

***Electromagnetic Emissions Test Report
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: SMR-650-216***

UPN: 2404A-650MR3
FCC ID: KL7-650MR-V5

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 #: IC 2845-2

REPORT DATE: January 19, 2009

FINAL TEST DATE: November 12, November 13, November 14
and November 17, 2008

AUTHORIZED SIGNATORY:



David W. Bare
Chief Engineer



Testing Cert #2016-01

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REVISION HISTORY

Rev #	Date	Comments	Modified By
1	1/29/09	Initial Release	-

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SCOPE

An electromagnetic emissions test has been performed on the Savi Technology, Inc. model SMR-650-216 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 SMR-650-216 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.

STATEMENT OF COMPLIANCE

The tested sample of Savi Technology, Inc. model SMR-650-216 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**TEST RESULTS SUMMARY****DEVICES OPERATING UNDER THE GENERAL LIMITS**

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.209	RSS 210 Table 3	Transmitter Fundamental Signal Emissions	5.1dB μ V/m @ 0.123MHz (-20.7dB)	Refer to table in limits section	Complies
15.209	RSS 210 Table 3	Transmitter Radiated Spurious Emissions	-34.8dB μ V/m @ 0.369MHz (-51.1dB)	Refer to table in limits section	Complies
	RSS GEN 4.4.1	99% Bandwidth	9.8 kHz	Information only	N/A

Note 1 – As the device is intended for hand-held operation 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	Antenna is integral to the device	Integral antenna or unique connector	Complies
15.109	RSS GEN 7.2.3 Table 1	Receiver spurious emissions	No receiver at 123 kHz	Refer to Standard	N/A
15.207	RSS GEN Table 2	AC Conducted Emissions	40.9dB μ V @ 0.353MHz	Refer to standard	Complies (-8.0 dB)
15.247 (b) (5) 15.407 (f)	RSS 102	RF Exposure Requirements	Refer to RSS 102 declaration	Refer to RSS 102	Complies
	RSP 100 RSS GEN 7.1.5	User Manual	See user's manual	Statement required regarding non-interference	Complies
	RSP 100 RSS GEN 7.1.5	User Manual	No detachable antenna	Statement required regarding detachable antenna	N/A

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 SMR-650-216 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. 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. When operating under 15.231 rules, the control/data signals are maximum 60 mS long and have a duty cycle of no more than 60% measured in a 100 mS period. There is one other type of control signals, 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, 47-63Hz, 1A.

The sample was received on November 12, 2008 and tested on November 12, November 13, November 14 and November 17, 2008. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
Savi Technology	SMR-650-216	RFID Tag Reader	S 0475208110007	KL7-650MR-V5

OTHER EUT DETAILS

The handheld terminal CK61NI is attached to the EUT via the interface adapter with a shielded cable with ferrite.

ANTENNA SYSTEM

The antenna systems used with the Savi Technology, Inc. model SMR-650-216 consist of an integral antenna for the 123 kHz transmitter and a monopole antenna with a custom connector for the 433.92 MHz transmitter.

ENCLOSURE

The SMR-650-216 enclosure is primarily constructed of plastic. It measures approximately 7cm wide by 2.5cm deep by 7cm high. The SMR-650-216 (Interface adapter) enclosure is primarily constructed of plastic. It measures approximately 9cm wide by 3cm deep by 3cm high.

MODIFICATIONS

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

Mod. #	Test	Date	Modification
1	Radiated Emission	12-Nov	Changed R33 from 6.8k ohms to 2.7k ohms
2	Radiated Emission	13-Nov	Added ferrite with part number 0431173951 from Fair-rite to the interface cable between POD to the BOOT.

SUPPORT EQUIPMENT

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

Manufacturer	Model	Description	Serial Number	FCC ID
Intermec	CK61NI	Handhold Reader	16300800707	DoC
Intermec	Decking Station	AD5	12350800775	DoC
Intermec	AC Adapter	073573	888594	N/A

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)
Docking Station				
Ethernet	Unterminated	UTP	Unshielded	3.0
Serial	Unterminated	DB 9	Shielded	1.5
USB Type B	Unterminated	USB	Shielded	1.5
USB Type A	Unterminated	USB	Shielded	1.5

The EUT interface adaptor has a serial cable. Preliminary testing showed that worse case is when the unit is attached to the docking station. The docking station serial port is connected to the EUT via the interface adapter. This port is the same as the serial port cable from the interface adaptor

EUT OPERATION

The EUT was continuously transmitting for transmitter mode tests. For receiver/digital device tests the EUT was pinged from the laptop and operated in receive mode.

TEST SITE**GENERAL INFORMATION**

Final test measurements were taken on November 12, November 13, November 14 and November 17, 2008 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	IC 2845-2	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.

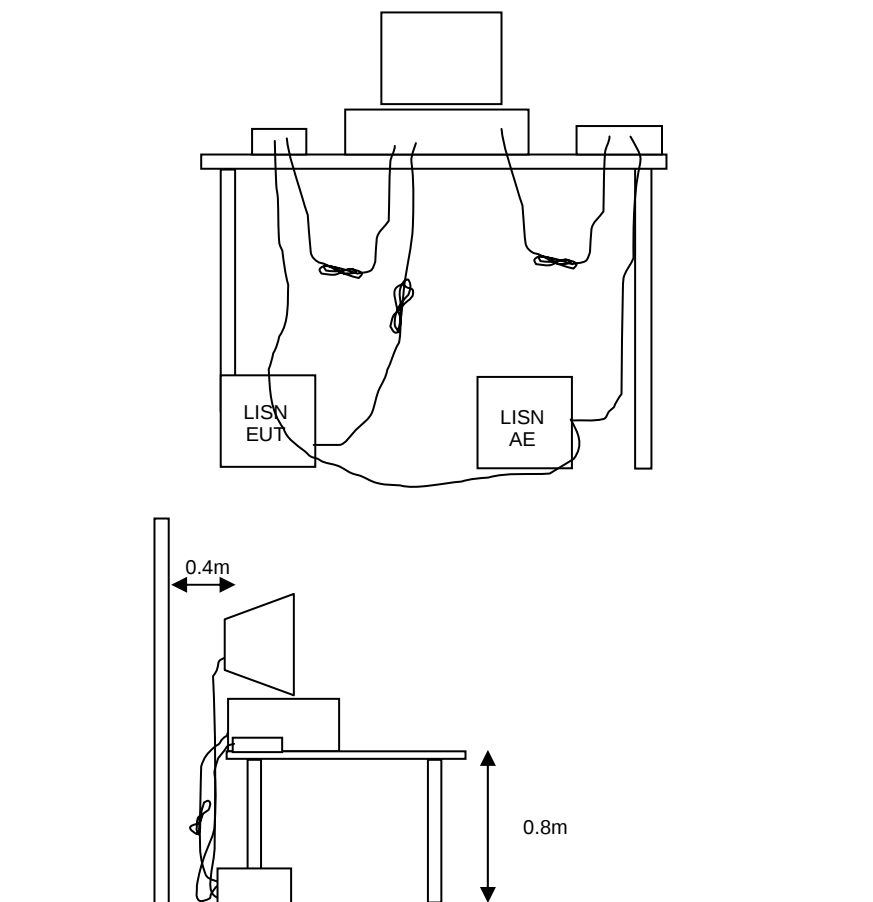
TEST PROCEDURES

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.



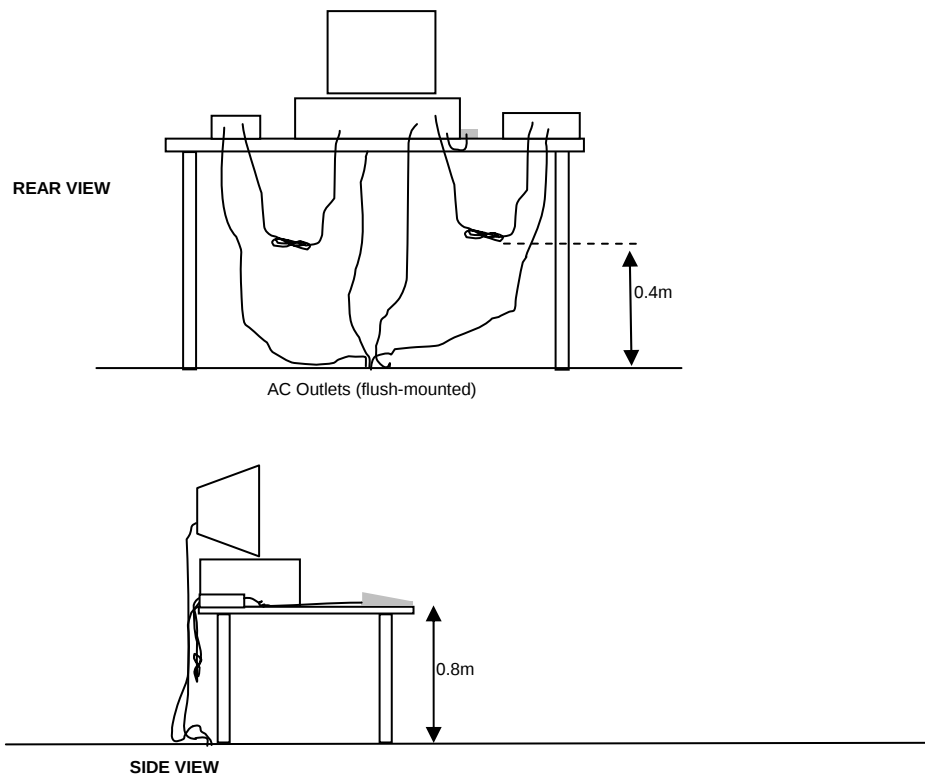
RADIATED EMISSIONS

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.

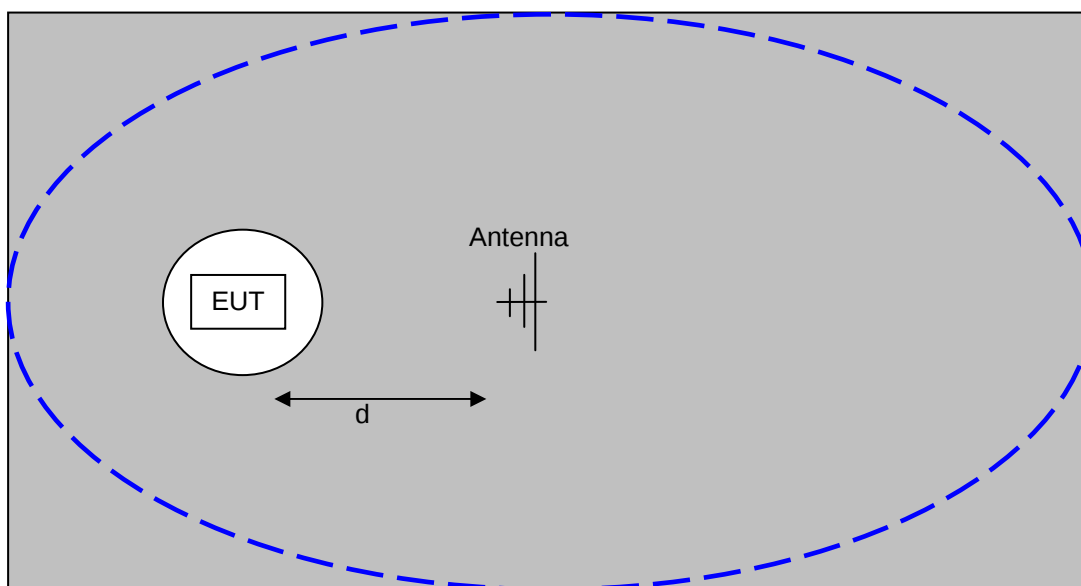
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

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.

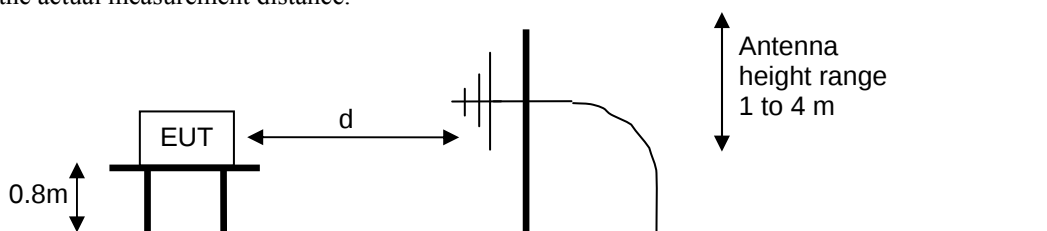
When testing above 18 GHz, the receive antenna is located at 1 meter from the EUT and the antenna height is restricted to a maximum of 2.5 meters.



Typical Test Configuration for Radiated Field Strength Measurements



The ground plane extends beyond the ellipse defined in CISPR 16 / CISPR 22 / ANSI C63.4 and is large enough to accommodate test distances (d) of 3m and 10m. Refer to the test data tables for the actual measurement distance.



Test Configuration for Radiated Field Strength Measurements
OATS- 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:

CONDUCTED EMISSIONS SPECIFICATION LIMITS: FCC 15.207; FCC 15.107(a), RSS GEN

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

GENERAL TRANSMITTER RADIATED EMISSIONS SPECIFICATION LIMITS

The table below shows the limits for the spurious emissions from transmitters that fall in restricted bands¹ (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	$2400/F_{\text{KHz}} @ 300\text{m}$	$67.6-20*\log_{10}(F_{\text{KHz}}) @ 300\text{m}$
0.490-1.705	$24000/F_{\text{KHz}} @ 30\text{m}$	$87.6-20*\log_{10}(F_{\text{KHz}}) @ 30\text{m}$
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:

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

where P is the eirp (Watts)

EXHIBIT 1: Test Equipment Calibration Data

1 Page

Radiated Emissions, 30 - 4,400 MHz, 12-14 of Nov-08**Engineer: Mehran Birgani**

<u>Manufacturer</u>	<u>Description</u>	<u>Model #</u>	<u>Asset #</u>	<u>Cal Due</u>
Elliott Laboratories	Biconical Antenna, 30-300 MHz	EL30.300	54	26-Mar-09
EMCO	Log Periodic Antenna, 0.3-1 GHz	3146A	364	13-Dec-08
Hewlett Packard	EMC Spectrum Analyzer, 9 kHz - 6.5 GHz	8595EM	780	09-Dec-08
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	09-Oct-09
Filtek	Filter, 1 GHz High Pass	HP12/1000-5BA	955	17-Jul-09
Rohde & Schwarz	Test Receiver, 0.009-2750 MHz	ESN	1332	29-Jan-09
EMCO	Antenna, Horn, 1-18 GHz	3115	1561	10-Jun-10

Conducted Emissions - AC Power Ports, 14-Nov-08**Engineer: Mehran Birgani**

<u>Manufacturer</u>	<u>Description</u>	<u>Model #</u>	<u>Asset #</u>	<u>Cal Due</u>
Elliott Laboratories	LISN, FCC / CISPR	LISN-3, OATS	304	31-Jul-09
Rohde & Schwarz	Pulse Limiter	ESH3 Z2	812	12-Feb-09
Rohde & Schwarz	Test Receiver, 0.009-2750 MHz	ESN	1332	29-Jan-09

Radiated Emissions, 0.009 - 30 MHz, 17-Nov-08**Engineer: Mehran Birgani**

<u>Manufacturer</u>	<u>Description</u>	<u>Model #</u>	<u>Asset #</u>	<u>Cal Due</u>
EMCO	Magnetic Loop Antenna, 10 kHz-30 MHz	6502	1299	05-Jan-09
Rohde & Schwarz	Test Receiver, 0.009-2750 MHz	ESN	1332	29-Jan-09

EXHIBIT 2: Test Measurement Data

10 Pages

Client:	Savi	Job Number:	J73540
Model:	SMR-650-216	T-Log Number:	T73709
		Account Manager:	Dean Eriksen
Contact:	Eugene Schlindwein	Project Engineer:	David Bare
Emissions Spec:	FCC 15.240, 15.231a	Class:	A
Immunity Spec:	-	Environment:	-

EMC Test Data

For The

Savi

Model

SMR-650-216

Date of Last Test: 11/17/2008

Client:	Savi	Job Number:	J73540
Model:	SMR-650-216	T-Log Number:	T73709
		Account Manager:	Dean Eriksen
Contact:	Eugene Schlindwein		
Emissions Spec:	FCC 15.240, 15.231a	Class:	A
Immunity Spec:	-	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. 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. When operating under 15.231 rules, the control/data signals are maximum 60 mS long and have a duty cycle of no more than 60% measured in a 100 mS period. There is one other type of control signals, 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, 47-63Hz, 1A.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
Savi Technology	SMR-650-216	RFID Tag Reader	S 0475208110007	KL7-650MR-V5

Other Discription

The handheld terminal attached to the (EUT) interface adapter via shielded cable with ferrite.

EUT Enclosure

The handheld terminal enclosure is primarily constructed of plastic. It measures approximately 7cm wide by 2.5cm deep by 3cm high. The EUT (Interface adapter) enclosure is primarily constructed of plastic. It measures approximately 9cm wide by 3cm deep by 3cm high.

Modification History

Mod. #	Test	Date	Modification
1	Radiated Emission	12-Nov	Changed R33 from 6.8k ohms to 2.7k ohms
2	Radiated Emission	13-Nov	Added ferrite with part number 0431173951 from Fair-rite to the interface cable between POD to the BOOT.



EMC Test Data

Client:	Savi	Job Number:	J73540
Model:	SMR-650-216	T-Log Number:	T73709
		Account Manager:	Dean Eriksen
Contact:	Eugene Schlindwein		
Emissions Spec:	FCC 15.240, 15.231a	Class:	A
Immunity Spec:	-	Environment:	-

Test Configuration #1

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
Intermec	CK61NI	Handhold Reader	16300800707	DoC
Intermec	Docking Station	AD5	12350800775	DoC
Intermec	AC Adapter	073573	888594	N/A

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)
Docking Station				
Ethernet	Unterminated	UTP	Unshielded	3.0
Serial	Unterminated	DB 9	Shielded	1.5
USB Type B	Unterminated	USB	Shielded	1.5
USB Type A	Unterminated	USB	Shielded	1.5

The EUT interface adaptor has a serial cable. Preliminary testing showed that worse case is when the unit is attached to the docking station. The docking station serial port is connected to the EUT via the interface adaptor. This port is the same as the serial port cable from the interface adaptor

EUT Operation During Emissions

The EUT was continuously transmitting for transmitter mode tests. For receiver/digital device tests the EUT was pinged from the laptop and operated in receive mode.

Client:	Savi	Job Number:	J73540
Model:	SMR-650-216	T-Log Number:	T73709
Contact:	Eugene Schlindwein	Account Manager:	Dean Eriksen
Standard:	FCC 15.240, 15.231a	Class:	A

Conducted Emissions - Power Ports

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 11/14/2008
 Test Engineer: Mehran Birgani
 Test Location: SVOATS #2

Config. Used: 1
 Config Change: None
 EUT Voltage: Refer to individual run

General Test Configuration

The EUT was located on a wooden table, 40 cm from a vertical coupling plane and 80cm from the LISN.

Ambient Conditions:

Temperature: 15-30 °C
 Rel. Humidity: 20-60 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power, 230V/50Hz	EN 55022 Class B	Pass	38.4dBµV @ 0.707MHz (-7.6dB)
2	CE, AC Power, 120V/60Hz	EN 55022 Class B	Pass	40.9dBµV @ 0.353MHz (-8.0dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

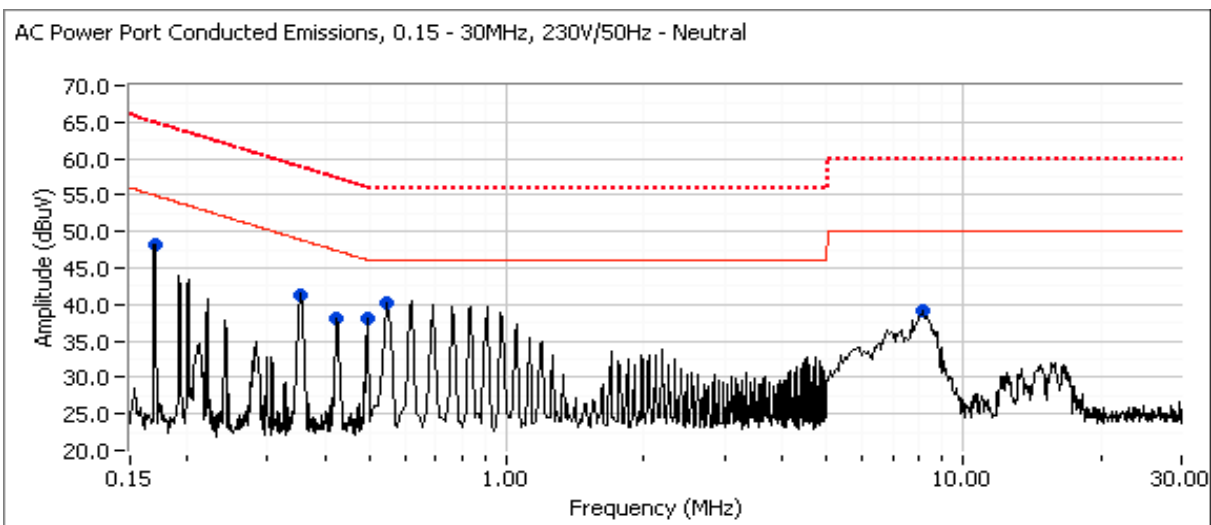
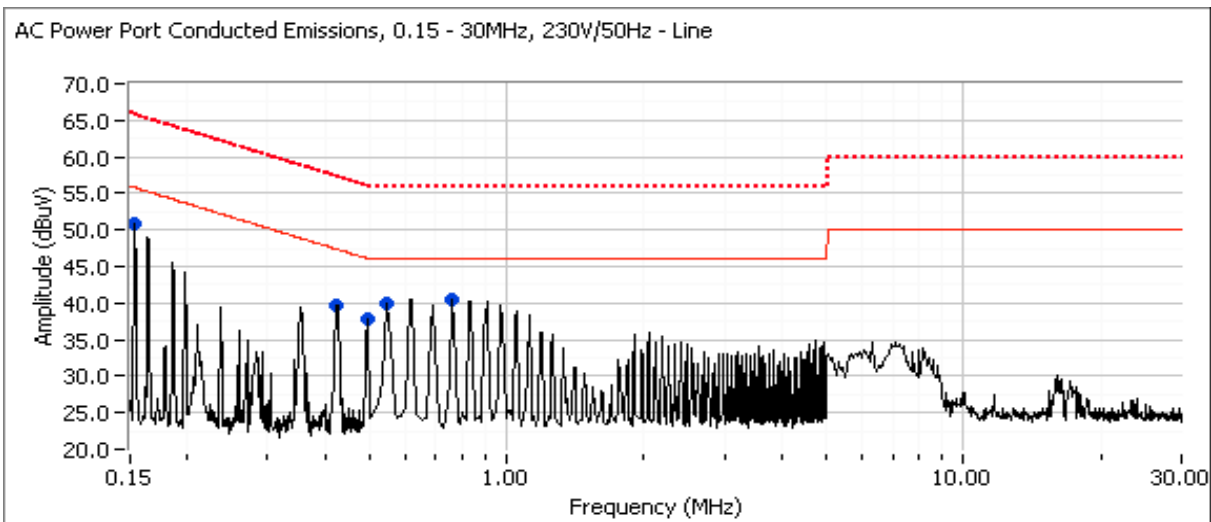
Deviations From The Standard

No deviations were made from the requirements of the standard.

Note: Transmitter was on and set to power setting of 14.

Client: Savi	Job Number: J73540
Model: SMR-650-216	T-Log Number: T73709
Contact: Eugene Schlindwein	Account Manager: Dean Eriksen
Standard: FCC 15.240, 15.231a	Class: A

Run #1: AC Power Port Conducted Emissions, 0.15 - 30MHz, 230V/50Hz



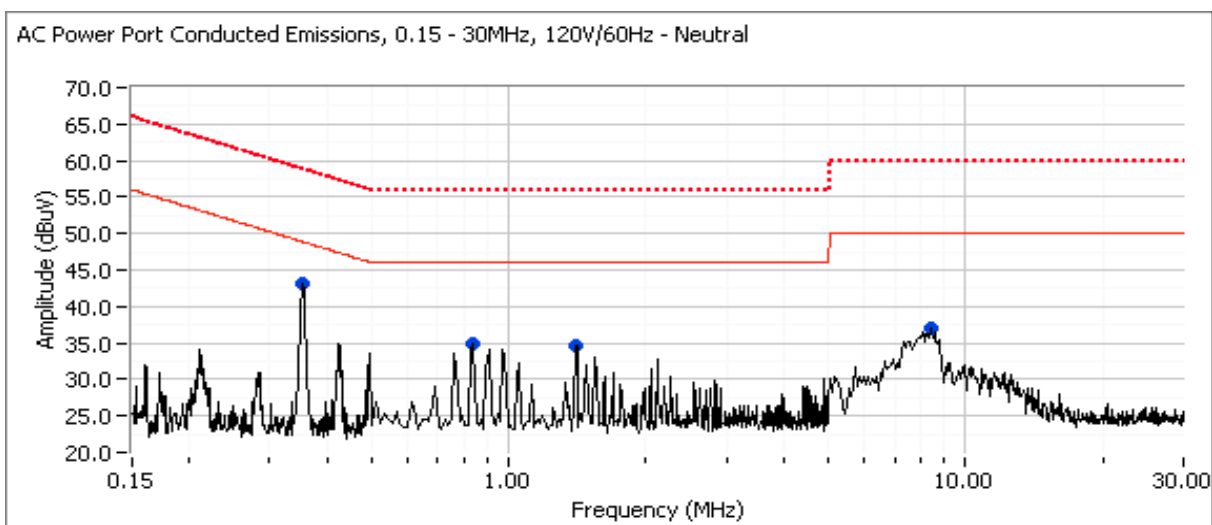
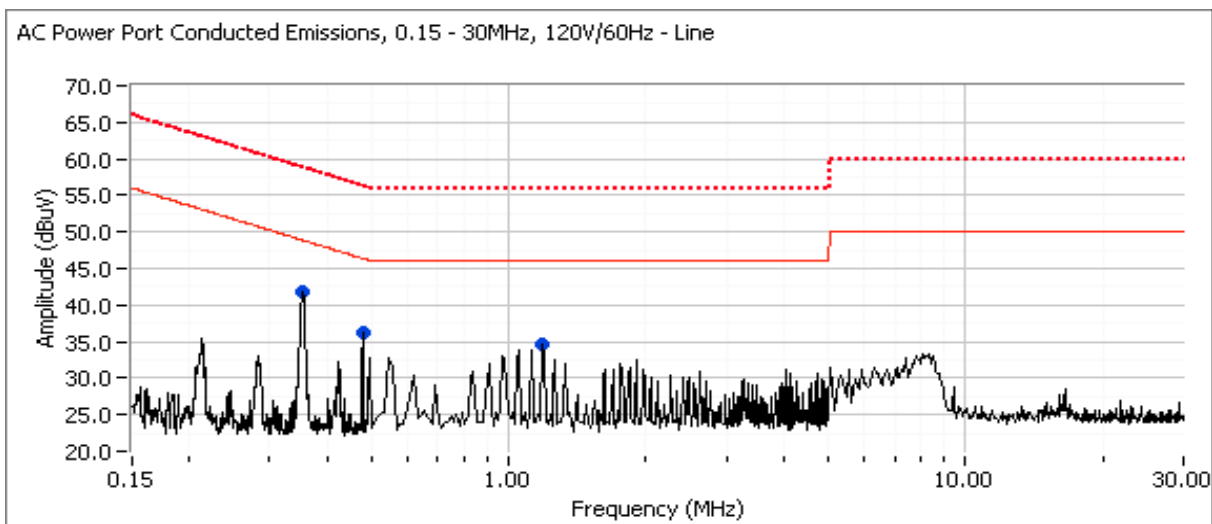
Client: Savi	Job Number: J73540
Model: SMR-650-216	T-Log Number: T73709
Contact: Eugene Schlindwein	Account Manager: Dean Eriksen
Standard: FCC 15.240, 15.231a	Class: A

Run #1: AC Power Port Conducted Emissions, 0.15 - 30MHz, 230V/50Hz

Frequency MHz	Level dB μ V	AC Line	EN 55022 Class B Limit	Margin	Detector QP/Ave	Comments
0.707	38.4	Line	46.0	-7.6	AVG	AVG (0.10s)
0.566	38.1	Neutral	46.0	-7.9	AVG	AVG (0.10s)
0.566	37.8	Line	46.0	-8.2	AVG	AVG (0.10s)
0.424	37.5	Neutral	47.4	-9.9	AVG	AVG (0.10s)
0.424	37.4	Line	47.4	-10.0	AVG	AVG (0.10s)
0.495	35.8	Neutral	46.1	-10.3	AVG	AVG (0.10s)
0.495	35.4	Line	46.1	-10.7	AVG	AVG (0.10s)
0.354	36.8	Neutral	48.9	-12.1	AVG	AVG (0.10s)
0.707	39.7	Line	56.0	-16.3	QP	QP (1.00s)
0.566	39.3	Neutral	56.0	-16.7	QP	QP (1.00s)
8.411	33.2	Neutral	50.0	-16.8	AVG	AVG (0.10s)
0.566	39.1	Line	56.0	-16.9	QP	QP (1.00s)
0.424	39.2	Neutral	57.4	-18.2	QP	QP (1.00s)
0.424	39.0	Line	57.4	-18.4	QP	QP (1.00s)
0.495	36.9	Neutral	56.1	-19.2	QP	QP (1.00s)
0.354	39.6	Neutral	58.9	-19.3	QP	QP (1.00s)
0.495	36.7	Line	56.1	-19.4	QP	QP (1.00s)
0.154	44.3	Line	65.8	-21.5	QP	QP (1.00s)
0.167	41.8	Neutral	65.1	-23.3	QP	QP (1.00s)
8.411	34.2	Neutral	60.0	-25.8	QP	QP (1.00s)
0.154	15.1	Line	55.8	-40.7	AVG	AVG (0.10s)
0.167	12.5	Neutral	55.1	-42.6	AVG	AVG (0.10s)

Client: Savi	Job Number: J73540
Model: SMR-650-216	T-Log Number: T73709
Contact: Eugene Schlindwein	Account Manager: Dean Eriksen
Standard: FCC 15.240, 15.231a	Class: A

Run #2: AC Power Port Conducted Emissions, 0.15 - 30MHz, 120V/60Hz



Client:	Savi	Job Number:	J73540
Model:	SMR-650-216	T-Log Number:	T73709
Contact:	Eugene Schlindwein	Account Manager:	Dean Eriksen
Standard:	FCC 15.240, 15.231a	Class:	A

Run #2: AC Power Port Conducted Emissions, 0.15 - 30MHz, 120V/60Hz

Frequency MHz	Level dB μ V	AC Line	EN 55022 Class B Limit	Class B Margin	Detector QP/Ave	Comments
0.353	40.9	Neutral	48.9	-8.0	AVG	AVG (0.10s)
0.354	40.0	Line	48.9	-8.9	AVG	AVG (0.10s)
0.495	28.5	Line	46.1	-17.6	AVG	AVG (0.10s)
0.848	32.1	Neutral	46.0	-13.9	AVG	AVG (0.10s)
1.201	30.7	Line	46.0	-15.3	AVG	AVG (0.10s)
1.414	18.6	Neutral	46.0	-27.4	AVG	AVG (0.10s)
8.195	30.6	Neutral	50.0	-19.4	AVG	AVG (0.10s)
0.353	41.8	Neutral	58.9	-17.1	QP	QP (1.00s)
0.354	41.2	Line	58.9	-17.7	QP	QP (1.00s)
0.495	30.1	Line	56.1	-26.0	QP	QP (1.00s)
0.848	33.1	Neutral	56.0	-22.9	QP	QP (1.00s)
1.201	31.8	Line	56.0	-24.2	QP	QP (1.00s)
1.414	25.2	Neutral	56.0	-30.8	QP	QP (1.00s)
8.195	32.3	Neutral	60.0	-27.7	QP	QP (1.00s)

Client:	Savi	Job Number:	J73540
Model:	SMR-650-216	T-Log Number:	T73709
Contact:	Eugene Schlindwein	Account Manager:	Dean Eriksen
Standard:	FCC 15.240, 15.231a	Class:	A

Radiated Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 11/17/2008
 Test Engineer: Mehran Birgani
 Test Location: SVOATS #2

Config. Used: 1
 Config Change: None
 Host Unit Voltage 120V/60Hz

General Test Configuration

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

The test distance and extrapolation factor (if used) are detailed under each run description.

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.

Ambient Conditions:

Temperature:	15-30 °C
Rel. Humidity:	20-60 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	0.009 - 30 MHz	FCC 15.209	Pass	5.1dBµV/m @ 0.123MHz (-20.7dB)
2	99% Bandwidth	RSS 210	-	9.8 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.

Frequency Range	Test Distance	Limit Distance	Extrapolation Factor
0.009 - 0.490 MHz	3	300	-80.0
0.490 - 1.705 MHz	10	30	-19.1
1.705 - 30.0 MHz	10	30	-19.1

Client:	Savi	Job Number:	J73540
Model:	SMR-650-216	T-Log Number:	T73709
Contact:	Eugene Schlindwein	Account Manager:	Dean Eriksen
Standard:	FCC 15.240, 15.231a	Class:	A

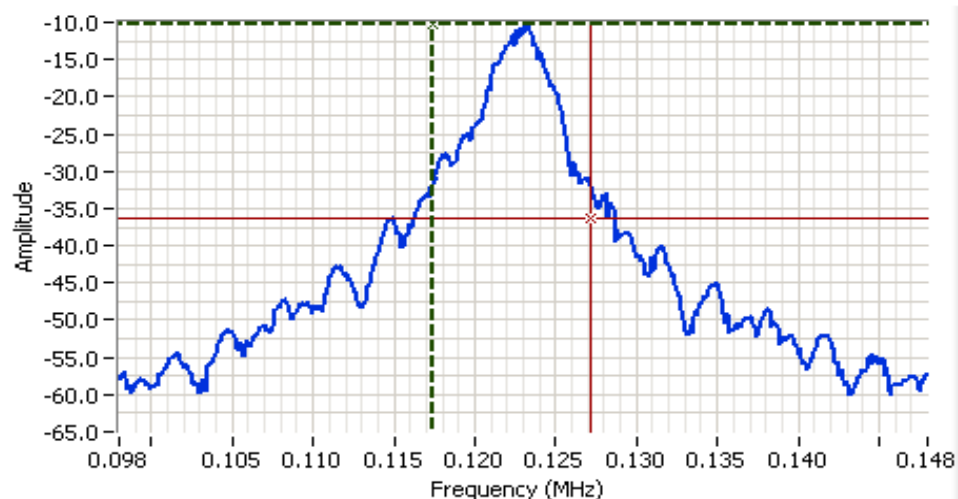
Run #1: Radiated Emissions, 0.009 - 30 MHz, FCC 15.209

Note - the extrapolation factor is based on $40\log(\text{test distance/limit distance})$ as permitted by FCC 15.31

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	O/C	Limit	Margin	Pk/QP/Avg	degrees	meters	
0.123	5.1	Open	25.8	-20.7	PK	314	1.0	PK (0.10s)- Side
0.123	4.2	Open	25.8	-21.6	PK	273	1.0	PK (0.10s)- Flat
0.123	1.9	Open	25.8	-23.9	PK	184	1.0	PK (1.00s)- Upright
0.123	0.5	Close	25.8	-25.3	PK	223	1.0	PK (0.10s)- Side
0.123	-3.1	Close	25.8	-28.9	PK	190	1.0	PK (1.00s)- Flat
0.123	-8.3	Close	25.8	-34.1	PK	90	1.0	PK (0.10s)- Upright
0.246	-37.2	Open	19.8	-57.0	QP	159	1.0	QP (1.00s) - Side
0.369	-34.8	Open	16.3	-51.1	QP	162	1.0	QP (1.00s) - Side
0.369	-41.1	Close	16.3	-57.4	QP	77	1.0	QP (1.00s) - Side

Note 1: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, with a peak limit 20dB above the average limit.

Run #1: 99% Bandwidth



Analyzer Settings

HP8564E
CF: 123 kHz
SPAN: 50.0 kHz
RB 1.00 kHz
VB 3.00 kHz
Detector Normal
Att 10
RL Offset 0.00
Sweep Time 200.0ms
Ref Lvl: 0.00DBM

Comments

99% BW: 9.8 kHz

Cursor 1 0.1174 -10.33
Cursor 2 0.1272 -36.33

Delta Freq. 9.82 kHz

Delta Amplitude 26.00

EXHIBIT 3: Photographs of Test Configurations

EXHIBIT 4: Proposed FCC ID Label & Label Location

***EXHIBIT 5: Detailed Photographs
of Savi Technology, Inc. Model SMR-650-216 Construction***

**EXHIBIT 6: Operator's Manual
for Savi Technology, Inc. Model SMR-650-216**

**EXHIBIT 7: Block Diagram
of Savi Technology, Inc. Model SMR-650-216**

**EXHIBIT 8: Schematic Diagrams
for Savi Technology, Inc. Model SMR-650-216**

**EXHIBIT 9: Theory of Operation
for Savi Technology, Inc. Model SMR-650-216**

EXHIBIT 10: Advertising Literature

EXHIBIT 11: RF Exposure Information