)1 **Applicant:** Watkins Johnson
3333 Hillview Avenue
Palo Alto, CA 94304

2.1033(b)2 **FCC ID**: NTTSX1126

2.1033(b)3 **Installation instructions** are found in attached document.

2.1033(b)4 A **brief description of the circuit functions** is found in attached document

2.1033(b)5 **Block diagram** is found in attached document

2.1033(b)6 **Report of measurements** is found below.

2.1033(b)7 **Product photographs** are attached in JPEG format.

2.1033(b)8 The EUT is operated with several **accessory devices** described below and in the attachments submitted.

2.1033(b) 9 The equipment for which certification is being sought **meet/does not require authorization under 15.37 transition provisions.**

2.1033(b)10 - 12 NOT APPLICABLE

The WJ UNII radio will be professionally installed. At present the antenna will be a 22.5 dBi flat panel type, integrated with the radio into a single assembly.

SUMMARY OF TEST RESULTS

15.407 General Technical Requirements

The UNII requirements for maximum power, peak power spectral density, minimum 26 dB emissions bandwidth, and maximum EIRP are interdependent variables. In addition, the level of transmitter spectral re-growth at the UNII band edges will limit the power output that may be transmitted into a particular antenna, since the emission limit is -17 or -25dBm/MHz EIRP, dependent on both antenna gain and power input.

The WJ UNII radio has user programmable output power levels from 5 - 25 dBm.

The 26 dB channel bandwidths, also user programmable, are 1.5MHz, 3MHz, or 6MHz.

A number of antennas can be used with the point-to-point UNII radio, with gains that vary
between 8 dBi and 34 dBi.

15.407(a)3 Power limits

17 dBm + 10 log (6) =	**24.8 dBm max. for 6 MHz channel**
17 dBm + 10log (3) =	**21.8 dBm max. for 3 MHz channel**
17 dBm + 10log (1.5) =	**18.8 dBm max. for 1.5 MHz channel**

Actual Design Power Output Levels:

1.5 MHz Channel: 18.8 dBm

3.0 MHz Channel: 16 dBm

6.0 MHz Channel: 13 dBm

Conducted Measurements performed at Watkins Johnson:

Power output

Power spectral density

Emissions bandwidth

Emissions mask

Band edge PDS

Results of FCC Testing for the SX1126 UNII Customer Premise Equipment Transceiver

July 19, 2000

Jay Kruse WJ Communications
Alberto Campos WJ Communications
Tom Cokenias Consultant

A SX1126 UNII Customer Premise Equipment (CPE) transceiver was tested for maximum power spectral density, maximum output power, and maximum Bandedge emissions. Based on consultation with Greg Czumak at the FCC (11/5/99), the following methods were developed for testing U-NII transceivers:

Peak Power Spectral Density **17 dBm/MHz**
- Resolution Bandwidth = 1MHz
- Video Bandwidth = 1 MHz
- Average = 100 sweeps
- Peak Search
- Measure Peak

Peak Transmit Power **17 dBm/MHz + 10*Log(Bandwidth in MHz)**
- Resolution Bandwidth ~ 1% Emission Bandwidth
- Video Bandwidth = Resolution Bandwidth
- Set Channel Bandwidth = Emission Bandwidth
- View Trace
- Measure Power in Channel Bandwidth

Band Edge **-17 dBm/MHz – Antenna Gain (Bandedge)**
-27 dBm/MHz – Antenna Gain (Bandedge ± 10 MHz)
- Resolution Bandwidth ~ 1% Emission Bandwidth
- Video Bandwidth = Resolution Bandwidth/30
- Center Frequency = Band Edge
- Set Adjacent Channel Bandwidth = 1 MHz
- View Trace
- Measure Power in Adjacent Channel d Bandwidth

Unit # 2120027005 was measured using the above methods. The power of the Orthogonal Frequency Division Multiplex (OFDM) input signal was –17 dBm. A block Diagram of the measurement setup is shown in Figure 1. The frequency range of the unit is from 5727 MHz to 5775 MHz and therefore the worse case Bandedge emissions occur at the lower end of the Band. Tables 1 and 6 summarize the FCC limits and the measured results. A 22.5 dBi antenna was used for all calculations. The total path loss (cables plus fixed attenuation) from the transceiver to the spectrum analyzer was 26.3 dB.

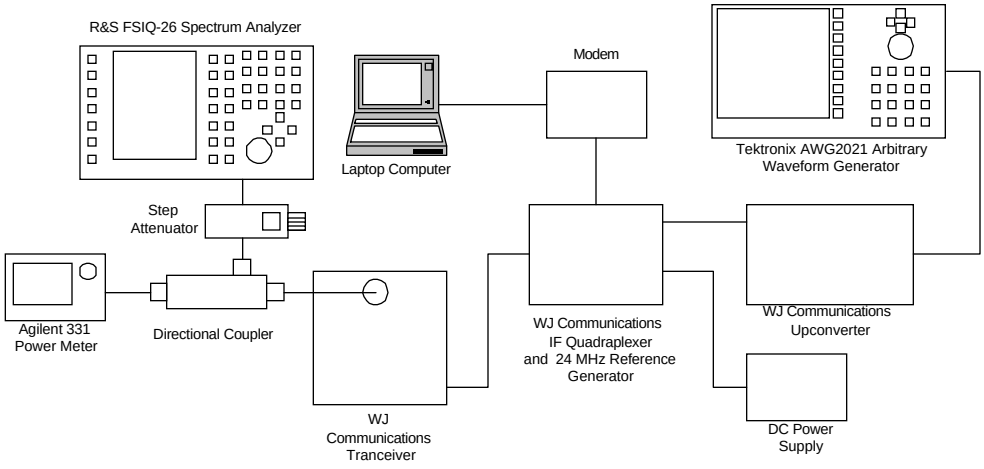


Figure 1. Block diagram of measurement setup.

Table 1. Low Channel data for Peak Spectral Density and Peak Transmit Power.

BW (MHz)	Maximum Allowed PSD (dBm/MHz)	Measured PSD (dBm/MHz)	Maximum Allowed Peak Transmit Power (dBm)	Measured Peak Transmit Power (dBm)
1.5	17	16.7	18.8	18.8
3.0	17	11.4	21.8	16.0
6.0	17	5.2	24.8	13.0

Table 2. Low Channel data for Band Edge Emmissions.

BW (MHz)	Maximum Allowed Bandege PSD (dBm/MHz) 5725 MHz	Maximum Measured BandedgePSD (dBm/MHz) 5725 MHz	Maximum Allowed Bandege PSD (dBm/MHz) 5715 MHz	Maximum Measured BandedgePSD (dBm/MHz) 5715 MHz
1.5	-39.5	-42.8	-49.5	-59.1
3.0	-39.5	-43.0	-49.5	-59.1
6.0	-39.5	-46.9	-49.5	-58.9

Table 3. Mid Channel data for Peak Spectral Density and Peak Transmit Power.

BW (MHz)	Maximum Allowed PSD (dBm/MHz)	Measured PSD (dBm/MHz)	Maximum Allowed Peak Transmit Power (dBm)	Measured Peak Transmit Power (dBm)
1.5	17	17.0	18.8	18.8
3.0	17	11.4	21.8	16.0
6.0	17	5.2	24.8	13.0

Table 4. Mid Channel data for Band Edge Emmissions.

BW (MHz)	Maximum Allowed Bandege PSD (dBm/MHz) 5725 MHz	Maximum Measured BandedgePSD (dBm/MHz) 5725 MHz	Maximum Allowed Bandege PSD (dBm/MHz) 5715 MHz	Maximum Measured BandedgePSD (dBm/MHz) 5715 MHz
1.5	-39.5	-58.5	-49.5	-60.3
3.0	-39.5	-57.8	-49.5	-60.7
6.0	-39.5	-61.7	-49.5	-60.7

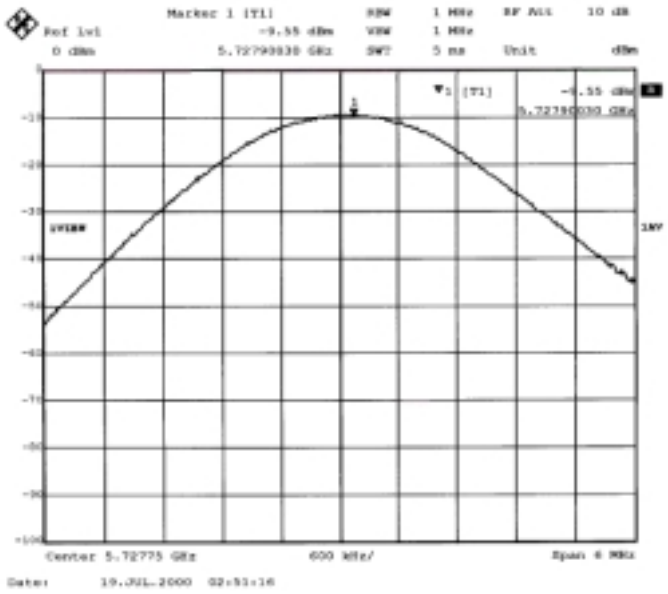
Table 5. High Channel data for Peak Spectral Density and Peak Transmit Power.

BW (MHz)	Maximum Allowed PSD (dBm/MHz)	Measured PSD (dBm/MHz)	Maximum Allowed Peak Transmit Power (dBm)	Measured Peak Transmit Power (dBm)
1.5	17	16.7	18.8	18.8
3.0	17	11.4	21.8	16.0
6.0	17	5.2	24.8	13.0

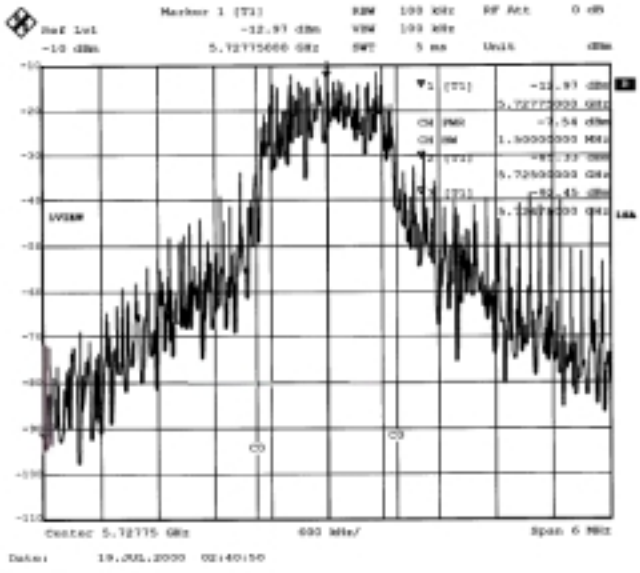
Table 6. High Channel data for Band Edge Emmissions.

BW (MHz)	Maximum Allowed Bandege PSD (dBm/MHz) 5725 MHz	Maximum Measured BandedgePSD (dBm/MHz) 5725 MHz	Maximum Allowed Bandege PSD (dBm/MHz) 5715 MHz	Maximum Measured BandedgePSD (dBm/MHz) 5715 MHz
1.5	-39.5	-59.5	-49.5	-59.8
3.0	-39.5	-59.6	-49.5	-59.4
6.0	-39.5	-58.8	-49.5	-59.2

Bandwidth = 1.5 MHz
Pout = 18.8 dBm
Loss = 11.3 dB
Attenuation = 15 dB
Low Channel

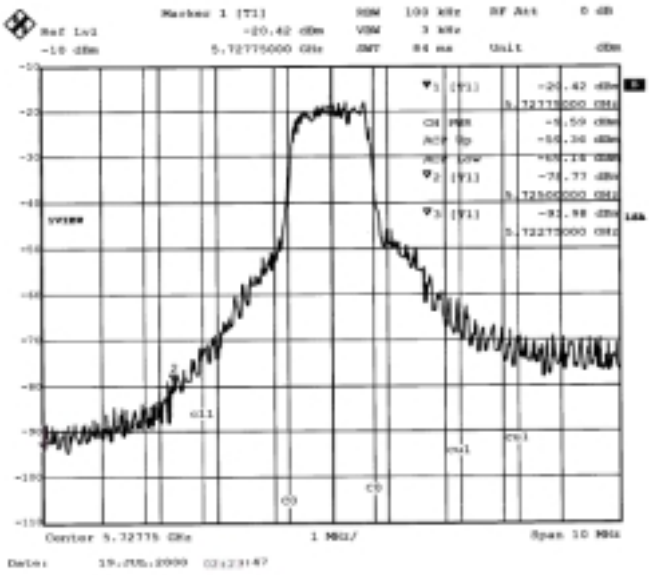


Maximum Power Spectral Density = -9.6 dBm/MHz +26.3 dB =16.7 dBm/MHz

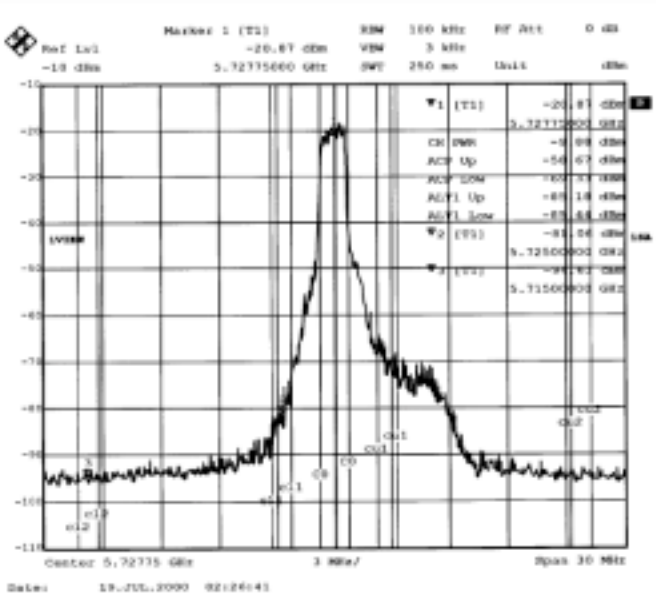


Maximum Transmit Output Power = -7.5 dBm +26.3 dB =18.8 dBm

Bandwidth = 1.5 MHz
Pout = 18.8 dBm
Loss = 11.3 dB
Attenuation = 15 dB
Low Channel

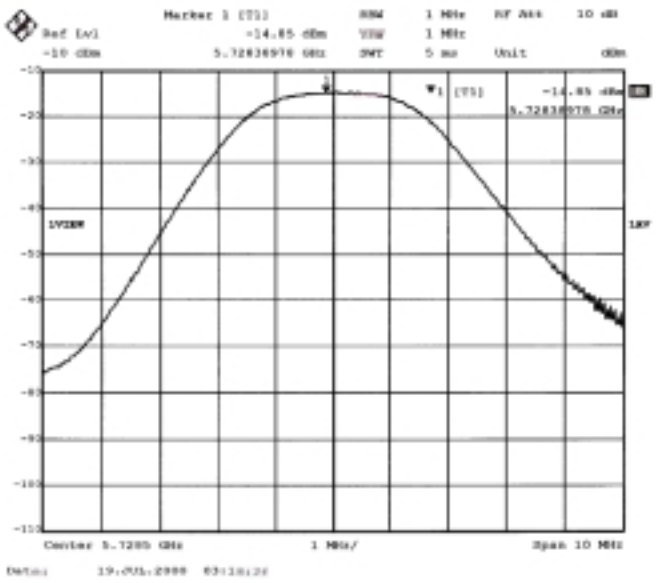


$P_{5725\ MHz}$= -69.1 dBm/MHz +26.3 dB =-42.8 dBm/MHz

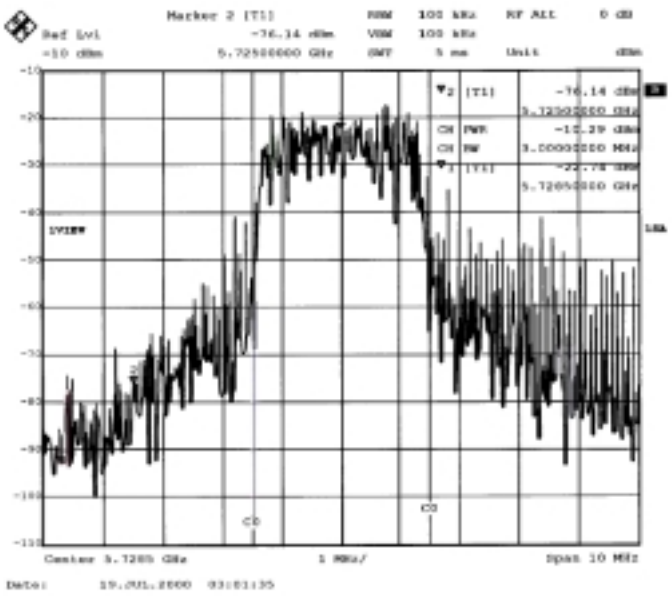


$P_{5715\ MHz}$= -85.4 dBm/MHz +26.3 dB =-59.1 dBm/MHz

Bandwidth = 3.0MHz
Pout = 16.0 dBm
Loss = 11.3 dB
Attenuation = 15 dB
Low Channel

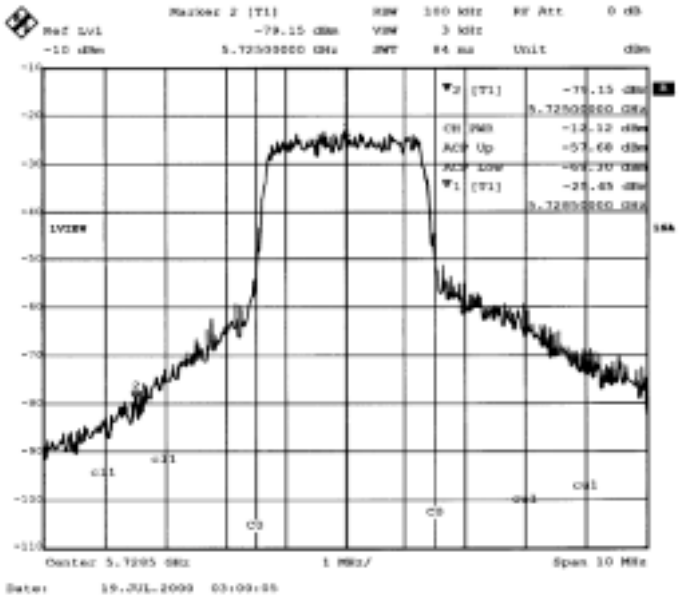


Maximum Power Spectral Density = -14.9 dBm/MHz +26.3 dB =11.4 dBm/MHz

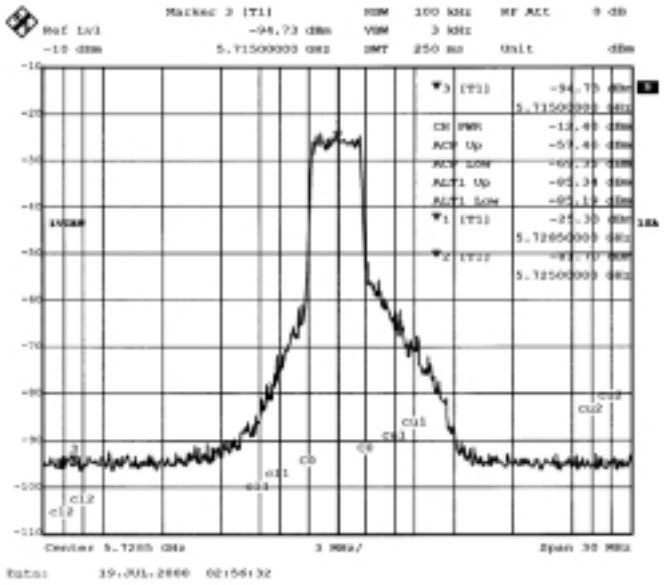


Maximum Transmit Output Power = -10.3 dBm +26.3 dB =16.0 dBm

Bandwidth = 3.0 MHz
Pout = 16.0 dBm
Loss = 11.3 dB
Attenuation = 15 dB
Low Channel

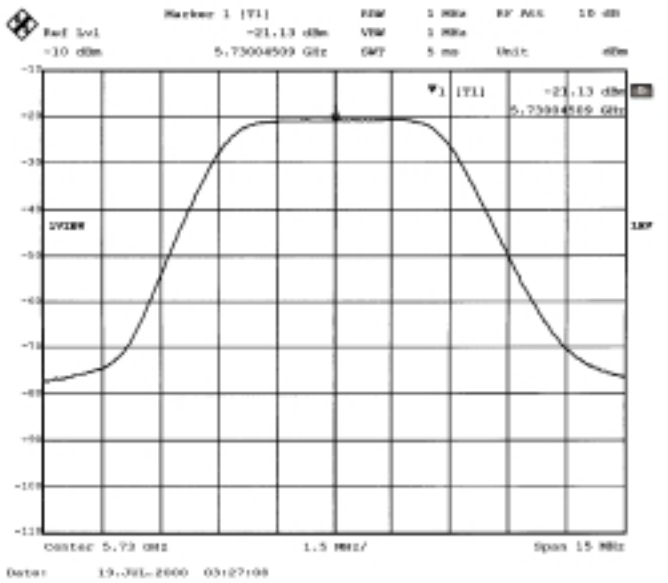


$P_{5725\ MHz}$= -69.3 dBm/MHz +26.3 dB =-43.0 dBm/MHz

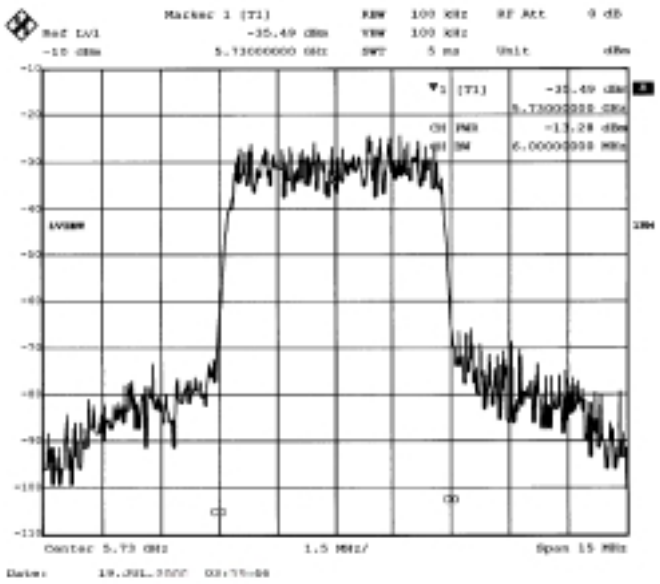


$P_{5715\ MHz}$= -85.2 dBm/MHz +26.3 dB =-58.9 dBm/MHz

Bandwidth = 6.0MHz
Pout = 13.0 dBm
Loss = 11.3 dB
Attenuation = 15 dB
Low Channel

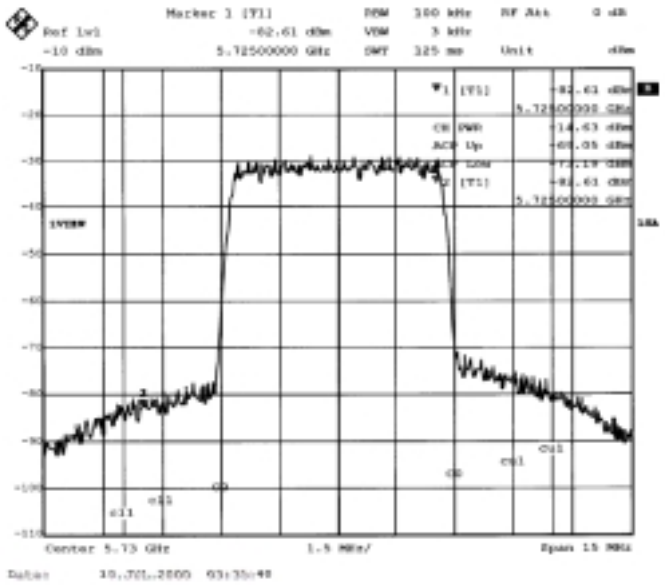


Maximum Power Spectral Density = -21.1 dBm/MHz +26.3 dB =5.2 dBm/MHz

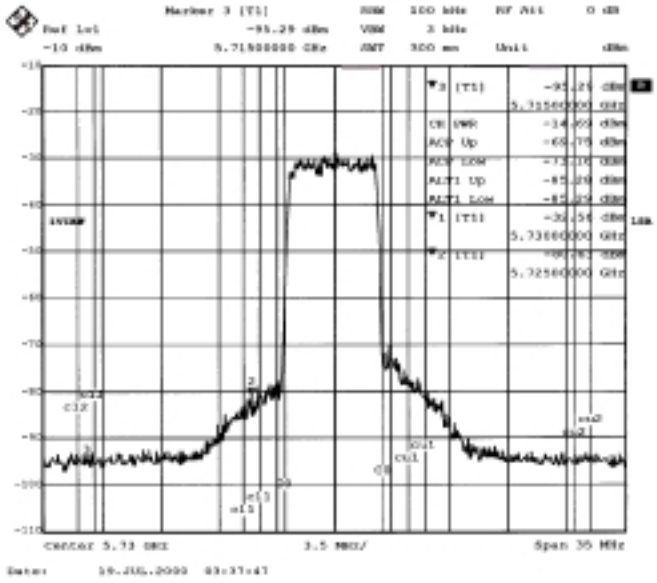


Maximum Transmit Output Power = -13.3 dBm +26.3 dB =13.0 dBm

Bandwidth = 6.0 MHz
Pout = 13.0 dBm
Loss = 11.3 dB
Attenuation = 15 dB
Low Channel

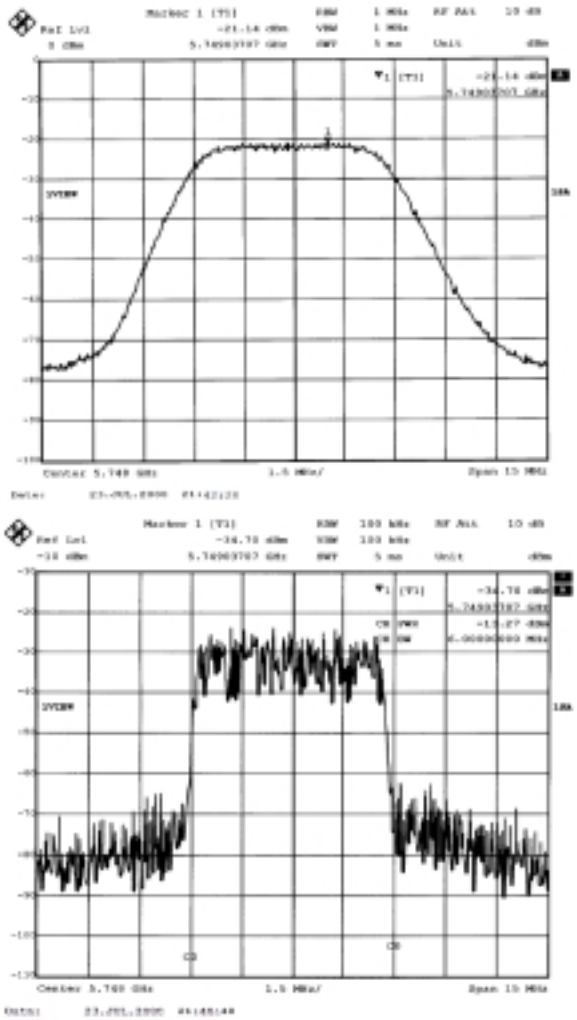


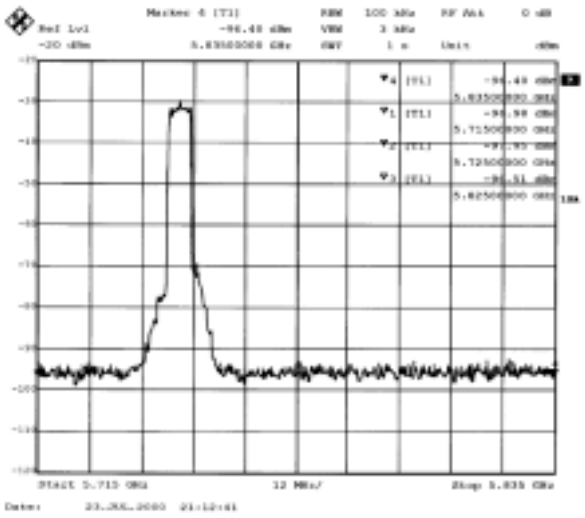
$P_{5725\ MHz}$= -73.2 dBm/MHz +26.3 dB =-46.9 dBm/MHz



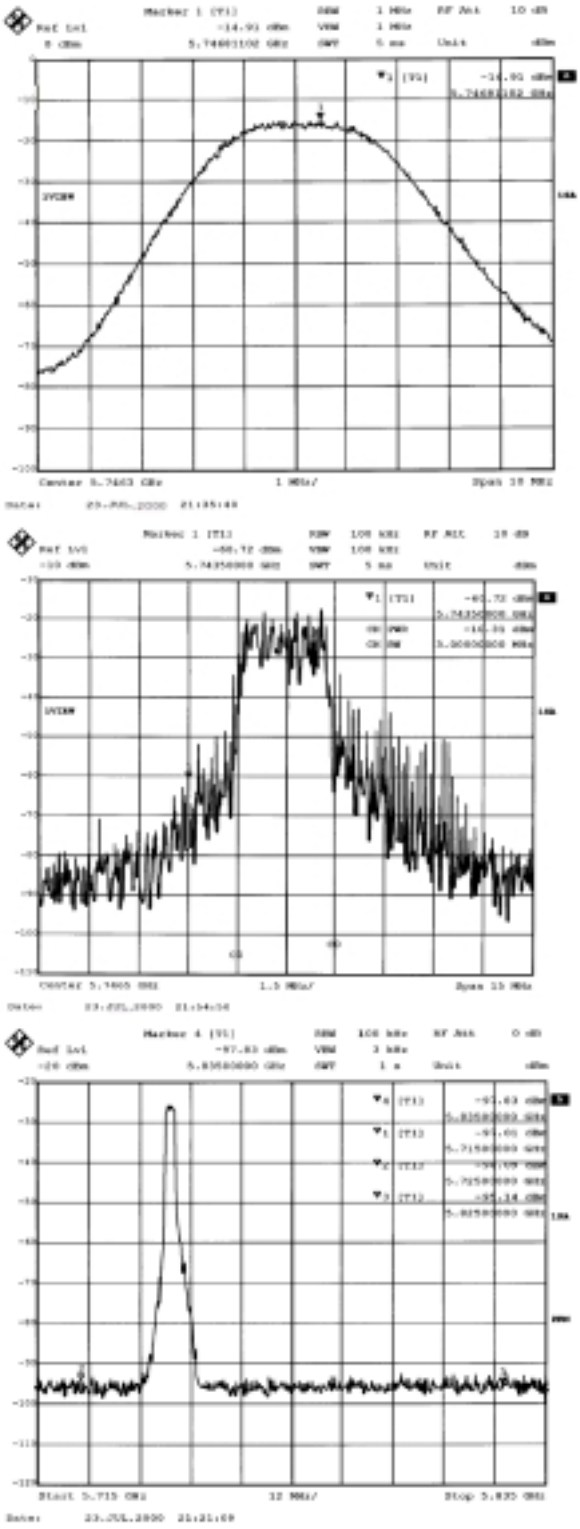
$P_{5715\ MHz}$= -85.3 dBm/MHz +26.3 dB =-59.0 dBm/MHz

Bandwidth = 6.0 MHz
Pout = 13.0 dBm
Loss =11.3 dB
Attenuation = 15 dB
Mid Channel

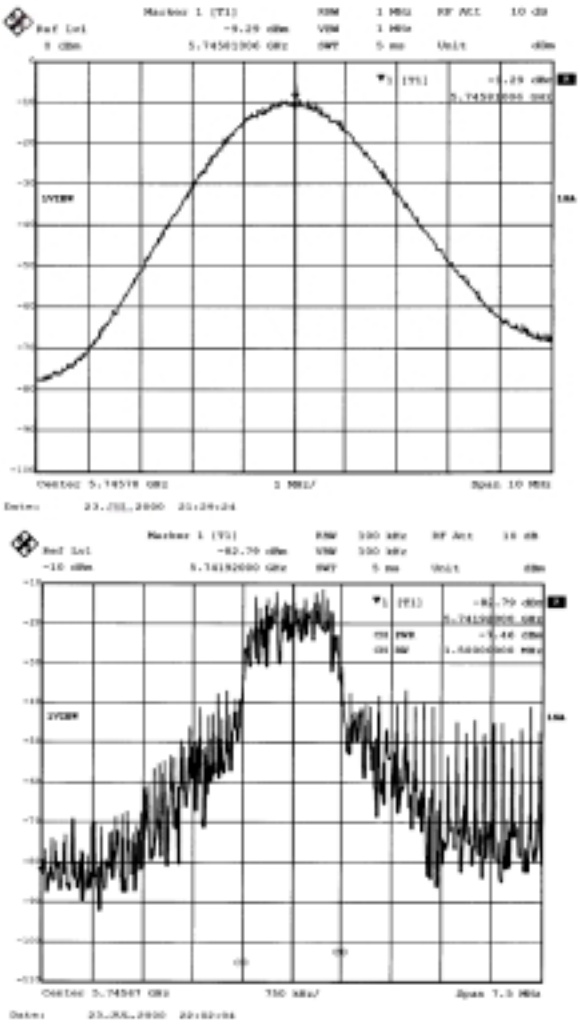


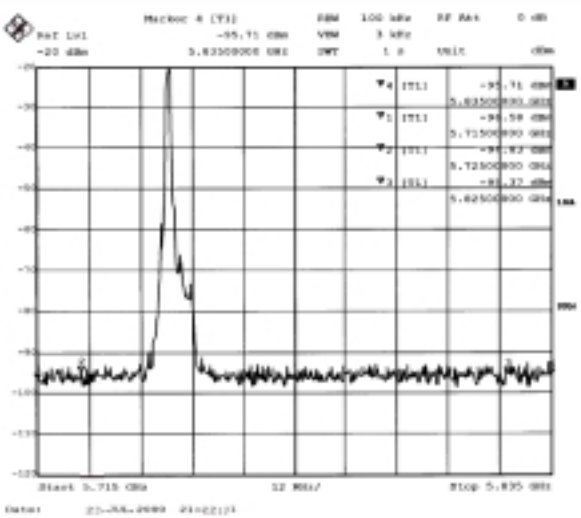


Bandwidth = 3.0 MHz
Pout = 16.0 dBm
Loss = 11.3 dB
Attenuation = 15 dB
Mid Channel

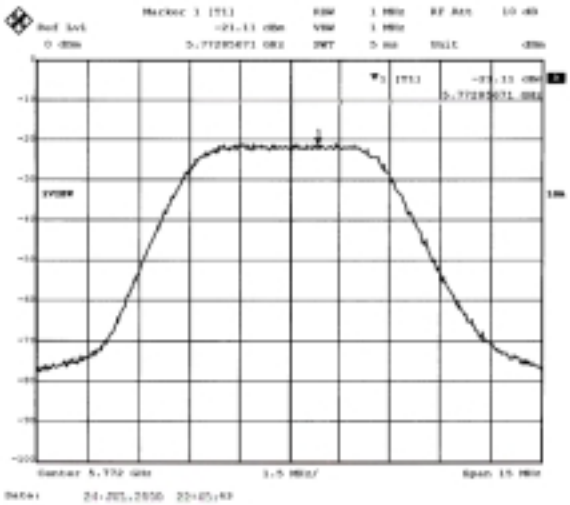


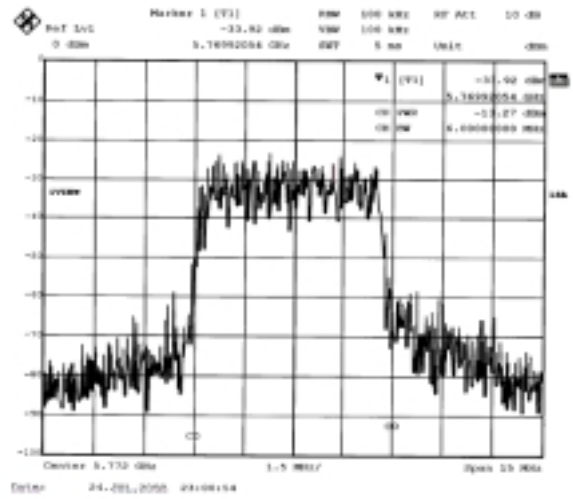
Bandwidth = 1.5 MHz
Pout = 18.8 dBm
Loss = 11.3 dB
Attenuation = 15 dB
Mid Channel

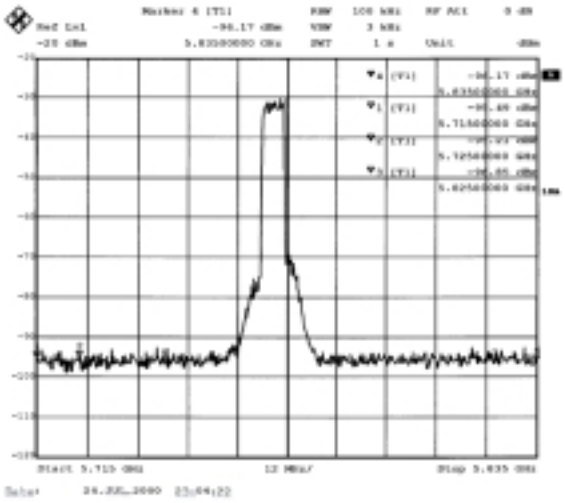




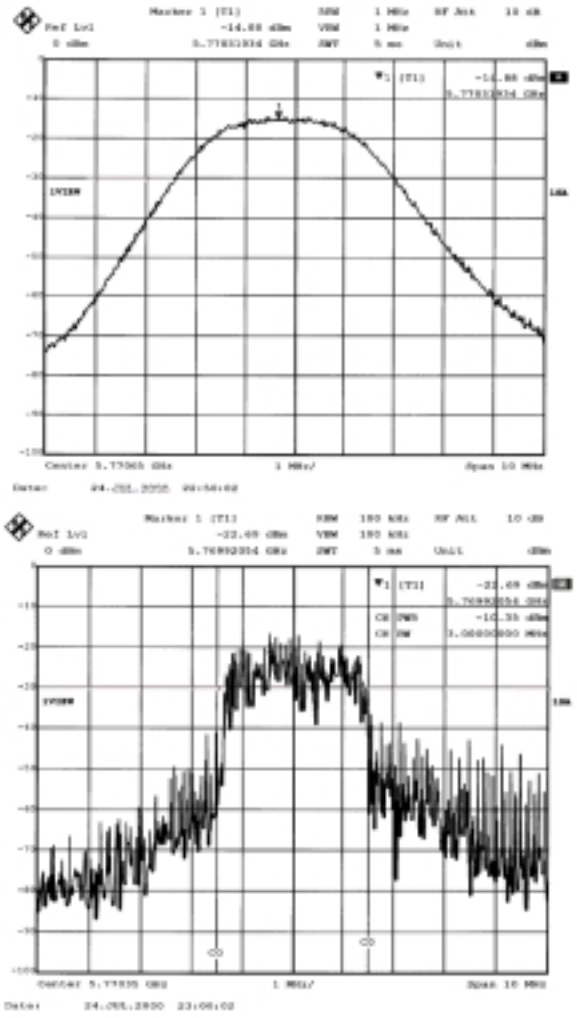
Bandwidth = 6.0 MHz
Pout = 13.0 dBm
Loss = 11.3 dB
Attenuation = 15 dB
High Channel

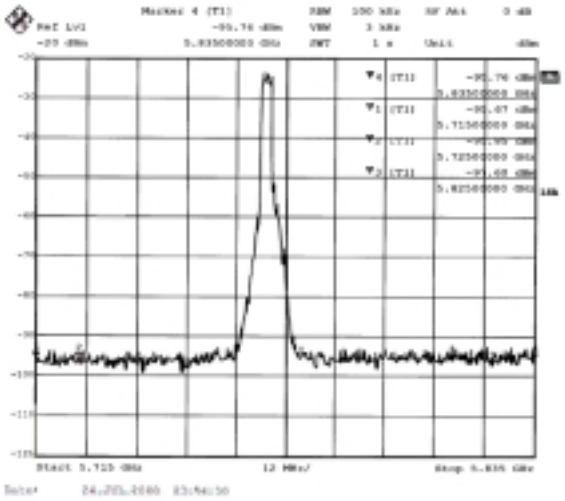




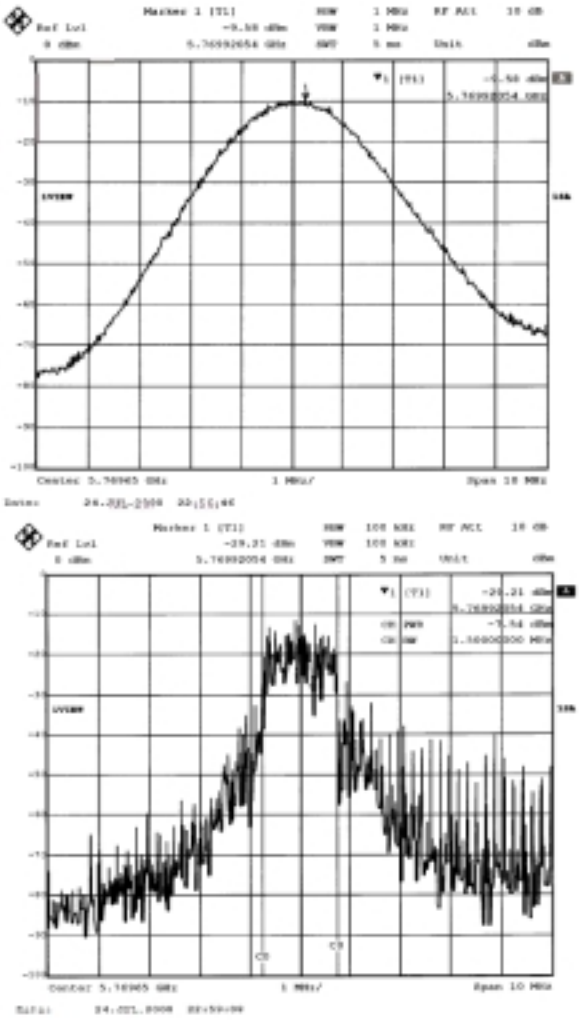


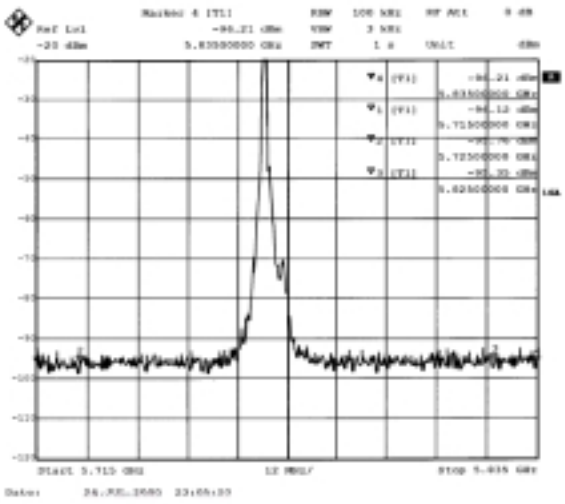
Bandwidth = 3.0 MHz
Pout = 16.0 dBm
Loss = 11.3 dB
Attenuation = 15 dB
High Channel





Bandwidth = 1.5 MHz
Pout = 18.8 dBm
Loss = 11.3 dB
Attenuation = 15 dB
High Channel





Radiated Emissions Measurements Performed at Cisco Systems

Restricted Bands Radiated Emissions to 40 GHz

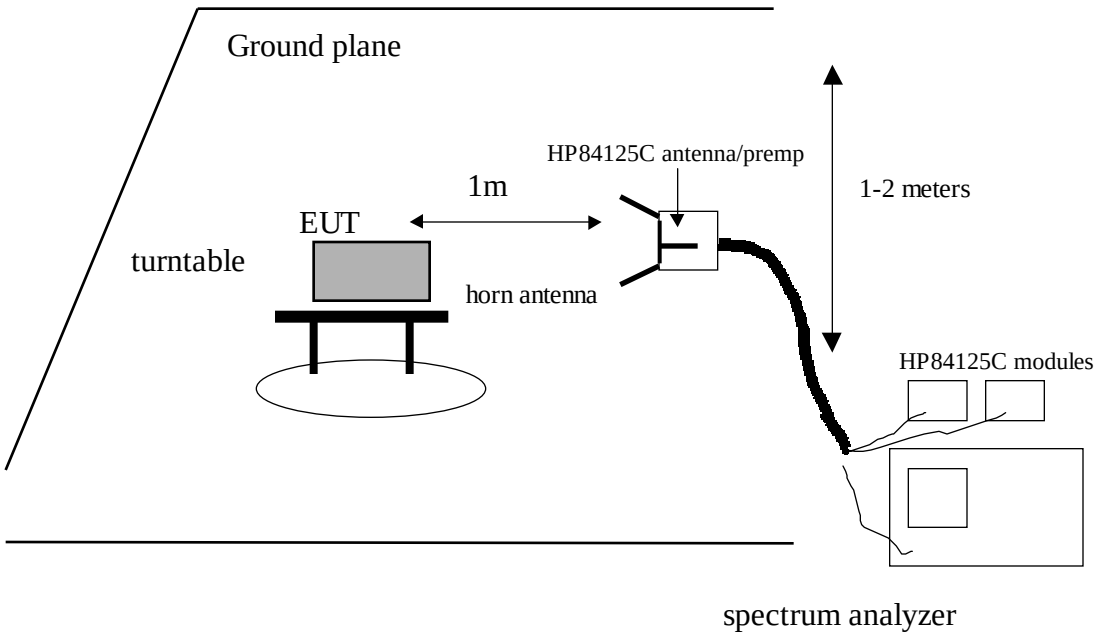
ITE Radiated Emissions, 30 – 1000 MHz

15.407(c)6 Field Strength of Spurious and Harmonic Radiation

Measurement Equipment Used:

HP 8565E Spectrum Analyzer
HP 84125C Microwave EMI Measurement System

Test Set-Up



Requirement

For restricted band emissions listed in 15.205 that are above 1 GHz, the limit of each spurious and harmonic emission detected shall be no more than

54 dBuV/m at 3m separation, using an average detector

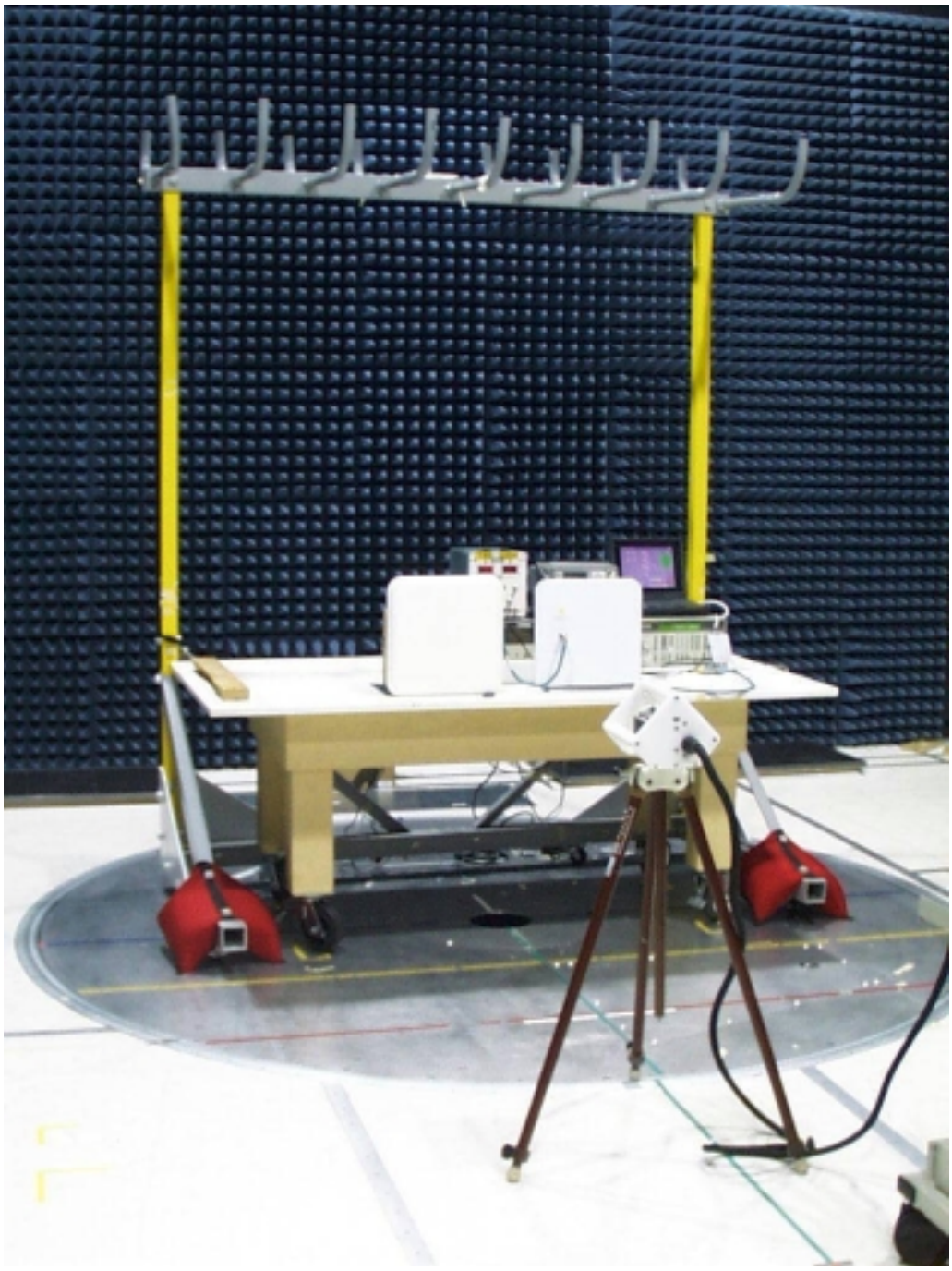
74 dBuV/m at 3m separation, using a peak detector

Test Method
With the transmitter operating at full power, 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 40 GHz.

Test Results

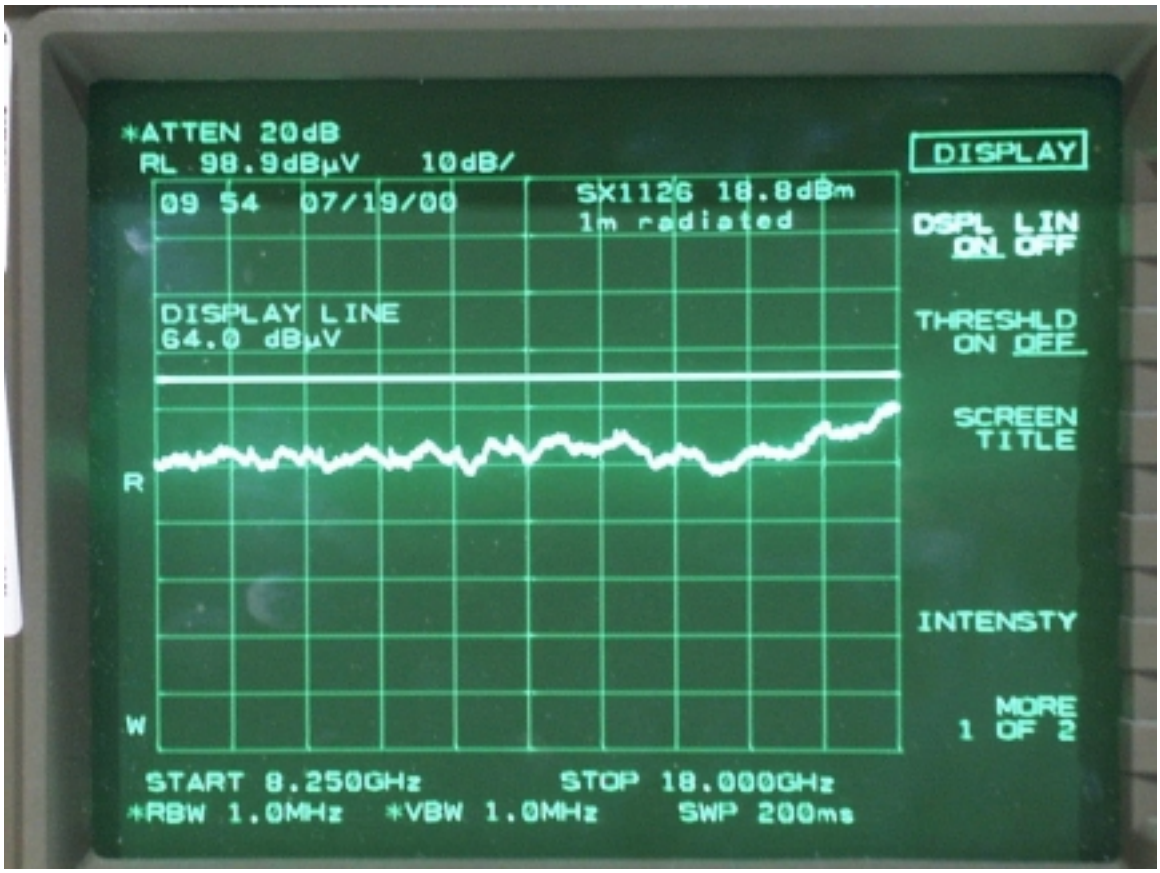
No emissions above instrumentation noise floor were detected. Tests were repeated at 1m and at 1ft separations. It was determined that there were no emissions within 10-20 dB of the limit, even at 1 ft separation.

Radiated Emissions Test Set-Up

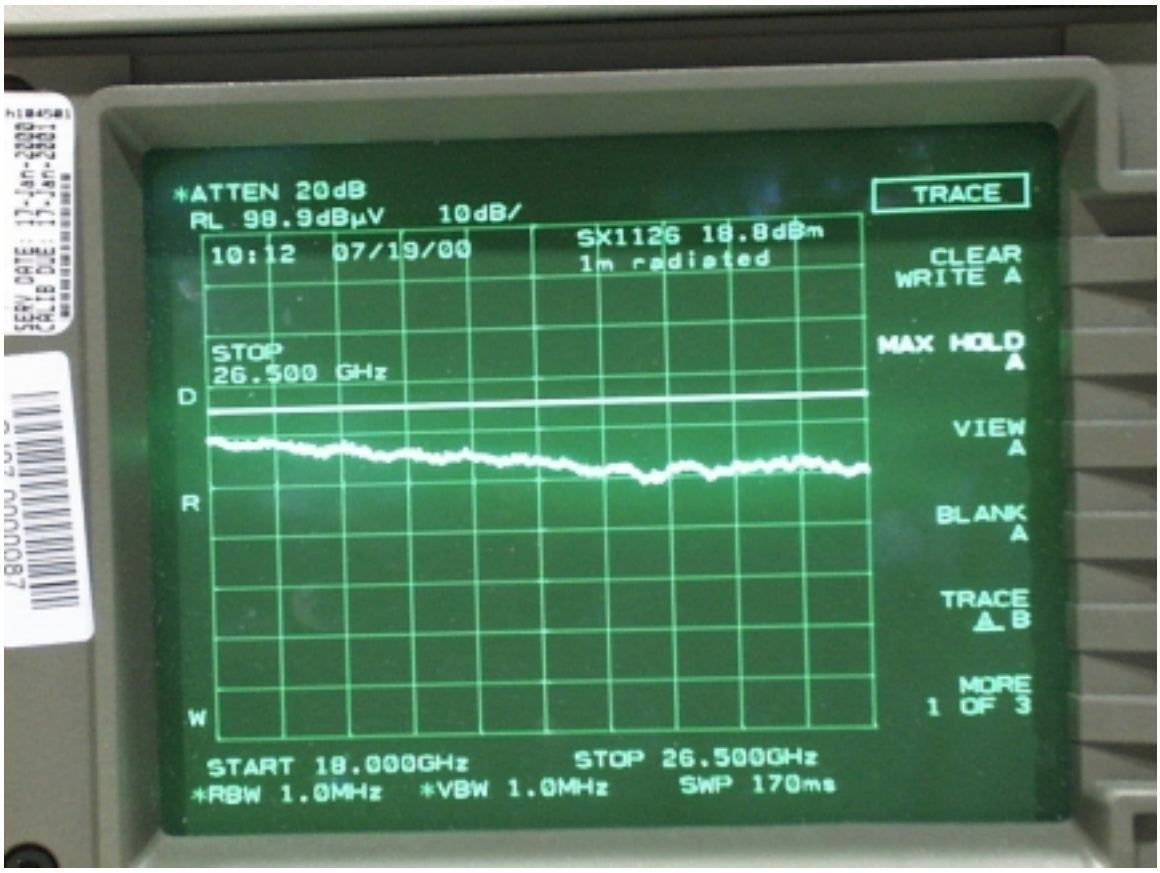


Note: In actual installation the antenna will be attached to transceiver. The EUT did not have the proper mounting hardware and connector type to attach antenna to radio.

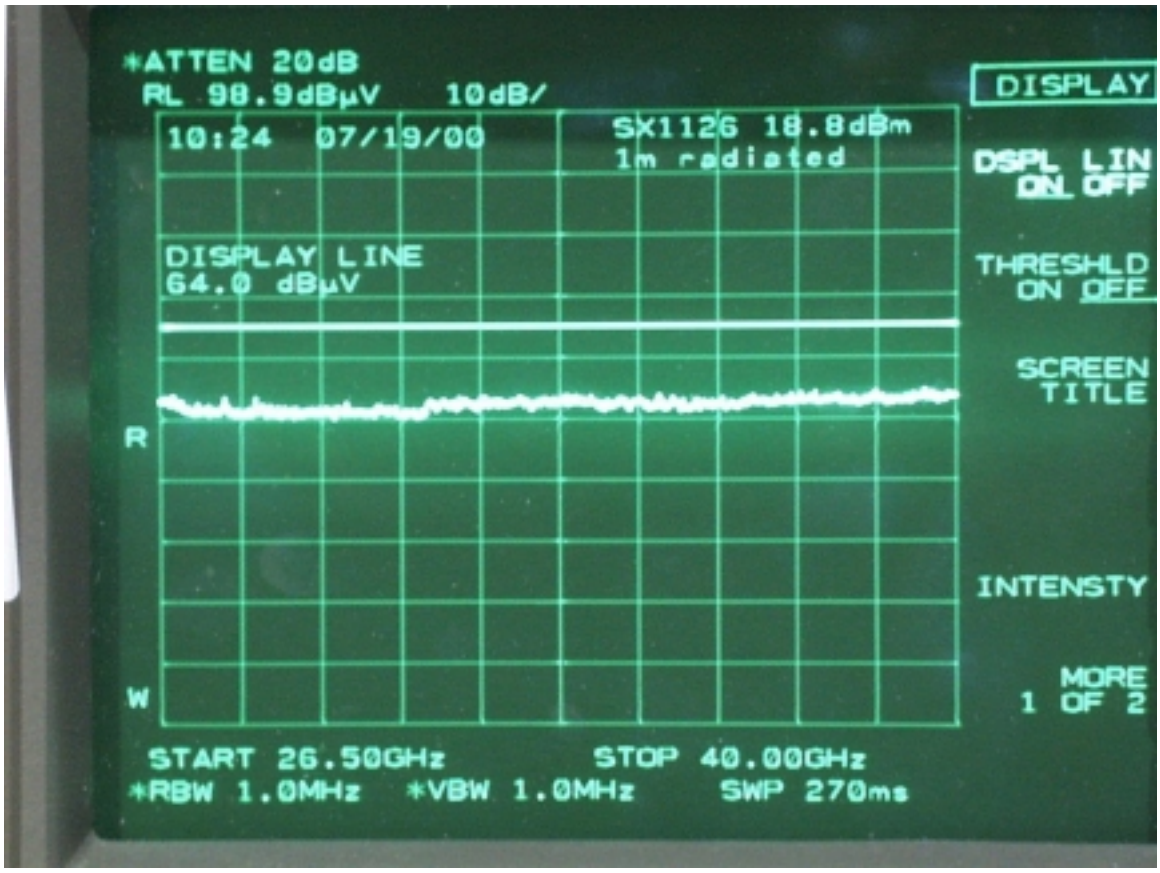
Radiated Emissions Noise Floor, 8.25-18 GHz



Radiated Emissions Noise Floor, 18 – 26.5 MHz



Radiated Emissions Noise Floor, 26.5 – 40 MHz



The HP84125C, when used with the memory card, applies all corrections such as cable loss, antenna factor, and amplifier gains to the received signal and displays a corrected field strength level on the spectrum analyzer screen. System operation is verified per user manual by connecting a signal generator to where the antenna port would normally connect, and comparing the displayed emission level with the theoretical level calculated for the system loss/gain parameters.

When checked in this manner, the HP84125C system readings were within+/- 2 dB of calculated values.

Part 15 Digital Device Emissions

Tests were performed to measure radiated emissions per 15.109 of the Rules.
Test procedures were per ANSI C63.2.

Test Site

All radiated testing was performed at Cisco Systems by me or under my supervision. Antenna conducted RF emissions were performed at Watkins Johnson and at Cisco. 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