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Electromagnetic Emissions Test Report and Application for Grant of Equipment Authorization pursuant to FCC Part 15, Subpart C Specifications for an Intentional Radiator on the Savi Technology, Inc. Model: SP-600-211

FCC ID: KL7-600SP-V4

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

TEST SITE: Elliott Laboratories, Inc.
684 W. Maude Avenue
Sunnyvale, CA 94086

REPORT DATE: July 30, 2002

FINAL TEST DATE: July 18 and July 23, 2002

AUTHORIZED SIGNATORY: Mark Briggs

Mark Briggs
Director of Engineering

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SCOPE

An electromagnetic emissions test has been performed on the Savi Technology, Inc. model SP-600-211 pursuant to Subpart C of Part 15 of FCC Rules for intentional radiators. 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 FCC performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

The test results recorded herein are based on a single type test of the Savi Technology, Inc. model SP-600-211 and therefore apply only to the tested sample. The sample was selected and prepared by Eugene Schlindwein of Savi Technology, Inc.

OBJECTIVE

The primary objective of the manufacturer is compliance with Subpart C of Part 15 of FCC Rules for the radiated and conducted emissions of intentional radiators. Certification of these devices is required as a prerequisite to marketing as defined in Part 2 the FCC Rules.

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.

STATEMENT OF COMPLIANCE

The tested sample of Savi Technology, Inc. model SP-600-211 complied with the requirements of Subpart C of Part 15 of the FCC Rules for low power intentional radiators.

Maintenance of FCC compliance is the responsibility of the manufacturer. Any modification of the product that 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.).

EMISSION TEST RESULTS

The following emissions tests were performed on the Savi Technology, Inc. model SP-600-211. The actual test results are contained in an exhibit of this report.

LIMITS OF CONDUCTED INTERFERENCE VOLTAGE

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.207.

The following measurement was extracted from the data recorded during the conducted emissions scan and represents the highest amplitude emission relative to the specification limit. The actual test data and any correction factors are contained in an exhibit of this report.

120V, 60Hz

Frequency MHz	Level dBuV	Power Lead	FCC Limit	FCC Margin	Detector QP/Ave	Comments
13.5170	47.5	Line	48.0	-0.5	QP	

LIMITS OF RADIATED INTERFERENCE FIELD STRENGTH

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.209.

The following measurement was extracted from the data recorded during the radiated electric field emissions scan and represents the highest amplitude emission relative to the specification limit. The actual test data and any correction factors are contained in an exhibit of this report.

Frequency KHz	Level dBuV/m	Pol v/h	FCC Limit	FCC Margin	Comments
122.9	25.2	AV	25.8	-0.6	Extrapolated from 20m to 300m using correction of 58.1Log(300/20)

MEASUREMENT UNCERTAINTIES

ISO Guide 25 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	± 3.2

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Savi Technology, Inc. model SP-600-211 is a 123 kHz transmitter (signpost) with integral antenna, which is designed to be used as part of an inventory tracking system. Normally, the EUT would be installed at access monitoring and control points, mounted on a wall or pole during operation. The EUT was, therefore, treated as tabletop equipment during testing to simulate the end user environment. The electrical rating of the EUT is 85-250 VAC, 47-440 Hz, 800/400 mA, 24 VDC, 800 mA.

The sample was received on July 18, 2002 and tested on July 18 and July 23, 2002. The EUT consisted of the following component(s):

Manufacturer/Model/Description	Serial Number
Savi Technology/ SP-600-211/ Fixed Signpost Tag Reader	0364002040072

OTHER EUT DETAILS

The SP-600-111 and SP-600-211 are identical devices except for the antenna used. The SP-600-111 has an internal antenna and the SP-600-211 has an external antenna. Both units have two sensor ports, two sync ports (sync in, sync out), power port and RS232 serial port. The serial port, when used, is intended to be used in conjunction with a serial-to-ethernet adapter rather than directly connected to a serial device.

For transmitter tests the serial port was connected to a PC to allow the EUT to be placed into a continuous transmit mode

ENCLOSURE

The EUT enclosure is primarily constructed of fabricated molded plastic. It measures approximately 17.5 cm wide by 17.5 cm deep by 7.5 cm high.

MODIFICATIONS

The EUT did not require modifications in order to comply with the emission specifications

SUPPORT EQUIPMENT

No support equipment was used during emissions testing.

EXTERNAL I/O CABLING

The I/O cabling configuration during emissions testing was as follows:

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Sync In	Unterminated	multiwire	Unshielded	15
Sync Out	Unterminated	multiwire	Unshielded	15
Sensor 1	Unterminated	multiwire	Unshielded	3
Sensor 2	Unterminated	multiwire	Unshielded	3
Antenna	Antenna	multiwire	Unshielded	0.25
Power	AC Mains	3 wire	Shielded	2

EUT OPERATION

The EUT was transmitting continuously during testing.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on July 18 and July 23, 2002 at the Elliott Laboratories Open Area Test Site # located at 684 West Maude Avenue, Sunnyvale, California. The test site contains separate areas for radiated and conducted emissions testing. Pursuant to section 2.948 of the Rules, construction, calibration, and equipment data has been filed with the Commission.

The FCC 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 FCC requirements.

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

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

RADIATED EMISSIONS SPECIFICATION LIMITS, SECTION 15.209

Frequency Range (MHz)	Limit (uV/m @ 3m)	Limit (dBuV/m @ 3m)
0.009-0.490	$2400/F_{KHz}$ @ 300m	$67.6-20*\log_{10}(F_{KHz})$ @ 300m
0.490-1.705	$24000/F_{KHz}$ @ 30m	$87.6-20*\log_{10}(F_{KHz})$ @ 30m
1.705 to 30	30 @ 30m	29.5 @ 30m
30 to 88	100	40
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

SAMPLE CALCULATIONS - CONDUCTED EMISSIONS

Receiver readings are compared directly to the conducted emissions specification limit (decibel form) as follows:

$$R_r - B = C$$

and

$$C - S = M$$

where:

R_r = Receiver Reading in dBuV

B = Broadband Correction Factor*

C = Corrected Reading in dBuV

S = Specification Limit in dBuV

M = Margin to Specification in +/- dB

* Broadband Level - Per ANSI C63.4, 13 dB may be subtracted from the quasi-peak level if it is determined that the emission is broadband in nature. If the signal level in the average mode is six dB or more below the signal level in the peak mode, the emission is classified as broadband.

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, is calculated by using the following formula:

$$F_d = 20*LOG_{10} (D_m/D_s)$$

where:

F_d = Distance Factor in dB

D_m = Measurement Distance in meters

D_s = Specification Distance in meters

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

Conducted and Radiated Emissions, 18-Jul-02
Engineer: Chris

Manufacturer	Description	Model #	Assett #	Cal interval	Last Calibrated	Cal Due
Elliott Laboratories	FCC / CISPR LISN	LISN-3, OATS	304	12	6/5/2002	6/5/2003
EMCO	Magnetic Loop Antenna, 10k-30MHz	6502	1299	12	12/26/2001	12/26/2002
Rohde& Schwarz	Pulse Limiter	ESH3 Z2	1398	12	2/7/2002	2/7/2003
Rohde & Schwarz	Test Receiver, 0.009-2000 MHz	ESN	1332	12	4/16/2002	4/16/2003

EXHIBIT 2: Test Data Log Sheets

ELECTROMAGNETIC EMISSIONS

TEST LOG SHEETS

AND

MEASUREMENT DATA

T47867 9 Pages

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EMC Test Data

Client:	Savi	Job Number:	J47862
Model:	SP-600-211 (123 kHz version)	T-Log Number:	T47867
		Proj Eng:	Mark Briggs
Contact:	Gene Schlindwein		
Emissions Spec:	FCC 15.209	Class:	N/A
Immunity Spec:	-	Environment:	-

EMC Test Data

For The

Savi

Model

SP-600-211 (123 kHz version)

Client:	Savi	Job Number:	J47862
Model:	SP-600-211 (123 kHz version)	T-Log Number:	T47867
		Proj Eng:	Mark Briggs
Contact:	Gene Schlindwein		
Emissions Spec:	FCC 15.209	Class:	N/A
Immunity Spec:	-	Environment:	-

EUT INFORMATION

General Description

The EUT is a 123 kHz transmitter (signpost) with integral antenna which is designed to be used as part of an inventory tracking system. Normally, the EUT would be installed at access monitoring and control points, mounted on a wall or pole during operation. The EUT was, therefore, treated as table-top equipment during testing to simulate the end user environment. The electrical rating of the EUT is 85-250 VAC, 47-440 Hz, 800/400 mA, 24 VDC, 800 mA.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
Savi Technology	SP-600-211	Fixed Signpost Tag reader	364002040072	KL7-600SP-V4

Other EUT Details

The SP-600-111 and SP-600-211 are identical except for antenna. The SP-600-111 has an internal antenna and the SP-600-211 has an external antenna. Both units have two sensor ports, two sync ports (sync in, sync out), power port and RS232 serial port. The serial port, when used, is intended to be used in conjunction with a serial-to-ethernet adapter rather than directly connected to a serial device. For transmitter tests the serial port was connected to a PC to allow the EUT to be placed into a continuous transmit mode

EUT Enclosure

The EUT enclosure is primarily constructed of fabricated molded plastic. It measures approximately 17.5 cm wide by 17.5 cm deep by 7.5 cm high.

Modification History

Mod. #	Test	Date	Modification
1	-	-	none made

Client:	Savi	Job Number:	J47862
Model:	SP-600-211 (123 kHz version)	T-Log Number:	T47867
		Proj Eng:	Mark Briggs
Contact:	Gene Schlindwein		
Emissions Spec:	FCC 15.209	Class:	N/A
Immunity Spec:	-	Environment:	-

Test Configuration #1

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
None				

Remote Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
none				

Interface Ports

		Cable(s)		
Port	Connected To	Description	Shielded or Unshielded	Length(m)
Sync In	Unterminated	multiwire	Unshielded	15
Sync Out	Unterminated	multiwire	Unshielded	15
Sensor 1	Unterminated	multiwire	Unshielded	3
Sensor 2	Unterminated	multiwire	Unshielded	3
Antenna	Antenna	multiwire	Unshielded	0.25
Power	AC Mains	3 wire	Shielded	2

EUT Operation During Emissions

The EUT was transmitting continuously during testing.

Client:	Savi	Job Number:	J47862
Model:	SP-600-211 (123 kHz version)	T-Log Number:	T47867
		Proj Eng:	Mark Briggs
Contact:	Gene Schlindwein		
Spec:	FCC 15.209	Class:	N/A

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: 7/18/2002
Test Engineer: Chris Byleckie
Test Location: SVOATS #2

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

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.

Ambient Conditions:

Temperature: 22°C
Rel. Humidity: 59%

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power 120V/60Hz	FCC B	Pass	-.5dB @ 13.517MHz

Modifications Made During Testing:

No Modifications performed.

Deviations From The Standard

No deviations were made from the requirements of the standard.

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EMC Test Data

Client:	Savi	Job Number:	J47862
Model:	SP-600-211 (123 kHz version)	T-Log Number:	T47867
		Proj Eng:	Mark Briggs
Contact:	Gene Schlindwein		
Spec:	FCC 15.209	Class:	N/A

Run #1: AC Power Port Conducted Emissions, 0.15 - 30MHz,120V/60Hz

Frequency	Level	AC	FCC B		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
13.5170	47.5	Line	48.0	-0.5	QP	
4.8480	44.2	Neutral	48.0	-3.8	QP	
4.0410	44.2	Neutral	48.0	-3.8	QP	
2.2890	44.2	Line	48.0	-3.8	QP	
4.4460	43.5	Neutral	48.0	-4.5	QP	
4.7130	40.8	Line	48.0	-7.2	QP	

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EMC Test Data

Client:	Savi	Job Number:	J47862
Model:	SP-600-211 (123 kHz version)	T-Log Number:	T47867
		Proj Eng:	Mark Briggs
Contact:	Gene Schlindwein		
Spec:	FCC 15.209	Class:	N/A

Radiated Emissions - FCC 15.209 Radio

Test Specifics

Objective: The objective is to perform preliminary measurements of the fundamental field strength and field strength of spurious emissions at 3m, 10m, and 20m.

Date of Test: 7/23/2002
Test Engineer: Chris Byleckie
Test Location: SVOATS #2

Config. Used: 1
Config Change:
EUT Voltage: 120Vac, 60Hz

General Test Configuration

The radio and integral antennae were located on a table during testing.

For radiated emissions testing below 30 MHz the measurement antenna was located 5, 10, and 20 meters from the EUT as noted. Radiated magnetic field measurements were made with the loop antenna located one meter above the ground plane. The loop was place 0 degress (Open Loop) and 90 degress (Close Loop).

Ambient Conditions:

Temperature: 22°C
Rel. Humidity: 59%

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	Fundamental	15.209	Pass	-.59dB @ 122.88kHz
2	Spurious	15.209	Pass	-1.51dB @ 615kHz

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.

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EMC Test Data

Client:	Savi	Job Number:	J47862
Model:	SP-600-211 (123 kHz version)	T-Log Number:	T47867
		Proj Eng:	Mark Briggs
Contact:	Gene Schlindwein		
Spec:	FCC 15.209	Class:	N/A

Run #1: Fundamental Field Strength -CW Mode w/ Unit Parallel to Table.

Below 150kHz a bandwidth of 1 kHz was used (Test receiver ESN)

EUT Loop antenna, Asset #1299, was elevated 1.0 meters above ground plane.

EUT perpendicular to the table

Frequency MHz	Reading dBµV	AF dB	Level dBuV/m	Detector	Distance (m)	Comments
0.123	83.1	10.5	93.6	Pk	20.0	**Open Loop**
0.123	83.1	10.5	93.6	AV	20.0	Open Loop
0.123	83.0	10.5	93.5	Pk	20.0	Close Loop
0.123	83.0	10.5	93.5	AV	20.0	Close Loop
0.123	100.6	10.5	111.1	Pk	10.0	**Open Loop**
0.123	100.6	10.5	111.1	AV	10.0	Open Loop
0.123	98.4	10.5	108.9	Pk	10.0	Close Loop
0.123	98.4	10.5	108.9	AV	10.0	Close Loop
0.123	122.2	10.5	132.7	Pk	5.0	**Open Loop**
0.123	122.2	10.5	132.7	AV	5.0	Open Loop
0.123	116.8	10.5	127.3	Pk	5.0	Close Loop
0.123	116.8	10.5	127.3	AV	5.0	Close Loop

EUT parallel to the table

Frequency MHz	Reading dBµV	AF dB	Level dBuV/m	Detector	Distance (m)	Comments
0.123	62.6	10.5	73.1	Pk	20.0	**Open Loop**
0.123	62.6	10.5	73.1	AV	20.0	Open Loop
0.123	57.2	10.5	67.7	Pk	20.0	Close Loop
0.123	55.5	10.5	66.0	AV	20.0	Close Loop
0.123	87.5	10.5	98.0	Pk	10.0	**Open Loop**
0.123	87.5	10.5	98.0	AV	10.0	Open Loop
0.123	58.2	10.5	68.7	Pk	10.0	Close Loop
0.123	58.2	10.5	68.7	AV	10.0	Close Loop
0.123	108.0	10.5	118.5	Pk	5.0	**Open Loop**
0.123	108.0	10.5	118.5	AV	5.0	Open Loop
0.123	80.0	10.5	90.5	Pk	5.0	Close Loop
0.123	80.0	10.5	90.5	AV	5.0	Close Loop

Elliott

EMC Test Data

Client:	Savi	Job Number:	J47862
Model:	SP-600-211 (123 kHz version)	T-Log Number:	T47867
		Proj Eng:	Mark Briggs
Contact:	Gene Schlindwein		
Spec:	FCC 15.209	Class:	N/A

Data Summary - Extrapolation Factor

Freq (kHz)	Level At Test Distance @5m		@10m		@20m		EUT orientation
	dBuV/m	dBuA/m	dBuV/m	dBuA/m	dBuV/m	dBuA/m	
123	**132.7**	81.2	**111.1**	59.6	**93.6**	42.1	Perpendicular

Extrapolation Factors For Fundamental Signal

The following extrapolation factors are calculated by dividing the difference between the field strengths at the two distances by the log (base ten) of the ratio of the two distances.

	Perpendicular
10m to 20m	-58.1
5m to 10m	-71.8
5m to 20m	-64.9

The equation used for extrapolation is:

Extrapolation =[(Fm - F) / Log (Dm/Ds)] dB

Where:

Fm = measured field strength in dBuV/m or dBuA/m
Ds is the specification test distance
Dm is the actual measurement distance used

Calculated extrapolation factor used for extrapolating the fundamental signal level:	-58.1	dB
Actual extrapolation from 20m to 300m:	68.4	dB
Highest field strength at 20m (average):	93.6	dBuV/m
Highest field strength at 20m (peak):	96.4	dBuV/m
Extrapolated level at 300m (Average):	25.2	dBuV/m
Extrapolated level at 300m (Peak):	28.0	dBuV/m

The limit for the peak field strength at 123 kHz is 45.8dBuV/m and for average the limit is 25.8dBuV/m.

Fundamental Signal Test results

Frequency kHz	Level dBµV/m	Detector	Limit	Margin	Notes
122.9	25.2	AV	25.8	**-0.6**	Extrapolated from 20m to 300m using correction of 58.1Log(300/20)
122.9	28.0	Pk	45.8	**-17.8**	Extrapolated from 20m to 300m using correction of 58.1Log(300/20)

Elliott

EMC Test Data

Client:	Savi	Job Number:	J47862
Model:	SP-600-211 (123 kHz version)	T-Log Number:	T47867
		Proj Eng:	Mark Briggs
Contact:	Gene Schlindwein		
Spec:	FCC 15.209	Class:	N/A

Run #2: Field Strength of Spurious Emissions - CW Mode

EUT Loop antenna, Asset #1299, was elevated 1.00 meters from ground plane.

EUT perpendicular to the table, Antenna Parallel to EUT

Frequency kHz	Reading dBµV	AF dB	Test Distance (m)	Extrapolation dB	Level dBµV/m	Detector	Limit	Margin	Notes
615.0	39.0	10.2	10.0	-19.1	30.1	QP	31.8	-1.7	Signal Sub
492.0	35.2	10.2	10.0	-19.1	26.3	QP	33.8	-7.4	
246.0	43.8	10.2	10.0	-59.1	-5.1	QP	19.8	-24.9	
369.0	33.6	10.2	10.0	-59.1	-15.3	QP	16.3	-31.5	

EUT perpendicular to the table, Antenna Perpendicular to EUT

Frequency kHz	Reading dBµV	AF dB	Test Distance (m)	Extrapolation dB	Level dBµV/m	Detector	Limit	Margin	Notes
615.0	39.2	10.2	10.0	-19.1	30.3	QP	31.8	-1.5	Signal Sub
492.0	38.3	10.2	10.0	-19.1	29.4	QP	33.8	-4.3	
369.0	50.2	10.2	10.0	-59.1	1.3	QP	16.3	-14.9	
246.0	45.3	10.2	10.0	-59.1	-3.6	QP	19.8	-23.4	

EUT parallel to the table, Antenna Parallel to EUT

Frequency kHz	Reading dBµV	AF dB	Test Distance (m)	Extrapolation dB	Level dBµV/m	Detector	Limit	Margin	Notes
615.0	37.8	10.2	10.0	-19.1	28.9	QP	31.8	-2.9	Signal Sub
492.0	33.1	10.2	10.0	-19.1	24.2	QP	33.8	-9.5	
369.0	41.3	10.2	10.0	-59.1	-7.6	QP	16.3	-23.8	
246.0	43.0	10.2	10.0	-59.1	-5.9	QP	19.8	-25.7	

EUT parallel to the table, Antenna Perpendicular to EUT

Frequency kHz	Reading dBµV	AF dB	Test Distance (m)	Extrapolation dB	Level dBµV/m	Detector	Limit	Margin	Notes
615.0	38.0	10.2	10.0	-19.1	29.1	QP	31.8	-2.7	
492.0	35.6	10.2	10.0	-19.1	26.7	QP	33.8	-7.0	
369.0	42.5	10.2	10.0	-59.1	-6.4	QP	16.3	-22.6	
246.0	40.6	10.2	10.0	-59.1	-8.3	QP	19.8	-28.1	

Notes:

Limit is an average limit below 150kHz (with an additional peak limit of the stated average limit plus 20dB), QP above 150kHz.
Measurements made with the appropriate detector.
Extrapolation factor was applied to the 20 m reading for the fundamental signal and to the 10m reading for the harmonics.
Extrapolation factor of 40Log(Test Distance/Specification Distance) was used for the measurements of the harmonics.