



Radio Test Report

*FCC Part 22
(824.2 MHz to 848.8 MHz)*

*FCC Part 24
(1850.2 MHz to 1909.8 MHz)*

*Model: Cell expansion pack (TK6CM) and cell expansion
pack with GPS (RTK GPS)*

FCCID: VSF22779

COMPANY: Juniper Systems, Inc.
1132 West 1700 North
Logan, UT 84321

TEST SITE(S): Elliott Laboratories
41039 Boyce Road.
Fremont, CA. 94538-2435

REPORT DATE: June 8, 2010

FINAL TEST DATES: May 14 and 17, 2010

AUTHORIZED SIGNATORY:

A handwritten signature in blue ink that reads "Mark Briggs".

Mark Briggs
Staff Engineer
Elliott Laboratories



Testing Cert #2016-01

Elliott Laboratories is accredited by the A2LA, certificate number 2016-01, to perform the test(s) listed in this report, except where noted otherwise. This report shall not be reproduced, except in its entirety, without the written approval of Elliott Laboratories

REVISION HISTORY

| Rev# | Date | Comments | Modified By |
|------|--------------|---------------|-------------|
| - | June 8, 2010 | First release | |

TABLE OF CONTENTS

REVISION HISTORY 2

TABLE OF CONTENTS 2

SCOPE..... 3

OBJECTIVE 4

STATEMENT OF COMPLIANCE..... 4

DEVIATIONS FROM THE STANDARDS 4

TEST RESULTS..... 5

 FCC PART 22 (HANDSET OR OTHER UE) 5

 FCC PART 24 (HANDSET OR OTHER UE) 5

 MEASUREMENT UNCERTAINTIES..... 5

EQUIPMENT UNDER TEST (EUT) DETAILS..... 6

 GENERAL..... 6

 OTHER EUT DETAILS..... 6

 ENCLOSURE..... 6

 MODIFICATIONS..... 6

 SUPPORT EQUIPMENT..... 7

 EUT INTERFACE PORTS 7

 EUT OPERATION 7

TESTING 8

 GENERAL INFORMATION..... 8

RADIATED EMISSIONS MEASUREMENTS..... 9

 INSTRUMENTATION 10

 FILTERS/ATTENUATORS 10

 ANTENNAS..... 10

 ANTENNA MAST AND EQUIPMENT TURNTABLE..... 11

SAMPLE CALCULATIONS 12

 RADIATED FIELD STRENGTH..... 12

 SAMPLE CALCULATIONS –RADIATED POWER..... 13

APPENDIX A TEST EQUIPMENT CALIBRATION DATA 1

APPENDIX B TEST DATA 2

APPENDIX C PHOTOGRAPHS 3

SCOPE

Tests have been performed on the Juniper Systems, Inc. model Cell expansion pack (TK6CM) and cell expansion pack with GPS (RTK GPS), pursuant to the relevant requirements of the following standard(s) in order to obtain device certification against the regulatory requirements of the Federal Communications Commission and Industry Canada.

- Code of Federal Regulations (CFR) Title 47 Part 2
- CFR 47 Part 22
- CFR 47 Part 24

Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in the following reference standards and as outlined in Elliott Laboratories test procedures:

ANSI C63.4:2003
ANSI TIA-603-C August 17, 2004

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant Industry Canada performance and procedural standards.

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.

The test results recorded herein are based on a single type test of the Juniper Systems, Inc. model Cell expansion pack (TK6CM) and cell expansion pack with GPS (RTK GPS) and therefore apply only to the tested sample. The sample was selected and prepared by Kent Campbell of Juniper Systems, Inc..

OBJECTIVE

The primary objective of the manufacturer is compliance with the regulations outlined in the previous section.

Prior to marketing in the USA, the device requires certification. Prior to marketing in Canada, Class I transmitters, receivers and transceivers require certification.

Certification is a procedure where the manufacturer submits test data and technical information to a certification body and receives a certificate or grant of equipment authorization upon successful completion of the certification body's review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units, which are subsequently manufactured.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product which 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.).

STATEMENT OF COMPLIANCE

The tested sample of Juniper Systems, Inc. model Cell expansion pack (TK6CM) and cell expansion pack with GPS (RTK GPS) complied with the requirements of the standards and frequency bands declared in the scope of this test report.

Maintenance of compliance is the responsibility of the manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the device with respect to the standards detailed in this test report.

DEVIATIONS FROM THE STANDARDS

No deviations were made from the published requirements listed in the scope of this report.

TEST RESULTS*FCC Part 22 (Handset or other UE)*

| FCC | Canada | Description | Measured | Limit | Result |
|--|--------|-------------|----------------------|-------------|--------|
| Transmitter Modulation, output power and other characteristics | | | | | |
| §2.1033 (c) (6) §2.1033 (c) (7) §2.1046 § 22.913(a) | - | ERP | 1.349 W (31.3dBm) | 7 Watts erp | Pass |
| Notes: The scope of testing was to determine compliance with the radiated power limits with the module installed inside the specific host systems detailed in this test report. All other characteristics of the module remain as reported in the original filing for the module. | | | | | |

FCC Part 24 (Handset or other UE)

| FCC | Canada | Description | Measured | Limit | Result |
|--|--------|-------------|----------------------|--------------|--------|
| Transmitter Modulation, output power and other characteristics | | | | | |
| §2.1033 (c) (6) §2.1033 (c) (7) §2.1046 § 24.232(c) | - | EIRP | 1.906 W (32.8dBm) | 2 Watts eirp | Pass |
| Notes: The scope of testing was to determine compliance with the radiated power limits with the module installed inside the specific host systems detailed in this test report. All other characteristics of the module remain as reported in the original filing for the module. | | | | | |

MEASUREMENT UNCERTAINTIES

ISO Guide 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 are based on a 95% confidence level (based on a coverage factor (k=2) and were calculated in accordance with NAMAS document NIS 81 and M3003.

| Measurement Type | Measurement Unit | Frequency Range | Expanded Uncertainty |
|--|------------------|------------------|----------------------|
| Radiated emission (substitution method) | dBm | 25 to 40,000 MHz | ± 2.5 dB |

EQUIPMENT UNDER TEST (EUT) DETAILS**GENERAL**

The equipment under test is a quad-band GPRS/EDGE GSM cellular modem radio module. Testing was performed to evaluate the radiated power from the module when installed into the Juniper Systems, Inc. model Cell expansion pack (TK6CM) and cell expansion pack with GPS (RTK GPS)

These expansion packs are designed for Juniper Systems' hand-held TK6000 system. They both use the radio module to provide a quad-band GPRS/EDGE GSM cellular modem interface. The RTK GPS also contains a GPS receiver module. The two expansion packs are very similar to each other with the major differences being the slightly larger enclosure for the RTK GPS to accommodate the additional GPS module and antenna connector. Power is provided by the host device which is powered from internal batteries or an external AC-DC adapter.

The sample was received on May 14, 2010 and tested on May 14 and 17, 2010. The EUT consisted of the following component(s):

| Company | Model | Description | Serial Number | FCC ID |
|-----------------|---------|---|---------------|---------------------------------|
| Juniper Systems | RTK GPS | Cellular expansion pack with GPS for TK6000 | - | Contains FCC ID: VSF22779 |
| Juniper Systems | TK6CM | Cellular expansion pack for TK6000 | - | |

OTHER EUT DETAILS

The EUT antenna for the GSM/GPRS module may be either a ¼- or ½-wave whip antenna. The antenna connects to the EUT via a standard SMA connection. Both antenna types were evaluated for both expansion packs.

ENCLOSURE

The RTK GPS enclosure is primarily constructed of plastic. It measures approximately 13 cm wide by 5.5 cm deep by 12.5 cm high. The TK6CM enclosure is primarily constructed of plastic. It measures approximately 12.5 cm wide by 4 cm deep by 10 cm high.

The GSM module has no enclosure. It is designed to be installed within the enclosure of a host computer.

MODIFICATIONS

No modifications were made to the EUT during the time the product was at Elliott.

SUPPORT EQUIPMENT

The following equipment was used as support equipment for testing:

| Company | Model | Description | Serial Number | FCC ID |
|-----------------|-------------|--|---------------|--------|
| Juniper Systems | TK6000 | Handheld Surveyor Computer | - | N/A |
| Phihong | PSA18R-120P | AC/DC Adapter (w/ferrite at adapter end) | - | N/A |

The following equipment was used as remote support equipment for emissions testing:

| Company | Model | Description | Serial Number | FCC ID |
|---------|--------|-------------------------|---------------|--------|
| Agilent | E5515C | Communications Test Set | - | - |

EUT INTERFACE PORTS

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

| Port | Connected To | Description | Cable(s) | |
|----------------------|---------------|-------------|------------------------|-----------|
| | | | Shielded or Unshielded | Length(m) |
| GPS Antenna Port | GPS antenna | Coaxial | Shielded | - |
| GSM/GPRS | Antenna | - | - | - |
| TK6000 - Serial (x2) | - | - | - | - |
| TK6000 - USB (A) | - | - | - | - |
| TK6000 - USB (B) | - | - | - | - |
| DC Power In | AC/DC Adapter | 2Wire | Shielded | 1.8 |

EUT OPERATION

During emissions testing the EUT was configured to continuously transmit on the noted channel at full power by the Agilent Communications Test Set via an over the air transmission link.

TESTING**GENERAL INFORMATION**

Antenna port measurements were taken at the Elliott Laboratories test site located at 41039 Boyce Road, Fremont, CA 94538-2435.

Radiated spurious emissions measurements were taken at the Elliott Laboratories Anechoic Chambers and/or Open Area Test Site(s) listed below. The sites conform to the requirements of ANSI C63.4: 2003 *American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz* and CISPR 16-1-4:2007 - *Specification for radio disturbance and immunity measuring apparatus and methods Part 1-4: Radio disturbance and immunity measuring apparatus Ancillary equipment Radiated disturbances*. They are on file with the FCC and industry Canada.

| Site | Registration Numbers | | Location |
|-----------|----------------------|------------|---|
| | FCC | Canada | |
| Chamber 5 | 211948 | IC 2845B-5 | 41039 Boyce Road Fremont, CA 94538-2435 |

In the case of Open Area Test Sites, ambient levels are at least 6 dB below the specification limits with the exception of predictable local TV, radio, and mobile communications traffic.

Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements.

RADIATED EMISSIONS MEASUREMENTS

Receiver radiated spurious emissions measurements are made in accordance with ANSI C63.4:2003 by measuring the field strength of the emissions from the device at a specific test distance and comparing them to a field strength limit. Where the field strength limit is specified at a longer distance than the measurement distance the measurement is extrapolated to the limit distance.

Transmitter radiated spurious emissions are initially measured as a field strength. The eirp or erp limit as specified in the relevant rule part(s) is converted to a field strength at the test distance and the emissions from the EUT are then compared to that limit. Emissions within 20dB of this limit are the subjected to a substitution measurement.

All radiated emissions measurements are performed in two phases. A preliminary scan of emissions is conducted in either an anechoic chamber or on an OATS during which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed across the complete frequency range of interest and at each operating frequency identified in the reference standard. One or more of these is with the antenna polarized vertically while the one or more of these is with the antenna polarized horizontally. Initial scans are made using a peak detector (RBW=VBW) and using scan rates to ensure that the EUT transmits before the sweep moves out of each resolution bandwidth (for transmit mode).

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 transmitter spurious emissions, where the limit is expressed as an effective radiated power, the eirp or erp is converted to a field strength limit.

Final measurements are made on an OATS or in a semi-anechoic chamber at the significant frequencies observed during the preliminary scan(s) using the same process of rotating the EUT and raising/lowering the measurement antenna to find the highest level of the emission. The field strength is recorded and, for receiver spurious emissions, compared to the field strength limit. For the final measurement the appropriate detectors (average, peak, normal, sample, quasi-peak) are used. For receiver measurements below 1GHz the detector is a Quasi-Peak detector, above 1GHz a peak detector is used and the peak value (RB=VB=1MHz) and average value (RB=1MHz, VB=10Hz) are recorded.

For transmitter spurious emissions, the radiated power of all emissions within 20dB of the calculated field strength limit are determined using a substitution measurement. The substitution measurement is made by replacing the EUT with an antenna of known gain (typically a dipole antenna or a double-ridged horn antenna), connected to a signal source. The output power of the signal generator is adjusted until the maximum field strength from the substitution antenna is similar to the field strength recorded from the EUT. The erp (or eirp) of the EUT is then calculated.

INSTRUMENTATION

An EMI receiver as specified in CISPR 16-1-1 is used for radiated emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 7000 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.

For measurements above the frequency range of the receivers and for all conducted measurements a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis.

Measurement bandwidths for the test instruments are set in accordance with the requirements of the standards referenced in this document.

Software control is used to correct the measurements for transducer factors (e.g. antenna) and the insertion loss of cables, attenuators and other series elements to obtain the final measurement value. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are exported in a graphic and/or tabular format, as appropriate.

FILTERS/ATTENUATORS

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

ANTENNAS

A combination of biconical, log periodic or bi-log antennas are used to cover the range from 30 MHz to 1000 MHz. Broadband antennas or tuned dipole antennas are used over the entire 25 to 1000 MHz frequency range as the reference antenna for substitution measurements.

Above 1000 MHz, a dual-ridge guide horn antenna or octave horn antenna are used as reference and measurement antennas.

The antenna calibration factors are included in site factors that are programmed into the test receivers and instrument control software when measuring the radiated field strength.

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.

Table mounted devices are placed on a non-conductive table at a height of 80 centimeters above the floor. Floor mounted equipment is 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. The EUT is positioned on a motorized turntable to allow it to be rotated during testing to determine the angle with the highest level of emissions.

SAMPLE CALCULATIONS

RADIATED FIELD STRENGTH

Measurements of radiated field strength are compared directly to the specification limit (decibel form). The receiver and/or control software corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

A distance factor is used when measurements are made at a test distance that is different to the specified limit distance by using the following formula:

$$F_d = 20 * \text{LOG}_{10} (D_m/D_s)$$

where:

$$F_d = \text{Distance Factor in dB}$$

$$D_m = \text{Measurement Distance in meters}$$

$$D_s = \text{Specification Distance in meters}$$

For electric field measurements below 30MHz the extrapolation factor is either determined by making measurements at multiple distances or a theoretical value is calculated using the formula:

$$F_d = 40 * \text{LOG}_{10} (D_m/D_s)$$

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

$$R_r = \text{Receiver Reading in dBuV/m}$$

$$F_d = \text{Distance Factor in dB}$$

$$R_c = \text{Corrected Reading in dBuV/m}$$

$$L_s = \text{Specification Limit in dBuV/m}$$

$$M = \text{Margin in dB Relative to Spec}$$

SAMPLE CALCULATIONS –RADIATED POWER

The erp/eirp limits for transmitter spurious measurements are converted to a field strength in free space using the following formula:

$$E = \frac{\sqrt{30 P G}}{d}$$

where:

- E = Field Strength in V/m
- P = Power in Watts
- G = Gain of isotropic antenna (numeric gain) = 1
- D = measurement distance in meters

The field strength limit is then converted to decibel form (dBuV/m) and the margin of a given emission peak relative to the limit is calculated (refer to *RADIATED FIELD STRENGTH*).

When substitution measurements are required (all signals with less than 20dB of margin relative to the calculated field strength limit) the eirp of the spurious emission is calculated using:

$$P_{EUT} = P_S - (E_S - E_{EUT})$$

and

$$P_S = G + P_{in}$$

where:

- P_S = effective isotropic radiated power of the substitution antenna (dBm)
- P_{in} = power input to the substitution antenna (dBm)
- G = gain of the substitution antenna (dBi)
- E_S = field strength the substitution antenna (dBm) at eirp P_S
- E_{EUT} = field strength measured from the EUT

Where necessary the effective isotropic radiated power is converted to effective radiated power by subtracting the gain of a dipole (2.2dBi) from the eirp value.

Appendix A Test Equipment Calibration Data

| <u>Manufacturer</u> | <u>Description</u> | <u>Model</u> | <u>Asset #</u> | <u>Cal Due</u> |
|----------------------------|---|---------------------------|-----------------------|-----------------------|
| Hewlett Packard | EMC Spectrum Analyzer, 9 KHz- 26.5 GHz | 8593EM | 1141 | 12/21/2010 |
| Sunol Sciences | Biconilog, 30-3000 MHz | JB3 | 1657 | 5/23/2010 |
| Hewlett Packard | EMC Spectrum Analyzer, 9 KHz- 26.5 GHz | 8593EM | 1141 | 12/21/2010 |
| EMCO | Antenna, Horn, 1-18 GHz (SA40-Red) | 3115 | 1142 | 7/15/2010 |
| Compliance Design | Tuned Dipole Antenna | Roberts (400- 1000MHz) | 1896 | 12/16/2011 |

Appendix B Test Data

T79288 5 Pages



EMC Test Data

| | | | |
|------------------------|--|------------------|-------------------|
| Client: | Juniper Systems | Job Number: | J78949 |
| Model: | RTK GPS (Thistle) and TK6CM Expansion Packs for TK6000 | T-Log Number: | T79288 |
| Contact: | Kent Campbell | Account Manager: | Christine Krebill |
| Emissions Standard(s): | FCC 22/24 | Class: | - |
| Immunity Standard(s): | - | Environment: | - |

EMC Test Data

For The

Juniper Systems

Model

RTK GPS (Thistle) and TK6CM Expansion Packs for TK6000

Date of Last Test: 5/17/2010

| | | | |
|-----------|--|------------------|-------------------|
| Client: | Juniper Systems | Job Number: | J78949 |
| Model: | RTK GPS (Thistle) and TK6CM Expansion Packs for TK6000 | T-Log Number: | T79288 |
| | | Account Manager: | Christine Krebill |
| Contact: | Kent Campbell | | |
| Standard: | FCC 22/24 | Class: | N/A |

**FCC Parts 22 and 24
Radiated Power Measurements (ERP, EIRP)**

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.

General Test Configuration

Radiated measurements are made with the EUT located on a non-conductive table, 3m from the measurement antenna.

Ambient Conditions:

Temperature: 10-25 °C
Rel. Humidity: 15-65 %

Summary of Results

| Run # | Test Performed | Limit | Pass / Fail | Result / Margin |
|-------------|---------------------|------------|-------------|--------------------------|
| 1 (TK6CM) | 850MHz Band - erp | 22.913 (a) | Pass | 29.3dBm (0.851 W) |
| 1 (TK6CM) | 1900MHz Band - eirp | 24.232(c) | Pass | 32.8dBm (1.905 W) |
| 2 (Thistle) | 850MHz Band - erp | 22.913 (a) | Pass | 31.3dBm (1.349 W) |
| 2 (Thistle) | 1900MHz Band - eirp | 24.232(c) | Pass | 29.9dBm (0.977 W) |

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.



Radio Test Data

| | | | |
|-----------|--|------------------|-------------------|
| Client: | Juniper Systems | Job Number: | J78949 |
| Model: | RTK GPS (Thistle) and TK6CM Expansion Packs for TK6000 | T-Log Number: | T79288 |
| | | Account Manager: | Christine Krebill |
| Contact: | Kent Campbell | | |
| Standard: | FCC 22/24 | Class: | N/A |

Run #1: Output Power, Radiated, TK6CM module.
 Measurements made at 3m with RB=3MHz, VB=3MHz, peak detector.

Run #1a - Preliminary field strength measurements
 Date: 5/14/2010 Engineer: John Caizzi Location: FT #5

| Frequency MHz | Level dB μ V/m | Pol v/h | FCC 22/24 | | Detector Pk/QP/Avg | Azimuth degrees | Height meters | Comments | Channel |
|--|-----------------------|------------|-----------|--------|-----------------------|--------------------|------------------|-------------|---------|
| | | | Limit | Margin | | | | | |
| Short (3bar) US antenna, RBW = VBW = 3MHz | | | | | | | | | |
| 835.890 | 131.9 | V | - | - | Pk | 237 | 1.00 | EUT upright | 186 |
| 836.280 | 126.6 | H | - | - | Pk | 145 | 1.00 | EUT upright | 186 |
| 836.520 | 133.2 | H | - | - | Pk | 332 | 1.03 | EUT flat | 186 |
| 836.480 | 126.7 | V | - | - | Pk | 14 | 1.95 | EUT flat | 186 |
| 825.040 | 130.0 | H | - | - | Pk | 270 | 1.44 | EUT flat | 128 |
| 848.640 | 130.5 | H | - | - | Pk | 269 | 1.32 | EUT flat | 251 |
| 1879.560 | 125.8 | H | - | - | Pk | 286 | 1.23 | EUT flat | 661 |
| 1879.520 | 124.7 | V | - | - | Pk | 335 | 1.27 | EUT upright | 661 |

| | | | | | | | | | |
|---------------------------------------|-------|---|---|---|----|-----|------|-------------|-----|
| Long antenna, RBW = VBW = 3MHz | | | | | | | | | |
| 838.320 | 128.3 | V | - | - | Pk | 18 | 1.92 | EUT flat | 186 |
| 835.800 | 132.3 | H | - | - | Pk | 319 | 1.02 | EUT flat | 186 |
| 834.280 | 124.9 | H | - | - | Pk | 105 | 1.31 | EUT upright | 186 |
| 834.400 | 128.6 | V | - | - | Pk | 255 | 1.55 | EUT upright | 186 |
| 1880.400 | 126.2 | V | - | - | Pk | 113 | 2.01 | EUT upright | 661 |
| 1879.880 | 133.3 | H | - | - | Pk | 35 | 1.21 | EUT flat | 661 |
| 1850.800 | 133.4 | H | - | - | Pk | 43 | 1.22 | EUT flat | 512 |
| 1910.960 | 135.1 | H | - | - | Pk | 44 | 1.19 | EUT flat | 810 |

| | | | |
|-----------|--|------------------|-------------------|
| Client: | Juniper Systems | Job Number: | J78949 |
| Model: | RTK GPS (Thistle) and TK6CM Expansion Packs for TK6000 | T-Log Number: | T79288 |
| | | Account Manager: | Christine Krebill |
| Contact: | Kent Campbell | | |
| Standard: | FCC 22/24 | Class: | N/A |

Substitution measurements

Horizontal

| Frequency MHz | Substitution measurements | | | Site Factor ⁴ | EUT measurements | | | eirp W | erp W |
|------------------|---------------------------|-------------------|-----------------|-----------------------------|------------------|------------|-----------|-----------|----------|
| | Pin ¹ | Gain ² | FS ³ | | FS ⁵ | eirp (dBm) | erp (dBm) | | |
| 825.040 | -2.1 | 1.7 | 101.0 | 101.4 | 130.0 | 28.6 | 26.4 | | 0.437 |
| 836.520 | -2.1 | 1.7 | 101.3 | 101.7 | 133.2 | 31.5 | 29.3 | | 0.851 |
| 848.640 | -2.0 | 1.7 | 100.8 | 101.1 | 130.5 | 29.4 | 27.2 | | 0.525 |
| 1850.800 | -1.0 | 8.1 | 108.1 | 101.0 | 133.4 | 32.4 | 30.2 | 1.738 | |
| 1879.880 | -1.0 | 8.1 | 108.7 | 101.6 | 133.3 | 31.7 | 29.5 | 1.479 | |
| 1910.960 | -1.0 | 8.1 | 109.4 | 102.3 | 135.1 | 32.8 | 30.6 | 1.905 | |

| | |
|---------|---|
| Note 1: | Pin is the input power (dBm) to the substitution antenna |
| Note 2: | Gain is the gain (dBi) for the substitution antenna. |
| 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. |

| | |
|---|------------------------------------|
| Client: Juniper Systems | Job Number: J78949 |
| Model: RTK GPS (Thistle) and TK6CM Expansion Packs for TK6000 | T-Log Number: T79288 |
| | Account Manager: Christine Krebill |
| Contact: Kent Campbell | |
| Standard: FCC 22/24 | Class: N/A |

Run #2: Output Power, Radiated, Thistle module.
Measurements made at 3m with RB=3MHz, VB=3MHz, peak detector.

Run #2a - Preliminary field strength measurements

Date: 5/17/2010 Engineer: John Caizzi Location: FT #5

| Frequency MHz | Level dB μ V/m | Pol v/h | FCC 22/24 | | Detector Pk/QP/Avg | Azimuth degrees | Height meters | Comments | Channel |
|--|-----------------------|------------|-----------|--------|-----------------------|--------------------|------------------|-------------|---------|
| | | | Limit | Margin | | | | | |
| Short (3bar) US antenna, RBW = VBW = 3MHz | | | | | | | | | |
| 834.760 | 131.1 | V | - | - | Pk | 208 | 1.00 | EUT upright | 186 |
| 834.440 | 134.5 | H | - | - | Pk | 326 | 1.00 | EUT flat | 186 |
| 824.480 | 133.7 | H | - | - | Pk | 331 | 1.01 | EUT flat | 128 |
| 849.840 | 134.5 | H | - | - | Pk | 328 | 1.00 | EUT flat | 251 |
| 1880.440 | 125.9 | V | - | - | Pk | 202 | 1.22 | EUT upright | 661 |
| 1879.800 | 130.7 | H | - | - | Pk | 120 | 1.16 | EUT flat | 661 |
| 1851.480 | 130.8 | H | - | - | Pk | 121 | 1.17 | EUT flat | 512 |
| 1911.480 | 130.6 | H | - | - | Pk | 120 | 1.15 | EUT flat | 810 |

Long antenna, RBW = VBW = 3MHz

| | | | | | | | | | |
|----------|-------|---|---|---|----|-----|------|-------------|-----|
| 834.920 | 134.5 | H | - | - | Pk | 330 | 1.00 | EUT flat | 186 |
| 835.400 | 131.3 | V | - | - | Pk | 102 | 1.00 | EUT upright | 186 |
| 1877.920 | 130.5 | H | - | - | Pk | 147 | 1.00 | EUT flat | 661 |
| 1883.280 | 130.0 | V | - | - | Pk | 239 | 1.00 | EUT upright | 661 |

Substitution measurements

Horizontal

| Frequency MHz | Substitution measurements | | | Site Factor ⁴ | EUT measurements | | | eirp W | erp W |
|------------------|---------------------------|-------------------|-----------------|-----------------------------|------------------|------------|-----------|-----------|----------|
| | Pin ¹ | Gain ² | FS ³ | | FS ⁵ | eirp (dBm) | erp (dBm) | | |
| 824.480 | -2.1 | 1.7 | 100.9 | 101.3 | 133.7 | 32.4 | 30.2 | | 1.047 |
| 834.440 | -2.1 | 1.7 | 101.3 | 101.7 | 134.5 | 32.8 | 30.6 | | 1.148 |
| 849.840 | -2.0 | 1.7 | 100.7 | 101.0 | 134.5 | 33.5 | 31.3 | | 1.349 |
| 1851.480 | -1.0 | 8.1 | 108.0 | 100.9 | 130.8 | 29.9 | 27.7 | 0.977 | |
| 1879.800 | -1.0 | 8.1 | 108.7 | 101.6 | 130.7 | 29.1 | 26.9 | 0.813 | |
| 1911.480 | -1.0 | 8.1 | 109.4 | 102.3 | 130.6 | 28.3 | 26.1 | 0.676 | |

- Note 1: Pin is the input power (dBm) to the substitution antenna
- Note 2: Gain is the gain (dBi) for the substitution antenna.
- 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.

Appendix C Photographs

Uploaded as a separate exhibit