Test Report for 2.6 GHz Customer Premises Transceiver

Requirement: Federal Communications Commissions
Test Requirements: Part 27

Applicant: Aperto Networks
1637 S Main Street
Milpitas CA 95035

Product ID: **FCC ID:** PS6SR1001-A1

II. DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)

The Aperto FCC ID: PS6SR1001-A1 is a Part 27 2.6 GHz customer premises transceiver.

RF Specifications

RF Frequency Band	2503-2683 MHz
RF Channels	Programmable in 1 MHz steps Power programmable in 0.2 dB steps
RF Signal Bandwidth	5.5 MHz (20 dB BW)
Modulation Type	16 QAM or QPSK (dynamically selected)
Transmitter Output Power	+20dBm maximum
Antenna to be added:	16 dBi omni nominal

III. TEST LOCATION

Radiated emissions tests were performed at:

Compliance Certification Services
571F Monterey Road
Morgan Hill, CA 95037

Antenna port conducted emissions tests and frequency stability testing was performed by Airgo at their laboratory facility in Milpitas CA

T.N. Cokenias 25 January 2006
EMC Consultant/Agent for Aperto Networks Inc.

FCC CERTIFICATION INFORMATION

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

1.1307(b) RF exposure information is provided in a separate attachment in the form of maximum permissible exposure (MPE) data.

2.1033(c)1 Applicant: Aperto Networks
1637 S Main Street
Milpitas CA 95035

2.1033(c)2 FCC ID: PS6SR1001-A1

2.1033(c)3 Installation instructions are found in separate document.

2.1033(c)4 Emission type: QPSK or 16QAM
Emission designator: 5M50G1D
5M50W1D

2.1033(c)5 Frequency range: 2503-2583 MHz

2.1033(c)6 Range of Operating Power

10 – 20 dBm

2.1033(c)7 Maximum Power Rating

20.42 dBm
Maximum allowed per 27.50(h): 2.0 watts TX power (33 dBm)

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

Refer to schematics, separate submission accompanying this application

2.1033(c)9 Tune-up procedure

Refer to installation instructions..

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

Complete product schematics are provided in separate attachments.
Circuit description and theory of operation are found in separate attachment.

2.1033(c)11 FCC ID Label

Refer to separate attachment.

2.1033(c)12 Product Photographs

Refer to separate attachment.

2.1033(c)13 Description of Modulation System

Digital data QPSK or 16QAM. Refer to theory of operation, separate attachment

2.1046 RF Output Power Measurements

Test Requirement: 27.50 Power and Antenna Height Requirments

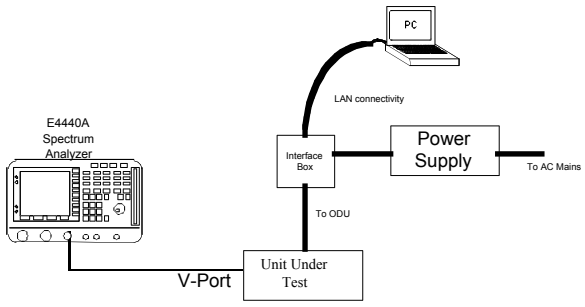
(2) *Mobile and other user stations*. Mobile stations are limited to 2.0 watts EIRP. All user stations are limited to 2.0 watts transmitter output power.

(4) For main, booster and response stations utilizing digital emissions with non-uniform power spectral density (*e.g*. unfiltered QPSK), the power measured within any 100 kHz resolution bandwidth within the 6 MHz channel occupied by the non-uniform emission cannot exceed the power permitted within any 100 kHz resolution bandwidth within the 6 MHz channel if it were occupied by an emission with uniform power spectral density, *i.e*., if the maximum permissible power of a station utilizing a perfectly uniform power spectral density across a 6 MHz channel were 2000 watts EIRP, this would result in a maximum permissible power flux density for the station of 2000/60 = 33.3 watts EIRP per 100 kHz bandwidth. If a non-uniform emission were substituted at the station, station power would still be limited to a maximum of 33.3 watts EIRP within any 100 kHz segment of the 6 MHz channel, irrespective of the fact that this would result in a total 6 MHz channel power of less than 2000 watts EIRP."

Test Location: Aperto Networks
Measurement equipment used:

Agilent E4440A Spectrum Analyzer
Low loss coaxial cable (1.8 dB at 2.6 GHz)

Test set-up:



Test set-up

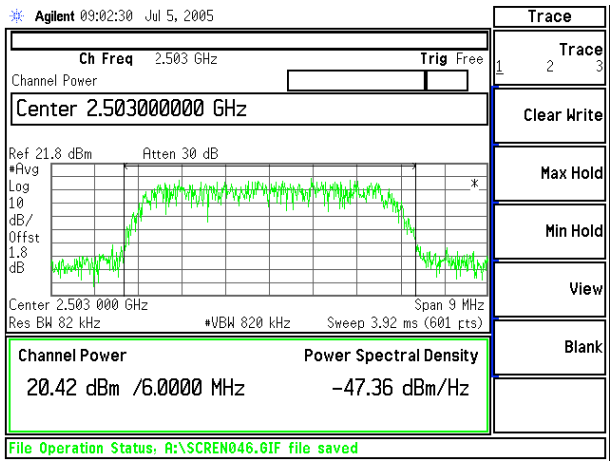
Test Procedures

1. Activate built-in Channel Power measurement feature.
2. Set integration bandwidth to 6 MHz
3. Record measurement.

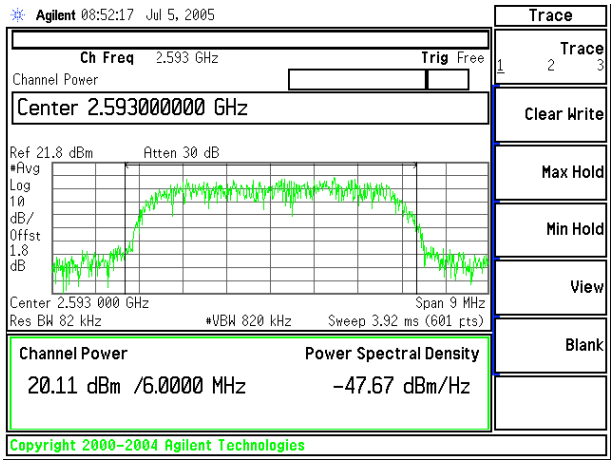
Test Results

F(MHz)	Pout
2503	20.42 dBm
2593	20.11 dBm
2683	20.06 dBm

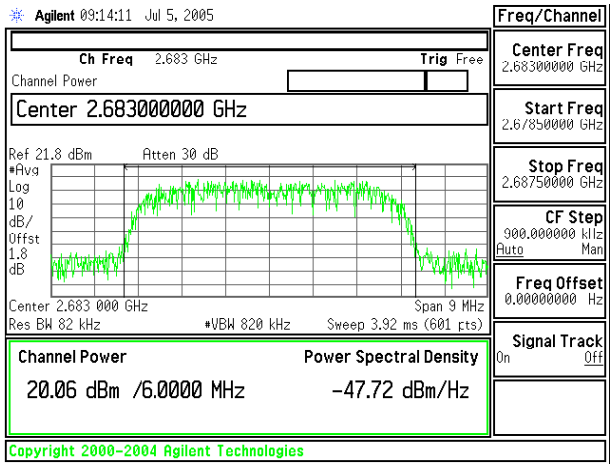
Refer to spectrum analyzer plots below.



Low Channel



Mid channel



High channel

Section 2.1047 Modulation Characteristics
Section 2.1051 Spurious and Harmonic Emissions at Antenna Terminals

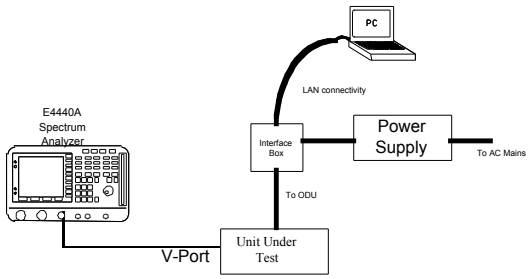
FCC Requirement/Limit: 27.53(l)

(l) For BRS and EBS stations, the power of any emissions outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) measured in watts.

(2) For fixed and temporary fixed digital stations, the attenuation shall be not less than 43 + 10 log (P) dB, unless a documented interference complaint is received from an adjacent channel licensee. Provided that the complaint cannot be mutually resolved between the parties, both licensees of existing and new systems shall reduce their out-of-band emissions by at least 67 + 10 log (P) dB measured at 3 MHz from their channel's edges for distances between stations exceeding 1.5 km. For stations separated by less than 1.5 km, the new licensee shall reduce attenuation at least 67 + 10 log (P) _ 20 log(D_{km}/1.5), or when colocated, limit the undesired signal level at the affected licensee's base station receiver(s) at the colocation site to no more than _107 dBm. Mobile Service Satellite licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS1 on the same terms and conditions as adjacent channel BRS or EBS licensees.

Test Location: Aperto Networks
Measurement equipment used:
Agilent E4440A Spectrum Analyzer
Low loss coaxial cable (1.8 dB at 2.6 GHz)

Test set-up:



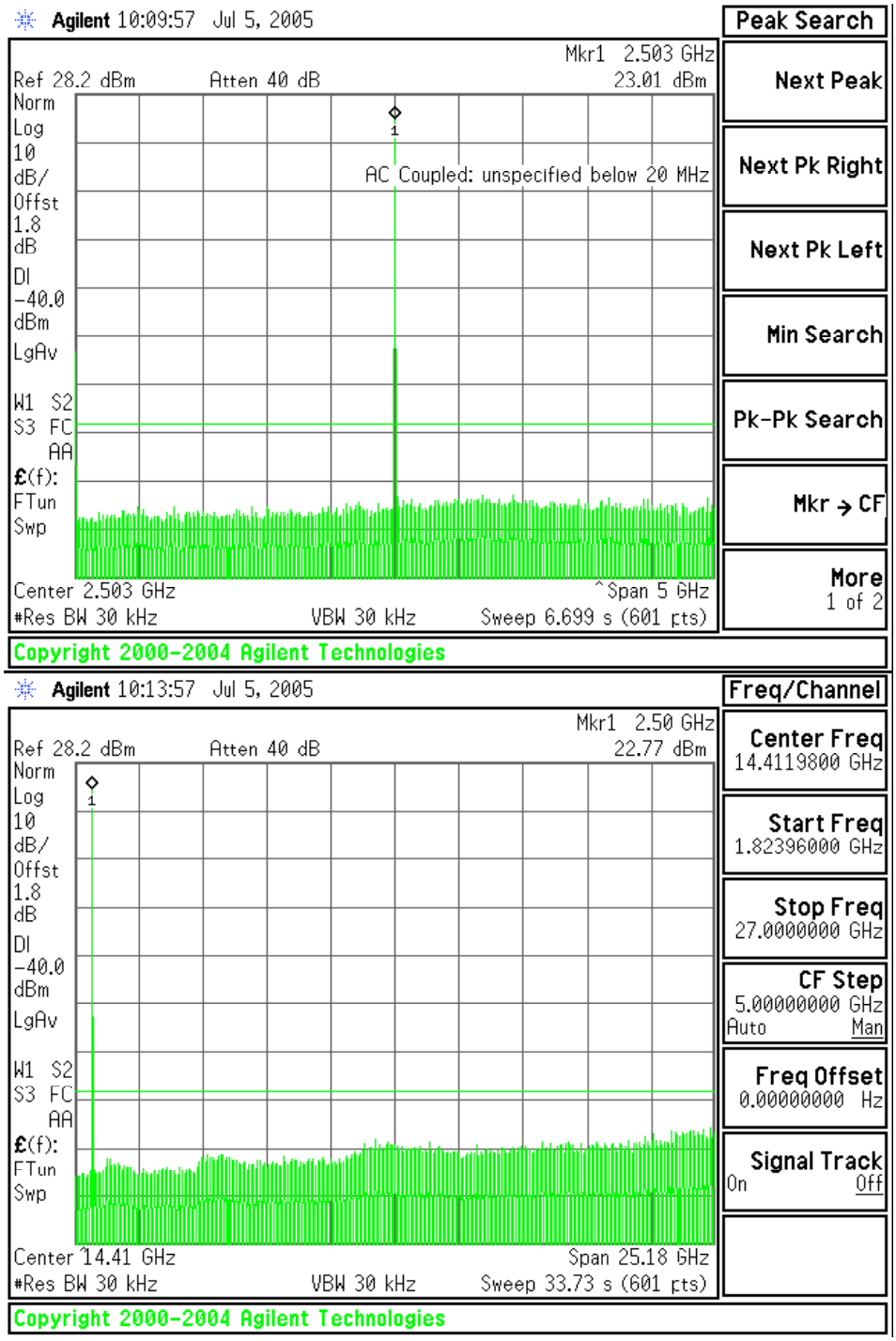
Test set-up

Test Procedures
The EUT was set to transmit continuously at Low, Mid, and High channels. Two plots at each operating frequency display out of band emissions from 0 MHz to 27 GHz.

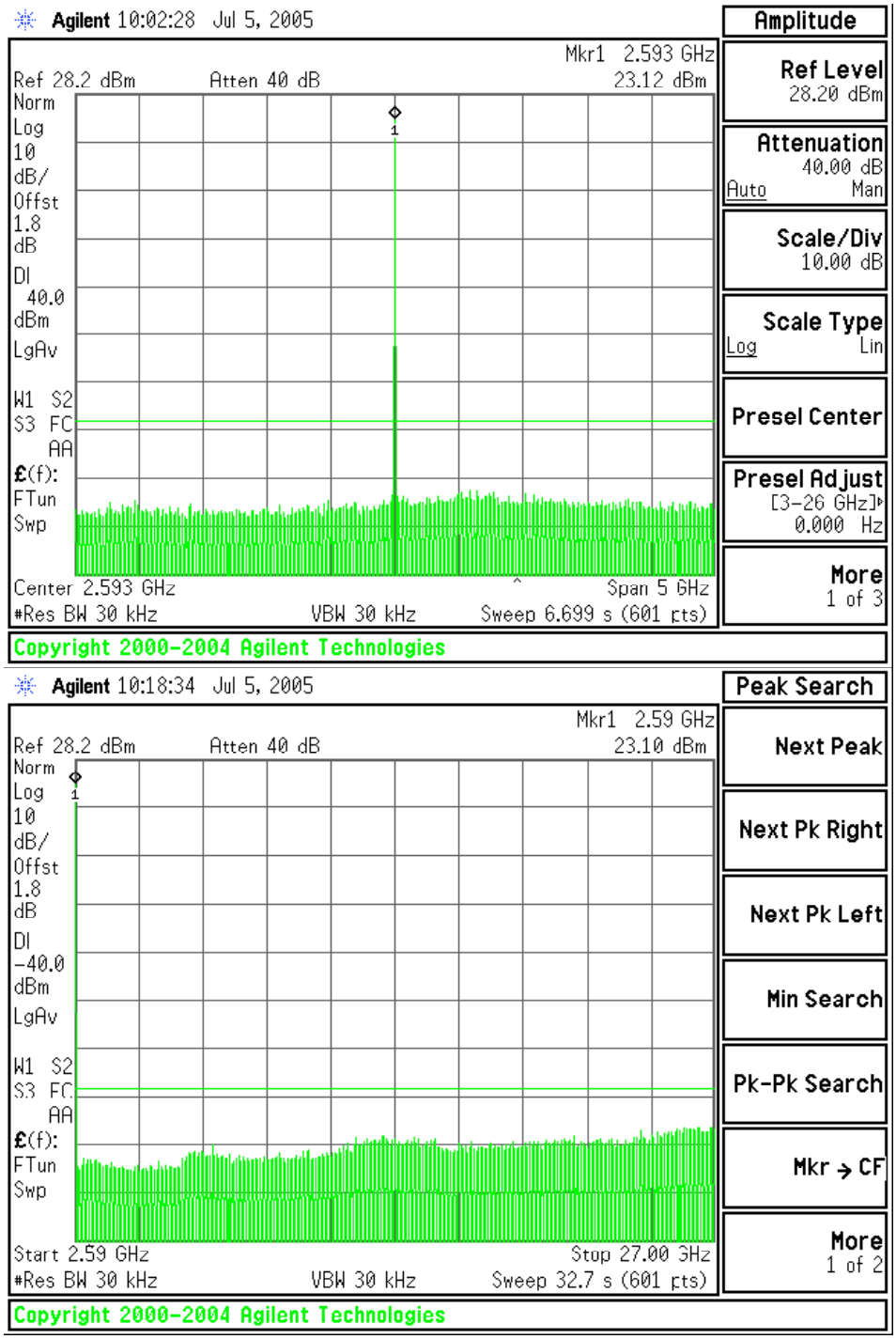
Test Results

Refer to spectrum analyzer plots below.

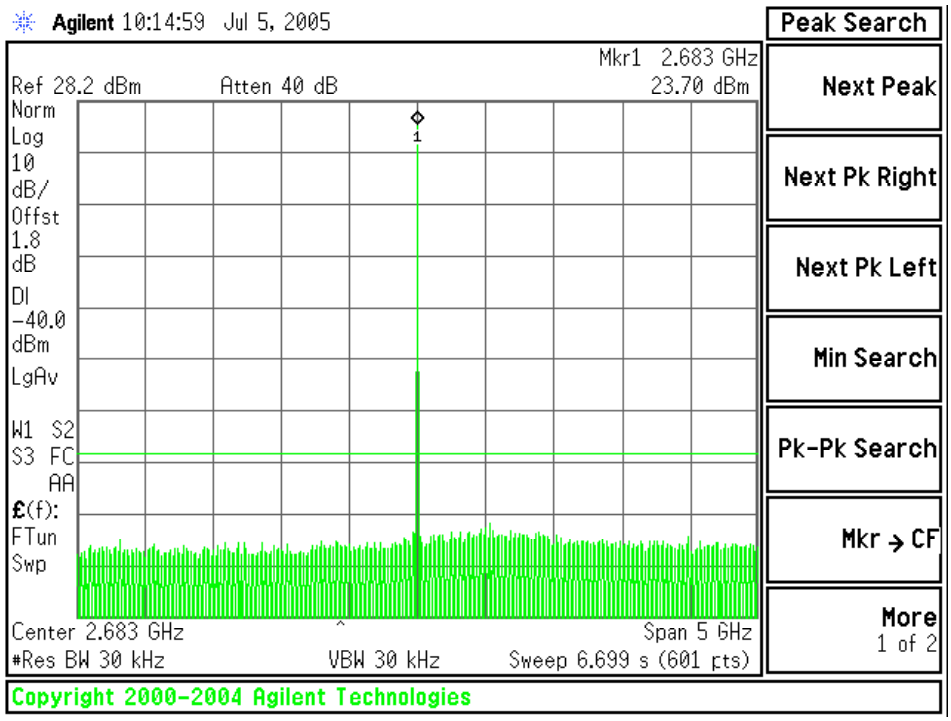
Out of band emissions are below –40 dBm, well below –13 dBm limit.

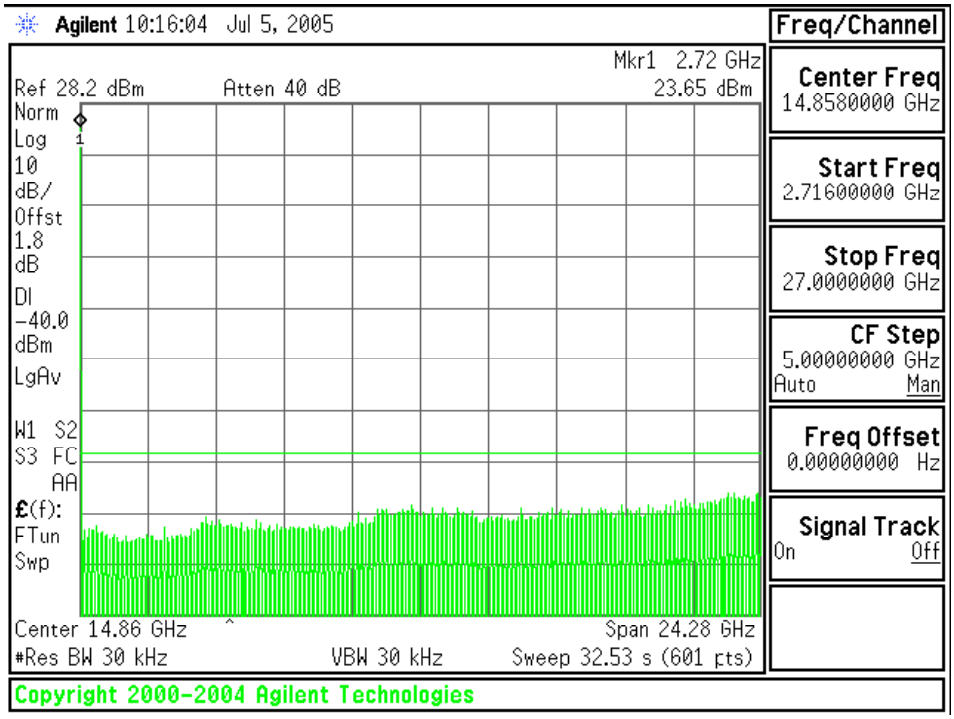


Low channel = 2503 MHz



Mid channel: 2593 MHz



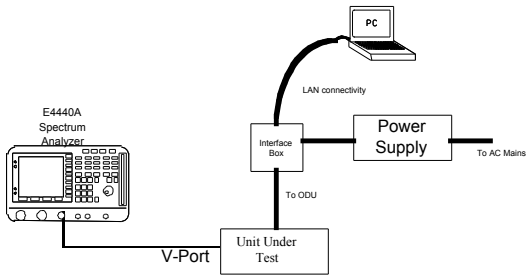


High Channel: 2683 MHz

Section 2.1049 Occupied Bandwidth
FCC Test Requirement/Limit: 27.53(l)

Test Location: Aperto Networks
Measurement equipment used:
Agilent E4440A Spectrum Analyzer
Low loss coaxial cable (1.8 dB at 2.6 GHz)

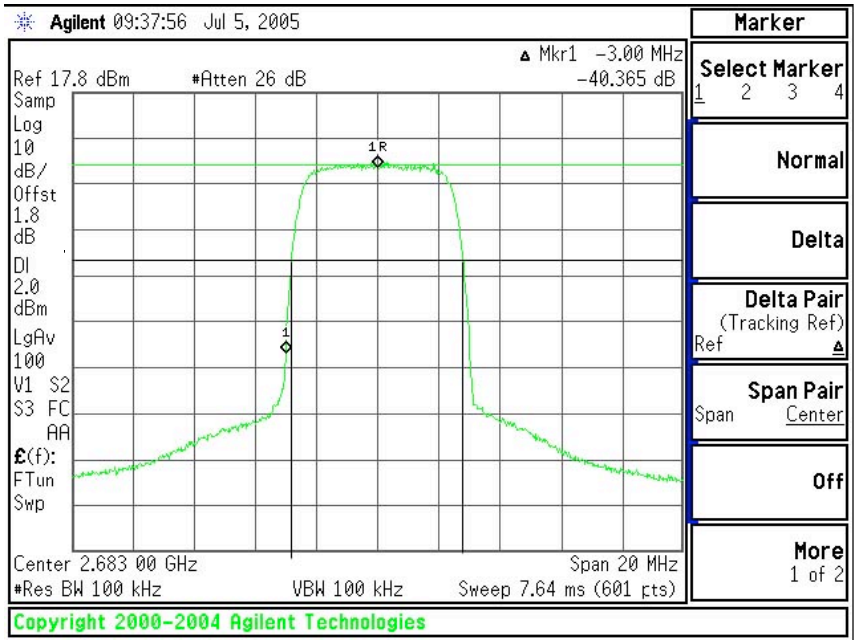
Test set-up:



Test set-up

Test Results

Occupied bandwidth 5.5 MHz, determined graphically.

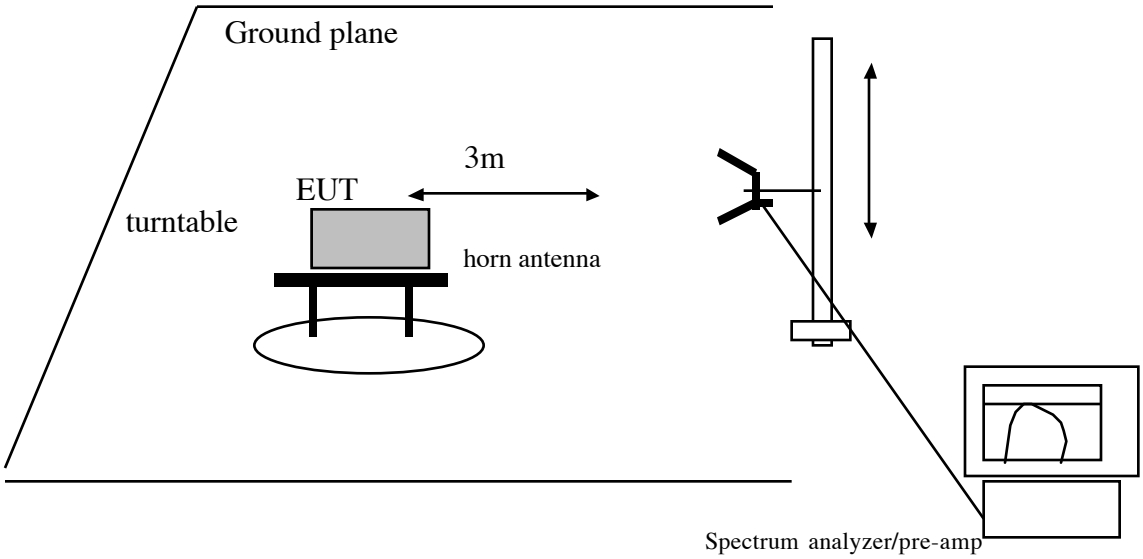


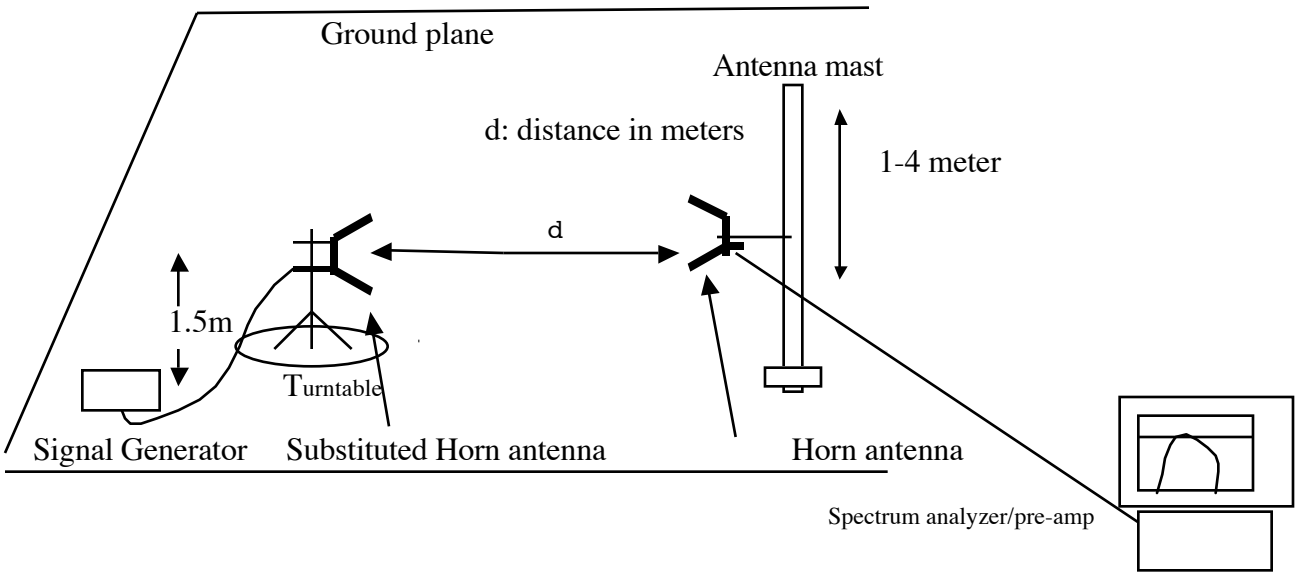
5.5 MHz ⟷

Section 2.1053 Field Strength of Spurious and Harmonic Radiation
FCC Requirement/Limit: 27.53(l)
Test Location: Compliance Certification Services

TEST EQUIPMENT LIST				
Name of Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Due Date**
Spectrum Analyzer 3 Hz ~ 44 GHz	*Agilent*	*E4446A*	*MY43360112*	*3/28/06*
Antenna, Horn 1 ~ 18 GHz	*EMCO*	*3115*	*6717*	*4/22/06*
Preamplifier, 1 ~ 26 GHz	**Miteq**	**NSP2600-SP**	**924342**	**9/2/06**
#N/A	*#N/A*	*#N/A*	*#N/A*	*#N/A*
LISN, 10 kHz ~ 30 MHz	*FCC*	*LISN-50/250-25-2*	*2023*	*8/30/06*
EMI Test Receiver	*R & S*	*ESHS 20*	*827129/006*	*6/3/06*

Test Set-Up





Minimum Requirement

-13 dBm ERP beyond 250% of authorized bandwidth

Test Method

The antenna output port of the EUT was terminated with a 50 ohm load. 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 10 fo.

The EUT was removed and was replaced by a substitution antenna connected via coax to a signal generator. The generator output was set to each emission frequency detected, the search antenna was raised and lowered, the turntable was rotated, until the maximum emission level was obtained. The signal generator output level was adjusted to match the radiated emission level from the EUT. After correcting for substitution antenna factor and generator cable loss, output power level is compared to the limit.

Test Results

Pass. All emissions detected were at least 14.7 dB below limits. Refer to test data below.

12/08/04 **High Frequency Substitution Measurement**

Compliance Certification Services, Morgan Hill 5m Chamber Site

Test Engr:William Zhuang
Project #:05U3871
Company:Tom Cokenias
EUT Descrip.:2.5GHz Device
EUT M/N:PACKETWAVE 230 - 25
Test Target:FCC Part 27
Mode Oper:Continous Transmit

Test Equipment:

EMCO Horn 1-18GHz: T73; S/N: 6717 @3m

Horn > 18GHz:

Limit: FCC 22

Hi Frequency Cables: ☑ (2 ft) ☐ (2 ~ 3 ft) ☐ (4 ~ 6 ft) ☑ (12 ft)

Pre-amplifer 1-26GHz: T87 Miteq 924342

Pre-amplifer

f GHz	SA reading (dBuV/m)	Ant. Pol. (H/V)	SG reading (dBm)	CL (dB)	Gain (dBi)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
5.186	49.0	V	-53.8	3.1	10.8	8.6	-48.3	-39.7	-8.6
5.186	45.1	H	-56.7	3.1	10.8	8.6	-51.2	-39.7	-11.6
7.779	43.3	V	-55.2	3.8	11.4	9.3	-49.7	-39.7	-10.0
7.779	42.2	H	-55.4	3.8	11.4	9.3	-49.9	-39.7	-10.3
5.006	44.2	V	-58.8	3.1	10.6	8.5	-53.4	-39.7	-13.7
5.006	44.9	H	-57.2	3.1	10.6	8.5	-51.7	-39.7	-12.1
7.509	43.6	V	-55.5	3.7	11.5	9.4	-49.8	-39.7	-10.2
7.509	44.0	H	-54.3	3.7	11.5	9.4	-48.7	-39.7	-9.0
5.372	48.3	V	-54.3	3.2	11.0	8.8	-48.7	-39.7	-9.1
5.372	47.3	H	-54.3	3.2	11.0	8.8	-48.7	-39.7	-9.0
8.058	42.6	V	-55.8	3.8	11.2	9.1	-50.5	-39.7	-10.8
8.058	42.2	H	-55.0	3.8	11.2	9.1	-49.7	-39.7	-10.1
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2.1055 Frequency Stability
FCC Limit: 27.54 Frequency stability.

The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

Temperature Range: -30C to +50 C
Supply Voltage Range: 85% - 115% nominal 108 – 130 VAC

Temperature v Frequency, -30C to +50C

c) In addition to all other requirements of this section, the following information is required for equipment incorporating heater type crystal oscillators to be used in mobile stations, for which type acceptance is first requested after March 25, 1974, except for battery powered, hand carried, portable equipment having less than 3 watts mean output power.

(1) Measurement data showing variation in transmitter output frequency from a cold start and the elapsed time necessary for the frequency to stabilize within the applicable tolerance. Tests shall be made after temperature stabilization at each of the ambient temperature levels; the lower temperature limit, 0[deg] centigrade and +30[deg] centigrade with no primary power applied.

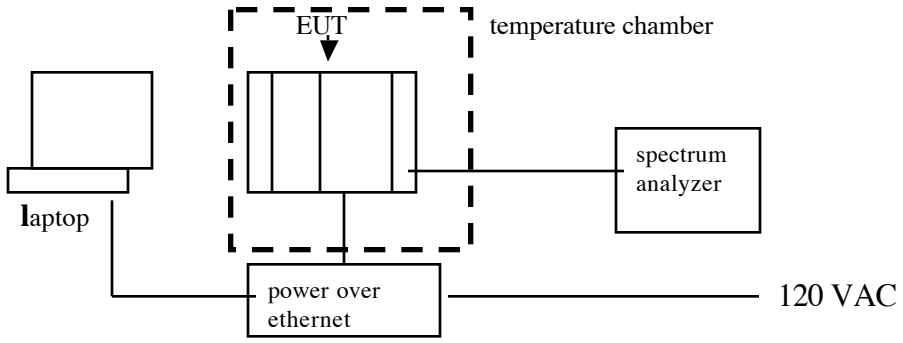
(2) Beginning at each temperature level specified in paragraph (c)(1) of this section, the frequency shall be measured within one minute after application of primary power to the transmitter and at intervals of no more than one minute thereafter until ten minutes have elapsed or until sufficient measurements are obtained to indicate clearly that the frequency has stabilized within the applicable tolerance, whichever time period is greater. During each test, the ambient temperature shall not be allowed to rise more than 10[deg] centigrade above the respective beginning ambient temperature level.

(3) The elapsed time necessary for the frequency to stabilize within the applicable tolerance from each beginning ambient temperature level as determined from the tests specified in this paragraph shall be specified in the instruction book for the transmitter furnished to the user.

Test Location: Aperto Networks
Measurement equipment used:

Agilent 4440ASpectrum analyzer
Cincinnati Sub Zero environment chamber Z16.

Test Setup



Test Procedures

The Subscriber radio is locked to the reference from the Base station radio PWR2500. Under these conditions, the carrier is modulated. To verify the stability of the radio, the RF Local Oscillator leakage is used to interpret the Carrier stability. The RFLO in the radio is on the high side. The measurements were done at carrier frequency of 2600 MHz, the corresponding RFLO is at 3065 MHz.

The yellow trace is at +25 deg C, Blue trace is at –40 deg C and Magenta trace is at +65 deg C. As can be seen that the stability is better than 10PPM.