

***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: SP-65Y-ZAB***

UPN: 2404A-650SP
FCC ID: KL7-65XSP-V2


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

TEST SITE: Elliott Laboratories, Inc.
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Sunnyvale, CA 94086

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FINAL TEST DATE: June 25, 2004

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TABLE OF CONTENTS

COVER PAGE.....	1
TABLE OF CONTENTS	2
SCOPE.....	4
OBJECTIVE.....	5
STATEMENT OF COMPLIANCE.....	5
TEST RESULTS SUMMARY.....	6
15.209 / RSS 210 TABLE 3	6
15.231 / RSS 210 SECTION 6.1	7
MEASUREMENT UNCERTAINTIES	7
EQUIPMENT UNDER TEST (EUT) DETAILS	8
GENERAL.....	8
ENCLOSURE	9
MODIFICATIONS.....	10
SUPPORT EQUIPMENT.....	10
EUT INTERFACE PORTS	10
EUT OPERATION	10
ANTENNA SYSTEM	10
TEST SITE.....	11
GENERAL INFORMATION.....	11
CONDUCTED EMISSIONS CONSIDERATIONS.....	11
RADIATED EMISSIONS CONSIDERATIONS	11
MEASUREMENT INSTRUMENTATION.....	12
RECEIVER SYSTEM.....	12
INSTRUMENT CONTROL COMPUTER.....	12
LINE IMPEDANCE STABILIZATION NETWORK (LISN).....	12
FILTERS/ATTENUATORS.....	13
ANTENNAS.....	13
ANTENNA MAST AND EQUIPMENT TURNTABLE.....	13
INSTRUMENT CALIBRATION.....	13

TABLE OF CONTENTS (Continued)

TEST PROCEDURES	14
EUT AND CABLE PLACEMENT	14
CONDUCTED EMISSIONS	14
RADIATED EMISSIONS	14
SPECIFICATION LIMITS AND SAMPLE CALCULATIONS	15
CONDUCTED EMISSIONS SPECIFICATION LIMITS, SECTION 15.207 & 15.107(A).....	15
CONDUCTED EMISSIONS SPECIFICATION LIMITS, RSS 210.....	15
FUNDAMENTAL AND HARMONIC LIMITS 15.231 (B) / RSS 210 TABLE 1	16
FUNDAMENTAL AND HARMONIC LIMITS 15.231 (E)/RSS 210 TABLE 4.....	17
RADIATED EMISSIONS SPECIFICATION LIMITS, SECTION 15.209 / RSS 210 TABLE 3.....	17
RADIATED EMISSIONS SPECIFICATION LIMITS, SECTION 15.109 / RSS 210 TABLE 3 (RECEIVER).....	18
SAMPLE CALCULATIONS - CONDUCTED EMISSIONS.....	18
SAMPLE CALCULATIONS - RADIATED EMISSIONS	19
EXHIBIT 1: Test Equipment Calibration Data	1
EXHIBIT 2: Test Measurement Data	2
EXHIBIT 3: Photographs of Test Configurations.....	3
EXHIBIT 4: EUT Details.....	4
EXHIBIT 5: Detailed Photographs of Savi Technology, Inc. Model SP-65Y-ZAB	5
EXHIBIT 6: Block Diagram of Savi Technology, Inc. Model SP-65Y-ZAB.....	6
EXHIBIT 7: Schematic Diagrams of Savi Technology, Inc. Model SP-65Y-ZAB	7
EXHIBIT 8: Theory of Operation for Savi Technology, Inc. Model SP-65Y-ZAB	8
EXHIBIT 9: Advertising Literature.....	9
EXHIBIT 10: Operator's Manual.....	10

SCOPE

An electromagnetic emissions test has been performed on the Savi Technology, Inc. model SP-65Y-ZAB 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 C63.4-1992 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 single type tests of various models from the Savi Technology, Inc. SP-65Y-ZAB series and therefore apply only to the tested samples. The samples were selected and prepared by Eugene Schlindwein of Savi Technology, Inc.

The sample tested is representative of the following models:

SP-650-011, SP-650-211, SP-650-311, SP-650-111, SP-651-011, SP-651-211,
SP-651-311, SP-651-111, SP-650-001, SP-650-201, SP-650-301, SP-650-101,
SP-651-001, SP-651-201, SP-651-301, SP-651-101, SP-652-001, SP-652-301

For a detailed description of each model please refer to the EUT Details section of this report.

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 SP-65Y-ZAB 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**15.209 / RSS 210 Table 3**

FCC Part 15 Section	RSS 210 Section	Description	Comments	Result
15.207 / 15.107		AC Conducted Emissions, 0.15 – 30 MHz (Worst-Case with 132kHz Tx)	37.8dB μ V @ 0.533MHz (-8.2dB)	Complies
	6.6 / 7.4	AC Conducted emissions 0.45 – 30 MHz (Worst-Case with 132kHz Tx)	47.5dB μ V @ 0.394MHz (-0.5dB)	
15.209	6.2.1	Transmitter Fundamental Signal Emissions, 0.123 MHz Large Loop Antenna	22.2dB μ V/m (12.8 μ V/m) @ 122.950kHz (-3.7dB)	Complies (note 1)
15.209	6.2.1	Transmitter Fundamental Signal Emissions, 0.123 MHz Small Loop Antenna	Not measured – large loop is worst case for loop antennas (refer to 132kHz data)	Complies (note 1)
15.209	6.2.1	Transmitter Fundamental Signal Emissions, 0.123 MHz Ferrite Antenna	1.6dB μ V/m (1.2 μ V/m) @ 122.950kHz (-24.2dB)	Complies (note 1)
15.209	6.2.1	Transmitter Fundamental Signal Emissions, 0.123 MHz 4-Element Handrail Antenna	2.4dB μ V/m (1.3 μ V/m) @ 122.950KHz (-23.4dB)	Complies (note 1)
15.209	6.2.1	Transmitter Fundamental Signal Emissions, 0.123 MHz 2-Element Handrail Antenna	4.3dB μ V/m (1.6 μ V/m) @ 122.950kHz (-21.5dB)	Complies (note 1)
15.209	6.2.1	Transmitter Fundamental Signal Emissions, 0.132 MHz Large Loop Antenna	22.8dB μ V/m (13.8 μ V/m) @ 131.579kHz (-2.4dB)	Complies (note 1)
15.209	6.2.1	Transmitter Fundamental Signal Emissions, 0.132 MHz Small Loop Antenna	21.4dB μ V/m (11.7 μ V/m) @ 132kHz (-4.4dB)	Complies (note 1)
15.209	6.2.1	Transmitter Fundamental Signal Emissions, 0.132 MHz Ferrite Antenna	1.1dB μ V/m (1.1 μ V/m) @ 131.579kHz (-24.2dB)	Complies (note 1)
15.231 (b)	6.2.1	Transmitter Radiated Spurious Emissions, Tx @ 123kHz Worst-case – 4-element handrail	9.5dB μ V/m (3.0 μ V/m) @ 245.900KHz (-10.3dB)	Complies (note 1)
15.231 (b)	6.2.1	Transmitter Radiated Spurious Emissions, Tx @ 132kHz	All spurious more than 20dB below the limit	Complies (note 1)
15.109	7.3	Receiver Spurious Emissions	No receiver	N/A

Note 1 – The ferrite and loop antennas were tested in all three orthogonal axes. The Handrail antennas were tested in two different axes.

15.231 / RSS 210 Section 6.1

FCC Part 15 Section	RSS 210 Section	Description	Comments	Result
15.207 / 15.107		AC Conducted Emissions, 0.15 – 30 MHz	37.8dB μ V @ 0.533MHz (-8.2dB)	Complies
	6.6 / 7.4	AC Conducted emissions 0.45 – 30 MHz	47.5dB μ V @ 0.394MHz (-0.5dB)	Complies
15.231 (a) (1)	6.1.1(a) (1)	Duration of manually activated transmission	N/A – all are software controlled	N/A
15.231 (a) (2)	6.1.1(a) (2)	Duration of automatically activated transmission (control signal)	5 seconds or less – refer to theory of operations	Complies
15.231 (a) (2)	6.1.1(a) (2)	Duration of automatically activated transmission (data signal)	1 second or less – refer to theory of operations	Complies
15.231 (a) (3)	6.1.1(a) (3)	Transmissions at predetermined / regular intervals are not permitted	N/A	N/A
15.231 (a) (4)	6.1.1(a) (4)	Pendency of transmissions used during emergencies involving fire, security, and safety of life	N/A	N/A
15.231 (b)	6.1.1(b) / Table 1	Transmitter Radiated Emissions, 433.9 MHz	80.0dB μ V/m (10000.0 μ V/m) @ 433.920MHz (-0.8dB)	Complies
15.231 (e)	6.1.1(e) / Table 2	Transmitter Radiated Emissions, 433.9 MHz	69.9dB μ V/m (3126.1 μ V/m) @ 433.920MHz (-3.0dB)	Complies
15.231 (b) (e)	6.1.1(b) / Table 1	Transmitter Radiated Spurious Emissions, 30-4180 MHz	57.5dB μ V/m (749.9 μ V/m) @ 867.840MHz (-3.3dB)	Complies
15.231 (c)	6.1.1 (c)	Bandwidth	135 kHz	Complies
15.109	7.3	Receiver Spurious Emissions	34.4dB μ V/m (52.5 μ V/m) @ 423.220MHz (-11.6dB)	Complies

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

Note 2 – As the device can be mounted in different orientations, all three orientations were used during testing.

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 NAMAS document NIS 81.

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. SP-65Y-ZAB series of rf signposts are designed to transmit at a low frequency (either 123 kHz or 132 kHz, dependant on model) to initiate a response from one of the Savi series of RFID tags. These tags are designed to transmit their ID at a frequency of 433.92 MHz. Some models in the SP-65Y-ZAB series include a 433.92 MHz transceiver to allow retrieval of a tag's ID and provide control signals to switch the tags on and off.

Under FCC Part 15.231 and RSS 210 section 6.1.1 there are different field strength limits for control and data signals. The device's operation at 433.9 MHz operates under these rules, and has a control signal (the Wake-Up signal) and data signals (pulsed transmissions with a 30% duty cycle in any 100ms period).

The signposts can be configured with a variety of antennas for the low frequency transmitter, dependent on model number. The basic model uses an internally mounted ferrite core antenna. External antennas are available, and these connect to the device using a proprietary connector. The external antennas are in two different styles, a rectangular cross-section loop antenna or a "handrail" antenna.

There are two different-sized external loop antennas (large and small). The main unit is mounted to these antennas, which are intended to be installed at exit and entry points to trigger RFID tags to transmit as they pass by.

The handrail antenna is designed to be inserted into a U-section handrail and comes in two different versions, one with two antenna elements and one with four antenna elements. The version with two antennas is designed for the elements to be installed in handrails on either side of a corridor. The four-antenna version is designed for locations where one corridor intersects with another and allows elements to be placed in handrails on both sides of the corridor and both sides of the intersection, thereby ensuring that a tag moving in either direction from the intersection is triggered.

The UHF transceiver uses two identical transceiver modules, each transmitter having its own antenna. This allows for diversity (either spatial or polarization) for communication between the transceiver and the tags. There are two options for antennas for the UHF transceiver, both of which are external and connect via reverse-gender SMA connectors. The options are either a short whip antenna (supplied as standard with the SP-652- ZAB units) that connects directly to the enclosure connectors or a longer, magnetic-mount whip antenna with a cable that can be provided as an accessory (Savi model # SPA-652-001).

The actual model numbers within the SP-65Y-ZAB series are coded as follows:

Y: 0 = base model; 1 = Ethernet adapter; 2 = Ethernet adapter and UHF transceiver with short whip or magnetic mount antenna

Z (LF Antenna): 0 = No antenna (may be used with Handrail, Internal Ferrite or External Loop antenna); 1 = Internal Ferrite antenna; 2 = External loop antenna (12' range); 3 = External loop antenna (8' range)

A (LF frequency): 0 = 132 kHz; 1 = 123 kHz

B (Indoor/Outdoor): 0 = Indoor enclosure; 1 = Outdoor enclosure (note, the enclosures are all plastic, the outdoor version has improved weatherproofing)

Normally the EUT would be installed at access monitoring and control points (entry & leave portals), mounted on a wall, ceiling or pole during operation. The EUT was, therefore, treated as tabletop equipment during testing to simulate the end-user environment. The EUT can be either AC or DC powered. The electrical rating of the EUT is 100-240 VAC, 50-60 Hz, 0.3 A and 12.8-30 VDC, 1.2 A.

The sample was received on June 24, 2004 and tested on June 25, 2004. The EUT consisted of the following component(s):

Manufacturer	Model	Description	Serial Number
Savi	SP-652-011	123kHz Spider ant	0400104070002
Savi	SP-652-211	123kHz Lg loop ant	0400104060007
Savi	SP-652-201	132kHz Lg loop ant	0400104060013
Savi	SP-652-311	123kHz Sm Loop ant	0400104060017
Savi	SP-652-111	123kHz Internal ant	0400104060002
Savi	SP-652-101	132kHz Internal ant	0400104060010
Savi	SPA-652-001	Magnetic-mount UHF Whip Antenna	None
Savi	SPA-652-002	2-HandrailAntenna kit	None
Savi	SPA-652-003	4-HandrailAntenna kit	None

Receive mode radiated spurious emissions were measured with the UHF transceiver connected to the short whip antenna. Preliminary testing demonstrated that this was the worst-case configuration with respect to radiation of the LO and its second and third harmonics. All other radiated emissions were performed on all antennas, with the exception of the small loop antenna at 132kHz. Testing the large and small loops at 123 kHz demonstrated that the emissions were higher with the larger loop antenna.

AC conducted emissions were performed on both a 123kHz (SP-652-211) and 132 kHz (SP-652-201) transmitter.

ENCLOSURE

The EUT enclosure is primarily constructed of molded plastic. It measures approximately 69 cm wide by 13 cm deep by 120 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 support equipment for testing:

Manufacturer	Model	Description	Serial Number	FCC ID
IBM	Thinkpad	Laptop	ANO9611TBOON	78-VA248 97/11
IBM	85G6709	AC Adapter	-	-

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)
Ethernet	Laptop	CAT 5	Unshielded	30
Sync Out	Unterminated	Multiwire	Shielded	30
Sync IN	Unterminated	Multiwire	Shielded	30
Antenna	Loop antenna	Multiwire	Shielded	0.25
AC in	AC Mains	3 wire	Unshielded	1.5
RS 232	Not cabled			

Note: The Configuration ports were not connected as the manufacturer stated that these are for diagnostic purpose and therefore would not normally be connected.

EUT OPERATION

The EUT was transmitting continuously for transmit mode measurements. For receive mode measurements both transmitters were turned off and the receiver was active.

Conducted emissions measurements were made with the EUT transmitting continuously on both LF transmitter and UHF transceiver.

No measurements were made with the device transmitting a pulsed signal. Average field strength measurements for the pulsed signals were made by subtracting an average correction factor from the peak field strength based on the 30% duty cycle (measured in any 100mS period) for the pulsed data and control signals.

ANTENNA SYSTEM

The LF antenna is either integral to the device (loop and ferrite antennas) or connect via a proprietary connector. The UHF antennas connect via a reverse gender SMA.

TEST SITE**GENERAL INFORMATION**

Final test measurements were taken on June 25, 2004 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 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 C63.4-1992.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing is performed in conformance with ANSI C63.4-1992. 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 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 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, 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	$2400/F_{\text{KHz}} @ 300\text{m}$	$67.6-20*\log_{10}(F_{\text{KHz}}) @ 300\text{m}$
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	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

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:

$$F_d = 20 * \text{LOG}_{10} (D_m/D_s)$$

where:

$$F_d = \text{Distance Factor in dB}$$

$$D_m = \text{Measurement Distance in meters}$$

$$D_s = \text{Specification Distance in meters}$$

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:

$$F_d = 40 * \text{LOG}_{10} (D_m/D_s)$$

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

Conducted Emissions - AC Power Ports, 25-Jun-04**Engineer: Juan Martinez**

<u>Manufacturer</u>	<u>Description</u>	<u>Model #</u>	<u>Asset #</u>	<u>Cal Due</u>
Fischer Custom Comm.	LISN, 100A	FCC-LISN-50/250-100-2	1205	05-Apr-05
Rohde & Schwarz	Test Receiver, 0.009-2750 MHz	ESN	1332	12-May-05
Rohde& Schwarz	Pulse Limiter	ESH3 Z2	1398	12-Jan-05

Radiated Emissions, .1 - 2MHz, 24-Jun-04 (Low Frequency Transmitters)**Engineer: Chris Byleckie**

<u>Manufacturer</u>	<u>Description</u>	<u>Model #</u>	<u>Asset #</u>	<u>Cal Due</u>
EMCO	Magnetic Loop Antenna, 10k-30MHz	6502	1299	16-Dec-04
Hewlett Packard	EMC Spectrum Analyzer, 9KHz - 22GHz	8593EM	1319	20-Nov-04

Radiated Emissions, 30 - 4,000 MHz, 25-Jun-04 to 29-Jun-04 (UHF Transceiver, Digital Device)**Engineer: Juan Martinez**

<u>Manufacturer</u>	<u>Description</u>	<u>Model #</u>	<u>Asset #</u>	<u>Cal Due</u>
EMCO	Horn Antenna, D. Ridge 1-18GHz	3115	786	29-Oct-04
Rohde & Schwarz	Test Receiver, 0.009-2750 MHz	ESN	1332	12-May-05
EMCO	Log Periodic Antenna, 0.2-2 GHz	3148	1404	17-Nov-04
EMCO	Biconical Antenna, 30-300 MHz	3110B	1498	15-Jan-05
Hewlett Packard	EMC Spectrum Analyzer 9kHz - 6.5GHz	8595EM	780	26-Feb-05
EMCO	Horn Antenna, D. Ridge 1-18GHz	3115	786	29-Oct-04
Hewlett Packard	EMC Spectrum Analyzer 9kHz - 6.5GHz	8595EM	787	10-Dec-04
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	12-Jan-05

Conducted Emissions - AC Power Ports, 26-Jun-04**Engineer: Juan Martinez**

<u>Manufacturer</u>	<u>Description</u>	<u>Model #</u>	<u>Asset #</u>	<u>Cal Due</u>
Fischer Custom Comm.	LISN, 100A	FCC-LISN-50/250-100-2	1205	05-Apr-05
Rohde & Schwarz	Test Receiver, 0.009-2750 MHz	ESN	1332	12-May-05
Rohde & Schwarz	Pulse Limiter	ESH3 Z2	1398	12-Jan-05

Radiated Emissions, 30 - 1,000 MHz, 11-Jan-05**Engineer: Juan Martinez**

<u>Manufacturer</u>	<u>Description</u>	<u>Model #</u>	<u>Asset #</u>	<u>Cal Due</u>
EMCO	Log Periodic Antenna, 0.2-1 GHz	3146	1294	08-Apr-05
Rohde & Schwarz	Test Receiver, 0.009-2750 MHz	ESN	1332	12-May-05
EMCO	Biconical Antenna, 30-300 MHz	3110B	1498	15-Jan-05

EXHIBIT 2: Test Measurement Data

T56150 42 Pages



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
		Account Manager:	Christine Vu
Contact:	Gene		
Emissions Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio
Immunity Spec:		Environment:	

EMC Test Data

For The

Savi Technology, Inc

Model

SP-65Y-ZAB Signpost

Date of Last Test: 10/1/2004



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
		Account Manager:	Christine Vu
Contact:	Gene		
Emissions Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio
Immunity Spec:	Enter immunity spec on cover	Environment:	

EUT INFORMATION

General Description

The EUT is a Signpost with either 123 kHz or 132 kHz Transmitter and 433.92 MHz Transceiver which is designed to be used as part of an RFID inventory tracking system. Normally the EUT would be installed at access monitoring and control points (entry & leave portals), mounted on a wall, ceiling or pole during operation. The EUT was, therefore, treated as tabletop equipment during testing to simulate the end-user environment. The EUT can be either AC or DC powered. The electrical rating of the EUT is 100-240 VAC, 50-60 Hz, 0.3 A, 12.8-30 VDC, 1.2 A.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
Savi	SP-652-011	123kHz Spider ant	0400104070002	TBD
Savi	SP-652-211	123kHz Lg loop ant	0400104060007	TBD
Savi	SP-652-201	132kHz Lg loop ant	0400104060013	TBD
Savi	SP-652-311	123kHz Sm Loop ant	0400104060017	TBD
Savi	SP-652-111	123kHz Internal ant	0400104060002	TBD
Savi	SP-652-101	132kHz Internal ant	0400104060010	TBD

Other EUT Details

Several tests were performed with different separations between the antenna elements for the handrail antenna. Little difference was observed with separations of between 10" and 1m.

EUT Enclosure

The EUT enclosure is primarily constructed of molded plastic. It measures approximately 69 cm wide by 13 cm deep by 120 cm high.

Modification History

Mod. #	Test	Date	Modification
1			None made during testing

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



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
		Account Manager:	Christine Vu
Contact:	Gene		
Emissions Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio
Immunity Spec:	Enter immunity spec on cover	Environment:	

Test Configuration #1

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
None				

Remote Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
IBM	Thinkpad	Laptop	ANO9611TBOON	78-VA248 97/11
IBM	85G6709	AC Adapter	-	-

Interface Cabling and Ports

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Ethernet	Laptop	CAT 5	Unshielded	30
Sync Out	Unterminated	Multiwire	Shielded	30
Sync IN	Unterminated	Multiwire	Shielded	30
Antenna	Loop antenna	Multiwire	Shielded	0.25
AC in	AC Mains	3 wire	Unshielded	1.5
RS 232	Not cabled			

Note: The Configuration ports were not connected as the manufacturer stated that these are for diagnostic purpose and therefore would not normally be connected.

EUT Operation During Emissions

Digital device radiated measurements and AC conducted emissions measurements: the EUT was transmitting continuously on both LF transmitter and UHF transceiver.

The EUT was transmitting continuously for transmit mode measurements. For receive mode measurements both transmitters were turned off and the receiver was active.

No measurements were made with the device transmitting a pulsed signal. Average field strength measurements for the pulsed signals were made by subtracting an average correction factor from the peak field strength based on the 10% duty cycle (measured in any 100mS period) for the pulsed data and control signals.



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Radiated Emissions - FCC Part 15 Subpart B - Receiver

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: 6/29/2004

Test Engineer: Juan Martinez

Test Location: SVOATS #2

Config. Used: 1

Config Change: None

EUT Voltage: 120V/60Hz

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated emissions testing. Remote support equipment was located approximately 30 meters from the test area with all I/O routed overhead.

Unless otherwise specified, the measurement antenna was located 3 meters from the EUT for the measurement range 30 - 4000 MHz.

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

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

Ambient Conditions:

Temperature:	24 °C
Rel. Humidity:	46 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	RE, 30 - 4000MHz, Maximized Emissions	FCC B	Pass	34.4dBμ V/m (52.5μ V/m) @ 423.220MHz (-11.6dB)

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.



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Run #1: Maximized Radiated Emissions, 30-4000 MHz

Frequency	Level	Pol	FCC Class B		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
423.220	34.4	v	46.0	-11.6	QP	161	1.0	LO
423.220	32.7	h	46.0	-13.3	QP	0	1.0	LO
846.456	21.6	v	46.0	-24.4	QP	0	1.0	x2 LO
846.456	21.5	h	46.0	-24.5	QP	360	1.0	x2 LO

Note that the higher order harmonics were below the noise floor of the instrumentation used (at least 20dB below the limit)



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Conducted Emissions - Power Ports

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: 6/25/2004
Test Engineer: Juan Martinez
Test Location: SVOATS #2

Config. Used: 1 (model SP-652-201)
Config Change: None
EUT Voltage: Refer to individual run

General Test Configuration

For tabletop equipment, the EUT was located on a wooden table, 40 cm from a vertical coupling plane and 80cm from the LISN. A second LISN was used for all local support equipment. Remote support equipment was located approximately 30 meters from the test area.

Ambient Conditions: Temperature: 25 °C
 Rel. Humidity: 42 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power, 230V/50Hz	FCC & CISPR 22 B EN 301 489-1	Pass	43.6dB μ V @ 0.318MHz (-6.2dB)
2	CE, AC Power, 120V/60Hz	FCC & CISPR 22 B EN 301 489-1	Pass	37.8dB μ V @ 0.533MHz (-8.2dB)
3	CE, AC Power, 120V/60Hz	RSS-210	Pass	47.5dB μ V @ 0.394MHz (-0.5dB)
4	CE, DC Power, 24Vdc	EN 301 489-1	Pass	47.5dB μ V @ 0.394MHz (-0.5dB)

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.



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Run #1: AC Power Port Conducted Emissions, 0.15 - 30MHz, 230V/50Hz (132kHz & 433MHz)

Frequency	Level	AC	EN55022 B		Detector	Comments
MHz	dB μ V	Line	Limit	Margin	QP/Ave	
0.318	43.6	Line	49.8	-6.2	Average	
0.212	41.8	Line	53.1	-11.3	Average	
0.212	51.0	Line	63.1	-12.1	QP	
0.318	37.0	Neutral	49.8	-12.8	Average	
0.318	46.3	Line	59.8	-13.5	QP	
0.212	39.6	Neutral	53.1	-13.5	Average	
6.400	46.1	Line	60.0	-13.9	QP	
0.212	48.2	Neutral	63.1	-14.9	QP	
0.318	43.2	Neutral	59.8	-16.6	QP	
6.400	33.4	Line	50.0	-16.6	Average	
20.650	40.0	Neutral	60.0	-20.0	QP	
20.650	26.3	Neutral	50.0	-23.7	Average	

Run #2: AC Power Port Conducted Emissions, 0.15 - 30MHz, 120V/60Hz (132kHz & 433MHz)

Frequency	Level	AC	EN55022 B		Detector	Comments
MHz	dB μ V	Line	Limit	Margin	QP/Ave	
0.533	37.8	Line	46.0	-8.2	Average	
0.212	41.4	Line	53.1	-11.7	Average	
0.318	37.3	Line	49.8	-12.5	Average	
0.212	49.8	Line	63.1	-13.3	QP	
6.400	36.4	Neutral	50.0	-13.6	Average	
0.212	48.3	Neutral	63.1	-14.8	QP	
0.318	34.7	Neutral	49.8	-15.1	Average	
0.212	37.9	Neutral	53.1	-15.2	Average	
0.533	39.8	Line	56.0	-16.2	QP	
0.318	42.0	Line	59.8	-17.8	QP	
0.318	40.5	Neutral	59.8	-19.3	QP	
6.400	40.6	Neutral	60.0	-19.4	QP	



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Run #3: AC Power Port Conducted Emissions, 0.15 - 30MHz, 120V/60Hz (132kHz & 433MHz)

Frequency	Level	AC	RSS-210		Detector	Comments
MHz	dB μ V	Line	Limit	Margin	QP/Ave	
5.550	41.1	Neutral	48.0	-6.9	QP	
6.400	40.0	Neutral	48.0	-8.0	QP	
0.533	39.8	Line	48.0	-8.2	QP	
6.400	39.8	Line	48.0	-8.2	QP	
0.533	37.4	Neutral	48.0	-10.6	QP	
5.650	37.3	Line	48.0	-10.7	QP	

Run #4: DC Power Port Conducted Emissions, 0.15 - 30MHz, 24Vdc (132kHz & 433MHz)

Frequency	Level	AC	EN55022 B		Detector	Comments
MHz	dB μ V	Line	Limit	Margin	QP/Ave	
0.394	47.5	Neutral	48.0	-0.5	Average	
0.394	47.5	Line	48.0	-0.5	Average	
0.658	45.4	Neutral	46.0	-0.6	Average	
0.658	44.7	Line	46.0	-1.3	Average	
0.922	41.6	Neutral	46.0	-4.4	Average	
0.922	41.2	Line	46.0	-4.8	Average	
0.394	53.0	Neutral	58.0	-5.0	QP	
0.394	53.0	Line	58.0	-5.0	QP	
0.658	50.8	Neutral	56.0	-5.2	QP	
0.658	50.1	Line	56.0	-5.9	QP	
0.922	46.7	Neutral	56.0	-9.3	QP	
0.922	46.4	Line	56.0	-9.6	QP	



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Conducted Emissions - Power Ports

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: 6/25/2004
Test Engineer: Juan Martinez
Test Location: SVOATS #2

Config. Used: 1 (model SP-652-211)
Config Change: None
EUT Voltage: Refer to individual run

General Test Configuration

For tabletop equipment, the EUT was located on a wooden table, 40 cm from a vertical coupling plane and 80cm from the LISN. A second LISN was used for all local support equipment. Remote support equipment was located approximately 30 meters from the test area.

Ambient Conditions: Temperature: 25 °C
 Rel. Humidity: 42 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power, 230V/50Hz	FCC & CISPR 22 B EN 301 489-1	Pass	37.9dB μ V @ 0.305MHz (-12.2dB)
2	CE, AC Power, 120V/60Hz	FCC & CISPR 22 B EN 301 489-1	Pass	40.0dB μ V @ 0.305MHz (-10.1dB)
3	CE, AC Power, 120V/60Hz	RSS-210	Pass	37.2dB μ V @ 0.810MHz (-10.8dB)
4	CE, DC Power, 24Vdc	EN 301 489-1	Pass	45.0dB μ V @ 0.612MHz (-1.0dB)

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.



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Run #1: AC Power Port Conducted Emissions, 0.15 - 30MHz, 230V/50Hz (123kHz & 433MHz)

Frequency	Level	AC	EN55022 B		Detector	Comments
MHz	dBμV	Line	Limit	Margin	QP/Ave	
0.305	37.9	Line	50.1	-12.2	Average	
0.301	36.7	Neutral	50.2	-13.5	Average	
0.202	49.4	Line	63.5	-14.1	QP	
0.202	48.5	Neutral	63.5	-15.0	QP	
0.202	36.7	Neutral	53.5	-16.8	Average	
0.202	36.6	Line	53.5	-16.9	Average	
0.305	43.1	Line	60.1	-17.0	QP	
6.800	40.8	Line	60.0	-19.2	QP	
0.301	40.8	Neutral	60.2	-19.4	QP	
0.404	27.5	Neutral	47.8	-20.3	Average	
6.800	28.6	Line	50.0	-21.4	Average	
0.404	34.0	Neutral	57.8	-23.8	QP	

Run #2: AC Power Port Conducted Emissions, 0.15 - 30MHz, 120V/60Hz (123kHz & 433MHz)

Frequency	Level	AC	EN55022 B		Detector	Comments
MHz	dBμV	Line	Limit	Margin	QP/Ave	
0.305	40.0	Line	50.1	-10.1	Average	
0.202	52.7	Neutral	63.5	-10.8	QP	
4.964	34.2	Line	46.0	-11.8	Average	
4.961	34.0	Neutral	46.0	-12.0	Average	
0.202	40.4	Neutral	53.5	-13.1	Average	
0.206	49.8	Line	63.4	-13.6	QP	
0.305	46.0	Line	60.1	-14.1	QP	
0.206	39.1	Line	53.4	-14.3	Average	
0.305	34.6	Neutral	50.1	-15.5	Average	
0.305	43.8	Neutral	60.1	-16.3	QP	
4.964	38.2	Line	56.0	-17.8	QP	
4.961	37.3	Neutral	56.0	-18.7	QP	



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Run #3: AC Power Port Conducted Emissions, 0.15 - 30MHz, 120V/60Hz (123kHz & 433MHz)

Frequency	Level	AC	RSS-210		Detector	Comments
MHz	dB μ V	Line	Limit	Margin	QP/Ave	
0.810	37.2	Line	48.0	-10.8	QP	
4.964	35.6	Line	48.0	-12.4	QP	
0.810	35.4	Neutral	48.0	-12.6	QP	
0.506	34.1	Neutral	48.0	-13.9	QP	
0.506	31.5	Line	48.0	-16.5	QP	
0.506	30.2	Neutral	48.0	-17.8	QP	

Run #4: DC Power Port Conducted Emissions, 0.15 - 30MHz, 24Vdc (123kHz & 433MHz)

Frequency	Level	AC	EN55022 B		Detector	Comments
MHz	dB μ V	Line	Limit	Margin	QP/Ave	
0.612	45.0	Line	46.0	-1.0	Average	
0.612	44.9	Neutral	46.0	-1.1	Average	
0.367	47.0	Neutral	48.6	-1.6	Average	
0.367	46.8	Line	48.6	-1.8	Average	
0.612	50.2	Line	56.0	-5.8	QP	
0.612	50.1	Neutral	56.0	-5.9	QP	
0.367	52.5	Line	58.6	-6.1	QP	
0.367	52.5	Neutral	58.6	-6.1	QP	
1.843	32.7	Line	46.0	-13.3	Average	
1.843	37.5	Line	56.0	-18.5	QP	
0.150	21.4	Neutral	56.0	-34.6	Average	
0.150	30.4	Neutral	66.0	-35.6	QP	



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Radiated Emissions (magnetic-mount whip antenna)

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: 6/25/2004

Test Engineer: Juan Martinez

Test Location: SVOATS #2

Config. Used: 1

Config Change: None

EUT Voltage: 120V/60Hz

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated emissions testing. Remote support equipment was located approximately 30 meters from the test area with all I/O connections routed overhead.

Unless otherwise specified, the measurement antenna was located 3 meters from the EUT for the measurement range 30 - 1000 MHz and 3m from the EUT for the frequency range 1 - 5 GHz.

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: 26 °C
Rel. Humidity: 40 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	RE, 433 MHz Fundamental	FCC 15.231 (a)	Pass	80.0dB μ V/m (10000.0 μ V/m) @ 433.920MHz (-0.8dB)
1	RE, 433 - 5000MHz, Harmonic Emissions	FCC 15.231 (a)	Pass	50.7dB μ V/m (342.8 μ V/m) @ 867.840MHz (-10.1dB)

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.



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Run #1: Radiated Emissions, Fundamental- Wake-Up Control Signal (5 Second)

Fundamental

Frequency	Level	Pol	FCC 15.231(a)		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
433.920	80.0	v	80.8	-0.8	Pk	179	1.0	Setting 48, Peak reading, Average limit
433.920	77.2	h	80.8	-3.6	Pk	317	1.0	Setting 48, Peak reading, Average limit

Harmonics (Note - harmonic emissions above 1GHz more than 20dB below limit).

Frequency	Level	Pol	FCC 15.231(a)		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
867.840	50.7	v	60.8	-10.1	Pk	73	1.0	Setting 48, Peak reading, Average limit
867.840	39.5	h	60.8	-21.3	Pk	360	1.0	Setting 48, Peak reading, Average limit

The EUT transmits four different control commands (Wake-Up, Hello, Sleep and Find) plus data signals. Apart from the wake-up command (measured above in run #1) which is a continuous signal. Due to the 5 second duration of the signal, no duty cycle averaging was made to the peak values. The Theory of Operations details how the different types of transmissions meet the timing requirements for control signals or data signals.



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Radiated Emissions (short whip antenna)

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: 6/25/2004

Test Engineer: Juan Martinez

Test Location: SVOATS #2

Config. Used: 1

Config Change: None

EUT Voltage: 120V/60Hz

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated emissions testing. Remote support equipment was located approximately 30 meters from the test area with all I/O connections routed overhead.

Unless otherwise specified, the measurement antenna was located 3 meters from the EUT for the measurement range 30 - 1000 MHz and 3m from the EUT for the frequency range 1 - 5 GHz.

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: 26 °C
Rel. Humidity: 40 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	RE, 433 MHz Fundamental	FCC 15.231 (a)	Pass	77.2dB μ V/m (7244.4 μ V/m) @ 433.920MHz (-3.6dB)
1	RE, 433 - 5000MHz, Harmonic Emissions	FCC 15.231 (a)	Pass	57.5dB μ V/m (749.9 μ V/m) @ 867.840MHz (-3.3dB)

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.



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Run #1: Radiated Emissions, Fundamental- Wake-Up Control Signal (5 Second)

Fundamental and Harmonics to 4400 MHz

Laying Flat								
Frequency	Level	Pol	FCC 15.231(a)		Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
433.920	75.8	v	80.8	-5.0	Pk	140	1.0	Setting 48, Peak reading, Average limit
433.920	75.5	h	80.8	-5.3	Pk	271	1.0	Setting 48, Peak reading, Average limit
867.840	53.7	v	60.8	-7.1	Pk	256	1.0	Setting 48, Peak reading, Average limit
867.840	50.9	h	60.8	-9.9	Pk	0	1.0	Setting 48, Peak reading, Average limit
Standing up								
Frequency	Level	Pol	FCC 15.231(a)		Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
867.840	57.5	h	60.8	-3.3	Pk	178	1.0	Setting 48, Peak reading, Average limit
433.920	76.5	h	80.8	-4.3	Pk	78	1.1	Setting 48, Peak reading, Average limit
433.920	73.0	v	80.8	-7.8	Pk	104	2.7	Setting 48, Peak reading, Average limit
867.840	47.3	v	60.8	-13.5	Pk	250	3.0	Setting 48, Peak reading, Average limit
On its Side								
Frequency	Level	Pol	FCC 15.231(a)		Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
433.920	77.2	h	80.8	-3.6	Pk	45	2.0	Setting 48, Peak reading, Average limit
867.840	57.2	h	60.8	-3.6	Pk	140	2.4	Setting 48, Peak reading, Average limit
867.840	53.5	v	60.8	-7.3	Pk	200	1.0	Setting 48, Peak reading, Average limit
433.920	73.2	v	80.8	-7.6	Pk	103	1.0	Setting 48, Peak reading, Average limit

The EUT transmits four different control commands (Wake-Up, Hello, Sleep and Find) plus data signals. Apart from the wake-up command (measured above in run #1) which is a continuous signal, the remaining signals are pulsed in nature. Due to the 5 second duration of the wake-up signal, no duty cycle averaging was made to the peak values. The Theory of Operations details how the different types of transmissions meet the timing requirements for control signals or data signals.



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Radiated Emissions (Data/Control Pulsed Transmissions)

Test Specifics

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

Date of Test: 1/11/2005
Test Engineer: Juan Martinez
Test Location: SVOATS #1

Config. Used: 1
Config Change: None
EUT Voltage: 120Vac, 60Hz

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated emissions testing. Remote support equipment was located approximately 30 meters from the test area with all I/O connections routed overhead.

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: 12 °C
Rel. Humidity: 61 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1,2	RE, Fundamental	15.231(e)	Pass	69.9dB μ V/m (3126.1 μ V/m) @ 433.920MHz (-3.0dB)
1,2	RE, Fundamental and 2nd harmonic	15.231(e)	Pass	46.1dB μ V/m (201.8 μ V/m) @ 867.840MHz (-6.8dB)
3	Bandwidth	15.231	Pass	135kHz

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.



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Magnetic-mount Whip Antenna

Run #1: Radiated Emissions, Fundamental (30% Duty cycle)

Measurements taken at 3 meter distance. Port A

Frequency	Level	Pol	FCC 15.231(e)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
433.920	69.4	v	72.9	-3.5	Avg	260	1.0	
433.920	62.9	h	72.9	-10.0	Avg	53	1.0	
433.920	79.9	v	92.9	-13.0	Pk	260	1.0	
433.920	73.4	h	92.9	-19.5	Pk	53	1.0	

Run #2: Radiated Emissions, Fundamental and 2nd harmonic (30% Duty cycle)

Measurements taken at 3 meter distance.

Port B (Higher power output was used to measured 2nd harmonic)

Frequency	Level	Pol	FCC 15.231(e)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
433.920	69.7	v	72.9	-3.2	Avg	3	1.3	
433.920	64.9	h	72.9	-8.0	Avg	294	1.0	
433.920	80.2	v	92.9	-12.7	Pk	3	1.3	
433.920	75.4	h	92.9	-17.5	Pk	294	1.0	

Frequency	Level	Pol	FCC 15.231(e)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
867.840	39.3	v	52.9	-13.6	Avg	2	1.0	
867.840	38.5	h	52.9	-14.4	Avg	0	1.0	
1301.760	38.0	v	52.9	-14.9	Avg	254	1.0	
867.840	49.8	v	72.9	-23.1	Pk	2	1.0	
867.840	49.0	h	72.9	-23.9	Pk	0	1.0	
1301.760	48.5	v	72.9	-24.4	Pk	254	1.0	

All other transmitter-spurious emissions were more than 20dB below the limit.

All average measurements are calculated from the peak measurement by applying a duty cycle correction factor of $20\log(0.3)$ for a 30% duty cycle.



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Short Whip Antenna

Run #1: Radiated Emissions, Fundamental (30% Duty cycle)

Measurements taken at 3 meter distance. Port A

Frequency	Level	Pol	FCC 15.231(e)		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
Flat								
433.920	68.5	h	72.9	-4.4	Avg	272	1.0	
433.920	63.5	v	72.9	-9.4	Avg	52	1.9	
433.920	79.0	h	92.9	-13.9	Pk	272	1.0	
433.920	74.0	v	92.9	-18.9	Pk	52	1.9	
Side								
433.920	68.3	h	72.9	-4.6	Avg	94	1.0	
433.920	61.7	v	72.9	-11.2	Avg	319	1.5	
433.920	78.8	h	92.9	-14.1	Pk	94	1.0	
433.920	72.2	v	92.9	-20.7	Pk	319	1.5	
Upright								
433.920	67.7	v	72.9	-5.2	Avg	125	1.0	
433.920	64.5	h	72.9	-8.4	Avg	325	1.0	
433.920	78.2	v	92.9	-14.7	Pk	125	1.0	
433.920	75.0	h	92.9	-17.9	Pk	325	1.0	

Run #2a: Radiated Emissions, Fundamental and 2nd harmonic (30% Duty cycle)

Measurements taken at 3 meter distance.

Port B (Higher power output was used to measured 2nd harmonic)

Frequency	Level	Pol	FCC 15.231(e)		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
433.920	69.9	v	72.9	-3.0	Avg	129	1.0	EUT Upright
433.920	69.5	h	72.9	-3.4	Avg	269	1.0	EUT Flat
433.920	68.5	h	72.9	-4.4	Avg	94	1.0	EUT On Side
433.920	65.6	v	72.9	-7.3	Avg	164	1.0	EUT Flat
433.920	64.5	h	72.9	-8.4	Avg	361	2.0	EUT Upright
433.920	62.9	v	72.9	-10.0	Avg	72	1.5	EUT On Side
433.920	80.4	v	92.9	-12.5	Pk	129	1.0	EUT Upright
433.920	80.0	h	92.9	-12.9	Pk	269	1.0	EUT Flat
433.920	79.0	h	92.9	-13.9	Pk	94	1.0	EUT On Side
433.920	76.1	v	92.9	-16.8	Pk	164	1.0	EUT Flat
433.920	75.0	h	92.9	-17.9	Pk	361	2.0	EUT Upright
433.920	73.4	v	92.9	-19.5	Pk	72	1.5	EUT On Side



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Run #2b: Radiated Emissions, 2nd harmonic (30% Duty cycle)

Measurements taken at 3 meter distance.

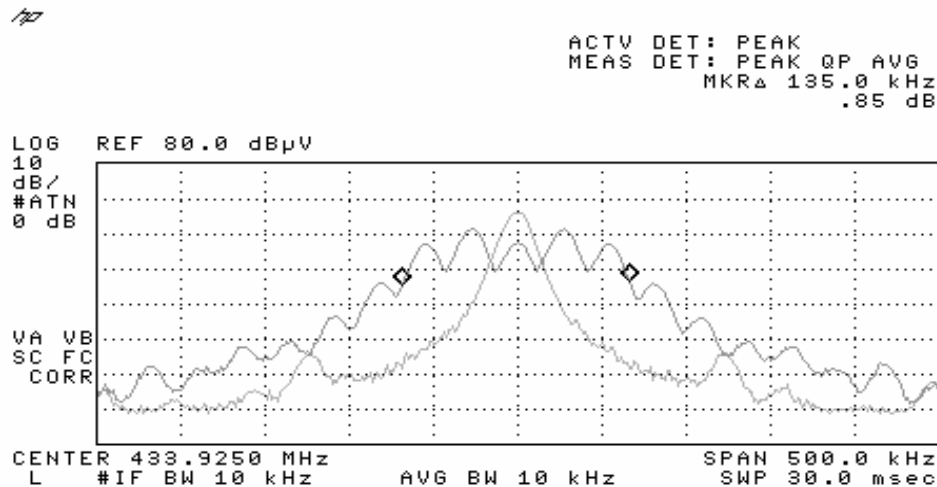
Port B (Port B had highest fundamental field strength)

Frequency	Level	Pol	FCC 15.231(e)		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
867.840	46.1	h	52.9	-6.8	Avg	116	1.2	EUT Upright
867.840	43.4	h	52.9	-9.5	Avg	13	1.0	EUT Flat
867.840	43.3	v	52.9	-9.6	Avg	5	1.0	EUT Flat
867.840	41.7	v	52.9	-11.2	Avg	127	1.0	EUT Upright
867.840	40.5	v	52.9	-12.4	Avg	232	1.4	EUT On Side
1301.760	38.7	v	52.9	-14.2	Avg	0	1.3	EUT Flat
867.840	56.6	h	72.9	-16.3	Pk	116	1.2	EUT Upright
867.840	36.4	h	52.9	-16.5	Avg	251	1.0	EUT On Side
867.840	53.9	h	72.9	-19.0	Pk	13	1.0	EUT Flat
867.840	53.8	v	72.9	-19.1	Pk	5	1.0	EUT Flat
867.840	52.2	v	72.9	-20.7	Pk	127	1.0	EUT Upright
867.840	51.0	v	72.9	-21.9	Pk	232	1.4	EUT On Side
1301.760	49.2	v	72.9	-23.7	Pk	0	1.3	EUT Flat
867.840	46.9	h	72.9	-26.0	Pk	251	1.0	EUT On Side

All other transmitter-spurious emissions were more than 20dB below the limit.

All average measurements are calculated from the peak measurement by applying a duty cycle correction factor of $20\log(0.3)$ for a 30% duty cycle.

Run #3: 20dB Bandwidth





EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Radiated Emissions (Internal Ferrite Antenna @ 132kHz)

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: 6/24/2004

Test Engineer: Chris Byleckie

Test Location: SVOATS #2

Config. Used: 1

Config Change: None

EUT Voltage: 120V/60Hz

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 10 and 20 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.

Ambient Conditions: Temperature: 21 °C
Rel. Humidity: 59 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1, 2, 3	RE, Fundamental, Preliminary Scan	FCC 15.209	Pass	1.1dBμV/m (1.1μV/m) @ 131.579kHz (-24.2dB)
4	RE, 132 kHz - 1.32 MHz, Harmonic Emissions	FCC 15.209	Pass	-16.4dBμV/m (0.2μV/m) @ 394.740kHz (-32.0dB)

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.



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Run #1: Preliminary Radiated Emissions, Fundamental (Laying Flat)

Measurements of the fundamental signal were made on the OATS at test distances of 10m and 20m and are recorded in the table below.

Frequency	Level	AF	Level	Pol	Detector	Azimuth	Height	Comments
kHz	dB μ V	dBm ⁻¹	dB μ V/m	(O / I)	Pk/QP/Avg	degrees	meters	
131.579	82.5	10.4	92.9	O	Pk	72	1.0	Tested at 10m - Note 1
131.579	62.4	10.4	72.8	O	Pk	260	1.0	Tested at 20m - Note 2

Note 3: Polarization of O indicates the loop was facing the EUT, I indicates that the loop was perpendicular to the EUT.

Extrapolation Factor Calculation:

Level at 10m: 92.9 dB μ V/m
Level at 20m: 72.8 dB μ V/m
Extrapolation from 10m to 20m: 66.8 dB
Extrapolation from 20m to 300m: **78.5**

Run #2: Preliminary Radiated Emissions, Fundamental (On its side)

Measurements of the fundamental signal were made on the OATS at test distances of 10m and 20m and are recorded in the table below.

Frequency	Level	AF	Level	Pol	Detector	Azimuth	Height	Comments
kHz	dB μ V	dBm ⁻¹	dB μ V/m	(O / I)	Pk/QP/Avg	degrees	meters	
131.579	66.0	10.4	76.4	O	Pk	156	1.0	Tested at 10m - Note 1
131.579	45.5	10.4	55.9	O	Pk	204	1.0	Tested at 20m - Note 2

Note 1: The maximum signal level was with antennas 10 inches separates between each other.

Note 2: The maximum signal level was with antennas 10 inches separates between each other.

Note 3: Polarization of O indicates the loop was facing the EUT, I indicates that the loop was perpendicular to the EUT.

Extrapolation Factor Calculation:

Level at 10m: 76.4 dB μ V/m
Level at 20m: 55.9 dB μ V/m
Extrapolation from 10m to 20m: 68.2 dB
Extrapolation from 20m to 300m: **80.2**



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Run #3: Preliminary Radiated Emissions, Fundamental (Standing up)

Measurements of the fundamental signal were made on the OATS at test distances of 10m and 20m and are recorded in the table below.

Frequency	Level	AF	Level	Pol	Detector	Azimuth	Height	Comments
kHz	dBμV	dBm ⁻¹	dBμV/m	(O / I)	Pk/QP/Avg	degrees	meters	
131.579	82.3	10.4	92.7	O	Pk	277	1.0	Tested at 10m - Note 1
131.579	63.6	10.4	74.0	O	Pk	79	1.0	Tested at 20m - Note 2

Note 1: The maximum signal level was with antennas 1 meter separates between each other.

Note 2: The maximum signal level was with antennas 1 meter separates between each other.

Note 3: Polarization of O indicates the loop was facing the EUT, I indicates that the loop was perpendicular to the EUT.

Extrapolation Factor Calculation:

Level at 10m:	92.7	dBμV/m
Level at 20m:	74.0	dBμV/m
Extrapolation from 10m to 20m:	62.0	dB
Extrapolation from 20m to 300m:	<u>72.9</u>	

Run #4: Summary For Fundamental and Harmonic Radiated Emissions (Worst Case configuration)

Frequency	Level	FCC 15.209	Detector	Azimuth	Height	Comments
kHz	dBμV/m	Limit	Margin	Pk/QP/Avg	degrees	meters
131.6	1.1	25.2	-24.2	Pk	79	1.0

Frequency	Level	FCC 15.209	Detector	Azimuth	Height	Comments
kHz	dBμV/m	Limit	Margin	Pk/QP/Avg	degrees	meters
394.7	-16.4	15.7	-32.0	Pk	0	1.0
394.7	-16.4	15.7	-32.0	Pk	0	1.0
263.1	-16.1	19.2	-35.3	Pk	0	1.0
526.3	-14.5	33.2	-47.7	Pk	0	1.0

Note 1: Level calculated by applying the extrapolation factor calculated from the measurements at 10m and 20m to the measurement recorded at 20m from run #3.

Note 2: Preliminary measurements showed there to be no significant signals at a distance of 20m from the EUT other than the fundamental signal. An extrapolation factor of $40\log(\text{measurement distance}/\text{specification distance})$ was used for the signals noted in the table above.

Note 3: All signals above 490kHz were less than 43.4dBuV/m (-8.2dBuA/m) at a distance of 3m, which is equivalent to a level of 3.4dBuV/m at the specification distance of 30m if using the suggested extrapolation factor of $40\log(\text{measurement distance}/\text{specification distance})$.



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Radiated Emissions (Small Loop Antenna @ 132kHz)

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: 6/24/2004

Test Engineer: Chris Byleckie

Test Location: SVOATS #2

Config. Used: 1

Config Change: None

EUT Voltage: 120V/60Hz

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 10 and 20 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.

Ambient Conditions:
Temperature: 21 °C
Rel. Humidity: 59 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1, 2, 3	RE, 132 kHz Fundamental Emissions	FCC 15.209	Pass	21.4dBµV/m (11.7µV/m) @ 132kHz (4.4dB)
4	RE - Spurious	FCC 15.209	Pass	> 20dB

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.



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Run #1: Preliminary Radiated Emissions, Fundamental (On its side)

EUT set for maximum Pout

Measurements of the fundamental signal were made on the OATS at test distances of 10m and 20m and are recorded in the table below.

Frequency	Level	AF	Level	Pol	Detector	Azimuth	Height	Comments
kHz	dB μ V	dBm ⁻¹	dB μ V/m	(O / I)	Pk/QP/Avg	degrees	meters	
132.000	104.3	10.4	114.7	O	Pk	0	1.0	Tested at 10m - Note 1
132.000	85.3	10.4	95.7	O	Pk	360	1.0	Tested at 20m - Note 2

Extrapolation Factor Calculation:

Level at 10m: 114.7 dB μ V/m
 Level at 20m: 95.7 dB μ V/m
 Extrapolation from 10m to 20m: 63.2 dB
 Extrapolation from 20m to 300m: **74.3**

Run #2: Worst Case Fundamental (Worst Case configuration)

Frequency	Level	FCC 15.209	Detector	Azimuth	Height	Comments
kHz	dB μ V/m	Limit	Margin	Pk/QP/Avg	degrees	meters
132.0	21.4	25.2	-3.8	Pk	0	1.0

Note 1:	Level calculated by applying the extrapolation factor calculated from the measurements at 10m and 20m to the measurement recorded at 20m from run #1.
Note 2:	Preliminary measurements showed there to be no significant signals at a distance of 20m from the EUT other than the fundamental signal. Apart from the fundamental transmission, all signals below 490kHz were less than 52dB μ V/m (1.85dB μ A/m) at a distance of 20m, which is equivalent to a level of -28dB μ V/m at the specification distance of 300m if using the suggested extrapolation factor of $40\log(\text{measurement distance}/\text{specification distance})$.
Note 3:	Preliminary measurements showed there to be no significant signals at a distance of 3m from the EUT other than the fundamental signal. All signals above 490kHz were less than 43.4dB μ V/m (-8.2dB μ A/m) at a distance of 3m, which is equivalent to a level of 3.4dB μ V/m at the specification distance of 30m if using the suggested extrapolation factor of $40\log(\text{measurement distance}/\text{specification distance})$.



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Radiated Emissions (Large Loop Antenna @ 132kHz)

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: 6/24/2004
Test Engineer: Chris Byleckie
Test Location: SVOATS #2

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

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 10 and 20 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.

Ambient Conditions:
Temperature: 21 °C
Rel. Humidity: 59 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1, 2, 3	RE, Fundamental, Preliminary Scan	FCC 15.209	Pass	22.8dBµV/m (13.8µV/m) @ 131.579kHz (-2.4dB)
4	RE, 132 kHz - 1.32 MHz, Harmonic Emissions	FCC 15.209	Pass	-10.8dBµV/m (0.3µV/m) @ 394.740kHz (-26.5dB)

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.



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Run #1: Preliminary Radiated Emissions, Fundamental (Laying Flat)

Measurements of the fundamental signal were made on the OATS at test distances of 10m and 20m and are recorded in the table below.

Frequency	Level	AF	Level	Pol	Detector	Azimuth	Height	Comments
kHz	dB μ V	dBm ⁻¹	dB μ V/m	(O / I)	Pk/QP/Avg	degrees	meters	
132.000	85.7	10.4	96.1	O	Pk	0	1.0	Tested at 10m - Note 1
132.000	62.0	10.4	72.4	O	Pk	354	1.0	Tested at 20m - Note 2

Note 1: Polarization of O indicates the loop was facing the EUT, I indicates that the loop was perpendicular to the EUT.

Extrapolation Factor Calculation:

Level at 10m: 96.1 dB μ V/m
Level at 20m: 72.4 dB μ V/m
Extrapolation from 10m to 20m: 78.9 dB
Extrapolation from 20m to 300m: 92.8

Run #2: Preliminary Radiated Emissions, Fundamental (On its side)

Measurements of the fundamental signal were made on the OATS at test distances of 10m and 20m and are recorded in the table below.

Frequency	Level	AF	Level	Pol	Detector	Azimuth	Height	Comments
kHz	dB μ V	dBm ⁻¹	dB μ V/m	(O / I)	Pk/QP/Avg	degrees	meters	
132.000	103.1	10.4	113.5	O	Pk	0	1.0	Tested at 10m - Note 1
132.000	84.6	10.4	95.0	O	Pk	360	1.0	Tested at 20m - Note 2

Note 1: Polarization of O indicates the loop was facing the EUT, I indicates that the loop was perpendicular to the EUT.

Extrapolation Factor Calculation:

Level at 10m: 113.5 dB μ V/m
Level at 20m: 95.0 dB μ V/m
Extrapolation from 10m to 20m: 61.4 dB
Extrapolation from 20m to 300m: 72.2



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Run #3: Preliminary Radiated Emissions, Fundamental (Standing up)

Measurements of the fundamental signal were made on the OATS at test distances of 10m and 20m and are recorded in the table below.

Frequency	Level	AF	Level	Pol	Detector	Azimuth	Height	Comments
kHz	dBμV	dBm ⁻¹	dBμV/m	(O / I)	Pk/QP/Avg	degrees	meters	
132.000	103.5	10.4	113.9	O	Pk	0	1.0	
132.000	84.5	10.4	94.9	O	Pk	360	1.0	

Note 1: Polarization of O indicates the loop was facing the EUT, I indicates that the loop was perpendicular to the EUT.

Extrapolation Factor Calculation:

Level at 10m: 113.9 dBμV/m
 Level at 20m: 94.9 dBμV/m
 Extrapolation from 10m to 20m: 63.0 dB
 Extrapolation from 20m to 300m: **74.1**

Run #4: Worst Case Fundamental and Harmonic Radiated Emissions (Worst Case configuration)

Frequency	Level	FCC 15.209	Detector	Azimuth	Height	Comments
kHz	dBμV/m	Limit	Margin	Pk/QP/Avg	degrees	meters
131.6	22.8	25.2	-2.4	Pk	354	1.0

Frequency	Level	FCC 15.209	Detector	Azimuth	Height	Comments
kHz	dBμV/m	Limit	Margin	Pk/QP/Avg	degrees	meters
394.7	-10.8	15.7	-26.5	Pk	0	1.0
263.1	-14.4	19.2	-33.6	Pk	0	1.0
526.3	-12.5	33.2	-45.7	Pk	0	1.0

Note 1: Level calculated by applying the extrapolation factor calculated from the measurements at 10m and 20m to the measurement recorded at 20m from run #2.

Note 2: Preliminary measurements showed there to be no significant signals at a distance of 20m from the EUT other than the fundamental signal. An extrapolation factor of $40\log(\text{measurement distance}/\text{specification distance})$ was used for the signals noted in the table above.

Note 3: All signals above 490kHz were less than 43.4dBuV/m (-8.2dBuA/m) at a distance of 3m, which is equivalent to a level of 3.4dBuV/m at the specification distance of 30m if using the suggested extrapolation factor of $40\log(\text{measurement distance}/\text{specification distance})$.



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Radiated Emissions (Internal Ferrite Antenna @ 123kHz)

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: 6/24/2004

Test Engineer: Chris Byleckie

Test Location: SVOATS #2

Config. Used: 1

Config Change: None

EUT Voltage: 120V/60Hz

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 10 and 20 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.

Ambient Conditions:

Temperature:	21 °C
Rel. Humidity:	59 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1, 2, 3	RE, Fundamental, Preliminary Scan	FCC 15.209	Pass	1.6dBµV/m (1.2µV/m) @ 122.950kHz (-24.2dB)
4	RE, 132 kHz - 1.32 MHz, Harmonic Emissions	FCC 15.209	Pass	-5.3dBµV/m (0.5µV/m) @ 245.900kHz (-25.1dB)

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.



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Run #1: Preliminary Radiated Emissions, Fundamental (Laying Flat)

Measurements of the fundamental signal were made on the OATS at test distances of 10m and 20m and are recorded in the table below.

Frequency	Level	AF	Level	Pol	Detector	Azimuth	Height	Comments
kHz	dBμV	dBm ⁻¹	dBμV/m	(O / I)	Pk/QP/Avg	degrees	meters	
122.950	83.3	10.4	93.7	O	Pk	118	1.0	Tested at 10m - Note 1
122.950	64.5	10.4	74.9	O	Pk	264	1.0	Tested at 20m - Note 2
122.950	61.9	10.4	72.3	I	Pk	0	1.0	Tested at 20m - Note 3

Note 1: Polarization of O indicates the loop was facing the EUT, I indicates that the loop was perpendicular to the EUT.

Extrapolation Factor Calculation:

Level at 10m: 93.7 dBμV/m
 Level at 20m: 74.9 dBμV/m
 Extrapolation from 10m to 20m: 62.4 dB
 Extrapolation from 20m to 300m: 73.3

Run #2: Preliminary Radiated Emissions, Fundamental (On its side)

Measurements of the fundamental signal were made on the OATS at test distances of 10m and 20m and are recorded in the table below.

Frequency	Level	AF	Level	Pol	Detector	Azimuth	Height	Comments
kHz	dBμV	dBm ⁻¹	dBμV/m	(O / I)	Pk/QP/Avg	degrees	meters	
122.950	68.6	10.4	79.0	O	Pk	110	1.0	Tested at 10m - Note 1
122.950	47.6	10.4	58.0	O	Pk	249	1.0	Tested at 20m - Note 2

Note 1: Polarization of O indicates the loop was facing the EUT, I indicates that the loop was perpendicular to the EUT.

Extrapolation Factor Calculation:

Level at 10m: 79.0 dBμV/m
 Level at 20m: 58.0 dBμV/m
 Extrapolation from 10m to 20m: 69.7 dB
 Extrapolation from 20m to 300m: 82.0



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Run #3: Preliminary Radiated Emissions, Fundamental (Standing up)

Measurements of the fundamental signal were made on the OATS at test distances of 10m and 20m and are recorded in the table below.

Frequency	Level	AF	Level	Pol	Detector	Azimuth	Height	Comments
kHz	dB μ V	dBm ⁻¹	dB μ V/m	(O / I)	Pk/QP/Avg	degrees	meters	
122.950	83.0	10.4	93.4	O	Pk	96	1.0	Tested at 10m - Note 1
122.950	63.9	10.4	74.3	O	Pk	279	1.0	Tested at 20m - Note 2

Note 1: Polarization of O indicates the loop was facing the EUT, I indicates that the loop was perpendicular to the EUT.

Extrapolation Factor Calculation:

Level at 10m: 93.4 dB μ V/m
 Level at 20m: 74.3 dB μ V/m
 Extrapolation from 10m to 20m: 63.4 dB
 Extrapolation from 20m to 300m: **74.6**

Run #4: Worst Case Fundamental and Harmonic Radiated Emissions (Worst Case configuration)

Frequency	Level	FCC 15.209	Detector	Azimuth	Height	Comments
kHz	dB μ V/m	Limit	Margin	Pk/QP/Avg	degrees	meters
123.0	1.6	25.8	-24.2	Pk	264	1.0

Frequency	Level	FCC 15.209	Detector	Azimuth	Height	Comments
kHz	dB μ V/m	Limit	Margin	Pk/QP/Avg	degrees	meters
245.9	-5.3	19.8	-25.1	Pk	0	1.0
368.7	-20.9	16.3	-37.1	Pk	0	1.0
491.6	-10.5	33.8	-44.3	Pk	0	1.0

Note 1: Level calculated by applying the extrapolation factor calculated from the measurements at 10m and 20m to the measurement recorded at 20m from run #1.

Note 2: Preliminary measurements showed there to be no significant signals at a distance of 20m from the EUT other than the fundamental signal. An extrapolation factor of $40\log(\text{measurement distance}/\text{specification distance})$ was used for the signals noted in the table above.

Note 3: All signals above 490kHz were less than 43.4dB μ V/m (-8.2dB μ A/m) at a distance of 3m, which is equivalent to a level of 3.4dB μ V/m at the specification distance of 30m if using the suggested extrapolation factor of $40\log(\text{measurement distance}/\text{specification distance})$.



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Radiated Emissions (Large Loop Antenna @ 123kHz)

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: 6/24/2004

Test Engineer: Juan Martinez

Test Location: SVOATS #2

Config. Used: 1

Config Change: None

EUT Voltage: 120V/60Hz

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 10 and 20 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.

Ambient Conditions: Temperature: 21 °C
Rel. Humidity: 59 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1, 2, 3	RE, Fundamental, Preliminary Scan	FCC 15.209	Pass	22.2dBµV/m (12.8µV/m) @ 122.950kHz (-3.7dB)
4	RE, 122.88 kHz - 1.228 MHz, Harmonic Emissions	FCC 15.209	Pass	-5.8dBµV/m (0.5µV/m) @ 245.900kHz (- 25.6dB)

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.



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Run #1: Preliminary Radiated Emissions, Fundamental (Laying Flat)

Measurements of the fundamental signal were made on the OATS at test distances of 10m and 20m and are recorded in the table below.

Frequency	Level	AF	Level	Pol	Detector	Azimuth	Height	Comments
kHz	dBμV	dBm ⁻¹	dBμV/m	(O / I)	Pk/QP/Avg	degrees	meters	
122.850	86.9	10.4	97.3	O	Pk	0	1.0	Tested at 10m - Note 1
122.850	63.4	10.4	73.8	O	Pk	0	1.0	Tested at 20m - Note 2

Extrapolation Factor Calculation:

Level at 10m: 97.3 dBμV/m
 Level at 20m: 73.8 dBμV/m
 Extrapolation from 10m to 20m: 78.1 dB
 Extrapolation from 20m to 300m: **91.8**

Run #2: Preliminary Radiated Emissions, Fundamental (On its side)

Measurements of the fundamental signal were made on the OATS at test distances of 10m and 20m and are recorded in the table below.

Frequency	Level	AF	Level	Pol	Detector	Azimuth	Height	Comments
kHz	dBμV	dBm ⁻¹	dBμV/m	(O / I)	Pk/QP/Avg	degrees	meters	
122.850	106.9	10.4	117.3	O	Pk	0	1.0	Tested at 10m - Note 1
122.850	89.0	10.4	99.4	O	Pk	360	1.0	Tested at 20m - Note 2
122.850	87.0	10.4	97.4	I	Pk	360	1.0	Tested at 20m - Note 2

Extrapolation Factor Calculation:

Level at 10m: 117.3 dBμV/m
 Level at 20m: 99.4 dBμV/m
 Extrapolation from 10m to 20m: 59.2 dB
 Extrapolation from 20m to 300m: **69.6**



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Run #2 continued

Frequency	Level	AF	Level	Pol	Detector	Azimuth	Height	Comments
kHz	dB μ V	dBm ⁻¹	dB μ V/m	(O / I)	Pk/QP/Avg	degrees	meters	
122.850	104.3	10.4	114.7	O	Pk			Tested at 10m - Note 1
122.850	85.1	10.4	95.5	O	Pk			Tested at 20m - Note 2

Extrapolation Factor Calculation:

Level at 10m: 114.7 dB μ V/m
Level at 20m: 95.5 dB μ V/m
Extrapolation from 10m to 20m: 63.7 dB
Extrapolation from 20m to 300m: 74.9

Final setting

Frequency	Level	AF	Level	Pol	Detector	Azimuth	Height	Comments
kHz	dB μ V	dBm ⁻¹	dB μ V/m	(O / I)	Pk/QP/Avg	degrees	meters	
122.850	105.3	10.4	115.7	O	Pk			Tested at 10m - Note 1
122.850	86.2	10.4	96.6	O	Pk			Tested at 20m - Note 2

Extrapolation Factor Calculation:

Level at 10m: 115.7 dB μ V/m
Level at 20m: 96.6 dB μ V/m
Extrapolation from 10m to 20m: 63.3 dB
Extrapolation from 20m to 300m: 74.5



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Run #3: Preliminary Radiated Emissions, Fundamental (Standing up)

Measurements of the fundamental signal were made on the OATS at test distances of 10m and 20m and are recorded in the table below.

Frequency	Level	AF	Level	Pol	Detector	Azimuth	Height	Comments
kHz	dB μ V	dBm ⁻¹	dB μ V/m	(O / I)	Pk/QP/Avg	degrees	meters	
122.850	105.4	10.4	115.8	O	Pk	0	1.0	Tested at 10m - Note 1
122.850	85.9	10.4	96.3	O	Pk	360	1.0	Tested at 20m - Note 2

Note 1: The maximum signal level was with antennas 1 meter separates between each other.

Note 2: The maximum signal level was with antennas 1 meter separates between each other.

Note 3: Polarization of O indicates the loop was facing the EUT, I indicates that the loop was perpendicular to the EUT.

Extrapolation Factor Calculation:

Level at 10m:	115.8	dB μ V/m
Level at 20m:	96.3	dB μ V/m
Extrapolation from 10m to 20m:	64.5	dB
Extrapolation from 20m to 300m:	<u>75.9</u>	

Run #4: Radiated Emissions (Worst Case configuration)

Frequency	Level	FCC 15.209	Detector	Azimuth	Height	Comments
kHz	dB μ V/m	Limit	Margin	Pk/QP/Avg	degrees	meters
122.95	22.2	25.8	-3.7	Pk	0	0.0

Frequency	Level	FCC 15.209	Detector	Azimuth	Height	Comments
kHz	dB μ V/m	Limit	Margin	Pk/QP/Avg	degrees	meters
245.9	-5.8	19.8	-25.5	Pk	0	1.0
368.7	-10.7	16.3	-26.9	Pk	0	1.0
491.6	-11.2	33.8	-45.0	Pk	0	1.0

Note 1: Level calculated by applying the extrapolation factor calculated from the measurements at 10m and 20m to the measurement recorded at 20m from run #2 (final settings).

Note 2: Preliminary measurements showed there to be no significant signals at a distance of 20m from the EUT other than the fundamental signal. An extrapolation factor of $40\log(\text{measurement distance}/\text{specification distance})$ was used for the signals noted in the table above.

Note 3: All signals above 490kHz were less than 43.4dB μ V/m (-8.2dB μ A/m) at a distance of 3m, which is equivalent to a level of 3.4dB μ V/m at the specification distance of 30m if using the suggested extrapolation factor of $40\log(\text{measurement distance}/\text{specification distance})$.



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Radiated Emissions (2-element handrail antenna)

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: 6/24/2004

Test Engineer: Juan Martinez

Test Location: SVOATS #2

Config. Used: 1

Config Change: None

EUT Voltage: 120V/60Hz

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 10 and 20 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.

Ambient Conditions:

Temperature:	21 °C
Rel. Humidity:	59 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1, 2, 3, 4	RE, Fundamental, Preliminary Scan	FCC 15.209	Pass	4.3dB μ V/m (1.6 μ V/m) @ 122.950kHz (-21.5dB)
5	RE, 122.88 kHz - 1.228 MHz, Harmonic Emissions	FCC 15.209	Pass	9.0dB μ V/m (2.8 μ V/m) @ 245.900kHz (-10.8dB)

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.



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Run #1: Preliminary Radiated Emissions, Fundamental (10 inches separation, Laying Flat) 2 Antennas

Measurements of the fundamental signal were made on the OATS at test distances of 10m and 20m and are recorded in the table below.

Frequency	Level	AF	Level	Pol	Detector	Azimuth	Height	Comments
kHz	dB μ V	dBm ⁻¹	dB μ V/m	(O / I)	Pk/QP/Avg	degrees	meters	
122.850	84.9	10.4	95.3	O	Pk	0	1.0	Tested at 10m - Note 1
122.850	65.9	10.4	76.3	O	Pk	354	1.0	Tested at 20m - Note 2

Note 1: Polarization of O indicates the loop was facing the EUT, I indicates that the loop was perpendicular to the EUT.

Extrapolation Factor Calculation:

Level at 10m: 95.3 dB μ V/m
Level at 20m: 76.3 dB μ V/m
Extrapolation from 10m to 20m: 63.2 dB
Extrapolation from 20m to 300m: **74.3** (This factor used to calculate the level in the table below)

Run #2: Preliminary Radiated Emissions, Fundamental (10 inches separation, On its side) 2 Antennas

Measurements of the fundamental signal were made on the OATS at test distances of 10m and 20m and are recorded in the table below.

Frequency	Level	AF	Level	Pol	Detector	Azimuth	Height	Comments
kHz	dB μ V	dBm ⁻¹	dB μ V/m	(O / I)	Pk/QP/Avg	degrees	meters	
122.850	84.9	10.4	95.3	O	Pk	0	1.0	Tested at 10m - Note 1
122.850	65.7	10.4	76.1	O	Pk	360	1.0	Tested at 20m - Note 2

Note 1: Polarization of O indicates the loop was facing the EUT, I indicates that the loop was perpendicular to the EUT.

Extrapolation Factor Calculation:

Level at 10m: 95.3 dB μ V/m
Level at 20m: 76.1 dB μ V/m
Extrapolation from 10m to 20m: 63.9 dB
Extrapolation from 20m to 300m: **75.1**



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Run #3: Preliminary Radiated Emissions, Fundamental (1 meter separation, laying down) 2 Antennas

Measurements of the fundamental signal were made on the OATS at test distances of 10m and 20m and are recorded in the table below.

Frequency	Level	AF	Level	Pol	Detector	Azimuth	Height	Comments
kHz	dB μ V	dBm ⁻¹	dB μ V/m	(O / I)	Pk/QP/Avg	degrees	meters	
122.850	84.3	10.4	94.7	O	Pk	0	1.0	Tested at 10m - Note 1
122.850	65.9	10.4	76.3	O	Pk	360	1.0	Tested at 20m - Note 2

Note 1: Polarization of O indicates the loop was facing the EUT, I indicates that the loop was perpendicular to the EUT.

Extrapolation Factor Calculation:

Level at 10m: 94.7 dB μ V/m
 Level at 20m: 76.3 dB μ V/m
 Extrapolation from 10m to 20m: 61.2 dB
 Extrapolation from 20m to 300m: 72.0

Run #4: Preliminary Radiated Emissions, Fundamental (1 Meter separation, On its side) 2 Antennas

Measurements of the fundamental signal were made on the OATS at test distances of 10m and 20m and are recorded in the table below.

Frequency	Level	AF	Level	Pol	Detector	Azimuth	Height	Comments
kHz	dB μ V	dBm ⁻¹	dB μ V/m	(O / I)	Pk/QP/Avg	degrees	meters	
122.850	84.9	10.4	95.3	O	Pk	0	1.0	Tested at 10m - Note 1
122.850	65.9	10.4	76.3	O	Pk	360	1.0	Tested at 20m - Note 2

Note 1: Polarization of O indicates the loop was facing the EUT, I indicates that the loop was perpendicular to the EUT.

Extrapolation Factor Calculation:

Level at 10m: 95.3 dB μ V/m
 Level at 20m: 76.3 dB μ V/m
 Extrapolation from 10m to 20m: 63.2 dB
 Extrapolation from 20m to 300m: 74.3



EMC Test Data

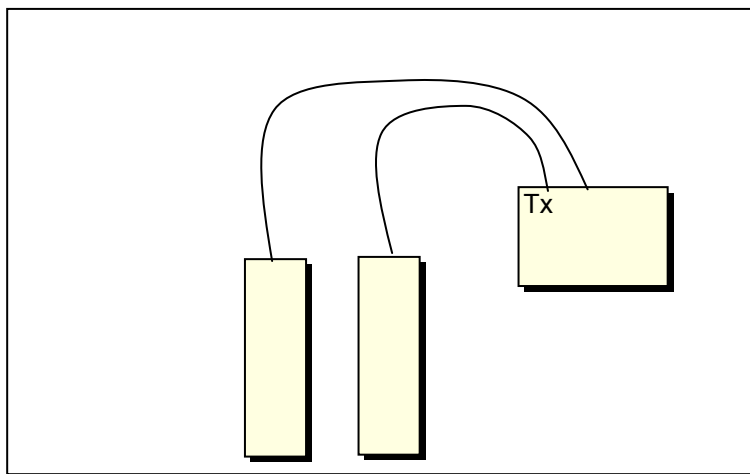
Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Run #5: Harmoinc Radiated Emissions

Frequency	Level	FCC 15.209		Detector	Azimuth	Height	Comments
kHz	dB μ V/m	Limit	Margin	Pk/QP/Avg	degrees	meters	
122.95	4.3	25.8	-21.5	Pk	354	1.0	Note 1

Frequency	Level	FCC 15.209		Detector	Azimuth	Height	Comments
kHz	dB μ V/m	Limit	Margin	Pk/QP/Avg	degrees	meters	
245.9	9.0	19.8	-10.8	Pk	-	-	Note 2, measured at 20m, extrapolated to 300m
368.7	3.0	16.3	-13.3	Pk	-	-	Note 2, measured at 20m, extrapolated to 300m
491.6	3.8	33.8	-30.0	Pk	-	-	Note 3, measured at 3m, extrapolated to 30m

Note 1:	Level calculated by applying the extrapolation factor calculated from the measurements at 10m and 20m to the measurement recorded at 20m with the antennas separated by 1m (run #3).
Note 2:	Preliminary measurements showed there to be no significant signals at a distance of 20m from the EUT other than the fundamental signal. An extrapolation factor of $40\log(\text{measurement distance}/\text{specification distance})$ was used for the signals noted in the table above.
Note 3:	All signals above 490kHz were less than 43.4dB μ V/m (-8.2dB μ A/m) at a distance of 20m, which is equivalent to a level of 3.4dB μ V/m at the specification distance of 30m if using the suggested extrapolation factor of $40\log(\text{measurement distance}/\text{specification distance})$.





EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Radiated Emissions (4-element handrail antenna)

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: 6/24/2004

Test Engineer: Juan Martinez

Test Location: SVOATS #2

Config. Used: 1

Config Change: None

EUT Voltage: 120V/60Hz

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 10 and 20 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.

Ambient Conditions: Temperature: 21 °C
Rel. Humidity: 59 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1, 2, 3, 4	RE, Fundamental, Preliminary Scan	FCC 15.209	Pass	2.4dB μ V/m (1.3 μ V/m) @ 122.950KHz (-23.4dB)
5	RE, 122.88 kHz - 1.228 MHz, Harmonic Emissions	FCC 15.209	Pass	9.5dB μ V/m (3.0 μ V/m) @ 245.900KHz (-10.3dB)

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.



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Run #1: Preliminary Radiated Emissions, Fundamental (10 inches separation, Laying Flat) 4 Antennas

Measurements of the fundamental signal were made on the OATS at test distances of 10m and 20m and are recorded in the table below.

Frequency	Level	AF	Level	Pol	Detector	Azimuth	Height	Comments
kHz	dB μ V	dBm ⁻¹	dB μ V/m	(O / I)	Pk/QP/Avg	degrees	meters	
122.950	82.5	10.4	92.9	O	Pk	0	1.0	Tested at 10m - Note 1
122.950	64.0	10.4	74.4	O	Pk	360	1.0	Tested at 20m - Note 2

Note 1: Polarization of O indicates the loop was facing the EUT, I indicates that the loop was perpendicular to the EUT.

Extrapolation Factor Calculation:

Level at 10m: 92.9 dB μ V/m
Level at 20m: 74.4 dB μ V/m
Extrapolation from 10m to 20m: 61.3 dB
Extrapolation from 20m to 300m: 72.0 (This factor used to calculate the level in the table below)

Run #2: Preliminary Radiated Emissions, Fundamental (10 inches separation, On its side) 4 Antennas

Measurements of the fundamental signal were made on the OATS at test distances of 10m and 20m and are recorded in the table below.

Frequency	Level	AF	Level	Pol	Detector	Azimuth	Height	Comments
kHz	dB μ V	dBm ⁻¹	dB μ V/m	(O / I)	Pk/QP/Avg	degrees	meters	
122.950	82.9	10.4	93.3	O	Pk	0	1.0	Tested at 10m - Note 1
122.950	64.1	10.4	74.50	O	Pk	360	1.0	Tested at 20m - Note 2

Note 1: Polarization of O indicates the loop was facing the EUT, I indicates that the loop was perpendicular to the EUT.

Extrapolation Factor Calculation:

Level at 10m: 93.3 dB μ V/m
Level at 20m: 74.5 dB μ V/m
Extrapolation from 10m to 20m: 62.6 dB
Extrapolation from 20m to 300m: 73.6 (This factor used to calculate the level in the table below)



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Run #3: Preliminary Radiated Emissions, Fundamental (25 inches separation, laying down) 4 Antennas

Measurements of the fundamental signal were made on the OATS at test distances of 10m and 20m and are recorded in the table below.

Frequency	Level	AF	Level	Pol	Detector	Azimuth	Height	Comments
kHz	dB μ V	dBm ⁻¹	dB μ V/m	(O / I)	Pk/QP/Avg	degrees	meters	
122.950	83.1	10.4	93.5	O	Pk	0	1.0	Tested at 10m - Note 1
122.950	64.1	10.4	74.52	O	Pk	360	1.0	Tested at 20m - Note 2

Note 1: Polarization of O indicates the loop was facing the EUT, I indicates that the loop was perpendicular to the EUT.

Extrapolation Factor Calculation:

Level at 10m: 93.5 dB μ V/m
Level at 20m: 74.5 dB μ V/m
Extrapolation from 10m to 20m: 63.0 dB
Extrapolation from 20m to 300m: **74.1** (This factor used to calculate the level in the table below)

Run #4: Preliminary Radiated Emissions, Fundamental (25 inches separation, On its side) 4 Antennas

Measurements of the fundamental signal were made on the OATS at test distances of 10m and 20m and are recorded in the table below.

Frequency	Level	AF	Level	Pol	Detector	Azimuth	Height	Comments
kHz	dB μ V	dBm ⁻¹	dB μ V/m	(O / I)	Pk/QP/Avg	degrees	meters	
122.950	83.1	10.4	93.5	O	Pk	0	1.0	Tested at 10m - Note 1
122.950	64.0	10.4	74.4	O	Pk	360	1.0	Tested at 20m - Note 2

Note 1: Polarization of O indicates the loop was facing the EUT, I indicates that the loop was perpendicular to the EUT.

Extrapolation Factor Calculation:

Level at 10m: 93.5 dB μ V/m
Level at 20m: 74.4 dB μ V/m
Extrapolation from 10m to 20m: 63.4 dB
Extrapolation from 20m to 300m: **74.6** (This factor used to calculate the level in the table below)



EMC Test Data

Client:	Savi Technology, Inc	Job Number:	J56067
Model:	SP-65Y-ZAB Signpost	T-Log Number:	T56150
Contact:	Gene	Account Manager:	Christine Vu
Spec:	FCC 15.209, 15.231, EN55022	Class:	A / Radio

Run #5: Harmonic Radiated Emissions (Worst case configuration 25 inches separation, laying down)

Frequency	Level	FCC 15.209		Detector	Azimuth	Height	Comments
KHz	dB μ V/m	Limit	Margin	Pk/OP/Avg	degrees	meters	
122.95	2.4	25.8	-23.4	Pk	360	1.0	Note 1

Frequency	Level	FCC 15.209		Detector	Azimuth	Height	Comments
KHz	dB μ V/m	Limit	Margin	Pk/OP/Avg	degrees	meters	
245.9	9.5	19.8	-10.3	Pk	-	-	Note 2, measured at 20m, extrapolated to 300m
368.8	-5.72	16.3	-22.0	Pk	-	-	Note 2, measured at 20m, extrapolated to 300m

Note 1:	Level calculated by applying the extrapolation factor calculated from the measurements at 10m and 20m to the measurement recorded at 20m with the antennas separated by 25" (run #1).
Note 2:	Preliminary measurements showed there to be no significant signals at a distance of 20m from the EUT other than the fundamental signal. An extrapolation factor of $40\log(\text{measurement distance}/\text{specification distance})$ was used for the signals noted in the table above.
Note 3:	All signals above 490kHz were less than 43.4dB μ V/m (-8.2dB μ A/m) at a distance of 3m, which is equivalent to a level of 3.4dB μ V/m at the specification distance of 30m if using the suggested extrapolation factor of $40\log(\text{measurement distance}/\text{specification distance})$.

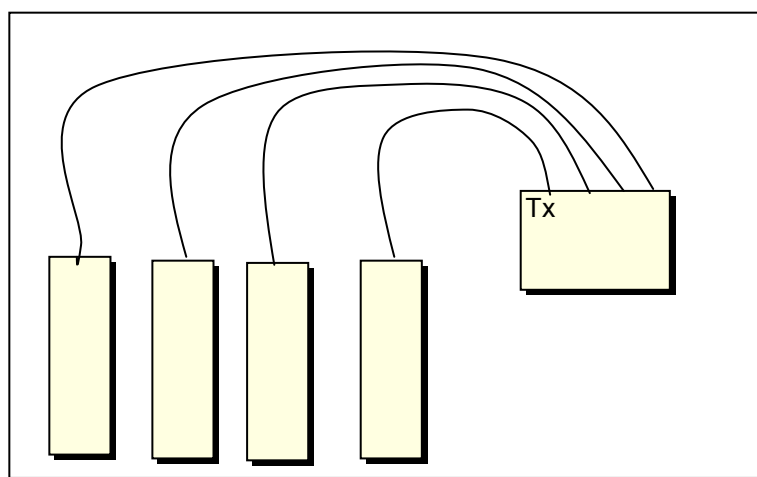


EXHIBIT 3: Photographs of Test Configurations

Pages

EXHIBIT 4: EUT Details

2 Pages

EXHIBIT 5: Detailed Photographs of Savi Technology, Inc. Model SP-65Y-ZAB

Pages

EXHIBIT 6: Block Diagram of Savi Technology, Inc. Model SP-65Y-ZAB

EXHIBIT 7: Schematic Diagrams of Savi Technology, Inc. Model SP-65Y-ZAB

Pages

EXHIBIT 8: Theory of Operation for Savi Technology, Inc. Model SP-65Y-ZAB

EXHIBIT 9: Advertising Literature

Pages

EXHIBIT 10: Operator's Manual

Pages