Elliott Laboratories Inc.
www.elliottlabs.com
684 West Maude Avenue
Sunnyvale, CA 94086-3518
408-245-7800 Phone
408-245-3499 Fax

Electromagnetic Emissions Test Report and Application for Grant of Equipment Authorization pursuant to Industry Canada RSS-Gen Issue 2 / RSS 210 Issue 7 FCC Part 15 Subpart C on the Savi Technology, Inc. Transmitter Model: ST-602-14

UPN:	2404A-602T1
FCC ID:	KL7-602T-V1
GRANTEE:	Savi Technology, Inc. 351 E. Evelyn Ave. Mountain View, CA 94041
TEST SITE:	Elliott Laboratories, Inc. 684 W. Maude Ave Sunnyvale, CA 94086
REPORT DATE:	July 17, 2007
FINAL TEST DATES:	April 4, 2007 and July 11, 2007

AUTHORIZED SIGNATORY: David W Bare

David W. Bare
Chief Technical Officer

ACCREDITED
2016-01

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

REVISION HISTORY

Revision #	Date	Comments	Modified By
1	August 1, 2007	Initial Release	David Guidotti

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

SCOPE

An electromagnetic emissions test has been performed on the Savi Technology, Inc. model ST-602-14 pursuant to the following rules:

Industry Canada RSS-Gen Issue 2
RSS 210 Issue 7 "Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment"
FCC Part 15 Subpart C

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

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-602-12 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-602-14 complied with the requirements of the following regulations:

Industry Canada RSS-Gen Issue 2
RSS 210 Issue 7 "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

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.231(a)	RSS-210 A1.1.1	Control Signals	Refer to Theory of Operation	Control Signals only	Complies
15.231 (a) (1)	RSS 210 A1.1.1 (1)	Duration of manually activated transmissions	No manually activated transmissions	< 5 seconds	N/A
15.231 (a) (2)	RSS 210 A1.1.1 (2)	Duration of automatically activated transmissions	< 5 seconds, refer to Theory of Operation	< 5 seconds	Complies
15.231 (a) (3)	RSS 210 A1.1.1 (3)	Transmissions at predetermined / regular intervals	Refer to Theory of Operation	Such transmissions are not permitted	Complies
15.231 (a) (4)	RSS 210 A1.1.1 (4)	Pendency of transmissions used during emergencies	Not for emergency use	Operation allowed during the pendancy of the alarm	N/A
15.231 (b)	RSS 210 Table 4	Fundamental Signal Strength	77.7dBµV/m (7673.6µV/m) @ 433.927MHz (-3.1dB)	Refer to table in limits section	Complies
15.231 (b) / 15.209	RSS 210 Table 2 / 4	Radiated Spurious Emissions, 30 - 4400 MHz	49.9dBµV/m (312.6µV/m) @ 1301.8MHz (-4.1dB)	Refer to table in limits section	Complies
15.231 (c)	RSS 210 A1.1.3	20dB Bandwidth	430KHz	< 0.25% of operating frequency < 1.085MHz	Complies
15.231 (d)	RSS 210 A1.1.4	Frequency Stability - 40.66 – 40.70 MHz band	-		N/A

Note 1 – Refer to the operational description included with this application for detailed description and timing diagrams for transmission duration.
Note 2 – As the device is intended for mounting in any orientation, it was tested in all three orthogonal orientations.

MOMENTARILY OPERATED DEVICES – DATA SIGNALS OR SIGNALS AT PREDETERMINED INTERVALS

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.231 (e)	RSS 210 A1.1.5	Duration of transmissions	330mS	< 1 second	Complies
15.231 (e)	RSS 210 A1.1.5	Period between transmissions	10s	> 30 times duration of signal and > 10s	Complies
15.231 (e)	RSS 210 Table 5	Fundamental Signal Strength	69.7dBµV/m (3054.9µV/m) @ 433.927MHz (-3.1dB)	Refer to table in limits section	Complies
15.231 (e) / 15.209	RSS 210 Table 5	Radiated Spurious Emissions, 30 - 4400 MHz	41.9dBµV/m (124.5µV/m) @ 1301.8MHz (-12.1dB)	Refer to table in limits section	Complies
15.231 (c)	RSS 210 A1.1.3	Bandwidth	448KHz	< 0.25% of operating frequency <1.085MHz	Complies
15.231 (d)	RSS 210 A1.1.4	Frequency Stability - 40.66 – 40.70 MHz band	-		N/A

Note 1 – Refer to the operational description included with this application for detailed description and timing diagrams for transmission duration.
Note 2 – 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 external connector	Non Standard Connector	Complies
15.109	RSS GEN 7.2.3 Table 1	Receiver spurious emissions	Receiver operates at 123kHz	Refer to Standard	N/A
15.207	RSS GEN Table 2	AC Conducted Emissions	Battery only	Refer to standard	N/A
-	RSP 100 RSS GEN 7.1.5	User Manual	See Users manual	Statement required regarding non-interference	Complies
-	RSP 100 RSS GEN 7.1.5	User Manual	Integral Antenna	Statement required regarding detachable antenna	NA

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 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-602-14 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 and July 11, 2007. The EUT consisted of the following component(s):

Manufacturer	Model	Description	Serial Number	FCC ID
Savi	ST-602-14	433MHz RF Tag	3060933	KL7-602T-V1

OTHER EUT DETAILS

The EUT is designed to receive commands from a SignPost transmitter at 123kHz. It then responds by transmitting different codes using FSK at 433.92MHz. A SaviReader receives these signals.

There are three different types of transmissions for data operation complying with section 15.231(e). The three transmissions modes are independent and not chained together and are in response to different controlling signals from one of the Savi Signpost devices that cause the tag to transmit. The Tag's firmware prevents it from transmitting any two signals with less than a 10 second interval between transmissions.

Beacon mode transmissions consist of single or multiple pulses of duration less than 10ms each. The device is programmed such that this transmission will occur only once in any 10 second period. The transmission occurs in response to a Signpost command at intervals of between 10 seconds and 9 hours. The maximum duration of the transmission is 330mS.

An alternative Beacon mode may be utilized. In this mode, transmissions consist of a programmable number of one to three pulses, each one of less than 10 msec duration, for a total of 330 milliseconds, followed by a minimum of 10 seconds of silence. The transmissions has a ~10% duty cycle (three 10ms pulses with a period of 100ms between each pulse) to allow it to meet the average field strength limit. This is a single transmission that consists of a single burst of up to three pulses, the series of three pulses are sent as a single transmission and are no different to, say, a header signal followed by two data packets. They should not be considered as three separate transmissions but as single data set comprised of three separate data packets.

Alarm mode is entered only upon detection of a low battery voltage. In this mode, the tag transmits a single packet with a maximum duration of less than 10 milliseconds and a minimum silent period between pulses of no less than 10 seconds.

For operation under section 15.231(a), only a single mode of transmission is used, signpost routing mode. The device sends control packets in response to passing near a Signpost. A maximum of 50 packets may be transmitted. Each packet is limited to 25ms in any 100ms period with the entire transmission lasting less than 5 seconds.

ANTENNA SYSTEM

The antenna system used with the Savi Technology, Inc. model ST-602-14 consists of a PCB mounted loop antenna.

ENCLOSURE

The EUT enclosure is primarily constructed of plastic. It measures approximately 4 cm wide by 1 cm deep by 6 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.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on April 4, 2007 and July 11, 2007 at the Elliott Laboratories Open Area Test Site #2 located at 684 West Maude Avenue, Sunnyvale, 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.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing is performed in conformance with ANSI C63.4:2003. 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.

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 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 exhibit of this report contains the list of test equipment used and calibration information.

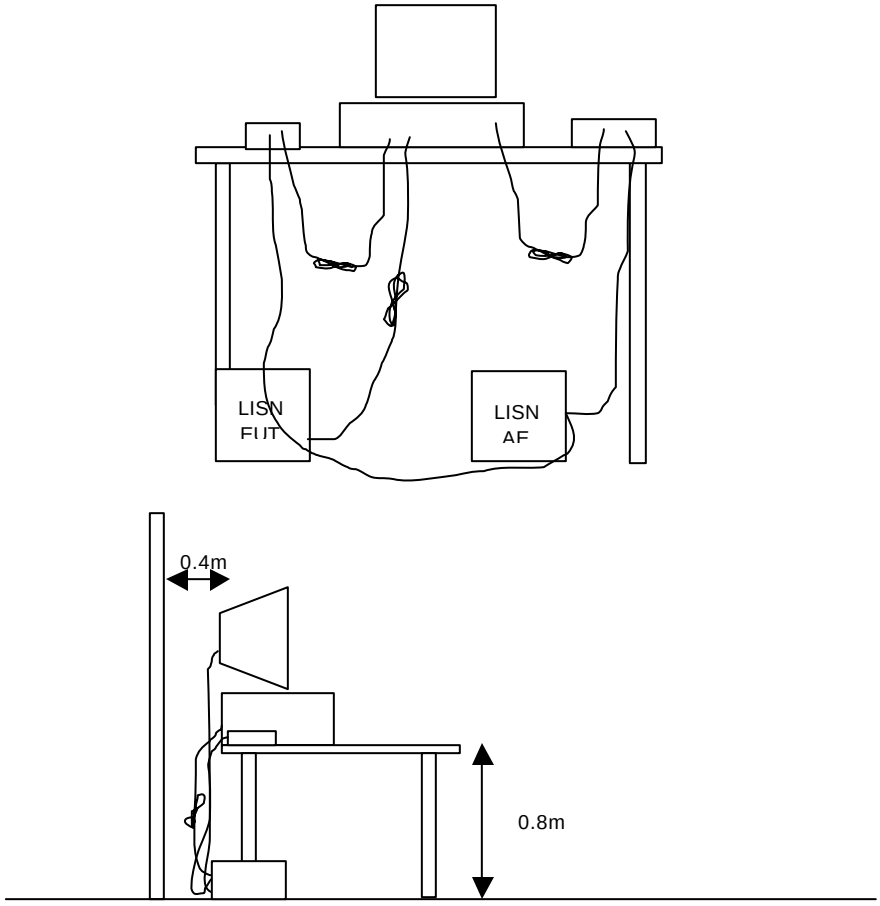
TEST PROCEDURES

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.



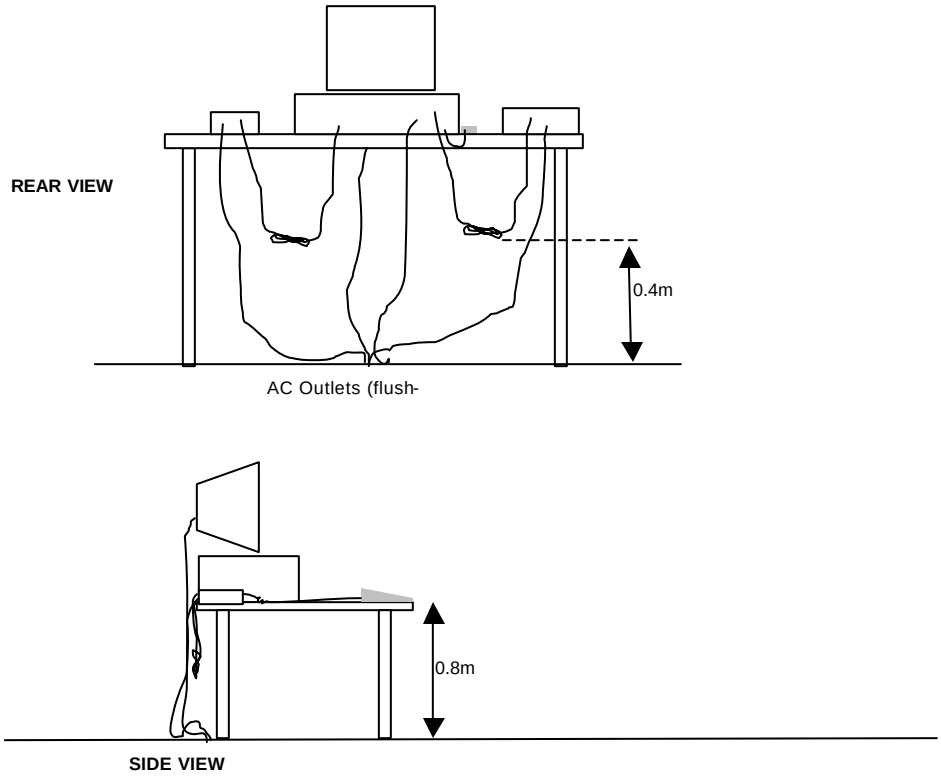
RADIATED EMISSIONS

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.

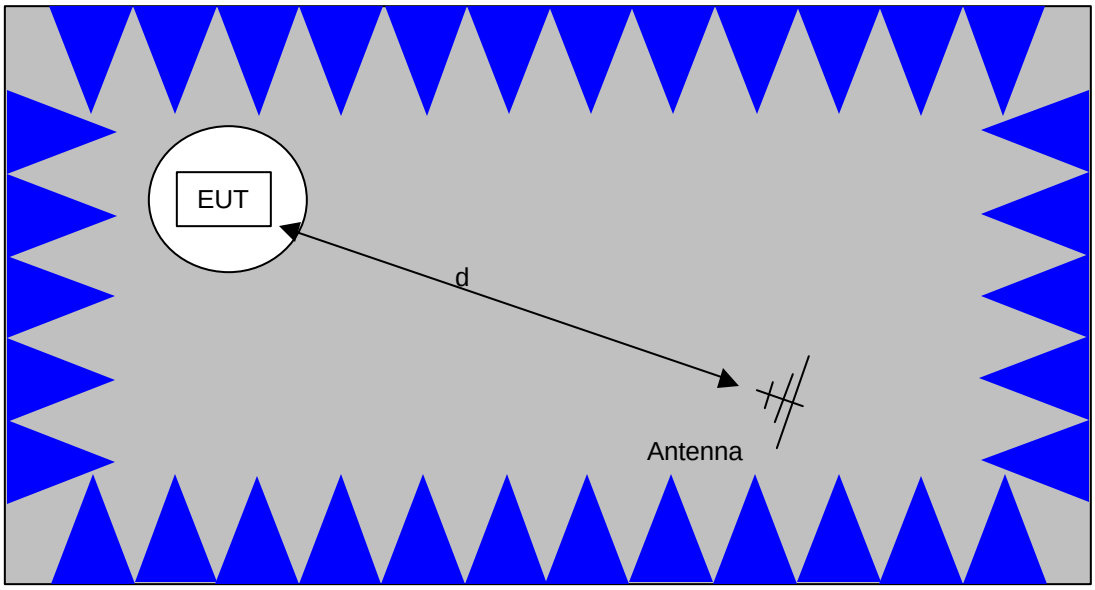
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

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.

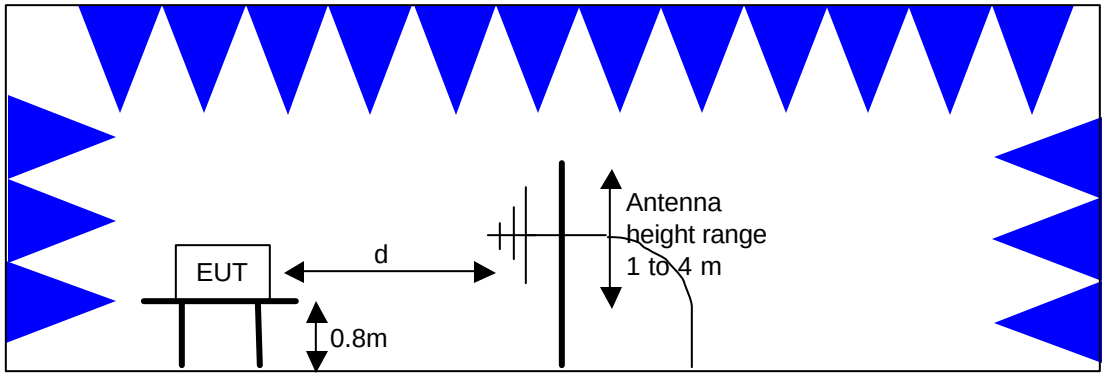


Typical Test Configuration for Radiated Field Strength Measurements



The anechoic materials on the walls and ceiling ensure compliance with the normalized site attenuation requirements of CISPR 16 / CISPR 22 / ANSI C63.4 for an alternate test site at the measurement distances used.

Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



Test Configuration for Radiated Field Strength Measurements
Semi-Anechoic Chamber, Plan and Side Views

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

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

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

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

2 Pages

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

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

14 Pages

Elliott

EMC Test Data

Client:	Savi	Job Number:	J67527
Model:	ST-602-14	T-Log Number:	T67528
		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-602-14

Client:	Savi	Job Number:	J67527
Model:	ST-602-14	T-Log Number:	T67528
		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-602-12	433MHz RF Tag	3060933	KL7-612T-V1

Other EUT Details

Testing was actually performed on the ST-602-12 tag. This was considered representative of the ST-602-14. The only difference is the enclosure shape. Both enclosures are plastic.

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 cm wide by 1 cm deep by 6 cm high.

Client:	Savi	Job Number:	J67527
Model:	ST-602-14	T-Log Number:	T67528
		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-602-14	T-Log Number:	T67528
		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	Comment
1	Fundamental Signal @ 433.92MHz	FCC 15.231(e)	Pass	69.7dBµV/m (3054.9µV/m) @ 433.927MHz (-3.1dB)
2	Transmitter Spurious Emissions	FCC 15.231(e)	Pass	41.9dBµV/m (124.5µV/m) @ 1301.8MHz (-12.1dB)
3	Bandwidth	FCC 15.231(c)	Pass	448kHz

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.

Elliott

EMC Test Data

Client:	Savi	Job Number:	J67527
Model:	ST-602-14	T-Log Number:	T67528
		Proj Eng:	Dean Eriksen
Contact:	Eugene Schlindwein		
Spec:	FCC Part 15.231	Class:	-

Run #1: Maximized Radiated Emissions, Fundamental Signal at 433.927MHz

Frequency	Level	Pol	15.231(e)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
433.927	69.7	H	72.8	-3.1	Avg	22	1.0	Flat
433.927	89.7	H	92.8	-3.1	Pk	22	1.0	Flat
433.927	84.8	V	92.8	-8.0	Pk	266	1.2	Upright
433.927	64.8	V	72.8	-8.0	Avg	266	1.2	Upright
433.927	83.8	V	92.8	-9.0	Pk	269	1.3	Side
433.927	63.8	V	72.8	-9.0	Avg	269	1.3	Side
433.927	80.3	H	92.8	-12.5	Pk	168	2.8	Upright
433.927	60.3	H	72.8	-12.5	Avg	168	2.8	Upright
433.927	78.9	H	92.8	-13.9	Pk	175	3.9	Side
433.927	58.9	H	72.8	-13.9	Avg	175	3.9	Side
433.927	75.8	V	92.8	-17.0	Pk	92	1.0	Flat
433.927	55.8	V	72.8	-17.0	Avg	92	1.0	Flat

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-602-14	T-Log Number:	T67528
		Proj Eng:	Dean Eriksen
Contact:	Eugene Schlindwein		
Spec:	FCC Part 15.231	Class:	-

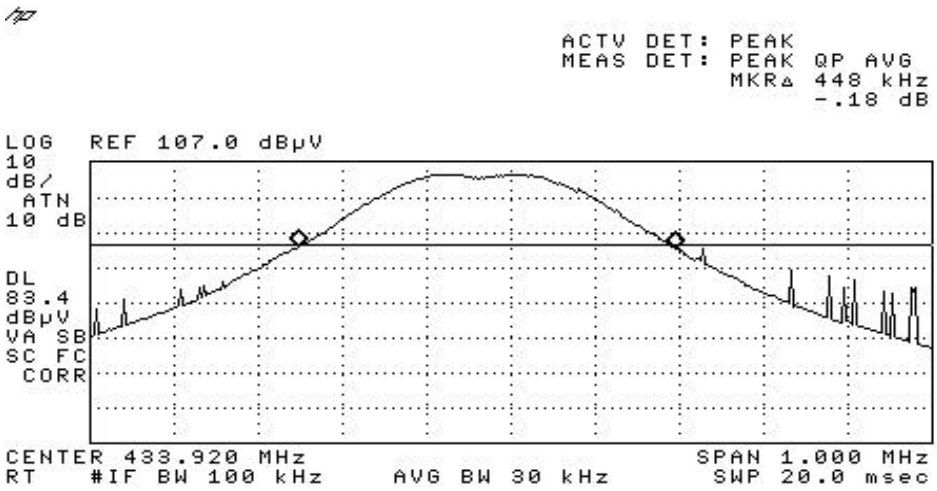
Run #2: Maximized Radiated Emissions - Spurious Emissions 30MHz - 4,400 MHz

Frequency	Level	Pol	15.231(e)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
1301.760	41.9	V	54.0	-12.1	AVG	332	1.1	Upright
1301.760	61.9	V	74.0	-12.1	PK	332	1.1	Upright
867.853	61.1	V	74.0	-12.9	PK	22	1.4	Upright
867.853	41.1	V	54.0	-12.9	AVG	22	1.4	Upright
1301.780	61.1	H	74.0	-12.9	PK	344	1.0	Flat
1301.780	41.1	H	54.0	-12.9	AVG	344	1.0	Flat
867.853	59.1	H	74.0	-14.9	PK	165	1.3	Upright
867.853	39.1	H	54.0	-14.9	AVG	165	1.3	Upright
867.853	58.4	H	74.0	-15.6	PK	330	1.0	Side
867.853	38.4	H	54.0	-15.6	AVG	330	1.0	Side
1301.780	58.4	V	74.0	-15.6	PK	103	1.1	Side
1301.780	38.4	V	54.0	-15.6	AVG	103	1.1	Side
1301.740	58.3	H	74.0	-15.7	PK	331	2.4	Side
1301.740	38.3	H	54.0	-15.7	AVG	331	2.4	Side
867.853	58.0	H	74.0	-16.0	PK	330	1.0	Flat
867.853	38.0	H	54.0	-16.0	AVG	330	1.0	Flat
1735.690	57.2	V	74.0	-16.8	PK	93	1.0	Upright
1735.690	37.2	V	54.0	-16.8	AVG	93	1.0	Upright
1735.690	56.7	V	74.0	-17.3	PK	95	1.0	Side
1735.690	36.7	V	54.0	-17.3	AVG	95	1.0	Side
1301.740	56.5	V	74.0	-17.5	PK	48	1.8	Flat
1301.740	36.5	V	54.0	-17.5	AVG	48	1.8	Flat
1735.720	56.1	V	74.0	-17.9	PK	255	1.0	Flat
1735.720	36.1	V	54.0	-17.9	AVG	255	1.0	Flat
1735.730	55.1	H	74.0	-18.9	PK	15	1.6	Side
1735.730	35.1	H	54.0	-18.9	AVG	15	1.6	Side
867.853	54.5	V	74.0	-19.5	PK	270	1.0	Side
867.853	34.5	V	54.0	-19.5	AVG	270	1.0	Side
1735.690	54.3	H	74.0	-19.7	PK	147	1.0	Flat
1735.690	34.3	H	54.0	-19.7	AVG	147	1.0	Flat
1301.760	53.5	H	74.0	-20.5	PK	346	1.7	Upright
1301.760	33.5	H	54.0	-20.5	AVG	346	1.7	Upright
867.853	50.6	V	74.0	-23.4	PK	230	1.8	Flat
867.853	30.6	V	54.0	-23.4	AVG	230	1.8	Flat
1735.690	48.7	H	74.0	-25.3	PK	4	2.3	Upright
1735.690	28.7	H	54.0	-25.3	AVG	4	2.3	Upright

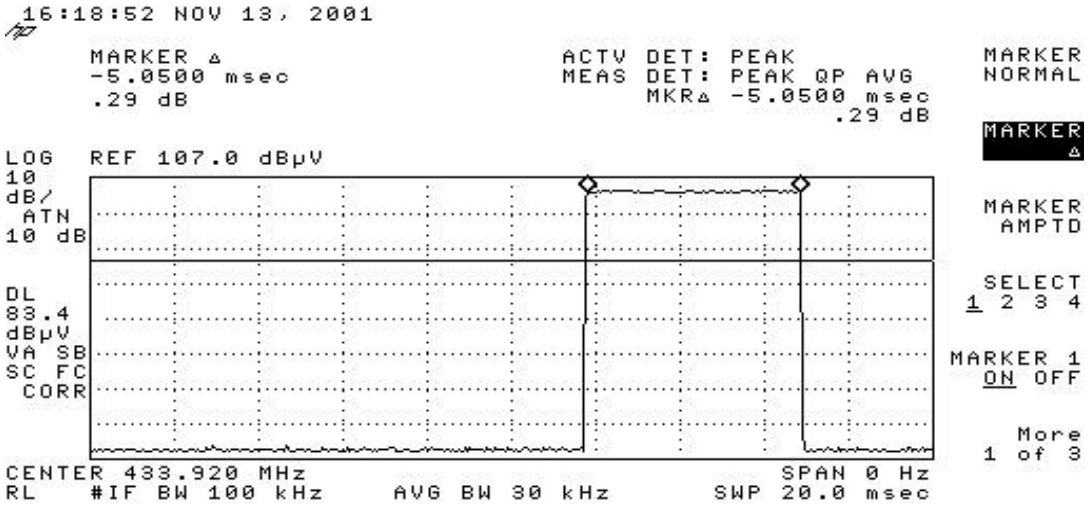
Client:	Savi	Job Number:	J67527
Model:	ST-602-14	T-Log Number:	T67528
		Proj Eng:	Dean Eriksen
Contact:	Eugene Schlindwein		
Spec:	FCC Part 15.231	Class:	-

Run #3: 20dB Bandwidth and duty cycle

The 20dB bandwidth was measured to be 448 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 5mS for a single transmission. The average correction factor to be applied to peak readings is, therefore, 20Log(10/100) = -20dB.



Elliott

EMC Test Data

Client:	Savi Technologies	Job Number:	J68552
Model:	ST-602-14	T-Log Number:	T68568
		Proj Eng:	Dean Eriksen
Contact:	Eugene Schlindwein		
Emissions Spec:	FCC Part 15.231a	Class:	-
Immunity Spec:	-	Environment:	-

EMC Test Data

For The

Savi Technologies

Model

ST-602-14

Client:	Savi Technologies	Job Number:	J68552
Model:	ST-602-14	T-Log Number:	T68568
		Proj Eng:	Dean Eriksen
Contact:	Eugene Schlindwein		
Emissions Spec:	FCC Part 15.231a	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-602-14	433MHz RF Tag	3060933	KL7-602T-V1

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 cm wide by 1 cm deep by 6 cm high.

Client:	Savi Technologies	Job Number:	J68552
Model:	ST-602-14	T-Log Number:	T68568
		Proj Eng:	Dean Eriksen
Contact:	Eugene Schlindwein		
Emissions Spec:	FCC Part 15.231a	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 Technologies	Job Number:	J68552
Model:	ST-602-14	T-Log Number:	T68568
		Proj Eng:	Dean Eriksen
Contact:	Eugene Schlindwein		
Spec:	FCC Part 15.231a	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: 7/11/2007
Test Engineer: Mehran Birgani
Test Location: OATS #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: 22 °C
Rel. Humidity: 43 %

Summary of Results

Run #	Test Performed	Limit	Result	Comment
1	Fundamental Signal @ 433.92MHz	FCC 15.231(a)	Pass	77.7dBµV/m (7673.6µV/m) @ 433.927MHz (-3.1dB)
2	Transmitter Spurious Emissions	FCC 15.231(a)	Pass	49.9dBµV/m (312.6µV/m) @ 1301.8MHz (-4.1dB)
3	20dB Bandwidth	FCC 15.231(c)	Pass	430 kHz
3	99% Bandwidth	RSS-GEN	Pass	185 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.

Elliott

EMC Test Data

Client:	Savi Technologies	Job Number:	J68552
Model:	ST-602-14	T-Log Number:	T68568
		Proj Eng:	Dean Eriksen
Contact:	Eugene Schlindwein		
Spec:	FCC Part 15.231a	Class:	-

Run #1: Maximized Radiated Emissions, Fundamental Signal at 433.927MHz

Frequency	Level	Pol	15.231(a)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
433.927	77.7	H	80.8	-3.1	Avg	22	1.0	Flat
433.927	72.8	V	80.8	-8.0	Avg	266	1.2	Upright
433.927	71.8	V	80.8	-9.0	Avg	269	1.3	Side
433.927	89.7	H	100.8	-11.1	Pk	22	1.0	Flat
433.927	68.3	H	80.8	-12.5	Avg	168	2.8	Upright
433.927	66.9	H	80.8	-13.9	Avg	175	3.9	Side
433.927	84.8	V	100.8	-16.0	Pk	266	1.2	Upright
433.927	63.8	V	80.8	-17.0	Avg	92	1.0	Flat
433.927	83.8	V	100.8	-17.0	Pk	269	1.3	Side
433.927	80.3	H	100.8	-20.5	Pk	168	2.8	Upright
433.927	78.9	H	100.8	-21.9	Pk	175	3.9	Side
433.927	75.8	V	100.8	-25.0	Pk	92	1.0	Flat

Note 1:	Duty cycle is 25% . A -12dB correction was used to determine the average level from the peak reading

Elliott

EMC Test Data

Client:	Savi Technologies	Job Number:	J68552
Model:	ST-602-14	T-Log Number:	T68568
		Proj Eng:	Dean Eriksen
Contact:	Eugene Schlindwein		
Spec:	FCC Part 15.231a	Class:	-

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

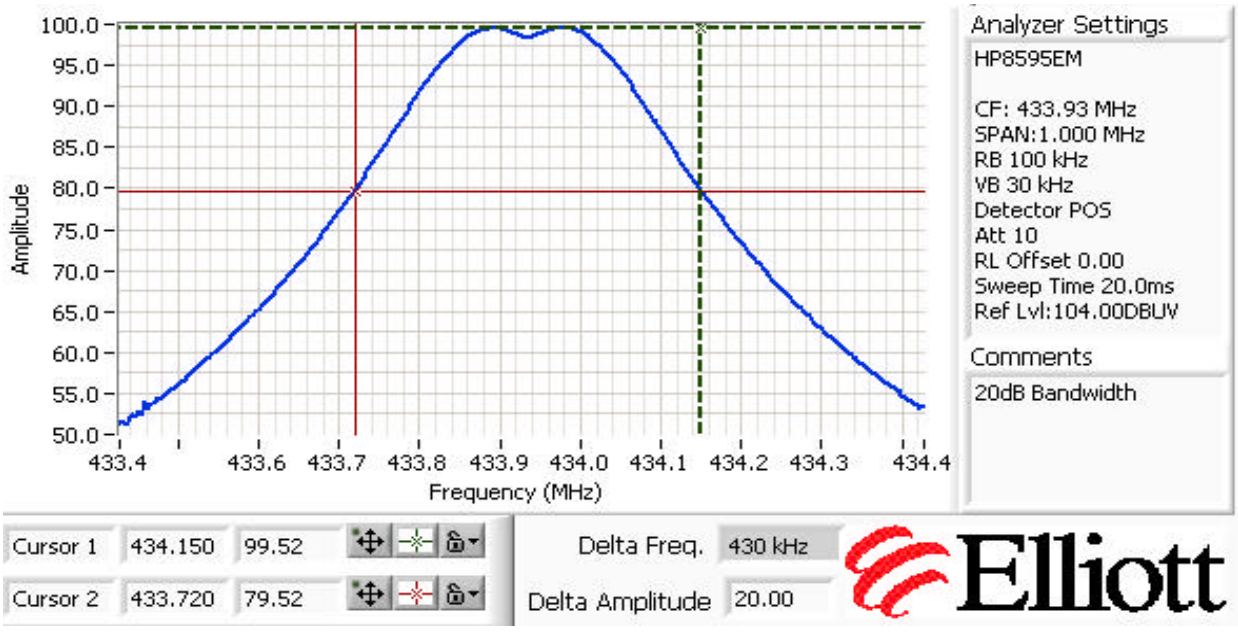
Frequency	Level	Pol	15.231(a)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
1301.760	49.9	V	54.0	-4.1	AVG	332	1.1	Upright
867.853	49.1	V	54.0	-4.9	AVG	22	1.4	Upright
1301.780	49.1	H	54.0	-4.9	AVG	344	1.0	Flat
867.853	47.1	H	54.0	-6.9	AVG	165	1.3	Upright
867.853	46.4	H	54.0	-7.6	AVG	330	1.0	Side
1301.780	46.4	V	54.0	-7.6	AVG	103	1.1	Side
1301.740	46.3	H	54.0	-7.7	AVG	331	2.4	Side
867.853	46.0	H	54.0	-8.0	AVG	330	1.0	Flat
1735.690	45.2	V	54.0	-8.8	AVG	93	1.0	Upright
1735.690	44.7	V	54.0	-9.3	AVG	95	1.0	Side
1301.740	44.5	V	54.0	-9.5	AVG	48	1.8	Flat
1735.720	44.1	V	54.0	-9.9	AVG	255	1.0	Flat
1735.730	43.1	H	54.0	-10.9	AVG	15	1.6	Side
867.853	42.5	V	54.0	-11.5	AVG	270	1.0	Side
1735.690	42.3	H	54.0	-11.7	AVG	147	1.0	Flat
1301.760	61.9	V	74.0	-12.1	PK	332	1.1	Upright
1301.760	41.5	H	54.0	-12.5	AVG	346	1.7	Upright
867.853	61.1	V	74.0	-12.9	PK	22	1.4	Upright
1301.780	61.1	H	74.0	-12.9	PK	344	1.0	Flat
867.853	59.1	H	74.0	-14.9	PK	165	1.3	Upright
867.853	38.6	V	54.0	-15.4	AVG	230	1.8	Flat
867.853	58.4	H	74.0	-15.6	PK	330	1.0	Side
1301.780	58.4	V	74.0	-15.6	PK	103	1.1	Side
1301.740	58.3	H	74.0	-15.7	PK	331	2.4	Side
867.853	58.0	H	74.0	-16.0	PK	330	1.0	Flat
1735.690	57.2	V	74.0	-16.8	PK	93	1.0	Upright
1735.690	56.7	V	74.0	-17.3	PK	95	1.0	Side
1301.740	56.5	V	74.0	-17.5	PK	48	1.8	Flat
1735.720	56.1	V	74.0	-17.9	PK	255	1.0	Flat
1735.730	55.1	H	74.0	-18.9	PK	15	1.6	Side
867.853	54.5	V	74.0	-19.5	PK	270	1.0	Side
1735.690	54.3	H	74.0	-19.7	PK	147	1.0	Flat
1301.760	53.5	H	74.0	-20.5	PK	346	1.7	Upright
867.853	50.6	V	74.0	-23.4	PK	230	1.8	Flat

Note 1:	Duty cycle is 25% . A -12dB correction was used to determine the average level from the peak reading

Client:	Savi Technologies	Job Number:	J68552
Model:	ST-602-14	T-Log Number:	T68568
		Proj Eng:	Dean Eriksen
Contact:	Eugene Schlindwein		
Spec:	FCC Part 15.231a	Class:	-

Run #3: 20dB Bandwidth and duty cycle

The 20dB bandwidth was measured to be 430 kHz (see plot below). The maximum permitted bandwidth is 1.085 MHz



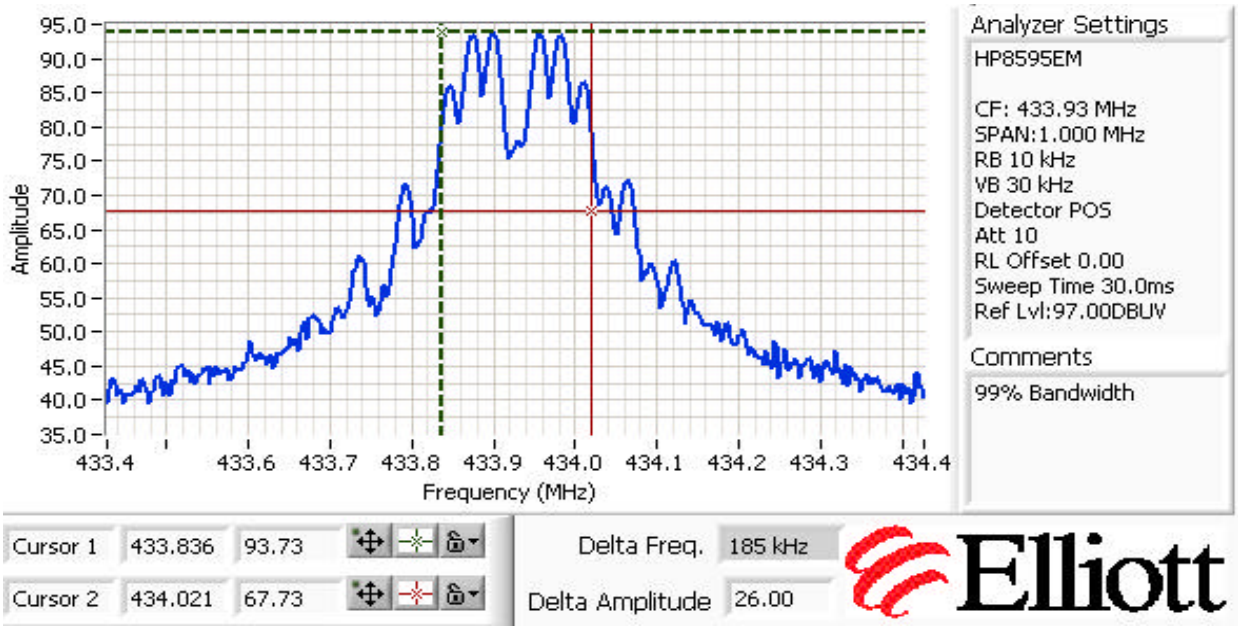


EXHIBIT 3: Photographs of Test Configurations

Uploaded as separate document

EXHIBIT 4: Proposed FCC ID Label & Label Location

Uploaded as separate document

EXHIBIT 5: Detailed Photographs of Savi Technology, Inc. Model ST-602-14 Construction

Uploaded as separate document

EXHIBIT 6: Operator's Manual for Savi Technology, Inc. Model ST-602-14

Uploaded as separate document

EXHIBIT 7: Block Diagram of Savi Technology, Inc. Model ST-602-14

Uploaded as separate document

EXHIBIT 8: Schematic Diagrams for Savi Technology, Inc. Model ST-602-14

Uploaded as separate document

EXHIBIT 9: Theory of Operation for Savi Technology, Inc. Model ST-602-14

Uploaded as separate document

EXHIBIT 10: Advertising Literature

Uploaded as separate document