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# *Electromagnetic Emissions Test Report*
# *and*
# *Application for Grant of Equipment Authorization*
# *Class II Permissive Change*
# *pursuant to*
# *Industry Canada RSS-Gen Issue 1 / RSS 210 Issue 6*
# *FCC Part 15 Subpart C*
# *on the*
# *Savi Technology, Inc.*
# *Transmitter*
# *Model: ST-604-12*

| | |
|---|---|
| UPN: | 2404A-604T |
| FCC ID: | KL7-612T-V2 |
| GRANTEE: | Savi Technology, Inc.<br>351 E. Evelyn Ave.<br>Mountain View, CA 94041 |
| TEST SITE: | Elliott Laboratories, Inc.<br>684 W. Maude Ave<br>Sunnyvale, CA 94086 |
| REPORT DATE: | April 25, 2007 |
| FINAL TEST DATE: | April 4, 2007 |

AUTHORIZED SIGNATORY: David W Bare

David W. Bare
Chief Technical Officer

ACCREDITED
2016-01

## *REVISION HISTORY*

| Revision # | Date | Comments | Modified By |
|---|---|---|---|
| 1 | May 16, 2007 | Initial Release | David Guidotti |
| | | | |
| | | | |
| | | | |

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## *TABLE OF CONTENTS (Continued)*

## *SCOPE*

An electromagnetic emissions test has been performed on the Savi Technology, Inc. model ST-604-12 pursuant to the following rules:

Industry Canada RSS-Gen Issue 1
RSS 210 Issue 6 "Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment"
FCC Part 15 Subpart C

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
RSS-212 Issue 1 Test Facilities and Test Methods for Radio Equipment

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

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.

The test results recorded herein are based on a single type test of the Savi Technology, Inc. model ST-604-12 and therefore apply only to the tested sample. The sample was selected and prepared by Eugene Schlindwein of Savi Technology, Inc.

## *OBJECTIVE*

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

Prior to marketing in the USA, all unlicensed transmitters and transceivers require certification. Receive-only devices operating between 30 MHz and 960 MHz are subject to either certification or a manufacturer's declaration of conformity, with all other receive-only devices exempt from the technical requirements.

Prior to marketing in Canada, Class I transmitters, receivers and transceivers require certification. Class II devices are required to meet the appropriate technical requirements but are exempt from certification requirements.

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 Savi Technology, Inc. model ST-604-12 complied with the requirements of the following regulations:

Industry Canada RSS-Gen Issue 1
RSS 210 Issue 6 "Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment"
FCC Part 15 Subpart C

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.).

## *TEST RESULTS SUMMARY*

### *MOMENTARILY OPERATED DEVICES – CONTROL SIGNALS – SignPost Mode*

| FCC Rule Part | RSS Rule Part | Description | Measured Value / Comments | Limit / Requirement | Result |
|---|---|---|---|---|---|
| 15.231 (a) (1) | RSS 210 A1.1.1 (1) | Duration of manually activated transmissions | No change from original design | < 5 seconds | Complies |
| 15.231 (a) (2) | RSS 210 A1.1.1 (2) | Duration of automatically activated transmissions | No change from original design | < 5 seconds | Complies |
| 15.231 (a) (3) | RSS 210 A1.1.1 (3) | Transmissions at predetermined / regular intervals | No change from original design | Such transmissions are not permitted | Complies |
| 15.231 (a) (4) | RSS 210 A1.1.1 (4) | Pendency of transmissions used during emergencies | - | - | N/A |
| 15.231 (b) | RSS 210 Table 4 | Fundamental Signal Strength | 89.2dBµV/m (28840.3µV/m) @ 433.926MHz | Refer to table in limits section | Complies (-3.6dB) |
| 15.231 (b) / 15.209 | RSS 210 Table 2 / 4 | Radiated Spurious Emissions, 30 - 4400 MHz | 44.1dBµV/m (160.3µV/m) @ 867.851MHz | Refer to table in limits section | Complies (-9.9dB) |
| 15.231 (c) | RSS 210 A1.1.3 | Bandwidth | 465 kHz | < 0.5% of operating frequency | Complies |
| 15.231 (d) | RSS 210 A1.1.4 | Frequency Stability - 40.66 – 40.70 MHz band | - | - | N/A |

Note 1 – As the device is intended for mounting in any orientation, it was tested in all three orthogonal orientations.

Note margin stated for emissions based on limits in 15.231(e) and RSS-210 Table 5. These limits are lower than required by 15.231(a) and RSS-210 Tables 2 and 4.

***MOMENTARILY OPERATED DEVICES – DATA SIGNALS OR SIGNALS AT PREDETERMINED INTERVALS- Beacon Mode***

| FCC Rule Part | RSS Rule Part | Description | Measured Value / Comments | Limit / Requirement | Result |
|---|---|---|---|---|---|
| 15.231 (e) | RSS 210 A1.1.5 | Duration of transmissions | No change from original design | < 1 second | Complies |
| 15.231 (e) | RSS 210 A1.1.5 | Period between transmissions | No change from original design | > 30 times duration of signal and > 10s | Complies |
| 15.231 (e) | RSS 210 Table 5 | Fundamental Signal Strength | 89.2dBµV/m (28840.3µV/m) @ 433.926MHz | Refer to table in limits section | Complies (-3.6dB) |
| 15.231 (e) / 15.209 | RSS 210 Table 5 | Radiated Spurious Emissions, 30 - 4400 MHz | 44.1dBµV/m (160.3µV/m) @ 867.851MHz | Refer to table in limits section | Complies (-9.9dB) |
| 15.231 (c) | RSS 210 A1.1.3 | Bandwidth | 465 kHz | < 0.5% of operating frequency | Complies |
| 15.231 (d) | RSS 210 A1.1.4 | Frequency Stability - 40.66 – 40.70 MHz band | - | - | N/A |

Note 1 – As the device is intended for mounting in any orientation, it was tested in all three orthogonal orientations.

***GENERAL REQUIREMENTS APPLICABLE TO ALL BANDS***

| FCC Rule Part | RSS Rule part | Description | Measured Value / Comments | Limit / Requirement | Result (margin) |
|---|---|---|---|---|---|
| 15.203 | - | RF Connector | No change from original design | Integral antenna or non-standard connector | Complies |
| 15.109 | RSS GEN 7.2.3 Table 1 | Receiver spurious emissions | Exempt | - | N/A |
| 15.207 | RSS GEN Table 2 | AC Conducted Emissions | Battery powered | Refer to standard | N/A |
| | RSP 100 RSS GEN 7.1.5 | User Manual | No change from original design | Statement required regarding non-interference | |

## *MEASUREMENT UNCERTAINTIES*

ISO/IEC17025 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 and were calculated in accordance with UKAS document LAB 34.

| Measurement Type | Frequency Range (MHz) | Calculated Uncertainty (dB) |
|---|---|---|
| Conducted Emissions | 0.15 to 30 | ± 2.4 |
| Radiated Emissions | 0.015 to 30 | ± 3.0 |
| Radiated Emissions | 30 to 1000 | ± 3.6 |
| Radiated Emissions | 1000 to 40000 | ± 6.0 |

## *EQUIPMENT UNDER TEST (EUT) DETAILS*

### *GENERAL*

The Savi Technology, Inc. model ST-604-12 is an rf tag which is designed to be used as part of an inventory tracking system. Normally, the EUT would be mounted to a piece of capital equipment. The EUT was treated as tabletop equipment during testing to simulate the end user environment.
The EUT is self-contained, with no interface ports for connection to external power or signal lines. It is powered via on-board cells.

The sample was received on April 4, 2007 and tested on April 4, 2007. The EUT consisted of the following component(s):

| Manufacturer | Model | Description | Serial Number | FCC ID |
|---|---|---|---|---|
| Savi | ST-604-12 | 433MHz RF Tag | 2017395 | KL7-612T-V2 |

### *OTHER EUT DETAILS*

The EUT is designed to receive commands from a SignPost transmitter at 123kHz. It then responds by transmitting an ID code using FSK at 433.92MHz. This signal is received by a SaviReader.

### *ANTENNA SYSTEM*

The antenna system used with the Savi Technology, Inc. model ST-604-12 consists of ?

### *ENCLOSURE*

The EUT enclosure is primarily constructed of plastic. It measures approximately 4.5 cm wide by 16 cm deep by 3 cm high.

### *MODIFICATIONS*

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

***SUPPORT EQUIPMENT***

No support equipment was used during emissions testing.

***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) |
| None | - | - | - | - |

***EUT OPERATION***

The EUT was configured to either transmit in Beacon Mode (transmitting its ID code at periodic intervals) or configured to be in stand-by/Receive mode.

## *PROPOSED MODIFICATION DETAILS*

### *GENERAL*

This section details the modifications to the Savi Technology, Inc. model ST-604-12. All performance and construction deviations from the characteristics originally reported to the FCC and IC are addressed.

### *RF CHIP*

The chip used in the RF circuit made by Infineon experienced a process change. The chip is now made on 8" wafers and uses AlCu metallization which improves the wiring to the ESD protection devices. Previously the chip was made on 6" wafers and used AlSiCu metallizations.

No other changes have been made to the product design or software.

## *TEST SITE*

### *GENERAL INFORMATION*

Final test measurements were taken on April 4, 2007 at the Elliott Laboratories Open Area Test Site #2 located at 684 West Maude Avenue, Sunnyvale, California or 41039 Boyce Road, Fremont, California Pursuant to section 2.948 of the FCC's Rules and section 3.3 of RSP-100, construction, calibration, and equipment data has been filed with the Commission.

ANSI C63.4:2003 recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement with the exception of predictable local TV, radio, and mobile communications traffic. The test site contains separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements of ANSI C63.4:2003 and RSS 212.

### *CONDUCTED EMISSIONS CONSIDERATIONS*

Conducted emissions testing is performed in conformance with ANSI C63.4:2003 and RSS 212. Measurements are made with the EUT connected to the public power network through a nominal, standardized RF impedance, which is provided by a line impedance stabilization network, known as a LISN. A LISN is inserted in series with each current-carrying conductor in the EUT power cord.

### *RADIATED EMISSIONS CONSIDERATIONS*

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment or in a semi-anechoic chamber. The test sites are maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4:2003 guidelines and meet the Normalized Site Attenuation (NSA) requirements of ANSI C63.4:2003 / RSS 212.

## *MEASUREMENT INSTRUMENTATION*

### *RECEIVER SYSTEM*

An EMI receiver as specified in CISPR 16-1 is used for emissions measurements. The receivers used can measure 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 CISPR detector used during measurements. If the repetition frequency of the signal being measured is below 20Hz, peak measurements are made in lieu of Quasi-Peak 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. Average measurements above 1000MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz, unless the signal is pulsed in which case the average (or video) bandwidth of the measuring instrument is reduced to onset of pulse desensitization and then increased.

### *INSTRUMENT CONTROL COMPUTER*

The receivers utilize either a Rohde & Schwarz EZM Spectrum Monitor/Controller or contain an internal Spectrum Monitor/Controller to view and convert the receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate. A personal computer is used to record all measurements made with the receivers.

The Spectrum Monitor provides a visual display of the signal being measured. In addition, the controller or a personal computer run automated data collection programs which control the receivers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors are added automatically.

### *LINE IMPEDANCE STABILIZATION NETWORK (LISN)*

Line conducted measurements utilize a fifty microhenry Line Impedance Stabilization Network as the monitoring point. The LISN used also contains a 250 uH CISPR adapter. This network provides for calibrated radio frequency noise measurements by the design of the internal low pass and high pass filters on the EUT and measurement ports, respectively.

***FILTERS/ATTENUATORS***

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

***ANTENNAS***

A loop antenna is used below 30 MHz. For the measurement range 30 MHz to 1000 MHz either a combination of a biconical antenna and a log periodic or a bi-log antenna is used. Above 1000 MHz, horn antennas are used. The antenna calibration factors to convert the received voltage to an electric field strength are included with appropriate cable loss and amplifier gain factors to determine an overall site factor, which is then programmed into the test receivers or incorporated into the test software.

***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. Measurements below 30 MHz are made with the loop antenna at a fixed height of 1m above the ground plane.

ANSI C63.4:2003 and RSS 212 specify 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 exhibit of this report contains the list of test equipment used and calibration information.

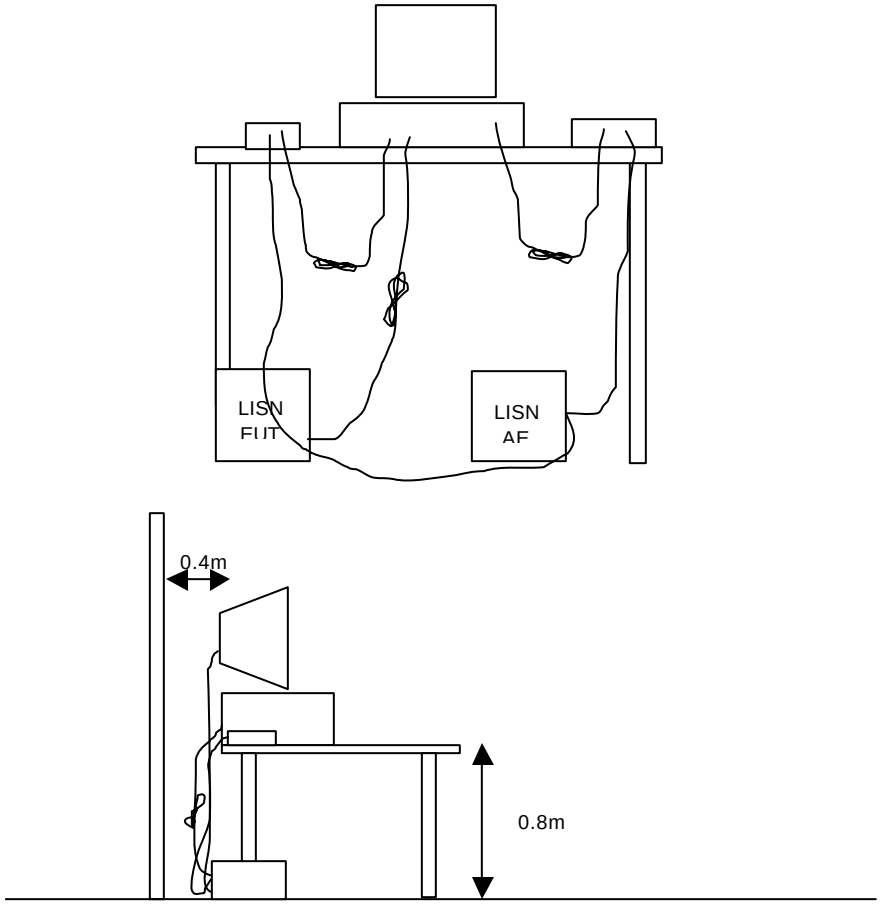
## *TEST PROCEDURES*

### *EUT AND CABLE PLACEMENT*

The regulations require that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.4:2003, and the worst-case orientation is used for final measurements.

### *CONDUCTED EMISSIONS*

Conducted emissions are measured at the plug end of the power cord supplied with the EUT. Excess power cord length is wrapped in a bundle between 30 and 40 centimeters in length near the center of the cord. Preliminary measurements are made to determine the highest amplitude emission relative to the specification limit for all the modes of operation. Placement of system components and varying of cable positions are performed in each mode. A final peak mode scan is then performed in the position and mode for which the highest emission was noted on all current carrying conductors of the power cord.



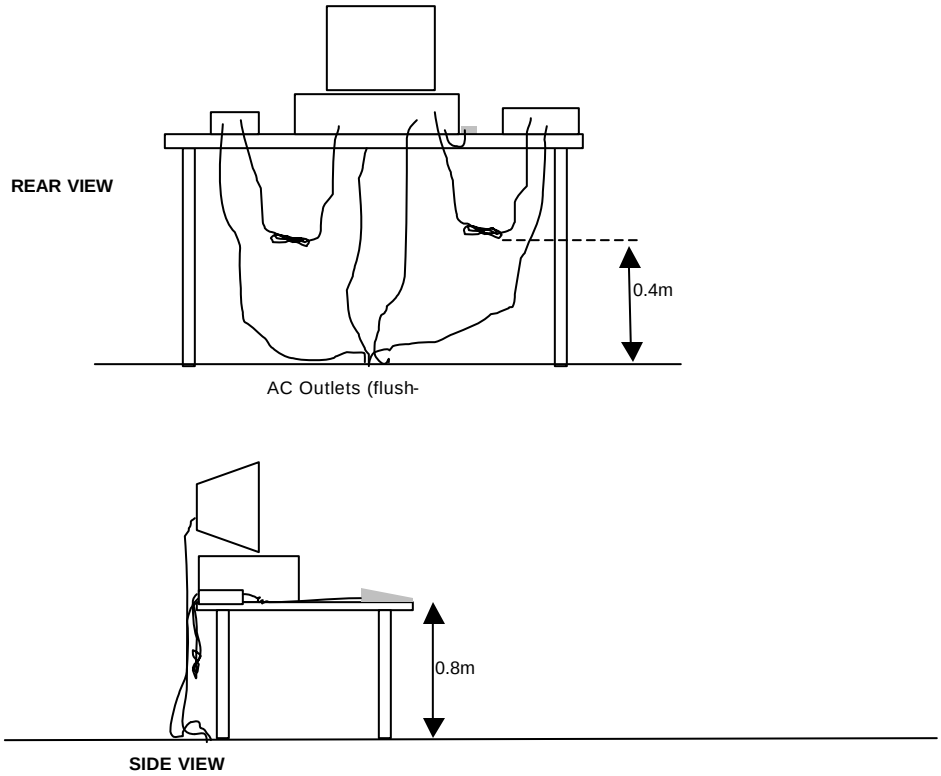
***RADIATED EMISSIONS***

A preliminary scan of the radiated emissions is performed in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed, one scan for each antenna polarization (horizontal and vertical; loop parallel and perpendicular to the EUT). During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied (for measurements above 30 MHz) and cable positions are varied to determine the highest emission relative to the limit. Preliminary scans may be performed in a fully anechoic chamber for the purposes of identifying the frequencies of the highest emissions from the EUT.

A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final maximization is a phase in which the highest amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth, which results in the highest emission is then maintained while varying the antenna height from one to four meters (for measurements above 30 MHz, measurements below 30 MHz are made with the loop antenna at a fixed height of 1m). The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain.

When testing above 18 GHz, the receive antenna is located at 1meter from the EUT and the antenna height is restricted to a maximum of 2.5 meters.




Typical Test Configuration for Radiated Field Strength Measurements

***BANDWIDTH MEASUREMENTS***

The 6dB, 20dB and/or 26dB signal bandwidth is measured in using the bandwidths recommended by ANSI C63.4. When required, the 99% bandwidth is measured using the methods detailed in RSS GEN.

***SPECIFICATION LIMITS AND SAMPLE CALCULATIONS***

The limits for conducted emissions are given in units of microvolts, and the limits for radiated emissions are given in units of microvolts per meter at a specified test distance. Data is measured in the logarithmic form of decibels relative to one microvolt, or dB microvolts (dBuV). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dBuV/m). The results are then converted to the linear forms of uV and uV/m for comparison to published specifications.

For reference, converting the specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. These limits in both linear and logarithmic form are as follows:

***GENERAL TRANSMITTER RADIATED EMISSIONS SPECIFICATION LIMITS***

The table below shows the limits for the spurious emissions from transmitters that fall in restricted bands[1] (with the exception of transmitters operating under FCC Part 15 Subpart D and RSS 210 Annex 9), the limits for all emissions from a low power device operating under the general rules of RSS 310 (tables 3 and 4), RSS 210 (table 2) and FCC Part 15 Subpart C section 15.209.

| Frequency Range (MHz) | Limit (uV/m) | Limit (dBuV/m @ 3m) |
|---|---|---|
| 0.009-0.490 | $2400/F_{KHz}$ @ 300m | $67.6-20*\log_{10}(F_{KHz})$ @ 300m |
| 0.490-1.705 | $24000/F_{KHz}$ @ 30m | $87.6-20*\log_{10}(F_{KHz})$ @ 30m |
| 1.705 to 30 | 30 @ 30m | 29.5 @ 30m |
| 30 to 88 | 100 @ 3m | 40 @ 3m |
| 88 to 216 | 150 @ 3m | 43.5 @ 3m |
| 216 to 960 | 200 @ 3m | 46.0 @ 3m |
| Above 960 | 500 @ 3m | 54.0 @ 3m |

[1] The restricted bands are detailed in FCC 15.203, RSS 210 Table 1 and RSS 310 Table 2

***RADIATED SPURIOUS EMISSIONS – MOMENTARILY OPERATED DEVICES***

The table below shows the limits for both the fundamental and spurious emissions for control signals. The limits for data signals, or signals with predetermined transmissions, are given in the second table

| Operating Frequency (MHz) | Fundamental Field Strength (microvolts/m) | Spurious Emissions (microvolts/m) |
|---|---|---|
| 70 - 130 | 1250 | 125 |
| 130 - 174 | 1250 - 3750 | 125 - 375 |
| 174 – 260 | 3750 | 375 |
| 260 – 470 | 3750 – 12,500 | 375 - 1250 |
| Above 470 | 12,500 | 1250 |

Spurious Emissions Limits – Control Signals

| Operating Frequency (MHz) | Fundamental Field Strength (microvolts/m) | Spurious Emissions (microvolts/m) |
|---|---|---|
| 70 - 130 | 500 | 50 |
| 130 - 174 | 500 - 1500 | 50 - 150 |
| 174 – 260 | 1500 | 150 |
| 260 – 470 | 1500 – 5000 | 150 - 500 |
| Above 470 | 5000 | 500 |

Spurious Emissions Limits – Data Signals

***SAMPLE CALCULATIONS - CONDUCTED EMISSIONS***

Receiver readings are compared directly to the conducted emissions specification limit (decibel form) as follows:

$$R_r - S = M$$

where:

$R_r$ = Receiver Reading in dBuV

S = Specification Limit in dBuV

M = Margin to Specification in +/- dB

***SAMPLE CALCULATIONS - RADIATED EMISSIONS***

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally 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, when used for electric field measurements above 30MHz, is calculated by using the following formula:

$$F_d = 20*LOG_{10} (D_m/D_s)$$

where:

$F_d$ = Distance Factor in dB

$D_m$ = Measurement Distance in meters

$D_s$ = 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:

$$F_d = 40*LOG_{10} (D_m/D_s)$$

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The antenna factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

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:

$R_r$ = Receiver Reading in dBuV/m

$F_d$ = Distance Factor in dB

$R_C$ = Corrected Reading in dBuV/m

$L_S$ = Specification Limit in dBuV/m

M = Margin in dB Relative to Spec

***SAMPLE CALCULATIONS - FIELD STRENGTH TO EIRP CONVERSION***

Where the radiated electric field strength is expressed in terms of the equivalent isotropic radiated power (eirp), or where a field strength measurement of output power is made in lieu of a direct measurement, the following formula is used to convert between eirp and field strength at a distance of 3m from the equipment under test:

$$E = \frac{1000000 \text{ v } 30\ P}{3} \quad \text{microvolts per meter}$$

where P is the eirp (Watts)

# *EXHIBIT 1: Test Equipment Calibration Data*

1 Page

**Radiated Emissions, 30 - 4,400 MHz, 04-Apr-07**
**Engineer: Mehran Birgani**

| Manufacturer | Description | Model # | Asset # | Cal Due |
|---|---|---|---|---|
| EMCO | Antenna, Horn, 1-18 GHz | 3115 | 487 | 24-May-08 |
| Hewlett Packard | EMC Spectrum Analyzer, 9 kHz - 6.5 GHz | 8595EM | 780 | 05-Sep-07 |
| Hewlett Packard | Microwave Preamplifier, 1-26.5GHz | 8449B | 870 | 15-Nov-07 |
| Filtek | Filter, 1 GHz High Pass | HP12/1000-5BA | 957 | 24-Apr-07 |
| EMCO | Log Periodic Antenna, 0.2-1 GHz | 3146 | 1294 | 25-May-07 |
| Rohde & Schwarz | Test Receiver, 0.009-2750 MHz | ESN | 1332 | 21-Nov-07 |

# *EXHIBIT 2: Test Measurement Data*

7Pages

Elliott

**EMC Test Data**

| | | | |
|---|---|---|---|
| Client: | Savi | Job Number: | J67527 |
| Model: | ST-604-12 | T-Log Number: | T67529 |
| | | Proj Eng: | Dean Eriksen |
| Contact: | Eugene Schlindwein | | |
| Emissions Spec: | FCC Part 15.231 | Class: | - |
| Immunity Spec: | - | Environment: | - |

# EMC Test Data

For The

## Savi

Model

**ST-604-12**

| | | | |
|---|---|---|---|
| Client: | Savi | Job Number: | J67527 |
| Model: | ST-604-12 | T-Log Number: | T67529 |
| | | Proj Eng: | Dean Eriksen |
| Contact: | Eugene Schlindwein | | |
| Emissions Spec: | FCC Part 15.231 | Class: | - |
| Immunity Spec: | - | Environment: | - |

# EUT INFORMATION

## General Description

The EUT is an rf tag which is designed to be used as part of an inventory tracking system. Normally, the EUT would be mounted to a piece of capital equipment. The EUT was treated as tabletop equipment during testing to simulate the end user environment.

The EUT is self contained, with no interface ports for connection to external power or signal lines. It is powered via on-board cells.

## Equipment Under Test

| Manufacturer | Model | Description | Serial Number | FCC ID |
|---|---|---|---|---|
| Savi | ST-604-12 | 433MHz RF Tag | 2017395 | KL7-612T-V2 |

## Other EUT Details

The EUT is designed to receive commands from a SignPost transmitter at 123kHz. It then responds by transmitting an ID code using FSK at 433.92MHz. This signal is received by a SaviReader.

## EUT Enclosure

The EUT enclosure is primarily constructed of plastic. It measures approximately 4.5 cm wide by 16 cm deep by 3 cm high.

Elliott

# EMC Test Data

| | | | |
|---|---|---|---|
| Client: | Savi | Job Number: | J67527 |
| Model: | ST-604-12 | T-Log Number: | T67529 |
| | | Proj Eng: | Dean Eriksen |
| Contact: | Eugene Schlindwein | | |
| Emissions Spec: | FCC Part 15.231 | Class: | - |
| Immunity Spec: | - | Environment: | - |

## Test Configuration #1

### Support Equipment

| Manufacturer | Model | Description | Serial Number | FCC ID |
|---|---|---|---|---|
| None | - | - | - | - |

### Interface Ports

| | | Cable(s) | | |
|---|---|---|---|---|
| Port | Connected To | Description | Shielded or Unshielded | Length(m) |
| None | - | - | - | - |

### EUT Operation During Emissions

The EUT was configured to either transmit in Beacon Mode (transmitting its ID code at periodic intervals) or configured to be in stand-by/Receive mode.

| | | | |
|---|---|---|---|
| Client: | Savi | Job Number: | J67527 |
| Model: | ST-604-12 | T-Log Number: | T67529 |
| | | Proj Eng: | Dean Eriksen |
| Contact: | Eugene Schlindwein | | |
| Spec: | FCC Part 15.231 | Class: | - |

# Radiated Emissions

## Test Specifics

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: 4/4/2007
Test Engineer: Mehran Birgani
Test Location: SVOATS #2

Config. Used: 1
Config Change: None
EUT Voltage: Internal Batteries

## General Test Configuration

The EUT was located on a 0.8m high wooden table on the turntable for radiated emissions testing perfromed in the anechoic chamber. The EUT was tested in all three ortogonal axes.

On the OATS, the measurement antenna was located 3 meters from the EUT.

Note, for testing above 1 GHz, the FCC specifies the limit as an average measurement. In addition, the FCC states that the peak reading of any emission above 1 GHz, can not exceed the average limit by more than 20 dB.

## Ambient Conditions:

Temperature: 16°C
Rel. Humidity: 66%

## Summary of Results

| Run # | Test Performed | Limit | Result | Margin |
|---|---|---|---|---|
| 1 | Fundamental Signal @ 433.92MHz | FCC 15.231(e) | Pass | 89.2dBµV/m (28840.3µV/m) @ 433.926MHz (-3.6dB) |
| 2 | Transmitter Spurious Emissions | FCC 15.231(e) | Pass | 44.1dBµV/m (160.3µV/m) @ 867.851MHz (-9.9dB) |
| 3 | Bandwidth | 15.231 | Pass | 465 kHz |

## 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.

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# EMC Test Data

| | | | |
|---|---|---|---|
| Client: | Savi | Job Number: | J67527 |
| Model: | ST-604-12 | T-Log Number: | T67529 |
| | | Proj Eng: | Dean Eriksen |
| Contact: | Eugene Schlindwein | | |
| Spec: | FCC Part 15.231 | Class: | - |

**Run #1: Maximized Radiated Emissions, Fundamental Signal at 433.92MHz**

| Frequency | Level | Pol | 15.231(e) | | Detector | Azimuth | Height | Comments |
|---|---|---|---|---|---|---|---|---|
| MHz | dBµV/m | V/H | Limit | Margin | Pk/QP/Avg | degrees | meters | |
| 433.926 | 89.2 | V | 92.8 | -3.6 | Pk | 311 | 1.1 | Upright |
| 433.926 | 69.2 | V | 72.8 | -3.6 | Avg | 311 | 1.1 | Upright |
| 433.926 | 88.1 | H | 92.8 | -4.7 | Pk | 21 | 1.0 | Side |
| 433.926 | 68.1 | H | 72.8 | -4.7 | Avg | 21 | 1.0 | Side |
| 433.926 | 87.6 | H | 92.8 | -5.2 | Pk | 5 | 1.0 | Flat |
| 433.926 | 67.6 | H | 72.8 | -5.2 | Avg | 5 | 1.0 | Flat |
| 433.926 | 84.8 | V | 92.8 | -8.0 | Pk | 73 | 1.2 | Flat |
| 433.926 | 64.8 | V | 72.8 | -8.0 | Avg | 73 | 1.2 | Flat |
| 433.926 | 82.5 | H | 92.8 | -10.3 | Pk | 249 | 1.0 | Upright |
| 433.926 | 62.5 | H | 72.8 | -10.3 | Avg | 249 | 1.0 | Upright |
| 433.926 | 80.2 | V | 92.8 | -12.6 | Pk | 98 | 1.1 | Side |
| 433.926 | 60.2 | V | 72.8 | -12.6 | Avg | 98 | 11.0 | Side |

| | |
|---|---|
| Note 1: | Average readings calculated from the peak readings by adding the average correction factor of -20dB to the peak reading. |
| Note 2: | Limits of 15.231(e) used. |

Elliott

# EMC Test Data

| | | | |
|---|---|---|---|
| Client: | Savi | Job Number: | J67527 |
| Model: | ST-604-12 | T-Log Number: | T67529 |
| | | Proj Eng: | Dean Eriksen |
| Contact: | Eugene Schlindwein | | |
| Spec: | FCC Part 15.231 | Class: | - |

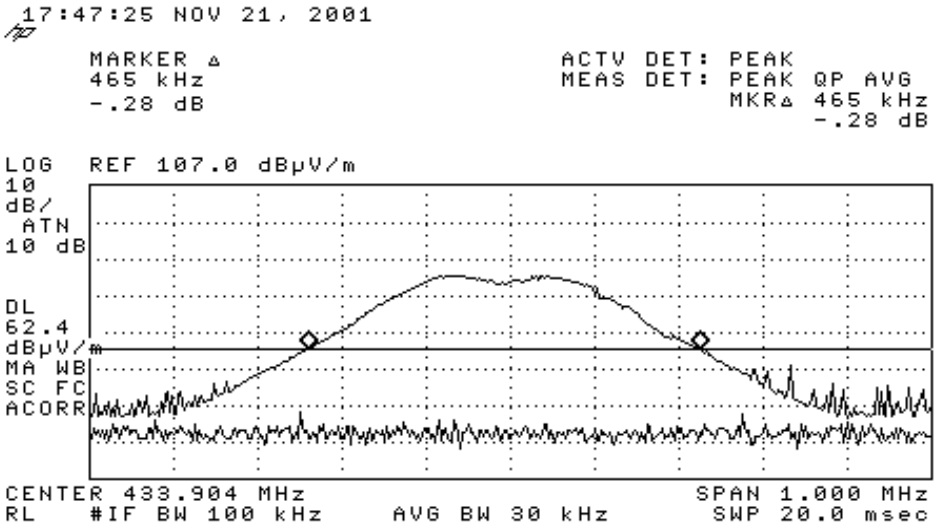
**Run #2: Maximized Radiated Emissions - Spurious Emissions 30MHz - 4,400 MHz**

| Frequency | Level | Pol | 15.231(e) | | Detector | Azimuth | Height | Comments |
|---|---|---|---|---|---|---|---|---|
| MHz | dBµV/m | V/H | Limit | Margin | Pk/QP/Avg | degrees | meters | |
| 867.851 | 44.1 | V | 54.0 | -9.9 | Avg | 18 | 1.2 | Upright |
| 867.851 | 64.1 | V | 74.0 | -9.9 | Pk | 18 | 1.2 | Upright |
| 867.851 | 64.0 | H | 74.0 | -10.0 | Pk | 170 | 1.0 | Flat |
| 867.851 | 44.0 | H | 54.0 | -10.0 | Avg | 170 | 1.0 | Flat |
| 867.851 | 63.5 | H | 74.0 | -10.5 | Pk | 176 | 1.0 | Side |
| 867.851 | 43.5 | H | 54.0 | -10.5 | Avg | 176 | 1.0 | Side |
| 1301.740 | 62.2 | V | 74.0 | -11.8 | PK | 179 | 1.3 | Upright |
| 1301.740 | 42.2 | V | 54.0 | -11.8 | AVG | 179 | 1.3 | Upright |
| 1735.650 | 60.2 | H | 74.0 | -13.8 | PK | 34 | 1.5 | Side |
| 1735.650 | 40.2 | H | 54.0 | -13.8 | AVG | 34 | 1.5 | Side |
| 1735.690 | 59.8 | H | 74.0 | -14.2 | PK | 156 | 2.0 | Flat |
| 1735.690 | 39.8 | H | 54.0 | -14.2 | AVG | 156 | 2.0 | Flat |
| 1735.660 | 59.7 | V | 74.0 | -14.3 | PK | 332 | 1.6 | Upright |
| 1735.660 | 39.7 | V | 54.0 | -14.3 | AVG | 332 | 1.6 | Upright |
| 867.851 | 57.8 | V | 74.0 | -16.2 | Pk | 244 | 2.9 | Side |
| 867.851 | 37.8 | V | 54.0 | -16.2 | Avg | 244 | 2.9 | Side |
| 1301.760 | 57.7 | H | 74.0 | -16.3 | PK | 140 | 1.6 | Flat |
| 1301.760 | 37.7 | H | 54.0 | -16.3 | AVG | 140 | 1.6 | Flat |
| 1301.750 | 57.5 | H | 74.0 | -16.5 | PK | 142 | 1.6 | Side |
| 1301.750 | 37.5 | H | 54.0 | -16.5 | AVG | 142 | 1.6 | Side |
| 1301.780 | 56.4 | V | 74.0 | -17.6 | PK | 247 | 1.1 | Flat |
| 1301.780 | 36.4 | V | 54.0 | -17.6 | AVG | 247 | 1.1 | Flat |
| 867.851 | 56.1 | V | 74.0 | -17.9 | Pk | 287 | 1.0 | Flat |
| 867.851 | 36.1 | V | 54.0 | -17.9 | Avg | 287 | 1.0 | Flat |
| 1301.790 | 55.9 | V | 74.0 | -18.1 | PK | 104 | 1.0 | Side |
| 1301.790 | 35.9 | V | 54.0 | -18.1 | AVG | 104 | 1.0 | Side |
| 1735.680 | 55.0 | V | 74.0 | -19.0 | PK | 120 | 1.3 | Side |
| 1735.680 | 35.0 | V | 54.0 | -19.0 | AVG | 120 | 1.3 | Side |
| 1735.660 | 54.6 | V | 74.0 | -19.4 | PK | 117 | 2.0 | Flat |
| 1735.660 | 34.6 | V | 54.0 | -19.4 | AVG | 117 | 2.0 | Flat |
| 1301.750 | 51.6 | H | 74.0 | -22.4 | PK | 230 | 1.0 | Upright |
| 1301.750 | 31.6 | H | 54.0 | -22.4 | AVG | 230 | 1.0 | Upright |
| 867.851 | 31.3 | H | 54.0 | -22.7 | Avg | 270 | 2.8 | Upright |
| 867.851 | 51.3 | H | 74.0 | -22.7 | Pk | 270 | 2.8 | Upright |
| 1735.640 | 47.7 | H | 74.0 | -26.3 | PK | 44 | 1.7 | Upright |
| 1735.640 | 27.7 | H | 54.0 | -26.3 | AVG | 44 | 1.7 | Upright |

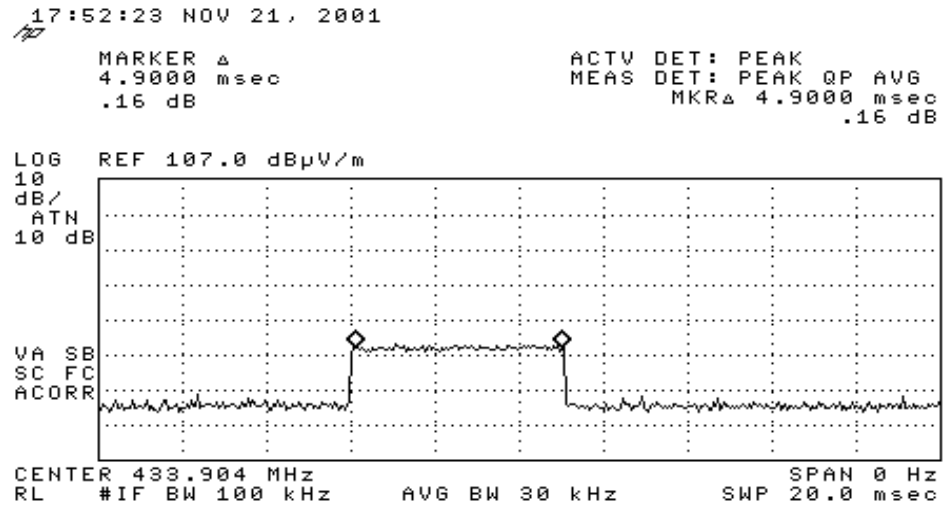
| | | | |
|---|---|---|---|
| Client: | Savi | Job Number: | J67527 |
| Model: | ST-604-12 | T-Log Number: | T67529 |
| | | Proj Eng: | Dean Eriksen |
| Contact: | Eugene Schlindwein | | |
| Spec: | FCC Part 15.231 | Class: | - |

**Run #3: 20dB Bandwidth and Duty Cycle**

The 20dB bandwidth was measured to be 465 kHz (see plot below). The maximum permitted bandwidth is 1.085 MHz.




**Duty cycle:** There are never more than two transmissions in a 125mS period. The maximum on time was 4.9mS for a single transmission. The average correction factor to be aplied to peak readings is, therefore, the maximum of -20dB.



# *EXHIBIT 3: Photographs of Test Configurations*

1 Page