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Electromagnetic Emissions Test Report
Application for Grant of Equipment Authorization
Class II Permissive Change
pursuant to
Industry Canada RSS-Gen Issue 2 / RSS 210 Issue 7
on the
Savi Technology, Inc.
Transmitter
Models: ST-656-I, ST-675-I and ST-676-I

UPN: 2404A-676T
FCC ID: KL7-676T-V1

GRANTEE: Savi Technology, Inc.
351 E. Evelyn Ave.
Mountain View, CA 94041

TEST SITE(S): Elliott Laboratories
684 W. Maude Ave
Sunnyvale, CA 94086
IC Site Registration #: 2845A-2

REPORT DATE: June 25, 2009

FINAL TEST DATE: June 15, 2009

AUTHORIZED SIGNATORY: ______________________
David W. Bare
Chief Engineer

ACCREDITED
Testing Cert #2016-01

REVISION HISTORY

Rev #	Date	Comments	Modified By
1	July 24, 2009	First Release	-

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SCOPE

An electromagnetic emissions test has been performed on the Savi Technology, Inc. model ST-676-I 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-676-I 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.

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-676-I 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

RFID DEVICES OPERATING IN THE 433.5 – 434.5MHz BANDS

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.240 (a)	RSS 210 A5	Location of operation	No change from original filing	Must be limited to commercial and industrial areas	Complies
15.240 (f)	-	Information to user		Notification of geographic limitations	Complies
15.240 (b)	RSS 210 A5 (1)	Duration of transmissions	No change from original filing	< 60s with 10s silent period	Complies
15.240 (b)	RSS 210 A5 (2)	Fundamental Signal Strength	77.9dBµV/m (7852.4µV/m) @ 433.92MHz (-2.9dB)	11000uV/m avg 55000uV/m pk	Complies
15.240 (c) / 15.209	RSS 210 Table 2	Radiated Spurious Emissions, 30 MHz – 4339 MHz	45.7dBµV/m (192.8µV/m) @ 1270.3MHz (-8.3dB)	Table 2	Complies
	RSP 100 RSS GEN 4.4.1	99% Bandwidth	No change from original filing	Information only	N/A

GENERAL REQUIREMENTS APPLICABLE TO ALL BANDS

FCC Rule Part	RSS Rule part	Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.203	-	RF Connector	Integral antennas	Unique connector or integral antenna	Complies
15.109	RSS GEN 7.2.3 Table 1	Receiver spurious emissions	45.7dBμV/m @ 1270.3MHz (-8.3dB)	Refer to table in limits section	Complies
15.207	RSS GEN Table 2	AC Conducted Emissions	N/A – Battery powered		
	RSP 100 RSS GEN 7.1.5	User Manual	No change from original filing	Statement required regarding non-interference	Complies
	RSP 100 RSS GEN 7.1.5	User Manual	N/A – Integral antenna	Statement required regarding detachable antenna	Complies

MEASUREMENT UNCERTAINTIES

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

Measurement Type	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. models ST-656-I, ST-675-I and ST-676-I are RFID tags that contain a transceiver operating at 433.92MHz. They also have a receiver that operates at 123 kHz. Normally, the EUT would be mounted to a container in a specific orientation. The EUT was placed on a table in this orientation during testing.
A response from the EUT is initiated by a 123 kHz signal from a Savi SignPost or 433.92 MHz signal from a Savi Reader. Upon receiving the initiation signal the EUT transmits a signal at 433.92 MHz. This signal is comprised of SignPost ID and Tag ID.
A response from the EUT is initiated by a 433.92 MHz Savi Reader signal. Upon receiving the initiation signal the EUT transmits a signal at 433.92 MHz. This signal is comprised of Tag ID.

The sample was received on June 15, 2009 and tested on June 15, 2009. The EUT consisted of the following component(s):

Manufacturer	Model	Description	Serial Number	FCC ID
Savi	ST-676-I	RFID Tag	5719220	KL7-676T-V1

OTHER EUT DETAILS

There are three versions of the tag - as detailed below. As the ST-676-I represents the most configured version of the tag it was considered to be the worst-case of the three models with respect to EMC performance. All tests were performed on a sample of the ST-676-I and the results are considered to represent the worst case of all 3 models.

- **The ST-656-I** is the basic RFID Tag intended for mounting on ISO Container Doors. The circuit card and battery are housed in a cover inside the locked door to prevent vandalism and theft of the battery. The UHF and Low Frequency Antennas and an audible buzzer are mounted in a protective low profile plastic case on the outside of the door.

- **The ST-676-I** is constructed similarly, except for the addition of internal door security and environmental sensors whose measurements can be monitored during a journey to detect unauthorized entry into the container. Sensor data may also be stored during a journey for later read-out and decision making over a serial or RF interface.

- **The ST-675-I** is a variant of the ST-676 which deletes the environmental sensors except for the Light Sensor.

ANTENNA SYSTEM

The antenna is integral to the device, thereby meeting the requirements of FCC 15.203.

ENCLOSURE

The EUT enclosure is primarily constructed of plastic covers over all circuitry/antenna, secured to a steel bracket. It measures approximately 19 cm wide by 10 cm deep by 12 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 transmitter was set to continuously transmit at 433 MHz for transmitter related tests and in a continuous receive mode for receiver related tests.

PROPOSED MODIFICATION DETAILS

GENERAL

No modifications have been made to the Savi Technology, Inc. models ST-656-I, ST-675-I and ST-676-I. Refer to the separate attestation letter from Savi Technology for this permissive change/re-assessment.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on June 15, 2009 at the test sites listed below. 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 and with industry Canada.

Site	Registration Numbers		Location
	FCC	Canada	
SVOATS #2	90593	2845A-2	684 West Maude Ave, Sunnyvale CA 94085-3518

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, on OATS sites, of predictable local TV, radio, and mobile communications traffic. The test site(s) contain 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 16-1-1 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.

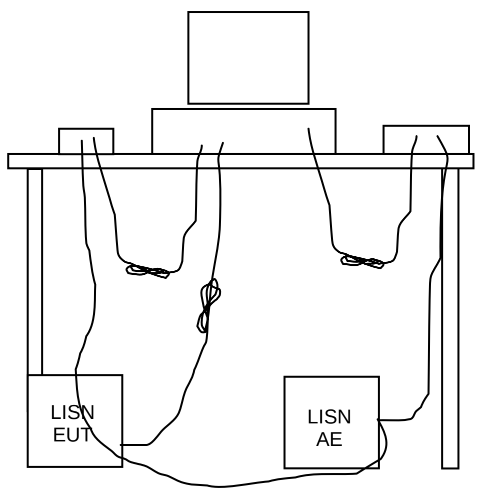
TEST PROCEDURES

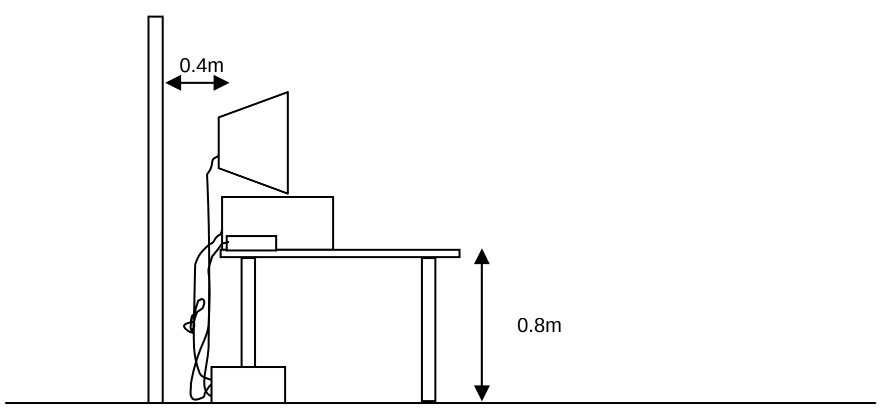
EUT AND CABLE PLACEMENT

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.



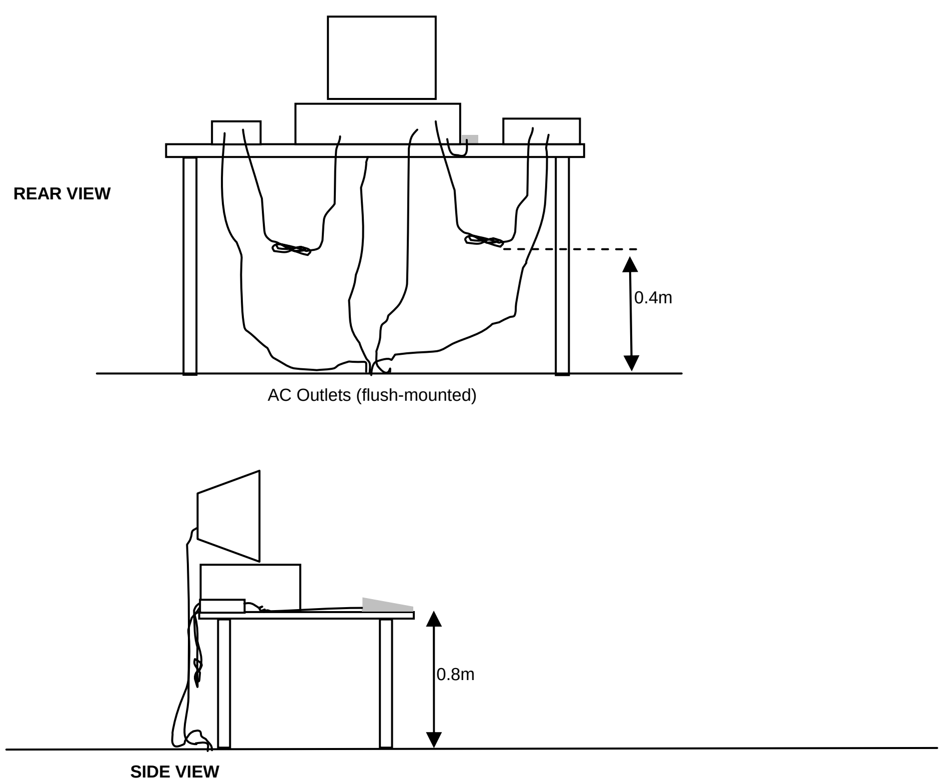


A preliminary scan of the radiated emissions is performed in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed, one scan for each antenna polarization (horizontal and vertical; loop parallel and perpendicular to the EUT). 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

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:

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

where P is the eirp (Watts)

EXHIBIT 1: Test Equipment Calibration Data

1 Page

Radiated Emissions, 30 - 5,000 MHz, 15-Jun-09
Engineer: Mehran Birgani

Manufacturer	Description	Model #	Asset #	Cal Due
Elliott Laboratories	Log Periodic Antenna 300-1000 MHz	EL300.1000	55	03-Apr-10
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	09-Oct-09
Filtek	Filter, 1 GHz High Pass	HP12/1000-5BA	957	30-Jul-09
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	12-Mar-10
Rohde & Schwarz	Test Receiver, 0.009-2750 MHz	ESN	1332	14-Apr-10
EMCO	Antenna, Horn, 1-18 GHz	3115	1561	10-Jun-10

EXHIBIT 2: Test Measurement Data

6 Pages

EMC Test Data

Client:	Savi	Job Number:	J74561
Model:	ST-676-I	T-Log Number:	T74618
		Account Manager:	Sherren Washington
Contact:	Eugene Schlindwein	Project Engineer:	David Bare
Emissions Spec:	FCC 15.231(a/e); FCC 15.240	Class:	A
Immunity Spec:	-	Environment:	-

EMC Test Data

For The

Savi

Model

ST-676-I

Date of Last Test: 6/15/2009

Client:	Savi	Job Number:	J74561
Model:	ST-676-I	T-Log Number:	T74618
		Account Manager:	Sherren Washington
Contact:	Eugene Schlindwein		
Emissions Spec:	FCC 15.231(a/e); FCC 15.240	Class:	A
Immunity Spec:	-	Environment:	-

EUT INFORMATION

General Description

The EUT is a RFID tag that contains a transceiver operating at 433.92MHz. It also has a receiver that operates at 123 kHz. Normally, the EUT would be mounted to a container in a specific orientation. The EUT was placed on a table in this orientation during testing.
A response from the EUT is initiated by a 123 kHz signal from a Savi SignPost or 433.92 MHz signal from a Savi Reader. Upon receiving the initiation signal the EUT transmits a signal at 433.92 MHz. This signal is comprised of SignPost ID and Tag ID.

A response from the EUT is initiated by a 433.92 MHz Savi Reader signal. Upon receiving the initiation signal the EUT transmits a signal at 433.92 MHz. This signal is comprised of Tag ID.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
Savi	ST-676-I	RFID Tag	5719220	KL7-676T-V1

Other EUT Details

There are three versions of the tag - as detailed below. As the ST-676-I represents the most configured version of the tag it was considered to be the worst-case of the three models with respect to EMC performance. All tests were performed on a sample of the ST-676-I and the results are considered to represent the worst case of all 3 models.
The ST-656-I is the basic RFID Tag intended for mounting on ISO Container Doors. The circuit card and battery are housed in a cover inside the locked door to prevent vandalism and theft of the battery. The UHF and Low Frequency Antennas and an audible buzzer are mounted in a protective low profile plastic case on the outside of the door.
The ST-676-I is constructed similarly, except for the addition of internal door security and environmental sensors whose measurements can be monitored during a journey to detect unauthorized entry into the container. Sensor data may also be stored during a journey for later read-out and decision making over a serial or RF interface.
The ST-675-I is a variant of the ST-676 which deletes the environmental sensors except for the Light Sensor.

EUT Antenna

The antenna is integral to the device, thereby meeting the requirements of FCC 15.203.

EUT Enclosure

The EUT enclosure is primarily constructed of plastic covers over all circuitry/antenna, secured to a steel bracket. It measures approximately 19 cm wide by 10 cm deep by 12 cm high.

Client:	Savi	Job Number:	J74561
Model:	ST-676-I	T-Log Number:	T74618
		Account Manager:	Sherren Washington
Contact:	Eugene Schlindwein		
Emissions Spec:	FCC 15.231(a/e); FCC 15.240	Class:	A
Immunity Spec:	-	Environment:	-

Test Configuration #1

Local Support Equipment

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

Remote Support Equipment

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

Interface Cabling and Ports

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

EUT Operation During Emissions Tests

The transmitter was set to continuously transmit at 433 MHz for transmitter related tests and in a continuous receive mode for receiver related tests.

Client:	Savi	Job Number:	J74561
Model:	ST-676-I	T-Log Number:	T74618
		Account Manager:	Sherren Washington
Contact:	Eugene Schlindwein	Project Engineer:	David Bare
Spec:	FCC 15.231(a/e); FCC 15.240	Class:	A

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.

General Test Configuration

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

Note, **preliminary** testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. **Maximized** testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

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 (°C): 15-20
Rel. Humidity (%): 30-55

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1a	RE, 433.92MHz, Fundamental	15.231(e) / RSS 210	Pass	69.9dBµV/m (3126.1µV/m) @ 433.92MHz (-3.0dB)
1a	RE, 433.92MHz, Fundamental	15.231(a) / RSS 210	Pass	77.9dBµV/m (7852.4µV/m) @ 433.92MHz (-2.9dB)
1a	RE, 433.92MHz, Fundamental	15.240 / RSS-210	Pass	77.9dBµV/m (7852.4µV/m) @ 433.92MHz (-2.9dB)
1b	RE, Tx Spurious Emissions	FCC 15.209	Pass	44.4dBµV/m (166.0µV/m) @ 867.84MHz (-1.6dB)
2	RE, Rx Spurious Emissions	15.109 & RSS-GEN	Pass	45.7dBµV/m (192.8µV/m) @ 1270.3MHz (-8.3dB)

Modifications Made During Testing:

The output power from the EUT was dropped to setting 129

Deviations From The Standard

No deviations were made from the requirements of the standard.

EMC Test Data

Client:	Savi	Job Number:	J74561
Model:	ST-676-I	T-Log Number:	T74618
		Account Manager:	Sherren Washington
Contact:	Eugene Schlindwein	Project Engineer:	David Bare
Spec:	FCC 15.231(a/e); FCC 15.240	Class:	A

Run #1: Radiated Emissions, 30 MHz - 4.3 GHz (S/N: 5725045)

Date of Test:	6/15/2009	Config. Used:	1
Test Engineer:	Mehran Birgani	Config Change:	None
Test Location:	SVOATS #2	EUT Voltage:	Battery

Run #1a: Fundamental Mesaurement of 433.923

Operation under 15.231(e)

Frequency	Level	Pol	FCC 15.231(e)		Detector	Azimuth	Height	Comments
MHz	dBμV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
433.920	69.9	V	72.9	-3.0	AVG	354	1.3	
433.920	62.5	H	72.9	-10.4	AVG	305	1.0	
433.920	89.9	V	92.9	-3.0	PK	354	1.3	
433.920	82.5	H	92.9	-10.4	PK	305	1.0	

Note 1:	Duty cycle is 10% . A -20dB correction was used to determine the average level from the peak reading

Operation under 15.231(a)

Frequency	Level	Pol	FCC 15.231(a)		Detector	Azimuth	Height	Comments
MHz	dBμV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
433.920	77.9	V	80.8	-2.9	AVG	354	1.3	
433.920	89.9	V	100.8	-10.9	PK	354	1.3	

Note 1:	Duty cycle is 25% . A -12dB correction was used to determine the average level from the peak reading
Note 2:	Peak readings made using a receiver and measurement bandwidth set to 120kHz.

Operation under 15.240

Frequency	Level	Pol	FCC 15.240		Detector	Azimuth	Height	Comments
MHz	dBμV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
433.920	77.9	V	80.8	-2.9	AVG	354	1.3	
433.920	89.9	V	94.8	-4.9	PK	354	1.3	

Note 1:	Duty cycle is 25% . A -12dB correction was used to determine the average level from the peak reading
Note 2:	Peak readings made using a receiver and measurement bandwidth set to 120kHz.

EMC Test Data

Client:	Savi	Job Number:	J74561
Model:	ST-676-I	T-Log Number:	T74618
		Account Manager:	Sherren Washington
Contact:	Eugene Schlindwein	Project Engineer:	David Bare
Spec:	FCC 15.231(a/e); FCC 15.240	Class:	A

Run #1b: Spurious Emissions, 30-4400 MHz (Tx Mode)

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBμV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
867.839	44.4	V	46.0	-1.6	QP	179	1.2	
867.839	42.0	H	46.0	-4.0	QP	360	1.2	
1301.830	37.1	H	54.0	-16.9	AVG	293	1.0	
1301.860	37.8	V	54.0	-16.2	AVG	103	1.1	
1735.760	28.7	H	54.0	-25.3	AVG	100	1.7	Note 2
1735.770	34.0	V	54.0	-20.0	AVG	160	1.0	Note 2
2169.660	33.5	H	54.0	-20.5	AVG	123	1.8	Note 2
2169.750	35.8	V	54.0	-18.2	AVG	337	1.0	Note 2
2603.470	26.0	H	54.0	-28.0	AVG	209	1.0	Note 2
2603.930	25.8	V	54.0	-28.2	AVG	256	1.0	Note 2
1301.730	49.1	H	74.0	-24.9	PK	293	1.0	
1301.780	49.8	V	74.0	-24.2	PK	103	1.1	
1735.800	46.0	V	74.0	-28.0	PK	160	1.0	Note 2
1736.320	40.7	H	74.0	-33.3	PK	100	1.7	Note 2
2169.460	45.5	H	74.0	-28.5	PK	123	1.8	Note 2
2169.760	47.8	V	74.0	-26.2	PK	337	1.0	Note 2
2603.030	37.8	V	74.0	-36.2	PK	256	1.0	Note 2
2603.320	38.0	H	74.0	-36.0	PK	209	1.0	Note 2

Note 1:	Worst case duty cycle for all three operational modes is 25% . A -12dB correction was used to determine the average level from the peak reading. All three orientations evaluated and all readings within 20dB of the limit were recorded.
Note 2:	Signal is not in a restricted band but the more stringent restricted band limit was used.
Note 3:	All harmonics were measured; however, the signals that were more than 28dB below the limit or were within the noise floor were not recorded.

Run #2: Spurious Emissions, Receive Mode, 30MHz - 2000 MHz

Frequency	Level	Pol	FCC 15.109		Detector	Azimuth	Height	Comments
MHz	dBμV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
1269.580	41.2	H	54.0	-12.8	PK	10	1.0	Note 1, noise floor
1270.270	45.7	V	54.0	-8.3	PK	254	1.4	Note 1, noise floor
423.228	25.0	H	46.0	-21.0	QP	240	1.4	
423.228	23.7	V	46.0	-22.3	QP	66	4.0	
846.456	22.2	V	46.0	-23.8	QP	360	1.0	Noise floor
846.456	21.6	H	46.0	-24.4	QP	360	1.0	Noise floor

Note 1:	Peak readings with the average limit.

EXHIBIT 3: Photographs of Test Configurations

Radiated Emissions Test Configuration Photographs