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Electromagnetic Emissions Test Report In Accordance With Industry Canada Radio Standards Specification 210 And FCC Part 15 Sections 15.209, 15.231 on the Savi Technology, Inc. Transmitter Model: SMR-650-21X

UPN:	2404A-650MR2
FCC ID:	KL7-650MR-V4
GRANTEE:	Savi Technology, Inc. 615 Tasman Drive Sunnyvale, CA 94089-1707
TEST SITE:	Elliott Laboratories, Inc. 684 W. Maude Ave Sunnyvale, CA 94086
REPORT DATE:	August 9, 2005
FINAL TEST DATE:	June 1, 2005

AUTHORIZED SIGNATORY: Mark Briggs

Mark Briggs
Principal Engineer

ACCREDITED
2016-01

Equipment Name and Model:

Transceiver SMR-650-21X

Manufacturer:

Savi Technology, Inc.
615 Tasman Drive
Sunnyvale, CA 94089-1707

Tested to applicable standard:
RSS210, Issue 5, February 1996
Low Power License-Exempt Radio Communication Devices

Test Report Prepared For:
Eugene Schlindwein
Savi Technology, Inc.
615 Tasman Drive
Sunnyvale, CA 94089-1707

Measurement Facility Description Filed With Department of Industry:

Departmental Acknowledgement Number: IC4548 SV1, IC4548 SV2

Declaration of Compliance

I declare that the testing was performed or supervised by me; that the test measurements were made in accordance with the above mentioned departmental standards (through the use of ANSI C63.4:2003 as detailed in section 5.3 of RSS-210, Issue 5); and that the equipment performed in accordance with the data submitted in this report.

Signature _____
Name Mark Briggs
Title Principal Engineer
Elliott Laboratories Inc.
Address 684 W. Maude Ave
Sunnyvale, CA 94086
USA

Date: August 9, 2005

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SCOPE

An electromagnetic emissions test has been performed on the Savi Technology, Inc. model SMR-650-21X pursuant to Subpart C of Part 15 of FCC Rules for intentional radiators and Industry Canada Radio Standards Specification RSS-210 for Low Power, License-Exempt Radio Communication Devices. Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in ANSI C63.4:2003 as outlined in Elliott Laboratories test procedures.

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 SMR-650-21X 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 Subpart C of Part 15 of FCC Rules for the radiated and conducted emissions of intentional radiators and Industry Canada RSS-210 for Low Power, License-Exempt Radio Communication Devices. Certification of these devices is required as a prerequisite to marketing as defined in Part 2 the FCC Rules and Industry Canada Radio Standards Procedure RSP-100.

Certification is a procedure where the manufacturer or a contracted laboratory makes measurements and submits the test data and technical information to the FCC. The FCC issues a grant of equipment authorization upon successful completion of their review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units, 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 SMR-650-21X complied with the requirements of Subpart C of Part 15 of the FCC Rules for low power intentional radiators and Industry Canada specification RSS 210 for Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands).

Maintenance of FCC 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

15.231 / RSS 210 Section 6.1 – Operation at 433.92 MHz

FCC Part 15 Section	RSS 210 Section	Description	Comments	Result
15.207 / 15.107		AC Conducted Emissions, 0.15 – 30 MHz	35.4dBµV (58.9µV) @ 1.009MHz (-10.6dB)	Complies
	6.6 / 7.4	AC Conducted emissions 0.45 – 30 MHz	40.5dBµV (105.9µV) @ 1.009MHz (-7.5dB)	Complies
15.231 (a) (1)	6.1.1(a) (1)	Duration of manually activated transmission	N/A – transmissions are automatically activated	N/A
15.231 (a) (2)	6.1.1(a) (2)	Duration of automatically activated transmission	All transmissions have a duration of 5 seconds or less. Note 1	Complies
15.231 (a) (3)	6.1.1(a) (3)	Transmissions at predetermined / regular intervals are not permitted	Refer to operational description for explanations.	Complies
15.231 (a) (4)	6.1.1(a) (4)	Pendency of transmissions used during emergencies involving fire, security, and safety of life	N/A – no such transmissions	N/A
15.231 (b)	6.1.1(b) / Table 1	Transmitter Radiated Emissions, 433.92 MHz	80.3dBµV/m (10351.4µV/m) @ 433.917MHz (-0.5dB)	Complies
15.231 (b)	6.1.1(b) / Table 1	Transmitter Radiated Spurious Emissions, 30-4180 MHz	38.5dBµV/m (84.1µV/m) @ 1301.8MHz (-15.5dB)	Complies
15.231 (e)	6.1.1(a) (1)	Duration of manually activated transmission	N/A – transmissions are automatically activated	N/A
15.231 (e)	6.1.1(e)	Duration of automatically activated transmission	All transmissions that include data signals have a duration of 1 second or less and a quiet period of 30seconds or more between transmissions. Note 1	Complies
15.231 (e)	6.1.1(e) / Table 4	Transmitter Radiated Emissions, 433.92 MHz	72.3dBµV/m (4121.0µV/m) @ 433.917MHz (-0.6dB)	Complies
15.231 (e)	6.1.1(e) / Table 4	Transmitter Radiated Spurious Emissions, 30-4180 MHz	35.2dBµV/m (57.5µV/m) @ 1301.8MHz (-18.8dB)	Complies
15.231 (c)	6.1.1 (c)	Bandwidth	185 kHz	Complies
15.231 (d)	6.1.1 (d)	Frequency Stability	N/A, device does not operate in the 40.66 – 40.70 MHz band	N/A
15.109	7.3	Receiver Spurious Emissions	Rx LO and harmonics more than 20dB below limit.	Complies

Note 1 – Refer to the operational description included with this application for detailed description and timing diagrams for transmission duration.

15.209 / RSS 210 Table 3 (Operation at 123 kHz)

FCC Part 15 Section	RSS 210 Section	Description	Comments	Result
15.207 / 15.107		AC Conducted Emissions, 0.15 – 30 MHz	35.9dBµV @ 0.864MHz (-10.1dB)	Complied
	6.6 / 7.4	AC Conducted emissions 0.45 – 30 MHz	42.1dBµV @ 0.864MHz (-5.9dB)	Complied
15.209	6.2.1	Transmitter Fundamental Signal Emissions, 0.123 MHz	15.7dBµV/m (6.1µV/m) @ 123KHz (-10.1dB)	Complies (note 1)
15.231 (b)	6.2.1	Transmitter Radiated Spurious Emissions, 0.1 – 30 MHz	-28.5dBµV/m (0.04µV/m) @ 393KHz (-44.2dB)	Complies (note 1)
	RSP100	Transmitter Bandwidth	14kHz	N/A – information only

Note 1 – As the device is intended for hand-held operation it was tested in all three orthogonal orientations.

MEASUREMENT UNCERTAINTIES

ISO Guide 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level 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	30 to 1000	± 3.6

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Savi Technology, Inc. model SMR-650-21X is a transceiver, which is designed to communicate with Savi's RFID tags. The device transmits at 123 kHz and at 433.92 MHz to initiate responses from tags within its vicinity. The tags transmit at 433.92 MHz, so the EUT also contains a receiver operating at 433.92 MHz. All models are identical except for type of serial interface cable and connector used to connect directly to the serial port of either a hand-held PDT or DB9 connector to a PC RS232 interface.

The device operates from an internal, rechargeable battery and is provided with external DC input used to recharge the battery via adapter. It is intended to be operated as a hand held device although it can operate while connected to the external AC-DC adapter.

The 123 kHz transmitter operates under part 15.209 of the FCC's rules. The 433.92 MHz transceiver operates under section 15.231 of the FCC rules.

The 433.92 MHz transmissions consist of both data and control signals. The data signals are 10 mS long and have a duty cycle of no more than 10% measured in a 100 mS period.

There are two types of control signals, one that has a 24% duty cycle and another, the Wake-Up with Hello Command signal, that is a 2.5 second transmission

Normally the EUT would be hand held during operation. The EUT was, therefore, treated as table-top equipment during testing to simulate the end-user environment. The electrical rating of the EUT adapter is 100-240VAC, 50-60Hz, 0.2A.

The sample was received on May 23, 2005 and tested on June 1, 2005. The EUT consisted of the following component(s):

Manufacturer	Model	Description	Serial Number	FCC ID
Savi Technology, Inc.	SMR-650-212	Transceiver	5039036	KL7 -650MR-V4
Savi Technology, Inc.	SMR-650-212	Transceiver	5039041	KL7 -650MR-V4

ENCLOSURE

The EUT enclosure is primarily constructed of plastic. It measures approximately 6.5 cm wide by 2.5 cm deep by 15 cm high.

MODIFICATIONS

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

SUPPORT EQUIPMENT

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

Handheld Terminal

Manufacturer	Model	Description	Serial Number	FCC ID
PowDec	WP05050I	Charger	WP05050I-1.3	N/A
IBM	ThinkPad	Laptop Computer	78-48-24897/11	ANO9611TBOON
Epson	Stylus C80	Printer	SD33E333382	DoC

Computer connection

Manufacturer	Model	Description	Serial Number	FCC ID
IBM	ThinkPad	Laptop Computer	78-48-24897/11	ANO9611TBOON

No remote 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)
Serial with level translators	PowDec	Multiwire	Shielded	0.2
PowDecDC	PowDec Charger	Two wire	Shielded	1.7
DB9	Laptop	Serial cable	Unshielded	2.7
PC Parallel	Printer		Shielded	2.7

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Serial	Laptop	Multiwire	Shielded	2.7
DC	Charger	Two wire	Shielded	1.5
Charger AC	Mains	Three wire	Shielded	1

EUT OPERATION

In Handheld Terminal Configuration, the EUT was set to continuously transmit a modulated signal at either 433.92 MHz or 123kHz. In Computer Connection Configuration, the EUT was set to continuously transmit at either 123 KHz or 433.92 MHz with modulation.

Pulsed operation was disabled for transmit-mode tests (i.e. the duty cycle was 100%).

For digital device emissions tests the EUT was in receive mode.

ANTENNA SYSTEM

The antenna system used with the Savi Technology, Inc. model SMR-650-21X consists of integral antennas.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on June 1, 2005 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. The test site is maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4:2003 guidelines.

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.

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.

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

ANTENNA MAST AND EQUIPMENT TURNTABLE

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

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 FCC requires 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

Radiated emissions measurements are performed in two phases as well. A preliminary scan of emissions is conducted in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed from 30 MHz up to the frequency required by the regulation specified on page 1. One or more of these is with the antenna polarized vertically while the one or more of these is with the antenna polarized horizontally. During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit.

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. 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. Emissions, which have values close to the specification limit may also be measured with a tuned dipole antenna to determine compliance.

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:

CONDUCTED EMISSIONS SPECIFICATION LIMITS, SECTION 15.207 & 15.107(a)

The table below shows the limits for the emissions on the AC power line from an intentional radiator and a receiver.

Frequency (MHz)	Average Limit (dBuV)	Quasi Peak Limit (dBuV)
0.150 to 0.500	Linear decrease on logarithmic frequency axis between 56.0 and 46.0	Linear decrease on logarithmic frequency axis between 66.0 and 56.0
0.500 to 5.000	46.0	56.0
5.000 to 30.000	50.0	60.0

CONDUCTED EMISSIONS SPECIFICATION LIMITS, RSS 210

Frequency Range (MHz)	Class B Limit (uV)	Class B Limit (dBuV)
0.450 to 30.000	250	48

FUNDAMENTAL AND HARMONIC LIMITS 15.231 (b) / RSS 210 Table 1

The table below shows the limits for both the Fundamental and Harmonic emissions for each frequency band of operation detailed in Section 15.231 (b) for control signals.

Operating Frequency (MHz)	Field strength (microvolts/m)	Harmonics (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

FUNDAMENTAL AND HARMONIC LIMITS 15.231 (e)/RSS 210 Table 4

The table below shows the limits for both the Fundamental and Harmonic emissions (that do not fall in restricted bands) for each frequency band of operation detailed in Section 15.231 (e) for data signals.

Operating Frequency (MHz)	Field strength (microvolts/m)	Harmonics (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

RADIATED EMISSIONS SPECIFICATION LIMITS, SECTION 15.209 / RSS 210 Table 3

The table below shows the limits for the spurious emissions from transmitters that fall in restricted bands and the limits for all emissions for a low power device operating under the general rules of RSS 210 and FCC Part 15 Subpart C.

Frequency Range (MHz)	Limit (uV/m @ 3m)	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	40
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

RADIATED EMISSIONS SPECIFICATION LIMITS, SECTION 15.109 / RSS 210 Table 3 (RECEIVER)

The table below shows the limits for emissions from the receiver.

Frequency Range (MHz)	Limit (uV/m @ 3m)	Limit (dBuV/m @ 3m)
30 to 88	100	40
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

Note – the RSS 210 limits are relaxed by 6dB above 1610 MHz.

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

EXHIBIT 1: Test Equipment Calibration Data

2 Pages

Radiated Emissions, 0.123 - 1,000 MHz, 01-Jun-05
Engineer: dbare

Manufacturer	Description	Model #	Asset #	Cal Due
EMCO	Magnetic Loop Antenna, 10kHz-30MHz	6502	1299	20-Dec-06
EMCO	Log Periodic Antenna, 0.2-2 GHz	3148	1321	30-Mar-07
Rohde & Schwarz	Test Receiver, 0.009-2750 MHz	ESN	1332	23-May-06

Radiated Emissions, .1 - 4,000MHz, 03-Jun-05
Engineer: Chris Byleckie

Manufacturer	Description	Model #	Asset #	Cal Due
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	26-Apr-06
Hewlett Packard	EMC Spectrum Analyzer 9kHz - 6.5GHz	8595EM	787	17-Dec-05
Filtek	High Pass Filter, 1GHz	HP12/1000-5BA	955	31-Mar-06
EMCO	Magnetic Loop Antenna, 10kHz-30MHz	6502	1299	20-Dec-06
EMCO	Biconical Antenna, 30-300 MHz	3110B	1320	25-Aug-05
EMCO	Log Periodic Antenna, 0.2-2 GHz	3148	1321	30-Mar-07
Rohde & Schwarz	Test Receiver, 0.009-2750 MHz	ESN	1332	23-May-06
ETS-Lindgren	Horn Antenna, D. Ridge 1-18GHz	3117	1662	11-Apr-06

Conducted Emissions - AC Power Ports, 06-Jun-05
Engineer: Chris Byleckie

Manufacturer	Description	Model #	Asset #	Cal Due
Elliott Laboratories	FCC / CISPR LISN	LISN-3, OATS	304	01-Jul-05
Hewlett Packard	EMC Spectrum Analyzer 9kHz - 6.5GHz	8595EM	780	26-May-07
Solar Electronics	LISN	8028-50-TS-24-BNC support	904	10-Aug-05
Rohde & Schwarz	Test Receiver, 0.009-2750 MHz	ESN	1332	23-May-06
Rohde& Schwarz	Pulse Limiter	ESH3 Z2	1398	11-Feb-06

Radiated Emissions, .009 - 4,000MHz, 07-Jun-05
Engineer: Chris Byleckie

Manufacturer	Description	Model #	Asset #	Cal Due
EMCO	Horn Antenna, D. Ridge 1-18GHz	3115	487	13-May-06
EMCO	Biconical Antenna, 30-300 MHz	3110B	801	09-Jul-05
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	13-Jan-06
EMCO	Magnetic Loop Antenna, 10kHz-30MHz	6502	1299	20-Dec-06
Hewlett Packard	EMC Spectrum Analyzer, 9KHz - 22GHz	8593EM	1319	28-Mar-06
Rohde & Schwarz	Test Receiver, 9kHz-2750MHz	ESCS 30	1337	12-Jan-06
EMCO	Log Periodic Antenna, 0.2-2 GHz	3148	1347	03-Nov-05

Conducted Emissions - AC Power Ports, 07-Jun-05
Engineer: Chris Byleckie

Manufacturer	Description	Model #	Asset #	Cal Due
Elliott Laboratories	FCC / CISPR LISN	LISN-4, OATS	362	01-Jul-05
Elliott Laboratories	LISN 2 x (Solar 8028 LISN + 6512 Caps)	LISN-5,Support	379	19-Aug-05
Rohde& Schwarz	Pulse Limiter	ESH3 Z2	812	11-Feb-06
Hewlett Packard	EMC Spectrum Analyzer, 9KHz - 22GHz	8593EM	1319	28-Mar-06
Rohde & Schwarz	Test Receiver, 9kHz-2750MHz	ESCS 30	1337	12-Jan-06

EN 300 220, EN 300 330, AS/NZS 4268 Power and Modulation Bandwidth, 15-Jun-05
Engineer: Mark Briggs

Manufacturer	Description	Model #	Asset #	Cal Due
Hewlett Packard	EMC Spectrum Analyzer 9kHz - 6.5GHz	8595EM	780	26-May-07

Radiated Emissions, 30 - 1,000 MHz - Preliminary Scans, 17-Jun-05
Engineer: Mark Briggs

Manufacturer	Description	Model #	Asset #	Cal Due
Elliott Laboratories	Biconical Antenna, 30-300 MHz	DM-105-T1	382	21-Sep-05
Electro Metrics	Conical log spiral antenna	LCA-25	1291	04-Nov-05
Hewlett Packard	RF Preamplifier, 100 kHz - 1.3 GHz	8447E	1606	28-Jul-05
Hewlett Packard	EMC Spectrum Analyzer 30Hz - 26.5GHz	8563EC	1033,WC	17-Feb-06

Radiated Emissions, 30 - 1,000 MHz, 17-Jun-05
Engineer: Mark Briggs

Manufacturer	Description	Model #	Asset #	Cal Due
EMCO	Biconical Antenna, 30-300 MHz	3110B	801	09-Jul-05
Rohde & Schwarz	Test Receiver, 9kHz-2750MHz	ESCS 30	1337	12-Jan-06
EMCO	Log Periodic Antenna, 0.2-2 GHz	3148	1347	03-Nov-05

EXHIBIT 2: Test Measurement Data

17 Pages

Elliott

EMC Test Data

Client:	Savi	Job Number:	J59842
Model:	SMR-650-212	T-Log Number:	T59865
		Account Manager:	
Contact:	Eugene Schlindwein		
Emissions Spec:	FCC 15.231(e); EN 300 330; EN 300 220	Class:	-
Immunity Spec:	EN 301 489-3	Environment:	-

EMC Test Data

For The

Savi

Model

SMR-650-212

Date of Last Test: 6/17/2005

Client:	Savi	Job Number:	J59842
Model:	SMR-650-212	T-Log Number:	T59865
		Account Manager:	
Contact:	Eugene Schlindwein		
Emissions Spec:	FCC 15.231(e); EN 300 330; EN 300 220	Class:	-
Immunity Spec:	EN 301 489-3	Environment:	-

EUT INFORMATION

General Description

The EUT is a transceiver which is designed to communicate with Savi's RFID tags. The device transmits at 123 kHz and at 433.92 MHz to initiate responses from tags within its vicinity. The tags transmit at 433.92 MHz, so the EUT also contains a receiver operating at 433.92 MHz. All models are identical except for type of serial interface cable and connector used to connect directly to hand held PC or similar device. The device operates from an internal, rechargable battery and is provided with external DC input used to recharge the battery via adapter. It is intended to be operated as a hand held device although it can operate while connected to the external AC-DC adapter. The 123 kHz transmitter operates under part 15.209 of the FCC's rules. The 433.92 MHz transceiver operates under section 15.231 of the FCC rules. The 433.92 MHz transmissions consist of both data and control signals. When operating under 15.231 rules, the data signals are 10 mS long and have a duty cycle of no more than 10% measured in a 100 mS period. There are two types of control signals, one that has a 24% duty cycle and another, the Wake-Up with Hello Command signal, that is a 2.5 second transmission
When operated under 15.209 rules, 123kHz transmissions may be continuous.
Normally the EUT would be hand held during operation. The EUT was, therefore, treated as table-top equipment during testing to simulate the end-user environment. The electrical rating of the EUT adapter is 100-240VAC, 50-60Hz, 0.2A.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
Savi Technology, Inc.	SMR-650-212	Transceiver	5039036	TBD
Savi Technology, Inc.	SMR-650-212	Transceiver	5039041	TBD

EUT Enclosure

The EUT enclosure is primarily constructed of plastic. It measures approximately 6.5 cm wide by 2.5 cm deep by 15 cm high.

Modification History

Mod. #	Test	Date	Modification
1	-	-	-

Modifications applied are assumed to be used on subsequent tests unless otherwise stated as a further modification.

Client:	Savi	Job Number:	J59842
Model:	SMR-650-212	T-Log Number:	T59865
		Account Manager:	
Contact:	Eugene Schlindwein		
Emissions Spec:	FCC 15.231(e); EN 300 330; EN 3	Class:	-
Immunity Spec:	EN 301 489-3	Environment:	-

Test Configuration #1

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
PowDec	WP05050I	Charger	WP05050I-1.3	N/A
IBM	ThinkPad	Laptop Computer	78-48-24897/11	ANO9611TBOON
Epson	Stylus C80	Printer	SD33E333382	DoC

Note: The normal serial peripheral would be a hand-held Personal Data Terminal and not a PC but it could be used with a PC.
Note: The printer was connected for digital device emissions tests.

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)
Serial with level translators	PowDec	Multiwire	Shielded	0.2
PowDecDC	PowDec Charger	Two wire	Shielded	1.7
DB9	Laptop	Serial cable	Unshielded	2.7
PC Parallel	Printer		Shielded	2.7

EUT Operation During Emissions

The EUT was set to continuously transmit at either 433.92 MHz with no modulation. For digital device emissions tests the EUT was in receive mode.

Client:	Savi	Job Number:	J59842
Model:	SMR-650-212	T-Log Number:	T59865
		Account Manager:	
Contact:	Eugene Schlindwein		
Emissions Spec:	FCC 15.231(e); EN 300 330; EN 3	Class:	-
Immunity Spec:	EN 301 489-3	Environment:	-

EUT Operation During Immunity

The EUT was tested in three different modes (see below). As the device is designed to be used as a portable device and not when connected to the AC-DC adapter only stand-by mode was evaluated during the tests applied to the AC power port.

Stand-By Mode: The EUT was positioned on the table in a stand-by mode (transmitter inactive, receiver active). A near field probe was placed beside the EUT and used to monitor 433 MHz to verify that the UHF transmitter did not transmit. If necessary (i.e. if the test phenomena were not applied in 433 MHz transmit/receive mode) the test was repeated while monitoring 123kHz to verify that the LF transmitter did not transmit.

433 MHz Transmit / Receive Mode: A Savi reader was located beside the EUT. The reader was controlled by a remote PC to send an interrogation request at 433 MHz and then report back the ID of the tag. The reader repeated this cycle at ~ 3 second intervals. The PC recorded the number of successful collections and the number of missed collections (i.e. cycles where the tag's response was not received). The 123kHz frequency was monitored to ensure no transmissions occurred at this frequency.

123kHz Transmit / 433 MHz Receive Mode: A SignPost and a reader were located close to the EUT and controlled by a PC to initiate a response from the Tag via the Signpost (at 123kHz) and then listen for the tag's response by the reader at 433 MHz. The cycle was repeated at ~ 3 second intervals. The PC recorded the number of successful collections and the number of missed collections (i.e. cycles where the tag's response was not received).

Test Configuration #1

Performance Criteria - EN 301 489-3

Criterion A: In Receive/Transmit modes the EUT shall respond to interrogations from the reader or signpost by transmitting its ID. The software should show no missed collections. Missed collections are acceptable when the test signal is at either the transmit or the receive frequency. In stand-by mode there shall be no transmissions from the tag.

Criterion B: In Receive/Transmit modes the EUT may fail to respond to interrogations from the reader or signpost during the test provided that it responds upon completion of the test. In stand-by mode there shall be no transmissions from the tag.

Client:	Savi	Job Number:	J59842
Model:	SMR-650-212	T-Log Number:	T59865
		Account Manager:	
Contact:	Eugene Schlindwein		
Emissions Spec:	FCC 15.231(e); EN 300 330; EN 3	Class:	-
Immunity Spec:	EN 301 489-3	Environment:	-

Test Configuration #2

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
IBM	ThinkPad	Laptop Computer	78-48-24897/11	ANO9611TBOON

Note: The normal serial peripheral would be a hand-held Personal Data Terminal and not a PC but it could be used with a PC.

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)
Serial	Laptop	Multiwire	Shielded	2.7
DC	Charger	Two wire	Shielded	1.5
Charger AC	Mains	Three wire	Shielded	1

EUT Operation During Emissions

The EUT was set to continuously transmit at either 123 KHz or 433.92 MHz with modulation.

EUT Operation During Immunity

The EUT was tested in three different modes (see below). As the device is designed to be used as a portable device and not when connected to the AC-DC adapter only stand-by mode was evaluated during the tests applied to the AC power port.

Stand-By Mode: The EUT was positioned on the table in a stand-by mode (transmitter inactive, receiver active). A near field probe was placed beside the EUT and used to monitor 433 MHz to verify that the device did not transmit.

433 MHz Receive / Transmit Mode: A Savi reader was located beside the EUT. The reader was controlled by a remote PC to send an interrogation request at 433 MHz and then report back the ID of the tag. The reader repeated this cycle at ~ 3 second intervals. The PC recorded the number of successful collections and the number of missed collections (i.e. cycles where the tag's response was not received). The 123kHz frequency was monitored to ensure no transmissions occurred at this frequency.

123kHz Receive / 433 MHz Transmit Mode: A SignPost and a reader were located close to the EUT and controlled by a PC to initiate a response from the Tag via the Signpost (at 123kHz) and then listen for the tag's response by the reader at 433 MHz. The cycle was repeated at ~ 3 second intervals. The PC recorded the number of successful collections and the number of missed collections (i.e. cycles where the tag's response was not received).

Client:	Savi	Job Number:	J59842
Model:	SMR-650-212	T-Log Number:	T59865
		Account Manager:	
Contact:	Eugene Schlindwein		
Emissions Spec:	FCC 15.231(e); EN 300 330; EN 3	Class:	-
Immunity Spec:	EN 301 489-3	Environment:	-

Performance Criteria - EN 301 489-3

Criterion A: In Receive/Transmit modes the EUT shall respond to interrogations from the reader or signpost by transmitting its ID. The software should show no missed collections. Missed collections are acceptable when the test signal is at either the transmit or the receive frequency. In stand-by mode there shall be no transmissions from the tag.

Criterion B: In Receive/Transmit modes the EUT may fail to respond to interrogations from the reader or signpost during the test provided that it responds upon completion of the test. In stand-by mode there shall be no transmissions from the tag.

Client:	Savi	Job Number:	J59842
Model:	SMR-650-212	T-Log Number:	T59865
		Account Manager:	-
Contact:	Eugene Schlindwein		
Spec:	FCC 15.231(e); EN 300 330; EN 300 220	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: 6/1/2005
Test Engineer: David Bare
Test Location: SVOATS #2

Config. Used: 1 and 2
Config Change: None
EUT Voltage: Battery (Charger connected to 120V, 60Hz in config 2)

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated emissions testing.
For radiated emissions testing below 30 MHz the measurement antenna was located 3 meters from the EUT, unless otherwise noted. Radiated magnetic field measurements were made with the loop antenna located one meter above the ground plane, with the loop of the antenna either parallel or perpendicular to the EUT.
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 in the 110 to 490 KHz range, the FCC specifies the limit as an average measurement. In addition, the FCC states that the peak reading of any emission can not exceed the average limit by more than 20 dB.

Ambient Conditions:

Temperature: 20 °C
Rel. Humidity: 56 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	Fundamental - config w/PDA	FCC 15.209	Pass	12.8dBµV/m (4.4µV/m) @ 123KHz (-13.0dB)
1	Spurious, 0.1 - 1.2 MHz - config w/PDA	FCC 15.209	Pass	-32.4dBµV/m (0.02µV/m) @ 393KHz (-48.1dB)
2	Fundamental - config w/PC	FCC 15.209	Pass	15.7dBµV/m (6.1µV/m) @ 123KHz (-10.1dB)
2	Spurious, 0.1 - 1.2 MHz - config w/PC	FCC 15.209	Pass	-28.5dBµV/m (0.04µV/m) @ 393KHz (-44.2dB)

Client:	Savi	Job Number:	J59842
Model:	SMR-650-212	T-Log Number:	T59865
		Account Manager:	-
Contact:	Eugene Schlindwein		
Spec:	FCC 15.231(e); EN 300 330; EN 300 220	Class:	-

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.

Run #1: Maximized Radiated Emissions, 9 KHz-30 MHz, tested with handheld terminal (Config 1)
Measured at 3m and extrapolated to 300m using 40LOG(1/d)

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
KHz	dBµV/m		Limit	Margin	Pk/QP/Avg	degrees	meters	
123.000	12.8	Open	25.8	-13.0	Avg	0	1.0	EUT flat on back
123.000	12.2	Open	25.8	-13.6	Avg	70	1.0	EUT on Side
123.000	7.6	Closed	25.8	-18.2	Avg	90	1.0	EUT flat on back
123.000	-0.7	Open	25.8	-26.5	Avg	0	1.0	EUT upright
123.000	18.7	Open	45.8	-27.1	Pk	0	1.0	EUT flat on back
123.000	18.3	Open	45.8	-27.5	Pk	70	1.0	EUT on Side
123.000	13.7	Closed	45.8	-32.1	Pk	90	1.0	EUT flat on back
123.000	5.5	Open	45.8	-40.3	Pk	0	1.0	EUT upright

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
KHz	dBµV/m		Limit	Margin	Pk/QP/Avg	degrees	meters	
393.000	-32.4	Closed	15.7	-48.1	Avg	90	1.0	EUT flat on back
393.000	-23.5	Closed	35.7	-59.2	Pk	90	1.0	EUT flat on back

Client:	Savi	Job Number:	J59842
Model:	SMR-650-212	T-Log Number:	T59865
		Account Manager:	-
Contact:	Eugene Schlindwein		
Spec:	FCC 15.231(e); EN 300 330; EN 300 220	Class:	-

Run #2: Maximized Radiated Emissions, 9 KHz-30 MHz, tested with computer connection (Config 2)
Measured at 3m and extrapolated to 300m using 40LOG(1/d)

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
KHz	dBµV/m		Limit	Margin	Pk/QP/Avg	degrees	meters	
123.000	15.7	Open	25.8	-10.1	Avg	80	1.0	EUT flat on back
123.000	15.3	Open	25.8	-10.5	Avg	270	1.0	EUT on Side
123.000	11.7	Closed	25.8	-14.1	Avg	0	1.0	EUT flat on back
123.000	11.4	Closed	25.8	-14.4	Avg	0	1.0	EUT on Side
123.000	1.3	Open	25.8	-24.5	Avg	0	1.0	EUT upright
123.000	21.1	Open	45.8	-24.7	Pk	80	1.0	EUT flat on back
123.000	20.7	Open	45.8	-25.1	Pk	270	1.0	EUT on Side
123.000	17.0	Closed	45.8	-28.8	Pk	0	1.0	EUT flat on back
123.000	16.9	Closed	45.8	-28.9	Pk	0	1.0	EUT on Side
123.000	6.8	Open	45.8	-39.0	Pk	0	1.0	EUT upright
123.000	-13.7	Closed	25.8	-39.5	Avg	60	1.0	EUT upright
123.000	-6.9	Closed	45.8	-52.7	Pk	60	1.0	EUT upright

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
KHz	dBµV/m		Limit	Margin	Pk/QP/Avg	degrees	meters	
393.000	-28.5	Open	15.7	-44.2	Avg	270	1.0	EUT flat on back
393.000	-18.7	Open	35.7	-54.4	Pk	270	1.0	EUT flat on back

Note 1:	Preliminary measurements showed there to be no significant signals at a distance of 3m from the EUT other than the fundamental signal and the 3rd harmonic. Apart from the fundamental transmission, all signals below 490kHz were less than 51.5dBuV/m (0dBuA/m) at a distance of 3m, which is equivalent to a level of -28.5dBuV/m at the specification distance of 300m if using the suggested extrapolation factor of 40log(measurement

Client:	Savi	Job Number:	J59842
Model:	SMR-650-212	T-Log Number:	T59865
		Account Manager:	-
Contact:	Eugene Schlindwein		
Spec:	FCC 15.231(e); EN 300 330; EN 300 220	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: 6/1/2005
Test Engineer: David Bare
Test Location: SVOATS #2
Config. Used: 2
Config Change: None
EUT Voltage: Battery (Charger connected to 120V, 60Hz)

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated emissions testing.

All radiated emissions measurements were made at a 3m test distance.

Ambient Conditions:

Temperature: 20 °C
Rel. Humidity: 56 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1a	RE, 433.92 MHz, Pulsed Control Signals - Fundamental Field Strength	FCC 15.231(b)	Pass	80.3dBµV/m (10351.4µV/m) @ 433.917MHz (-0.5dB)
1a	RE, 30 - 4339.25MHz, Pulsed Control Signals - Spurious Emissions	FCC 15.231(b)	Pass	38.5dBµV/m (84.1µV/m) @ 1301.8MHz (-15.5dB)
1a	RE, 433.92 MHz, Pulsed Data Signals - Fundamental Field Strength	FCC 15.231(e)	Pass	72.3dBµV/m (4121.0µV/m) @ 433.917MHz (-0.6dB)
1b	RE, 30 - 4339.25MHz, Pulsed Data Signals - Spurious Emissions	FCC 15.231(e)	Pass	35.2dBµV/m (57.5µV/m) @ 1301.8MHz (-18.8dB)
1c	RE, 433.92MHz, Wake-up Control Signal	FCC 15.231(b)	Pass	79.3dBµV/m (9225.7µV/m) @ 433.926MHz (-1.5dB)
1c	RE, 30 - 4339.25MHz, Wake-up Control Signal - spurious	FCC 15.231(b)	Pass	46.5dBµV/m (210.4µV/m) @ 1735.7MHz (-34.3dB)
2	20dB Bandwidth	FCC 15.231(c)	Pass	185kHz

Client:	Savi	Job Number:	J59842
Model:	SMR-650-212	T-Log Number:	T59865
		Account Manager:	-
Contact:	Eugene Schlindwein		
Spec:	FCC 15.231(e); EN 300 330; EN 300 220	Class:	-

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.

Run #1a: Maximized Radiated Emissions, 30-4339.250MHz Control Signals with 25% duty cycle (12dB ACF)
Power setting 10 - Fundamental Field Strength
Laying Flat

Frequency	Level	Pol	FCC 15.231(b)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
433.917	80.3	h	80.8	-0.5	Avg	320	1.0	Fundamental Signal
433.917	92.3	h	100.8	-8.5	Pk	320	1.0	Fundamental Signal
433.917	69.1	v	80.8	-11.7	Avg	260	1.0	Fundamental Signal
433.917	81.1	v	100.8	-19.7	Pk	260	1.0	Fundamental Signal

Sideways.

Frequency	Level	Pol	FCC 15.231(b)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
433.917	78.6	h	80.8	-2.2	Avg	330	1.0	Fundamental Signal
433.917	73.7	v	80.8	-7.1	Avg	80	1.0	Fundamental Signal
433.917	90.6	h	100.8	-10.2	Pk	330	1.0	Fundamental Signal
433.917	85.7	v	100.8	-15.1	Pk	80	1.0	Fundamental Signal

Upright

Frequency	Level	Pol	FCC 15.231(b)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
433.917	80.1	v	80.8	-0.7	Avg	0	1.1	Fundamental Signal
433.917	79.8	h	80.8	-1.0	Avg	240	1.0	Fundamental Signal
433.917	92.1	v	100.8	-8.7	Pk	0	1.1	Fundamental Signal
433.917	91.8	h	100.8	-9.0	Pk	240	1.0	Fundamental Signal

Elliott

EMC Test Data

Client:	Savi	Job Number:	J59842
Model:	SMR-650-212	T-Log Number:	T59865
		Account Manager:	-
Contact:	Eugene Schlindwein		
Spec:	FCC 15.231(e); EN 300 330; EN 300 220	Class:	-

Spurious Emissions

Laying Flat

Frequency	Level	Pol	FCC 15.231(b)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1301.760	35.5	v	54.0	-18.5	Avg	217	1.0	Restricted Band Signal
1301.760	35.1	h	54.0	-18.9	Avg	106	1.0	Restricted Band Signal
1301.760	47.5	v	74.0	-26.5	Pk	217	1.0	Restricted Band Signal
1301.760	47.1	h	74.0	-27.0	Pk	106	1.0	Restricted Band Signal
867.834	27.0	h	60.8	-33.8	Avg	0	1.0	
867.834	26.1	v	60.8	-34.7	Avg	96	1.2	
867.834	39.0	h	80.8	-41.8	Pk	0	1.0	
867.834	38.1	v	80.8	-42.7	Pk	96	1.2	

Sideways.

Frequency	Level	Pol	FCC 15.231(b)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1301.760	38.5	v	54.0	-15.5	Avg	358	1.0	Restricted Band Signal
1735.680	39.7	h	60.8	-21.1	Avg	203	1.1	
1301.760	32.8	h	54.0	-21.2	Avg	314	1.0	Restricted Band Signal
1735.680	38.3	v	60.8	-22.5	Avg	191	1.0	
1301.760	50.5	v	74.0	-23.5	Pk	358	1.0	Restricted Band Signal
1301.760	45.8	h	74.0	-28.2	Pk	314	1.0	Restricted Band Signal
1735.680	51.7	h	80.8	-29.1	Pk	203	1.1	
1735.680	50.3	v	80.8	-30.5	Pk	191	1.0	
867.834	24.3	h	60.8	-36.5	Avg	307	1.0	
867.834	23.6	v	60.8	-37.2	Avg	248	1.3	
867.834	36.3	h	80.8	-44.5	Pk	307	1.0	
867.834	35.6	v	80.8	-45.2	Pk	248	1.3	

Upright

Frequency	Level	Pol	FCC 15.231(b)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1301.760	33.2	v	54.0	-20.8	Avg	222	1.0	Restricted Band Signal
1735.680	37.7	v	60.8	-23.1	Avg	246	1.0	
1301.760	45.2	v	74.0	-28.8	Pk	222	1.0	Restricted Band Signal
1735.680	49.7	v	80.8	-31.1	Pk	246	1.0	
867.834	22.2	v	60.8	-38.6	Avg	0	1.2	Substitution
867.834	20.2	h	60.8	-40.6	Avg	40	1.0	Substitution
867.834	32.3	v	80.8	-48.5	Pk	0	1.2	Substitution
867.834	30.5	h	80.8	-50.3	Pk	40	1.0	Substitution

Note - Average values are caluclated form the peak measurement by applying a -12dB correction factor assuming a duty cycle of no more than 25% in any 100ms period.

Client:	Savi	Job Number:	J59842
Model:	SMR-650-212	T-Log Number:	T59865
		Account Manager:	-
Contact:	Eugene Schlindwein		
Spec:	FCC 15.231(e); EN 300 330; EN 300 220	Class:	-

Run #1b: Maximized Radiated Emissions, 30-4339.250MHz Data Signals with 10% duty cycle (20dB ACF)
Power setting 10 - Fundamental Field Strength
Laying Flat

Frequency	Level	Pol	FCC 15.231(e)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
433.917	72.3	h	72.9	-0.6	Avg	320	1.0	Fundamental Signal
433.917	92.3	h	92.9	-0.6	Pk	320	1.0	Fundamental Signal
433.917	81.1	v	92.9	-11.8	Pk	260	1.0	Fundamental Signal
433.917	61.1	v	72.9	-11.8	Avg	260	1.0	Fundamental Signal

Sideways.

Frequency	Level	Pol	FCC 15.231(e)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
433.917	70.6	h	72.9	-2.3	Avg	330	1.0	Fundamental Signal
433.917	90.6	h	92.9	-2.3	Pk	330	1.0	Fundamental Signal
433.917	65.7	v	72.9	-7.2	Avg	80	1.0	Fundamental Signal
433.917	85.7	v	92.9	-7.2	Pk	80	1.0	Fundamental Signal

Upright

Frequency	Level	Pol	FCC 15.231(e)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
433.917	92.1	v	92.9	-0.8	Pk	0	1.1	Fundamental Signal
433.917	72.1	v	72.9	-0.8	Avg	0	1.1	Fundamental Signal
433.917	71.8	h	72.9	-1.1	Avg	240	1.0	Fundamental Signal
433.917	91.8	h	92.9	-1.1	Pk	240	1.0	Fundamental Signal

Power setting 10 - Spurious Emissions
Laying Flat

Frequency	Level	Pol	FCC 15.231(e)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1301.760	47.5	v	74.0	-26.5	Pk	217	1.0	Restricted Band
1301.760	27.5	v	54.0	-26.5	Avg	217	1.0	Restricted Band
1301.760	27.1	h	54.0	-26.9	Avg	106	1.0	Restricted Band
1301.760	47.1	h	74.0	-26.9	Pk	106	1.0	Restricted Band
867.834	19.0	h	60.8	-41.8	Avg	0	1.0	
867.834	39.0	h	80.8	-41.8	Pk	0	1.0	
867.834	18.1	v	60.8	-42.7	Avg	96	1.2	
867.834	38.1	v	80.8	-42.7	Pk	96	1.2	

continued on next page ...

Client:	Savi	Job Number:	J59842
Model:	SMR-650-212	T-Log Number:	T59865
		Account Manager:	-
Contact:	Eugene Schlindwein		
Spec:	FCC 15.231(e); EN 300 330; EN 300 220	Class:	-

Sideways.

Frequency	Level	Pol	FCC 15.231(e)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1735.680	31.7	h	52.9	-21.2	Pk	203	1.1	
1735.680	51.7	h	72.9	-21.2	Avg	203	1.1	
1735.680	30.3	v	52.9	-22.6	Pk	191	1.0	
1735.680	50.3	v	72.9	-22.6	Avg	191	1.0	
1301.760	30.5	v	54.0	-23.5	Avg	358	1.0	Restricted Band
1301.760	50.5	v	74.0	-23.5	Pk	358	1.0	Restricted Band
1301.760	25.8	h	54.0	-28.2	Avg	314	1.0	Restricted Band
1301.760	45.8	h	74.0	-28.2	Pk	314	1.0	Restricted Band
867.834	16.3	h	52.9	-36.6	Avg	307	1.0	
867.834	36.3	h	72.9	-36.6	Pk	307	1.0	
867.834	15.6	v	52.9	-37.3	Avg	248	1.3	
867.834	35.6	v	72.9	-37.3	Pk	248	1.3	

Upright

Frequency	Level	Pol	FCC 15.231(e)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1301.760	35.2	v	54.0	-18.8	Avg	222	1.0	Restricted Band
1735.680	29.7	v	52.9	-23.2	Avg	246	1.0	
1735.680	49.7	v	72.9	-23.2	Pk	246	1.0	
1301.760	45.2	v	74.0	-28.8	Pk	222	1.0	Restricted Band
867.834	22.2	v	52.9	-30.7	Avg	0	1.2	Substitution
867.834	20.2	h	52.9	-32.7	Avg	40	1.0	Substitution
867.834	32.3	v	72.9	-40.6	Pk	0	1.2	Substitution
867.834	30.5	h	72.9	-42.4	Pk	40	1.0	Substitution

Note - Average values are caluclated form the peak measurement by applying a -20B correction factor assuming a duty cycle of no more than 10% in any 100ms period.

Client:	Savi	Job Number:	J59842
Model:	SMR-650-212	T-Log Number:	T59865
		Account Manager:	-
Contact:	Eugene Schlindwein		
Spec:	FCC 15.231(e); EN 300 330; EN 300 220	Class:	-

Run #1c: Maximized Radiated Emissions, 30-4339.250MHz Wake-Up Control Signal
Power setting 36

Laying flat - fundamental

Frequency	Level	Pol	FCC 15.231(b)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
433.926	79.3	v	80.8	-1.5	Avg	0	1.0	Fundamental Signal
433.926	79.3	v	100.8	-21.5	Pk	0	1.0	Fundamental Signal

Laying flat - spurious

Frequency	Level	Pol	FCC 15.231(b)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
867.834	26.2	v	60.8	-34.6	Avg	40	1.2	
867.834	36.7	v	80.8	-44.1	Pk	40	1.2	
1301.760	43.3	h	74.0	-30.7	Pk	221	2.0	Restricted Band Signal
1301.760	23.3	h	54.0	-30.7	Avg	221	1.0	Restricted Band Signal

Sideways - spurious

Frequency	Level	Pol	FCC 15.231(b)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1735.680	46.5	v	80.8	-34.3	Pk	121	1.0	
1735.680	26.5	v	60.8	-34.3	Avg	121	1.0	

Note - Testing was performed with the EUT in all three orientations during the measurements for the data and control signals. As the control signal and wake-up signals use the same circuitry, measurements of the Wake-Up signal were made with the device in the orientations that produced the highest signal levels during the pulsed control signal measurements.

Client:	Savi	Job Number:	J59842
Model:	SMR-650-212	T-Log Number:	T59865
		Account Manager:	-
Contact:	Eugene Schlindwein		
Spec:	FCC 15.231(e); EN 300 330; EN 300 220	Class:	-

Run #1d: Maximized Radiated Emissions, 30-4339.250MHz

Power setting 10

Configuration #4 - spot check to verify that the fundamental field strength and spurious emissions when connected to a data terminal were no higher than for the test configuration connecetd to a PC via a serial adapter cable.

Pulsed data signals - fundamental (20dB Average correction factor to calculate average value from peak)

Frequency	Level	Pol	FCC 15.231(e)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
433.917	71.7	v	72.9	-1.2	Avg	332	1.1	Fundamental Signal
433.917	91.7	v	92.9	-1.2	Pk	332	1.1	Fundamental Signal
433.917	63.5	h	72.9	-9.4	Avg	2263	1.0	Fundamental Signal
433.917	83.5	h	92.9	-9.4	Pk	263	1.0	Fundamental Signal

Pulsed data signals - spurious (20dB Average correction factor to calculate average value from peak)

Frequency	Level	Pol	FCC 15.231(e)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1735.680	44.8	v	74.0	-29.2	Pk	0	1.0	
1735.680	24.8	v	54.0	-29.2	Avg	0	1.0	
1301.760	44.7	v	74.0	-29.3	Pk	13	1.2	Restricted Band Signal
1301.760	24.7	v	54.0	-29.3	Avg	13	1.2	Restricted Band Signal
867.834	14.8	v	52.9	-38.1	Avg	11	1.0	Substitution
867.834	34.8	v	72.9	-38.1	Pk	11	1.0	Substitution
867.834	13.5	h	54.0	-40.5	Avg	314	1.5	Substitution
867.834	33.5	h	74.0	-40.5	Pk	314	1.5	Substitution

Pulsed control signals - fundamental (12dB Average correction factor to calculate average value from peak)

Frequency	Level	Pol	FCC 15.231(b)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
433.917	79.7	v	80.8	-1.1	Avg	332	1.1	Fundamental Signal
433.917	91.7	v	100.8	-9.1	Pk	332	1.1	Fundamental Signal
433.917	71.5	h	80.8	-9.3	Avg	2263	1.0	Fundamental Signal
433.917	83.5	h	100.8	-17.3	Pk	263	1.0	Fundamental Signal

Pulsed control signals - spurious (12dB Average correction factor to calculate average value from peak)

Frequency	Level	Pol	FCC 15.231(b)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1735.680	32.8	v	54.0	-21.2	Avg	0	1.0	
1301.760	32.7	v	60.8	-28.1	Avg	13	1.2	Restricted Band Signal
1735.680	44.8	v	74.0	-29.2	Pk	0	1.0	
1301.760	44.7	v	80.8	-36.1	Pk	13	1.2	Restricted Band Signal
867.834	22.8	v	60.8	-38.0	Avg	11	1.0	Substitution
867.834	34.8	v	80.8	-46.0	Pk	11	1.0	Substitution
867.834	13.5	h	60.8	-47.3	Avg	314	1.5	Substitution
867.834	33.5	h	80.8	-47.3	Pk	314	1.5	Substitution

Client:	Savi	Job Number:	J59842
Model:	SMR-650-212	T-Log Number:	T59865
		Account Manager:	-
Contact:	Eugene Schlindwein		
Spec:	FCC 15.231(e); EN 300 330; EN 300 220	Class:	-

Run #3 20dB Bandwidth

The 20dB bandwidth was measured to be 185kHz using a RBW of 10kHz
Maximum permitted is 1.08 MHz.

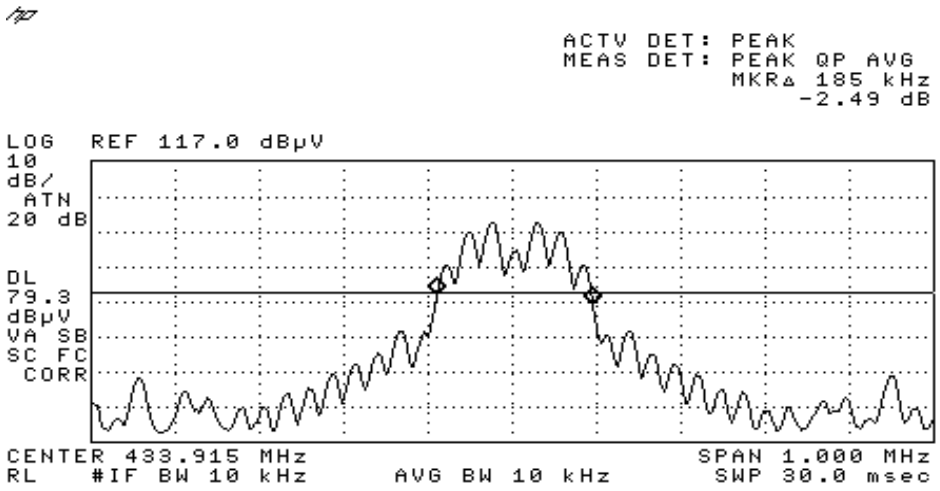

EXHIBIT 3: Photographs of Test Configurations

3 Pages

EXHIBIT 4: Label and Label Location

3 Pages

EXHIBIT 5: Detailed Photographs of Savi Technology, Inc. Model SMR-650-21X

3 Pages

EXHIBIT 6: Block Diagram of Savi Technology, Inc. Model SMR-650-21X

EXHIBIT 7: Schematic Diagrams of Savi Technology, Inc. Model SMR-650-21X

EXHIBIT 8: Theory of Operation for Savi Technology, Inc. Model SMR-650-21X

EXHIBIT 9: Advertising Literature

EXHIBIT 10: Operator's Manual