Elliott Laboratories
www.elliotlabs.com
684 West Maude Avenue
Sunnyvale, CA 94085-3518
408-245-7800 Phone
408-245-3499 Fax

Electromagnetic Emissions Test Report
In Accordance With Industry Canada

FCC Part 22 and Part 24

Juniper Systems, Inc.
Transmitter
Model: MTSMC-E

FCC ID NUMBER:	VSF22455
GRANTEE:	Juniper Systems, Inc. 1132 West 1700 North Logan, UT 84321
TEST SITE:	Elliott Laboratories 684 W. Maude Avenue Sunnyvale, CA 94086
REPORT DATE:	September 2, 2009
FINAL TEST DATE:	August 14, August 20 and August 21, 2009
AUTHORIZED SIGNATORY:	Mark Briggs Staff Engineer

ACCREDITED

Testing Cert #2016-01

REVISION HISTORY

Revision #	Date	Comments	Modified By
-	September 21, 2009	First Release	-

TABLE OF CONTENTS

SCOPE

Testing has been performed on the Juniper Systems, Inc. model MTSMC-E in the TK6000 host system to determine the eirp and erp against the requirements of FCC Part 22 and FCC part 24. The equipment was tested in accordance with the procedures specified in Sections 2.1046 to 2.1057 of the FCC Rules. TIA-603 was also used as a test procedure guideline to perform some of the required tests.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

OBJECTIVE

The primary objective of the manufacturer is compliance with the FCC Part 22 and FCC Part 24. Certification of these devices is required as a prerequisite to marketing as defined in Section 2.1033.

Certification is a procedure where the manufacturer or a contracted laboratory makes measurements and submits the test data and technical information to FCC & Industry Canada. FCC & Industry Canada issues a grant of equipment authorization and a certification number upon successful completion of their review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units subsequently manufactured.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product that may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

SUMMARY OF TEST RESULTS

Part 2 Measurements Required Section	FCC Rule section	Test Performed	Measured Value	Limit	Result
2.1046: RF power output	22.913 (a)	Effective radiated power	26.7 dBm erp 0.468W erp	7 Watts ERP	Complies
2.1046: RF power output	24.232 (c)	Effective isotropic radiated power	22.2dBm eirp 0.166W eirp	2 Watts EIRP	Complies

Measurements were limited to the evaluation of the eirp and erp for the module installed in the host system. All other characteristics of the module remain unchanged.

MEASUREMENT UNCERTAINTIES

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below were calculated using the approach described in CISPR 16-4-2:2003 using a coverage factor of k=2, which gives a level of confidence of approximately 95%. The levels were found to be below levels of *U*cispr and therefore no adjustment of the data for measurement uncertainty is required.

Measurement Type	Measurement Unit	Frequency Range	Expanded Uncertainty
RF frequency	Hz	25 to 7,000 MHz	1.7×10^{-7}
RF power, conducted	dBm	25 to 7,000 MHz	± 0.52 dB
Conducted emission of transmitter	dBm	25 to 40,000 MHz	± 0.7 dB
Conducted emission of receiver	dBm	25 to 40,000 MHz	± 0.7 dB
Radiated emission (substitution method)	dBm	25 to 40,000 MHz	± 2.5 dB
Radiated emission (field strength)	dBμV/m	25 to 1,000 MHz 1 to 40 GHz	± 3.6 dB ± 6.0 dB

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Juniper Systems, Inc. model MTSMC-E is a GSM/EDGE Cellular radio module. Testing was performed with the module installed in the Juniper Systems hand-held system, model TK6000.

As the TK6000 may be held in the users hand or mounted to a surveyor pole during operation eirp/erp measurements were made with the device in both orientations.

The sample was received on August 14, 2009 and tested on August 14, August 20 and August 21, 2009. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
Multi Tech Systems, Inc.	MTSMC-E	GSM/EDGE cellular radio module		VSF22455

ANTENNA SYSTEM

The antenna system used with the Juniper Systems, Inc. model MTSMC-E in the TK6000 host consists of an external antenna, model number ANCF2-1HRA. A specification sheet for this antenna will be uploaded with the application documents.

ENCLOSURE

The module does not have an enclosure but meets all pertinent requirements for modular approval.

The host enclosure is primarily constructed of magnesium alloy and plastic. It measures approximately 13 cm wide by 4 cm deep by 27 cm high..

MODIFICATIONS

The EUT did not require modifications during testing in order to comply with the emission specifications.

SUPPORT EQUIPMENT

The following support equipment was used during testing.

Company	Model	Description	Serial Number
Juniper Systems, Inc.	TK6000	Hand held computer	None
Agilent	E5515C	Cellular simulator	None

EUT INTERFACE PORTS

The I/O cabling configuration during emissions testing was as follows:

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
AC/DC Power	AC Mains	2 Wire	Unshielded	1.0

EUT OPERATION

A communications test set was used to initiate an over-the-air link to the system under test. The test set was configured to set the device under test to transmit at maximum power.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on August 14, 2009 at the Elliott Laboratories test sites located at 684 West Maude Ave, Sunnyvale, CA 94085-3518.

RADIATED EMISSIONS CONSIDERATIONS

Radiated measurements are performed in an open field environment or Anechoic Chamber. The test site is maintained free of conductive objects within the CISPR 16-1 defined elliptical area.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1 is used for emissions measurements. The receivers are capable of measuring over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the particular detector used during measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. If average measurements above 1000MHz are performed, the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz is used.

INSTRUMENT CONTROL COMPUTER

A personal computer is utilized to record the receiver measurements of the field strength at the antenna, which is then compared directly with the appropriate specification limit. The receiver is programmed with appropriate factors to convert the received voltage into filed strength at the antenna. Results are printed in a graphic and/or tabular format, as appropriate.

The test receiver also provides a visual display of the signal being measured.

OUTPUT POWER

A spectrum analyzer was used to measure the peak power and peak radiated field strength.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or EUT and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transmitters and transient events.

ANTENNAS

A biconical antenna is used to cover the range from 30 MHz to 300 MHz and a log periodic antenna is utilized from 300 MHz to 1000 MHz. Narrowband tuned dipole antennas are used over the 30 to 1000 MHz range for precision measurements of field strength. Above 1000 MHz, a horn antenna is used. The antenna calibration factors are included in site factors programmed into the test receivers

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor drive to vary the antenna height.

The requirements of ANSI C63.4:2003 were used for configuration of the equipment turntable. It specifies that the test height above ground for table-mounted devices shall be 80 centimeters. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An appendix of this report contains the list of test equipment used and calibration information.

TEST PROCEDURES

General: For Transmitters with detachable antenna, direct measurements for output power, modulation characterization, occupied bandwidth, and frequency stability are performed with the antenna port of the EUT connected to either the power meter, modulation analyzer, or spectrum analyzer via a suitable attenuator and/or filter. The attenuators and/or filters are used to ensure that the transmitter fundamental will not overload the front end of the measurement instrument.

Procedure B – Power Measurement (Conducted Method): The following procedure was used for transmitters that do use external antennas.

1) Set the EUT to maximum power and to the lowest channel.
2) Either a power meter or a spectrum analyzer was used to measure the power output.
3) If a spectrum analyzer was used a resolution and video bandwidth 10kHz was used to measure the power output. Corrected for any external attenuation used for the protection of the input of analyzer. In addition, For CDMA or TDMA modulations set spectrum analyzer resolution to 1MHz and video to 30 kHz. Use video averaging with a 100-sample rate.
4) If a power meter was used, corrected for any external attenuation used for the protection of the input of the sensor head. Also set the power sensor correction by setting up the frequency range that will be measured.
5) Repeat this for the high channel and all modulations that will be used and all output ports used for transmission

Procedure N - Field Strength Measurement: The EUT was set on the turntable and the search antenna position 3 meters away. The output antenna terminal was terminated with a 50-ohm terminator. The EUT was set at the middle of the frequency band and set at maximum output power.

For the first scan, a pre-liminary measurement is performed. A preliminary scan of emissions is conducted in which all significant EUT frequencies are identified with the system in a nominal configuration. One or more of these is with the antenna polarized vertically while the one or more of these are with the antenna polarized horizontally. During the preliminary scans, the EUT is rotated through 360˚, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit.

For the final measurement, Substitution method is performed on spurious emissions not being 20-dB below the calculated radiated limit. Substitution method is performed by replacing the EUT with a horn antenna and signal generator. The horn antenna factors can be reference to a half-wave dipole in dBi. The signal generator power level was adjusted until a similar level, which was measured on the first scan, is achieved on the spectrum analyzer. The level on the signal generator is than added to the antenna factor, in dBi, which will give the corrected value.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

RADIATED EMISSIONS SPECIFICATION LIMITS

The limits for radiated emissions are based on the power of the transmitter at the operating frequency. Data is measured in the logarithmic form of decibels relative to one milliwatt (dBm) or one microvolt/meter (dBuV/m,). The field strength of the emissions from the EUT is measured on a test site with a receiver.

Below is a formula example used to calculate the attenuation requirement, relative to the transmitters power output, in dBuV/m. For this example an operating power range of 3 watts is used. The radiated emissions limit for spurious signals outside of the assigned frequency block is $43+10\text{Log}_{10}$(mean output power in watts) dB below the measured amplitude at the operating power.

CALCULATIONS – EFFECTIVE RADIATED POWER

$$E(V/m) = \frac{\sqrt{30 * P * G}}{d}$$

E= Field Strength in V/m
P= Power in Watts (for this example we use 3 watts)
G= Gain of antenna in numeric gain (Assume 1.64 for ERP)
d= distance in meters

$$E(V/m) = \frac{\sqrt{30 * 3 \text{ watts} * 1.64 \text{ dB}}}{3 \text{ meters}}$$

20 * log (4.049 V/m * 1,000,000) = 132.14 dBuV/m @ 3 meters

FCC Rules request an attenuation of 43 + 10 log (3) or 47.8 dB for all emissions outside the assigned block, the limit for spurious and harmonic emissions is:

132.1 dBuV/m – 47.8 dB = 84.3 dBuV/m @ 3 meter.

Note: Substitution Method is performed for spurious emission not being 20-dB below the calculated field strength and for determining the erip and erp of the intentional signal.

EXHIBIT 1: Test Equipment Calibration Data

Manufacturer	Description	Model #	Asset #	Cal Due
EMCO	Log Periodic Antenna, 0.3-1 GHz	3146A	364	23-Dec-09
Hewlett Packard	EMC Spectrum Analyzer, 9 KHz-26.5 GHz	8593EM	1141	29-Dec-09
EMCO	Antenna, Horn, 1-18 GHz	3117	1662	11-Apr-10

EXHIBIT 2: Test Data Log Sheets

ELECTROMAGNETIC EMISSIONS

TEST LOG SHEETS

AND

MEASUREMENT DATA

T76431 4 Pages

Client:	Juniper systems	Job Number:	J76286
Model:	MTSMC-E in TK6000	T-Log Number:	T76431
		Account Manager:	Dean Eriksen
Contact:	Kent Cambell		-
Emissions Standard(s):	FCC Part 22, 24, RSS 132, 133	Class:	-
Immunity Standard(s):	-	Environment:	-

EMC Test Data

For The

Juniper systems

Model

MTSMC-E in TK6000

Date of Last Test: 8/21/2009

Client:	Juniper systems	Job Number:	J76286
Model:	MTSMC-E in TK6000	T-Log Number:	T76431
		Account Manager:	Dean Eriksen
Contact:	Kent Cambell		
Standard:	FCC Part 22, 24, RSS 132, 133	Class:	N/A

EIRP and ERP Measurements
FCC Part 22, 24 / RSS 132, 133

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 8/14/2009
Test Engineer: Mehran Birgani
Test Location: Chamber #2

Config. Used: 1
Config Change: None
EUT Voltage: 120V, 60Hz

General Test Configuration

The EUT was located on the turntable for radiated spurious emissions testing.

The measurement antenna was located 3 meters from the EUT.

Ambient Conditions:

Temperature: 22 °C
Rel. Humidity: 38 %

Summary of Results

Run #	Test Performed	Limit	Pass / Fail	Result / Margin
2	850MHz Band	22.913 (a)	Pass	26.7 dBm erp 0.468W erp
2	1900MHz Band	24.232(c)	Pass	22.2dBm eirp 0.166W eirp

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	Juniper systems	Job Number:	J76286
Model:	MTSMC-E in TK6000	T-Log Number:	T76431
		Account Manager:	Dean Eriksen
Contact:	Kent Cambell		
Standard:	FCC Part 22, 24, RSS 132, 133	Class:	N/A

Run #1: Radiated Spurious Emissions, Transmit Mode
Measurements made at 3m with RB=3MHz, VB=3MHz, peak detector.
Results Table - All channels

Frequency	Level	Pol	FCC		Detector	Azimuth	Height	Comments	Channel
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters		
835.800	120.0	V	-	-	PK	360	1.7	Upright	190
836.330	115.2	H	-	-	PK	162	1.7	Upright	190
837.330	112.9	V	-	-	PK	142	1.7	Flat	190
837.350	121.9	H	-	-	PK	311	1.7	Flat	190
824.980	116.7	V	-	-	PK	249	1.7	Flat	128
824.230	121.7	H	-	-	PK	360	1.7	Flat	128
849.330	112.5	V	-	-	PK	245	1.7	Flat	251
848.650	120.5	H	-	-	PK	81	1.7	Flat	251
1879.450	117.5	V	-	-	PK	200	1.7	Flat	661
1879.000	114.0	H	-	-	PK	244	1.7	Flat	661
1879.950	116.5	V	-	-	PK	168	1.7	Upright	661
1880.550	113.5	H	-	-	PK	36	1.7	Upright	661
1849.700	120.1	V	-	-	PK	158	1.7	Upright	512
1849.100	117.5	H	-	-	PK	0	1.7	Upright	512
1909.100	114.7	V	-	-	PK	332	1.7	Upright	810
1908.830	113.3	H	-	-	PK	335	1.7	Upright	810

Note - output power at the antenna terminal was measured to be 0.66Watts in the 1900 MHz band as listed on the grant.
Note - output power at the antenna terminal was measured to be 1.35Watts in the 850 MHz band as listed on the grant.

Client:	Juniper systems	Job Number:	J76286
Model:	MTSMC-E in TK6000	T-Log Number:	T76431
		Account Manager:	Dean Eriksen
Contact:	Kent Cambell		
Standard:	FCC Part 22, 24, RSS 132, 133	Class:	N/A

Run #2: Radiated Spurious Emissions, Transmit Mode: Final Field Strength and Substitution Measurements
Measurements made at 3m

Horizontal

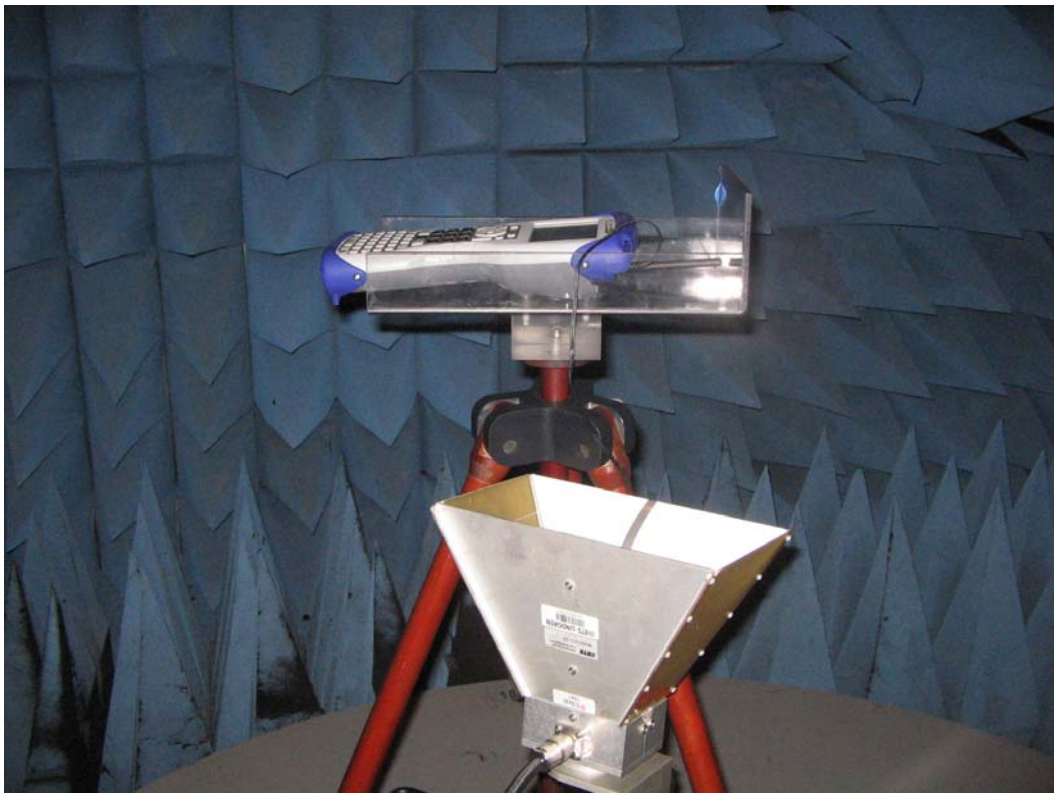
Frequency	Substitution measurements			Site	EUT measurements				
MHz	Pin[1]	Gain[2]	FS[3]	Factor[4]	FS[5]	eirp (dBm)	erp (dBm)	eirp (W)	erp (W)
824.20	0.0	7.0	99.8	92.8	121.7	28.9	26.7	0.776	0.468
836.60	0.0	6.7	99.7	93.0	121.9	28.9	**26.7**	0.776	**0.468**
848.80	0.0	7.4	99.2	91.8	120.5	28.7	26.5	0.741	0.447
1850.20	0.0	3.5	102.4	98.9	117.5	18.6	16.4	0.072	0.044
1880.00	0.0	3.5	102.0	98.5	114.0	15.5	13.3	0.035	0.021
1909.80	0.0	3.6	102.1	98.5	113.3	14.8	12.6	0.030	0.018

Vertical

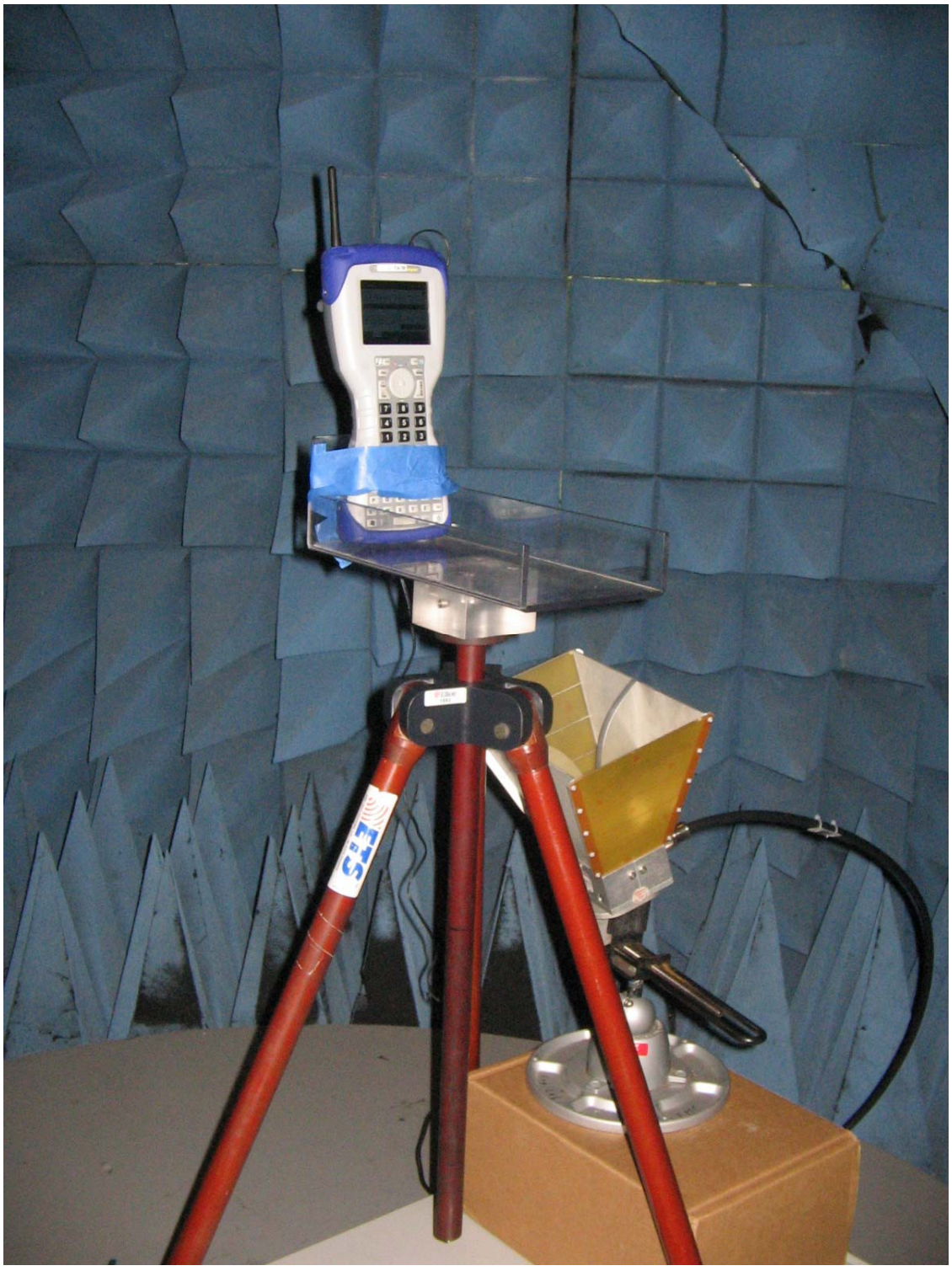
Frequency	Substitution measurements			Site	EUT measurements				
MHz	Pin[1]	Gain[2]	FS[3]	Factor[4]	FS[5]	eirp (dBm)	erp (dBm)	eirp (W)	erp (W)
824.20	0.0	7.0	99.6	92.6	116.7	24.1	21.9	0.257	0.155
836.60	0.0	6.7	99.5	92.8	120.0	27.2	25.0	0.525	0.316
848.80	0.0	7.4	98.6	91.2	112.5	21.3	19.1	0.135	0.081
1850.20	0.0	3.5	101.4	97.9	120.1	**22.2**	20.0	**0.166**	0.100
1880.00	0.0	3.5	100.8	97.3	117.5	20.2	18.0	0.105	0.063
1909.80	0.0	3.6	101.1	97.5	114.7	17.2	15.0	0.052	0.032

Note 1:	Pin is the input power (dBm) to the substitution antenna
Note 2:	Gain is the gain (dBi) for the substitution antenna. A dipole has a gain of 2.2dBi.
Note 3:	FS is the field strength (dBuV/m) measured from the substitution antenna.
Note 4:	Site Factor - this is the site factor to convert from a field strength in dBuV/m to an eirp in dBm.
Note 5:	EUT field strength as measured during initial run.

EXHIBIT 3: Test Configuration Photographs



Note – horn antenna in photo is connected to the wireless communications test set to establish the control link to the EUT


ETS