

***Electromagnetic Emissions Test Report
and
Application for Grant of Equipment Authorization
pursuant to
FCC Part 15, Subpart C Specifications for an
Intentional Radiator
and FCC Part 15, Subpart B Specifications for a
Receiver on the
Savi Technology, Inc.
Model: SMR-640P-101 and SMR-640P-110***

FCC ID: KL7-600MR-V1 and KL7-600MR-V1

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: June 7, 2002

FINAL TEST DATE: May 29, 2002, May 31, 2002, June 3, 2002



AUTHORIZED SIGNATORY: _____

Mark Briggs
Director of Engineering

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SCOPE

An electromagnetic emissions test has been performed on the Savi Technology, Inc. model SMR-640P-101 pursuant to Subpart C of Part 15 of FCC Rules for intentional radiators and Subpart B of Part 15 of FCC Rules for receivers. 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 transceiver 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 SMR-640P-101 and therefore apply only to the tested sample. The sample was selected and prepared by Gene Schlindwein of Savi Technology, Inc.

OBJECTIVE

The primary objective of the manufacturer is compliance with Subparts B and C of Part 15 of FCC Rules for the radiated and conducted emissions of intentional radiators and receivers. 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 SMR-640P-101 complied with the requirements of Subpart C of Part 15 of the FCC Rules for low power intentional radiators and the requirements of Subpart B of Part 15 of the FCC Rules for receivers operating between 30 MHz and 960 MHz.

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.).

EMISSION TEST RESULTS

The following emissions tests were performed on the Savi Technology, Inc. model SMR-640P-101. 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 for an intentional radiator and Part 15 Section 15.107(a) for a receiver.

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.

Frequency MHz	Level dBuV	Power Lead	12.207 / 15.107(a) Limit	Margin	Detector QP/Ave	Comments
0.5442	38.8	Neutral	48.0	-9.2	QP	

LIMITS OF RADIATED FIELD STRENGTH - RECEIVER

The EUT tested complied with the limits detailed in FCC Rules Part 15 FCC Rules Part 15 Section 15.109(a) for a receiver.

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.

30 – 1000 MHz

Frequency MHz	Level dBuV/m	Pol v/h	Class B		Detector Pk/QP/Avg	Azimuth Degrees	Height Meters	Comments
			Limit	Margin				
867.525	45.3	v	46.0	-0.7	QP	190	1.0	EUT on its back

LIMITS OF RADIATED FIELD STRENGTH –INTENTIONAL SIGNAL

The fundamental signal levels complied with the limits detailed in FCC Rules Part 15 Section 15.23(a) in the case of the Wake-Up and control signals and section 15.231(e) for the data signals.

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.

Wake-Up signal operating under 15.231(a)

Frequency MHz	Level dBuV/m	Pol v/h	15.231(a)		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
433.885	79.3	v	100.8	-21.5	Pk	126	1.3	EUT Upright

Pulsed Control signals operating under 15.231(a)

Frequency MHz	Level dBuV/m	Pol v/h	15.231(a)		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
433.885	80.6	v	80.8	-0.2	Avg	300	1.2	EUT Upright

Data signals operate on a 25% duty cycle. Average readings calculated from the peak readings by subtracting 12dB.

Data signals operating under 15.231(e)

Frequency MHz	Level dBuV/m	Pol v/h	15.231(e)		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
433.885	72.6	v	72.9	-0.3	Avg	300	1.2	EUT Upright

Data signals operate on a 10% duty cycle. Average readings calculated from the peak readings by subtracting 20dB.

BANDWIDTH

The bandwidth of the 433 MHz signals is 485kHz.

DUTY CYCLE / PERIOD OF OPERATION

Data signal transmissions consist of a pulse train of 9.96ms pulses, 1 pulse every 100ms (duty cycle = 10%). The pulse train transmission lasts for 0.912s and there is a silent period of 30s between successive transmissions, thereby meeting the timing requirements of 15.231(e).

The Wake-Up control signal lasts for 2.5 seconds and is a random transmission triggered by a motion detector or operator. The timing of this signal meets the requirements of 15.231(a).

The "Hello" control pulse lasts for 3.64ms and the "Sleep" control pulse lasts for 5.86ms. The maximum duty cycle of these transmissions is four "Sleep" pulses in any 100ms period (23.44ms per 100ms, or 24% duty cycle). The combination of a single "Hello" pulse plus "Sleep" pulses lasts for 4.3 seconds. As the transmission of these pulses is triggered by a collection event they are random in nature. The "Hello"/"Sleep" transmissions meet the timing requirements of 15.231(a).

The types of signal transmitted (control versus data) are fully described in the *Theory of Operations* that accompanies this application. Plots of the timings for all transmissions are attached to the test data.

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 SMR-640P-101 and SMR-640P-110 are transceivers that are designed to communicate with Savi's RFID tags. Both units communicate to Tags as a transceiver at 433.92 MHz (the mode of operation covered under this test report) and use identical transmit circuitry to achieve this. The two devices also transmit in the LF range at either 132kHz (SMR-640P-101) or 123kHz (SMR-640P-110).

The device has a serial (RS232) interface to connect directly to a hand-held PC or similar device and operates from internal, rechargeable batteries. The device has an external DC input used to recharge the batteries via adapter. It is intended to be used as a hand-held device although it can operate while connected to the external AC-DC adapter.

The 132kHz and 123kHz transmitters operate under part 15.209 of the FCC's rules. The 433 MHz transceiver operates under section 15.231 of the FCC rules. The 433MHz transmissions consist of both data signals and control signals. The data signals are 10mS long and have a duty cycle of no more than 10% measured in a 100mS period. There are two types of control signal, one that has a duty cycle of 24% and another, the Wake-Up signal, which is a 2.5second transmission.

The 10mS data signals were tested against the requirements of 15.231(e). The Wake-Up control signal and pulsed control signals were tested against the requirements of 15.231(a).

The sample was received on May 29, 2002 and tested on May 29, 2002, May 31, 2002, June 3, 2002.

The EUT consisted of the following component(s):

Manufacturer	Model	Description	Serial Number
Savi	SMR-640P-101	Mobile reader	0386505020006

ENCLOSURE

The EUT enclosure is primarily constructed of plastic.

MODIFICATIONS

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

SUPPORT EQUIPMENT

The following equipment was used as local support equipment while testing the emissions from the 132kHz transmitter and 433MHz transceiver:

Manufacturer	Model	Description	Serial Number	FCC ID
IBM	2635	Laptop	78-VA24897/11	ANO9611TBOON

No remote support equipment was used during emissions testing.

EXTERNAL I/O CABLING

The I/O cabling configuration while testing the radiated emissions from the transmitters was as follows:

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
RS232	Not connected	30cm integral cable		
DC	AC-DC adapter		unshielded	

The I/O cabling configuration while testing the radiated emissions from the receiver and during conducted emissions tests was as follows:

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
EUT RS232	Laptop	30cm integral cable	shielded	0.3
EUT DC	AC-DC adapter	2-wire	unshielded	1
Printer Parallel	Laptop Parallel	Multiconductor	shielded	3

EUT OPERATION**Radiated**

The EUT was transmitting at either 433 MHz or 132 KHz or was placed in receive-only mode.

Conducted

The 132kHz transmitter was operating and the laptop was running a batch file that created a scrolling 'H' pattern on the screen. The test was not repeated with the 433 MHz transmitter operating as the 132kHz mode was determined to be the worst-case mode.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on May 29, 2002, May 31, 2002, June 3, 2002 at the Elliott Laboratories Open Area Test Site #2 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 are performed in conformance with ANSI C63.4-1992. Measurements are made with the EUT connected to the public power network through 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 Range (MHz)	Limit (uV)	Limit (dBuV)
0.450 to 30.000	250	48

FUNDAMENTAL AND HARMONIC LIMITS 15.231 (b)

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)

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

The table below shows the limits for the spurious emissions from transmitters that fall in restricted bands.

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(a) (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:

$$R_r - B = C$$

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:

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

where:

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

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

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

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:

$$R_r = \text{Receiver Reading in dBuV/m}$$

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

$$R_c = \text{Corrected Reading in dBuV/m}$$

$$L_s = \text{Specification Limit in dBuV/m}$$

$$M = \text{Margin in dB Relative to Spec}$$

EXHIBIT 1: Test Equipment Calibration Data

Radiated Emissions Preliminary Scans, 24-May-02

Engineer: Mark

<u>Manufacturer</u>	<u>Description</u>	<u>Model #</u>	<u>Assett #</u>	<u>Cal interval</u>	<u>Last Calibrated</u>	<u>Cal Due</u>
EMCO	Conical Log Spiral Antenna	3101	608	12	5/15/2002	5/15/2003
EMCO	Magnetic Loop Antenna, 10k-30MHz	6502	296	12	1/16/2002	1/16/2003
Hewlett Packard	Microwave Preamplifier 0.5-26.5GHz	83017A	1257	12	10/16/2001	10/16/2002
Hewlett Packard	RF Preamplifier, 100 kHz - 1.3 GHz	8447D	999	12	4/24/2002	4/24/2003
Hewlett Packard	Spectrum Analyzer, 9KHz - 22GHz	8593EM	1319	12	4/5/2002	4/5/2003
AH Systems	Biconical Antenna	SAS-200/540H	686	12	5/8/2002	5/8/2003
Dorado	Horn Antenna 1-12GHz		1258	12	11/18/2001	11/18/2002

Radiated Emissions, 30 - 1000 MHz, 29-May-02

Engineer: Vishal

<u>Manufacturer</u>	<u>Description</u>	<u>Model #</u>	<u>Assett #</u>	<u>Cal interval</u>	<u>Last Calibrated</u>	<u>Cal Due</u>
EMCO	Log Periodic Antenna, 0.3-1 GHz	3146A	364	12	8/28/2001	8/28/2002
Rohde & Schwarz	Test Receiver, 0.009-2000 MHz	ESN	1332	12	4/16/2002	4/16/2003

Conducted and Radiated Emissions, 31-May-02

Engineer: mfaustino

<u>Manufacturer</u>	<u>Description</u>	<u>Model #</u>	<u>Assett #</u>	<u>Cal interval</u>	<u>Last Calibrated</u>	<u>Cal Due</u>
Elliott Laboratories	FCC / CISPR LISN	LISN-3, OATS	304	12	6/14/2001	6/14/2002
EMCO	Magnetic Loop Antenna, 10k-30MHz	6502	296	12	1/16/2002	1/16/2003
EMCO	Biconical Antenna, 30-300 MHz	3110B	801	12	5/13/2002	5/13/2003
EMCO	Log Periodic Antenna, 0.3-1 GHz	3146A	364	12	8/28/2001	8/28/2002
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
Solar Electronics	Support Equipment LISN, 0.150-30.0 MHz	8012-50-R-24-BNC	305	12	7/30/2001	7/30/2002

Radiated Emissions, 1 - 4.0 GHz, 03-Jun-02

Engineer: mfaustino

<u>Manufacturer</u>	<u>Description</u>	<u>Model #</u>	<u>Assett #</u>	<u>Cal interval</u>	<u>Last Calibrated</u>	<u>Cal Due</u>
EMCO	Horn Antenna, D. Ridge 1-18GHz	3115	1242	12	10/9/2001	10/9/2002
Filtek	High Pass Filter, 1GHz	HP12/1000-5BA	956	12	3/12/2002	3/12/2003
Hewlett Packard	EMC Spectrum Analyzer, Opt. 026 ,9 KHz -26.5GHz	8593EM	1141	12	3/11/2002	3/11/2003
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	12	1/15/2002	1/15/2003

EXHIBIT 2: Test Data Log Sheets

ELECTROMAGNETIC EMISSIONS

TEST LOG SHEETS

AND

MEASUREMENT DATA

T47386 22 Pages
Timing and Bandwidth Plots 7 Pages



EMC Test Data

Client:	Savi	Job Number:	J47361
Model:	SAVI SMR-640P-101	T-Log Number:	T47386
		Proj Eng:	Mark Briggs
Contact:	Eugene Schlindwein		
Emissions Spec:	FCC 15 B, 15.209, 15.231	Class:	A
Immunity Spec:	-	Environment:	-

EMC Test Data

For The

Savi

Model

SAVI SMR-640P-101



EMC Test Data

Client:	Savi	Job Number:	J47361
Model:	SAVI SMR-640P-101	T-Log Number:	T47386
Contact:	Eugene Schindwein	Proj Eng:	Mark Briggs
Emissions Spec:	FCC 15 B, 15.209, 15.231	Class:	A
Immunity Spec:	-	Environment:	-

EUT INFORMATION

General Description

The EUT is a transceiver which is designed to communicate with Savi's RFID tags. The device transmits at 132kHz and at 433.92 MHz to initiate responses from tags within its vicinity. The Tag's transmit at a frequency of 433.92 MHz, so the EUT also contains a receiver operating at 433.92 MHz.

The device has a serial (RS232) interface to connect directly to a hand-held PC or similar device and operates from internal, rechargeable batteries. The device has an external DC input used to recharge the batteries via adapter. It is intended to be used as a hand-held device although it can operate while connected to the external AC-DC adapter.

The 132kHz transmitter operates under part 15.209 of the FCC's rules. The 433 MHz transceiver operates under section 15.231 of the FCC rules. The 433MHz transmissions consist of both data signals and control signals. The data signals are 10mS long and have a duty cycle of no more than 10% measured in a 100mS period. There are two types of control signal, one that has a 24% duty-cycle and another, the Wake-Up signal, that is a 2.5second transmission.

The data signals were tested against the requirements of 15.231(e). The control signals were tested against the requirements of 15.231(a).

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
Savi	SMR-640P-101	Mobile reader	0386505020006	

EUT Enclosure

The EUT enclosure is primarily constructed of plastic.

Modification History

Mod. #	Test	Date	Modification
1	-	-	None



EMC Test Data

Client:	Savi	Job Number:	J47361
Model:	SAVI SMR-640P-101	T-Log Number:	T47386
Contact:	Eugene Schlindwein	Proj Eng:	Mark Briggs
Emissions Spec:	FCC 15 B, 15.209, 15.231	Class:	A
Immunity Spec:	-	Environment:	-

Test Configuration #1

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
None				

Remote Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
None				

Interface Ports

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
RS232	Not connected	30cm integral cable		
DC	AC-DC adapter		unshielded	

EUT Operation During Emissions

The EUT was transmitting at either 433 MHz or 132 KHz.



EMC Test Data

Client:	Savi	Job Number:	J47361
Model:	SAVI SMR-640P-101	T-Log Number:	T47386
Contact:	Eugene Schindwein	Proj Eng:	Mark Briggs
Emissions Spec:	FCC 15 B, 15.209, 15.231	Class:	A
Immunity Spec:	-	Environment:	-

Test Configuration #2 (Digital Device Testing)

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
IBM	2635	Laptop	78-VA24897/11	ANO9611TBOON
Epson	P952A	Printer	ADA0013241	BKMFBP952A

Remote Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
None				

Interface Ports

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
EUT RS232	Laptop	30cm integral cable	shielded	0.3
EUT DC	AC-DC adapter	2-wire	unshielded	1
Printer Parallel	Laptop Parallel	Multiconductor	shielded	3

EUT Operation During Emissions

The EUT was placed in receive-only mode and the laptop was running a batch file that created a scrolling 'H' pattern on the screen.



EMC Test Data

Client: Savi	Job Number: J47361
Model: SAVI SMR-640P-101	T-Log Number: T47386
Contact: Eugene Schindwein	Proj Eng: Mark Briggs
Spec: FCC 15 B, 15.209, 15.231	Class: A

Radiated Emissions

Test Specifics

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

Date of Test: 5/29/2002,
 Test Engineer: V. Narayan,
 Test Location: SVOATS #2,

Config. Used: #2
 Config Change: See individual run notes.
 EUT Voltage: 120V/60Hz

General Test Configuration

The EUT was connected to the laptop PC as detailed in configuration #2. For the digital device/receiver tests the device was operating in receive mode with both transmitters disabled.
 The measurement antenna was located 10m from the EUT for the digital device tests and 3m from the EUT for the receiver LO measurements.
 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:

	5/29/2002	5/31/2002
Temperature:	23°C	19°C
Rel. Humidity:	68%	69%

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	RE, Maximized emissions, 30 - 1000 MHz (Receiver)	FCC 15.109	Pass	-7dB @ 867.525433.78
3	RE, Maximized Emissions, 30 - 1000 MHz (Digital Device)	FCC Class A	Pass	-1dB @ 66.83MHz

Modifications Made During Testing:

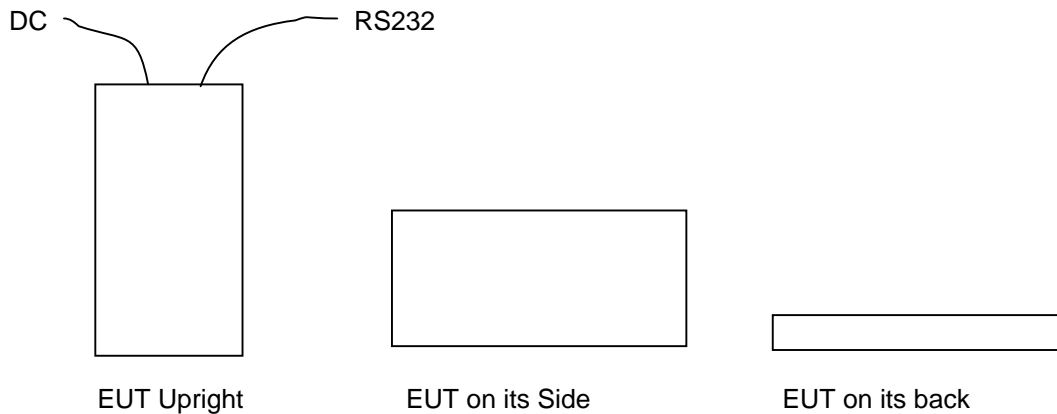
Modifications are detailed under each run description.

Deviations From The Standard

No deviations were made from the requirements of the standard.

Client: Savi	Job Number: J47361
Model: SAVI SMR-640P-101	T-Log Number: T47386
Contact: Eugene Schlindwein	Proj Eng: Mark Briggs
Spec: FCC 15 B, 15.209, 15.231	Class: A

Run #1: Maximized Radiated Emissions, 309 - 1000 MHz: Receiver-related emissions
 Tested at 3m as per FCC rules for a receiver on 5/29/2002, SVOATS #2.



Frequency MHz	Level dB μ V/m	Pol v/h	FCC 15.109		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
867.525	45.3	v	46.0	-0.7	QP	190	1.0	EUT on its back
867.525	45.0	h	46.0	-1.0	QP	200	1.0	EUT on its side
867.525	43.6	v	46.0	-2.4	QP	230	1.0	EUT upright
867.525	43.6	h	46.0	-2.4	QP	200	1.0	EUT upright
433.780	43.2	h	46.0	-2.8	QP	200	1.0	EUT on its back
433.780	42.9	v	46.0	-3.1	QP	180	1.0	EUT upright
867.525	42.8	h	46.0	-3.2	QP	270	1.1	EUT on its back
433.780	42.0	v	46.0	-4.0	QP	250	1.2	EUT on its side
433.780	41.9	h	46.0	-4.1	QP	230	1.0	EUT upright
433.780	41.9	h	46.0	-4.1	QP	210	1.0	EUT on its side
433.780	41.7	v	46.0	-4.3	QP	180	1.2	EUT on its back
867.525	41.1	v	46.0	-4.9	QP	10	1.0	EUT on its side

Note 1: During testing the printer was removed from the test configuration. This was a test of the emissions from the receiver and not the from the digital device so the printer was not necessary.



EMC Test Data

Client: Savi	Job Number: J47361
Model: SAVI SMR-640P-101	T-Log Number: T47386
Contact: Eugene Schindwein	Proj Eng: Mark Briggs
Spec: FCC 15 B, 15.209, 15.231	Class: A

Run #2: Preliminary Radiated Emissions, 30 - 1000 MHz (Digital Device)

Tested at 10m as per FCC Rules for a Class A digital device

Frequency MHz	Level dB μ V/m	Pol v/h	FCC Class A		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
66.830	36.3	V	39.1	-2.8	QP	163	1.0	
334.100	34.7	V	46.4	-11.7	QP	80	1.0	
801.835	33.7	H	46.4	-12.7	QP	230	1.0	
33.420	26.4	V	39.1	-12.7	QP	188	1.0	
200.460	30.2	V	43.5	-13.3	QP	9	1.0	Signal substitution
467.745	32.8	H	46.4	-13.6	QP	46	1.0	
334.100	32.1	H	46.4	-14.3	QP	92	1.0	
31.090	24.6	V	39.1	-14.5	QP	180	1.0	
868.695	31.1	H	46.4	-15.3	QP	185	1.0	
467.745	30.1	V	46.4	-16.3	QP	47	1.0	
200.460	26.7	H	43.5	-16.8	QP	250	4.0	Signal substitution
801.835	28.0	V	46.4	-18.4	QP	116	2.0	
735.035	27.4	H	46.4	-19.0	QP	212	1.0	
167.060	22.9	H	43.5	-20.6	QP	294	4.0	
868.695	25.5	V	46.4	-20.9	QP	301	1.0	Signal substitution
40.010	17.6	V	39.1	-21.5	QP	0	1.0	
167.060	20.1	V	43.5	-23.4	QP	343	1.0	
735.035	21.1	V	46.4	-25.3	QP	261	1.0	

Run #3: Maximized Radiated Emissions, 30 - 1000 MHz from Run #2 (Digital Device)

Tested at 10m as per FCC Rules for a Class A digital device

Frequency MHz	Level dB μ V/m	Pol v/h	FCC Class A		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
66.830	38.1	V	39.1	-1.0	QP	163	1.0	
334.100	34.7	V	46.4	-11.7	QP	80	1.0	
801.835	33.7	H	46.4	-12.7	QP	230	1.0	
33.420	28.1	V	39.1	-11.0	QP	188	1.0	
200.460	30.2	V	43.5	-13.3	QP	9	1.0	Signal substitution
467.745	32.8	H	46.4	-13.6	QP	46	1.0	



EMC Test Data

Client: Savi	Job Number: J47361
Model: SAVI SMR-640P-101	T-Log Number: T47386
Contact: Eugene Schlindwein	Proj Eng: Mark Briggs
Spec: FCC 15 B, 15.209, 15.231	Class: 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: 5/31/2002
 Test Engineer: Marissa Faustino
 Test Location: SVOATS #2

Config. Used: #2
 Config Change: The 132kHz Tx was on
 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.

Ambient Conditions: Temperature: 19°C
 Rel. Humidity: 69%

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power 230V/50Hz	EN 301 489-3	Pass	-2.25dB @ .405MHz
2	CE, AC Power 120V/60Hz	FCC Class B / 15.207	Pass	-9.2dB @ .544MHz

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	Job Number: J47361
Model: SAVI SMR-640P-101	T-Log Number: T47386
Contact: Eugene Schindwein	Proj Eng: Mark Briggs
Spec: FCC 15 B, 15.209, 15.231	Class: A

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

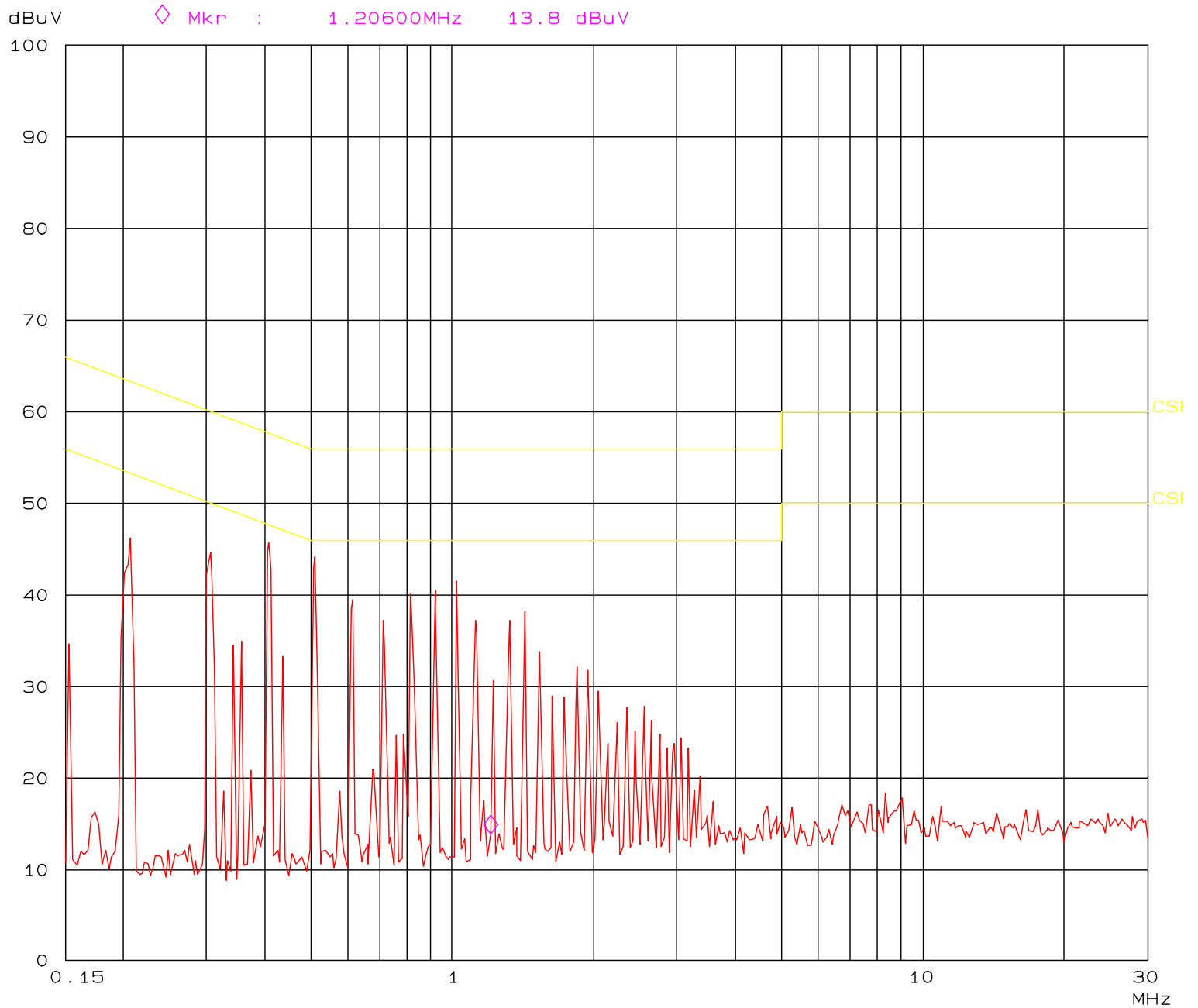
Frequency MHz	Level dB μ V	AC Line	EN 301 489-3		Detector QP/Ave	Comments
			Limit	Margin		
0.4050	45.5	Neutral	47.8	-2.3	Average	
0.5100	43.2	Line	46.0	-2.8	Average	
0.4080	44.8	Line	47.7	-2.9	Average	
0.5070	42.0	Neutral	46.0	-4.0	Average	
0.2048	42.6	Line	53.4	-10.8	Average	
0.4050	45.9	Neutral	57.8	-11.9	QP	
0.5100	43.9	Line	56.0	-12.1	QP	
0.4080	45.2	Line	57.7	-12.5	QP	
0.5070	43.4	Neutral	56.0	-12.6	QP	
0.2048	43.0	Line	63.4	-20.4	QP	
0.1530	42.7	Neutral	65.8	-23.1	QP	
0.1530	14.1	Neutral	55.8	-41.7	Average	

Run #2: AC Power Port Conducted Emissions, 0.45 - 30MHz, 120V/60Hz

Frequency MHz	Level dB μ V	AC Line	FCC 15.109B, 15.209		Detector QP/Ave	Comments
			Limit	Margin		
0.5442	38.8	Neutral	48.0	-9.2	QP	
0.6330	38.7	Neutral	48.0	-9.3	QP	
0.6355	38.4	Line	48.0	-9.6	QP	
0.5449	37.9	Line	48.0	-10.1	QP	
1.2719	37.4	Line	48.0	-10.6	QP	
1.2703	37.3	Neutral	48.0	-10.7	QP	

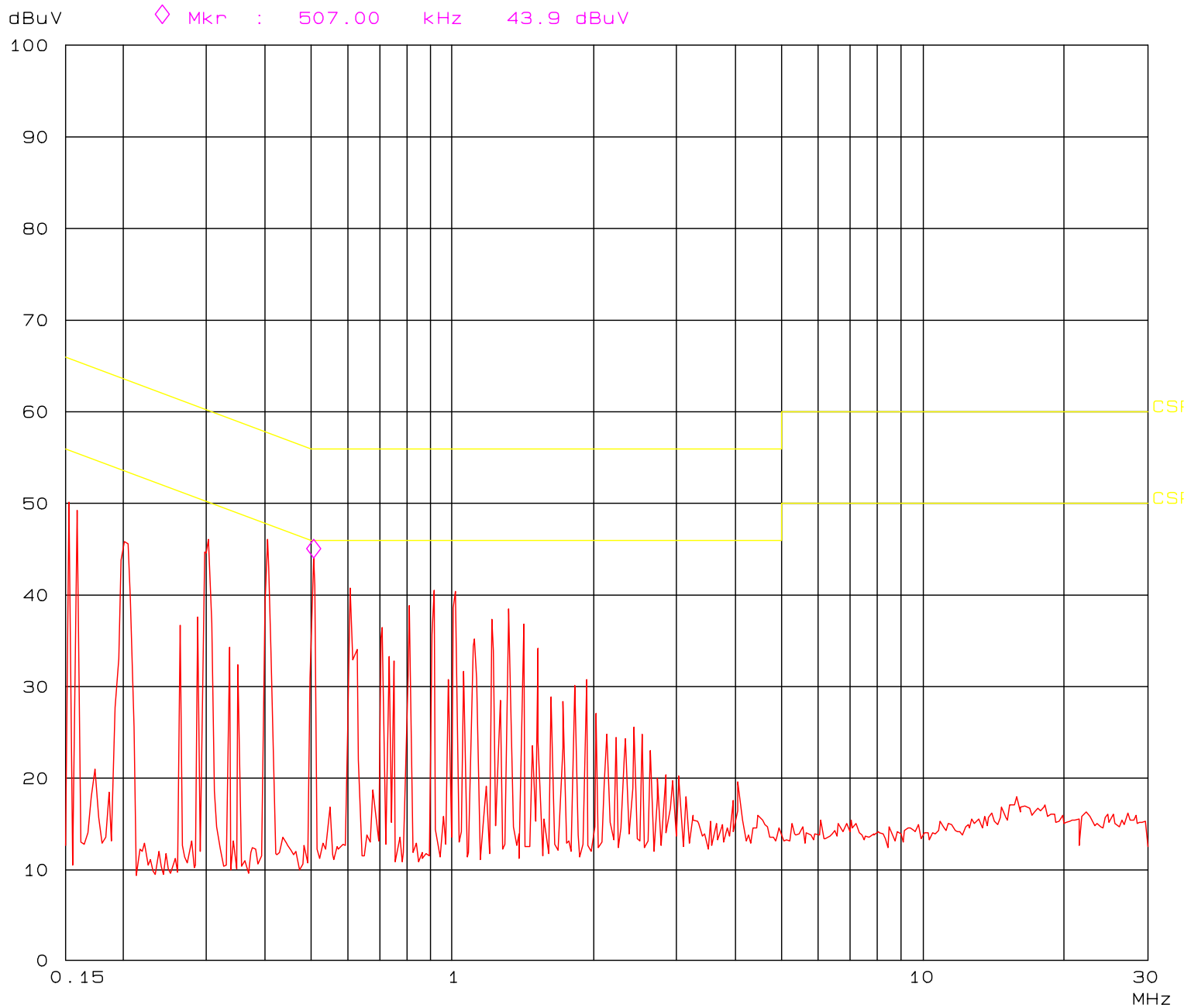
Conducted Emissions

Operator: Marissa Fausitno
Comment: Savi Technology
SMR-600P-102
EN 301 489-3
Run 1
230V/50Hz
Line



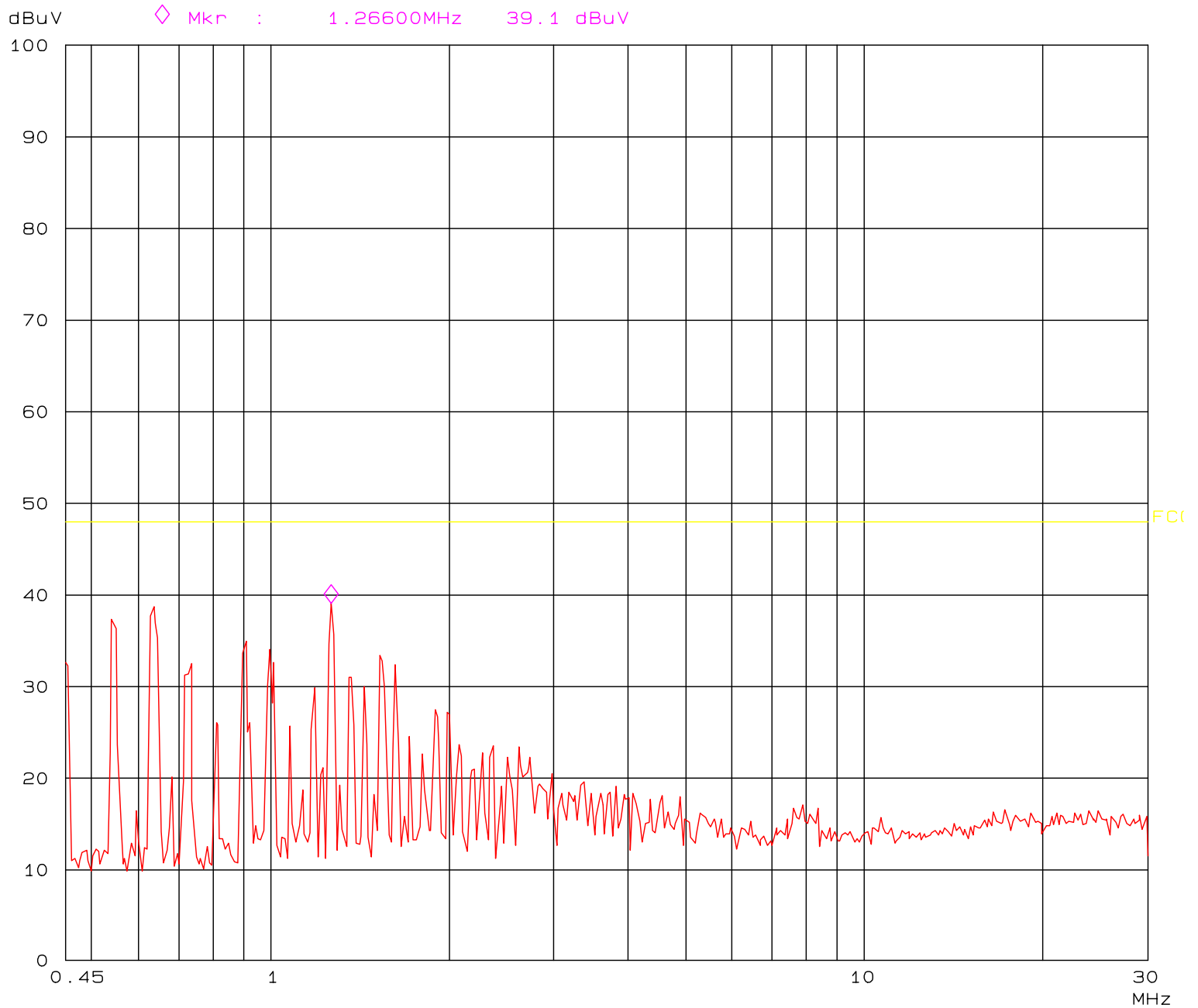
Conducted Emissions

Operator: Marissa Fausitno
Comment: Savi Technology
SMR-600P-102
EN 301 489-3
Run 1
230V/50Hz
Neutral



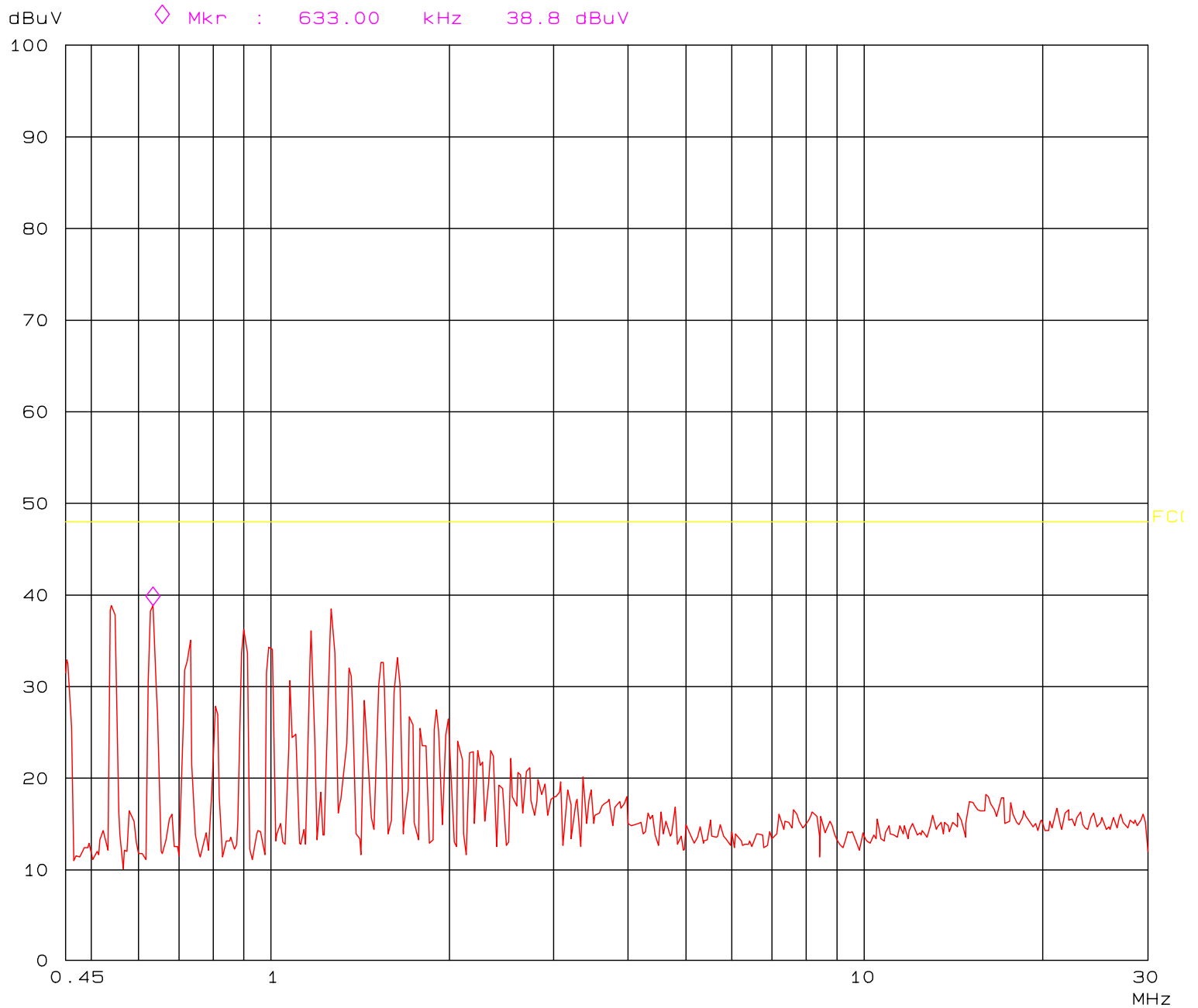
Conducted Emissions

Operator: Marissa Fausitno
Comment: Savi Technology
SMR-600P-102
FCC Class B
Run 2
120V/60Hz
Line



Conducted Emissions

Operator: Marissa Fausitno
Comment: Savi Technology
SMR-600P-102
FCC Class B
Run 2
120V/60Hz
Neutral



Client: Savi	Job Number: J47361
Model: SAVI SMR-640P-101	T-Log Number: T47386
Contact: Eugene Schlindwein	Proj Eng: Mark Briggs
Spec: FCC 15 B, 15.209, 15.231	Class: A

Radiated Emissions - FCC 15.231 Control and Data Signals

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: 5/29/02, 5/31/02, 6/3/02
 Test Engineer: V. Narayan, M. Faustino
 Test Location: SVOATS #2,

Config. Used: #1
 Config Change: N/A
 EUT Voltage: 120V/60Hz

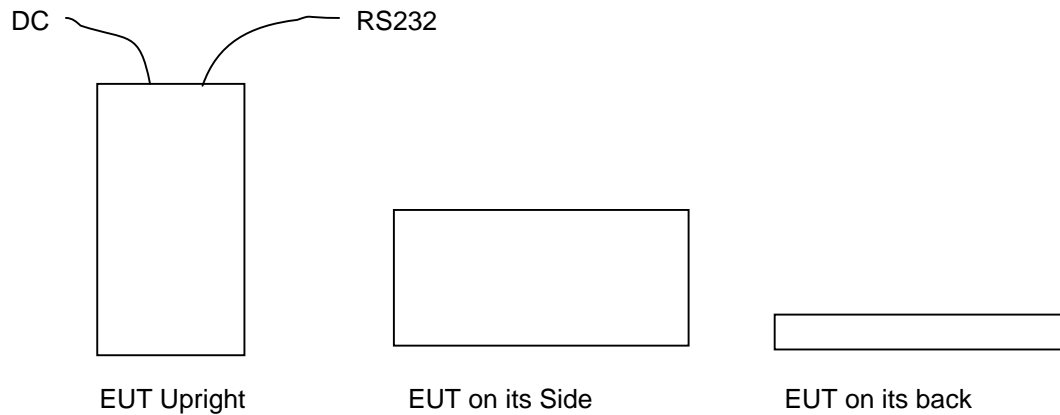
General Test Configuration

The 433 MHz transmitter was set to its maximum output level for each signal type (pulsed data, pulsed control and Wake-Up control signals) during the test. The transmitter was operating continuously. Average correction factors based on the duty cycle of the pulsed signals were applied to the peak measurement to obtain the average measurement. Average measurement of the "Wake-Up" signal was made using an average detector and with the EUT transmitting a modulated signal.

The measurement antenna was located 3m from the EUT. The measurement data has been extrapolated to the appropriate distance.

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.

The EUT was tested oriented in three orthogonal orientations as shown below:





EMC Test Data

Client: Savi	Job Number: J47361
Model: SAVI SMR-640P-101	T-Log Number: T47386
Contact: Eugene Schindwein	Proj Eng: Mark Briggs
Spec: FCC 15 B, 15.209, 15.231	Class: A

Ambient Conditions:

	5/29/2002	5/31/2002	6/3/2002
Temperature:	23°C	19°C	21°C
Rel. Humidity:	68%	69%	52%

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1a	RE, 433.92 MHz Fundamental Signal - Pulsed Data Signal	FCC 15.31(e)	Pass	-.3dB @ 433.885MHz
1b	RE, 30MHz - 4.4GHz (10mS Data Signal)	FCC 15.31(e)	Pass	-2.6dB @ 2169.72MHz
2a	RE, 433.92 MHz Fundamental Signal - "Pulsed" Control	FCC 15.31(a)	Pass	-0.2dB @ 433.885433.885
2b	RE, 30MHz - 4.4GHz ("Pulse-Control)	FCC 15.31(a)	Pass	-10.2dB @ 3905.73905.66
3a	RE, 433.92 MHz Fundamental Signal - "Wake-Up" Control	FCC 15.31(a)	Pass	-21.5dB @ 433.885MHz
3b	RE, 30MHz - 4.4GHz ("Wake-Up" Control)	FCC 15.31(a)	Pass	-10.9dB @ 3905.66MHz

Modifications Made During Testing:

Modifications are detailed under each run description.

Deviations From The Standard

No deviations were made from the requirements of the standard.



EMC Test Data

Client: Savi	Job Number: J47361
Model: SAVI SMR-640P-101	T-Log Number: T47386
Contact: Eugene Schindwein	Proj Eng: Mark Briggs
Spec: FCC 15 B, 15.209, 15.231	Class: A

Run #1: Preliminary Radiated Emissions, 30 - 4000 MHz: Transmit Mode (433.92 MHz) - 10mS Data Signal
3-orientations of the EUT tested

Fundamental Signal and second harmonic measured on 5/29/02. All others measured on 6/3/02

Frequency MHz	Level dBµV/m	Pol v/h	FCC 15.231(e)		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
433.885	92.6	v	92.9	-0.3	Pk	300	1.2	EUT Upright
433.885	72.6	v	72.9	-0.3	Avg	300	1.2	EUT Upright
433.885	91.8	v	92.9	-1.1	Pk	290	1.2	EUT on its side
433.885	71.8	v	72.9	-1.1	Avg	290	1.2	EUT on its side
433.885	91.7	h	92.9	-1.2	Pk	230	1.0	EUT on its back
433.885	71.7	h	72.9	-1.2	Avg	230	1.0	EUT on its back
433.885	91.5	v	92.9	-1.4	Pk	300	1.2	EUT Upright
433.885	71.5	v	72.9	-1.4	Avg	300	1.2	EUT Upright
433.885	90.9	v	92.9	-2.0	Pk	180	1.1	EUT on its back
433.885	70.9	v	72.9	-2.0	Avg	180	1.1	EUT on its back
433.885	90.5	h	92.9	-2.4	Pk	230	1.0	EUT on its side
433.885	70.5	h	72.9	-2.4	Avg	230	1.0	EUT on its side
433.885	90.1	h	92.9	-2.8	Pk	240	1.0	EUT Upright
433.885	70.1	h	72.9	-2.8	Avg	240	1.0	EUT Upright

Spurious Signals

Frequency MHz	Level dBµV/m	Pol v/h	FCC 15.231(e)		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
3905.660	35.8	v	54.0	-18.2	Avg	0	1.0	EUT on its back - restricted band
3905.660	55.8	v	74.0	-18.2	Pk	0	1.0	EUT on its back - restricted band
3905.660	35.8	h	54.0	-18.2	Avg	0	1.0	EUT on its back - restricted band
3905.660	55.8	h	74.0	-18.2	Pk	0	1.0	EUT on its back - restricted band
2169.720	35.6	h	54.0	-18.4	Avg	144	1.0	EUT on its side
2169.720	55.6	h	74.0	-18.4	Pk	144	1.0	EUT on its side
867.765	34.3	h	52.9	-18.6	Avg	40	1.0	EUT on its back
867.765	54.3	h	72.9	-18.6	Pk	40	1.0	EUT on its back
867.765	33.2	h	52.9	-19.7	Avg	180	1.0	EUT on its side
867.765	53.2	h	72.9	-19.7	Pk	180	1.0	EUT on its side
1735.735	34.2	v	54.0	-19.8	Avg	186	1.0	EUT upright
1735.735	54.2	v	74.0	-19.8	Pk	186	1.0	EUT upright
3471.675	34.1	v	54.0	-19.9	Avg	295	1.8	EUT upright
3471.675	54.1	v	74.0	-19.9	Pk	295	1.8	EUT upright
3471.675	33.9	v	54.0	-20.1	Avg	0	1	EUT on its back-noise floor
3471.675	53.9	v	74.0	-20.1	Pk	0	1	EUT on its back-noise floor
3471.675	33.9	h	54.0	-20.1	Avg	215	2.4	EUT on its back
3471.675	53.9	h	74.0	-20.1	Pk	215	2.4	EUT on its back
3037.690	33.9	v	54.0	-20.1	Avg	0	1	EUT on its back-noise floor
3037.690	53.9	v	74.0	-20.1	Pk	0	1	EUT on its back-noise floor
3037.690	33.9	h	54.0	-20.1	Avg	0	1	EUT on its back-noise floor



EMC Test Data

Client: Savi						Job Number: J47361		
Model: SAVI SMR-640P-101						T-Log Number: T47386		
Contact: Eugene Schindwein						Proj Eng: Mark Briggs		
Spec: FCC 15 B, 15.209, 15.231						Class: A		
3037.690	53.9	h	74.0	-20.1	Pk	0	1	EUT on its back-noise floor
2169.720	33.6	v	54.0	-20.4	Avg	152	1.0	EUT on its side
2169.720	53.6	v	74.0	-20.4	Pk	152	1.0	EUT on its side
3471.675	53.5	h	74.0	-20.5	Pk	104	1.5	EUT upright
2169.720	33.5	v	54.0	-20.5	Avg	148	1.0	EUT upright
2169.720	53.5	v	74.0	-20.5	Pk	148	1.0	EUT upright
867.765	31.7	v	52.9	-21.2	Avg	170	1.5	EUT Upright
867.765	51.7	v	72.9	-21.2	Pk	170	1.5	EUT Upright
1735.735	32.5	v	54.0	-21.5	Avg	121	1.0	EUT on its side
1735.735	52.5	v	74.0	-21.5	Pk	121	1.0	EUT on its side
867.765	31.1	h	52.9	-21.8	Avg	140	1.0	EUT Upright
867.765	51.1	h	72.9	-21.8	Pk	140	1.0	EUT Upright
3037.690	32.1	v	54.0	-21.9	Avg	134	1.1	EUT on its side
3037.690	52.1	v	74.0	-21.9	Pk	134	1.1	EUT on its side
3037.690	32.0	h	54.0	-22.0	Avg	0	1.0	EUT upright-noise floor
3037.690	52.0	h	74.0	-22.0	Pk	0	1.0	EUT upright-noise floor
3037.690	32.0	v	54.0	-22.0	Avg	0	1.0	EUT upright-noise floor
3037.690	52.0	v	74.0	-22.0	Pk	0	1.0	EUT upright-noise floor
3905.660	32.0	h	54.0	-22.0	Avg	0	1.0	EUT upright - restricted band
3905.660	52.0	h	74.0	-22.0	Pk	0	1.0	EUT upright - restricted band
3905.660	32.0	v	54.0	-22.0	Avg	0	1.0	EUT upright - restricted band
3905.660	52.0	v	74.0	-22.0	Pk	0	1.0	EUT upright - restricted band
3905.660	32.0	v	54.0	-22.0	Avg	0	1.0	EUT on its side - restricted band
3905.660	52.0	v	74.0	-22.0	Pk	0	1.0	EUT on its side - restricted band
3905.660	32.0	h	54.0	-22.0	Avg	0	1.0	EUT on its side - restricted band
3905.660	52.0	h	74.0	-22.0	Pk	0	1.0	EUT on its side - restricted band
3471.675	32.0	v	54.0	-22.0	Avg	0	1.0	EUT on its side-noise floor
3471.675	52.0	v	74.0	-22.0	Pk	0	1.0	EUT on its side-noise floor
3471.675	32.0	h	54.0	-22.0	Avg	0	1.0	EUT on its side-noise floor
3471.675	52.0	h	74.0	-22.0	Pk	0	1.0	EUT on its side-noise floor
3037.690	32.0	h	54.0	-22.0	Avg	0	1.0	EUT on its side-noise floor
3037.690	52.0	h	74.0	-22.0	Pk	0	1.0	EUT on its side-noise floor
1735.735	32.0	h	54.0	-22.0	Avg	115	1.1	EUT on its back
1735.735	52.0	h	74.0	-22.0	Pk	115	1.1	EUT on its back
1735.735	31.9	h	54.0	-22.1	Avg	186	1.3	EUT on its side
1735.735	51.9	h	74.0	-22.1	Pk	186	1.3	EUT on its side
2603.705	31.9	h	54.0	-22.1	Avg	160	1.1	EUT on its back - restricted band
2603.705	51.9	h	74.0	-22.1	Pk	160	1.1	EUT on its back - restricted band
2169.720	31.6	h	54.0	-22.4	Avg	124	1.0	EUT upright
2169.720	51.6	h	74.0	-22.4	Pk	124	1.0	EUT upright
2603.705	31.5	h	54.0	-22.5	Avg	115	1.2	EUT upright - restricted band
2603.705	51.5	h	74.0	-22.5	Pk	115	1.2	EUT upright - restricted band

continued on following page



EMC Test Data

Client: Savi	Job Number: J47361
Model: SAVI SMR-640P-101	T-Log Number: T47386
Contact: Eugene Schindwein	Proj Eng: Mark Briggs
Spec: FCC 15 B, 15.209, 15.231	Class: A

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2603.705	31.3	v	54.0	-22.7	Avg	196	1.0	EUT upright - restricted band
2603.705	51.3	v	74.0	-22.7	Pk	196	1.0	EUT upright - restricted band
2603.705	51.2	v	74.0	-22.8	Pk	210	1.0	EUT on its back - restricted band
2603.705	31.2	v	54.0	-22.8	Avg	210	1.0	EUT on its back - restricted band
2603.705	31.0	v	54.0	-23.0	Avg	71	1.0	EUT on its side - restricted band
2603.705	51.0	v	74.0	-23.0	Pk	71	1.0	EUT on its side - restricted band
2169.720	30.8	v	54.0	-23.2	Avg	60	1.0	EUT on its back
2169.720	50.8	v	74.0	-23.2	Pk	60	1.0	EUT on its back
2169.720	50.7	h	74.0	-23.3	Pk	189	1.0	EUT on its back
2169.720	30.7	h	54.0	-23.3	Avg	189	1.0	EUT on its back
867.765	29.3	v	52.9	-23.6	Pk	290	1.0	EUT on its back
2603.705	30.4	h	54.0	-23.6	Avg	124	1.0	EUT on its side - restricted band
2603.705	50.4	h	74.0	-23.6	Pk	124	1.0	EUT on its side - restricted band
867.765	49.3	v	72.9	-23.6	Pk	290	1.0	EUT on its back
867.765	28.5	v	52.9	-24.4	Pk	280	1.0	EUT on its side
867.765	48.5	v	72.9	-24.4	Pk	280	1.0	EUT on its side
1735.735	29.5	h	54.0	-24.5	Avg	196	1.6	EUT upright
1735.735	49.5	h	74.0	-24.5	Pk	196	1.6	EUT upright
1735.735	49.2	v	74.0	-24.8	Pk	183	1.0	EUT on its back
1735.735	29.2	v	54.0	-24.8	Avg	183	1.0	EUT on its back
1301.750	28.6	h	54.0	-25.4	Avg	318	1.0	EUT on its side - restricted band
1301.750	48.6	h	74.0	-25.4	Pk	318	1.0	EUT on its side - restricted band
1301.750	27.3	h	54.0	-26.7	Avg	8	1.0	EUT on its back - restricted band
1301.750	47.3	h	74.0	-26.7	Pk	8	1.0	EUT on its back - restricted band
1301.750	26.9	h	54.0	-27.1	Avg	178	1.1	EUT upright - restricted band
1301.750	46.9	h	74.0	-27.1	Pk	178	1.1	EUT upright - restricted band
1301.750	26.9	v	54.0	-27.1	Avg	173	1.0	EUT on its back - restricted band
1301.750	46.9	v	74.0	-27.1	Pk	173	1.0	EUT on its back - restricted band
1301.750	26.6	v	54.0	-27.4	Avg	332	1.1	EUT upright - restricted band
1301.750	46.6	v	74.0	-27.4	Pk	332	1.1	EUT upright - restricted band
1301.750	24.8	v	54.0	-29.2	Avg	204	1.0	EUT on its side - restricted band
1301.750	44.8	v	74.0	-29.2	Pk	204	1.0	EUT on its side - restricted band
3471.675	23.5	h	54.0	-30.5	Avg	104	1.5	EUT upright

Note 1: FCC 15.231(e) limit for spurious emissions is 72.98dBuV/m Peak, 52.9dBuV/m average below 1GHz, except for signals falling in restricted bands where the limit is the 15.209 general limit. Above 1GHz the 15.209 general limits are used as these permit higher levels of emissions than the 15.231(e) limit.

Note 2: All average measurements calculate from the peak measurement using an average correction factor of 20dB. This factor is based on a maximum duty cycle of 10% in any 100mS window.



EMC Test Data

Client: Savi	Job Number: J47361
Model: SAVI SMR-640P-101	T-Log Number: T47386
Contact: Eugene Schindwein	Proj Eng: Mark Briggs
Spec: FCC 15 B, 15.209, 15.231	Class: A

Run #2: Preliminary Radiated Emissions, 30 - 4000 MHz: Transmit Mode (433.92 MHz) - Control Signal
Fundamental Signal and second harmonic measured on 5/29/02. All others measured on 6/3/02

Duty cycle = 25 %

Fundamental Signal

Frequency MHz	Level dB μ V/m	Pol v/h	FCC 15.231(a)		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
433.885	92.6	v	100.8	-8.2	Pk	300	1.2	EUT Upright
433.885	80.6	v	80.8	-0.2	Avg	300	1.2	EUT Upright
433.885	91.5	h	100.8	-9.3	Pk	300	1.2	EUT Upright
433.885	79.5	h	80.8	-1.3	Avg	300	1.2	EUT Upright
433.885	90.1	h	100.8	-10.7	Pk	240	1.0	EUT Upright
433.885	78.1	h	80.8	-2.7	Avg	240	1.0	EUT Upright
433.885	91.8	v	100.8	-9.0	Pk	290	1.2	EUT on its side
433.885	79.8	v	80.8	-1.0	Avg	290	1.2	EUT on its side
433.885	90.5	h	100.8	-10.3	Pk	230	1.0	EUT on its side
433.885	78.5	h	80.8	-2.3	Avg	230	1.0	EUT on its side
433.885	90.9	v	100.8	-9.9	Pk	180	1.1	EUT on its back
433.885	78.9	v	80.8	-1.9	Avg	180	1.1	EUT on its back
433.885	91.7	h	100.8	-9.1	Pk	230	1.0	EUT on its back
433.885	79.7	h	80.8	-1.1	Avg	230	1.0	EUT on its back

Spurious Signals

Frequency MHz	Level dB μ V/m	Pol v/h	FCC 15.231(a)		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
867.765	51.7	v	80.8	-29.1	Pk	170	1.5	EUT Upright
867.765	39.7	v	60.8	-21.1	Avg	170	1.5	EUT Upright
1301.750	46.6	v	74.0	-27.4	Pk	332	1.1	EUT upright - restricted band
1301.750	34.6	v	54.0	-19.4	Avg	332	1.1	EUT upright - restricted band
1735.735	54.2	v	80.8	-26.6	Pk	186	1.0	EUT upright
1735.735	42.2	v	60.8	-18.6	Avg	186	1.0	EUT upright
2169.720	53.5	v	80.8	-27.3	Pk	148	1.0	EUT upright
2169.720	41.5	v	60.8	-19.3	Avg	148	1.0	EUT upright
2603.705	51.3	v	80.8	-29.5	Pk	196	1.0	EUT upright
2603.705	39.3	v	60.8	-21.5	Avg	196	1.0	EUT upright
3037.690	52.0	v	80.8	-28.8	Pk	0	1.0	EUT upright-noise floor
3037.690	40.0	v	60.8	-20.8	Avg	0	1.0	EUT upright-noise floor
3471.675	54.1	v	80.8	-26.7	Pk	295	1.8	EUT upright
3471.675	42.1	v	60.8	-18.7	Avg	295	1.8	EUT upright
3905.660	52.0	v	74.0	-22.0	Pk	0	1.0	EUT upright - restricted band
3905.660	40.0	v	54.0	-14.0	Avg	0	1.0	EUT upright - restricted band
867.765	51.1	h	80.8	-29.7	Pk	140	1.0	EUT Upright
867.765	39.1	h	60.8	-21.7	Avg	140	1.0	EUT Upright

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EMC Test Data

Client: Savi	Job Number: J47361
Model: SAVI SMR-640P-101	T-Log Number: T47386
Contact: Eugene Schindwein	Proj Eng: Mark Briggs
Spec: FCC 15 B, 15.209, 15.231	Class: A

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1301.750	46.9	h	74.0	-27.1	Pk	178	1.1	EUT upright - restricted band
1301.750	34.9	h	54.0	-19.1	Avg	178	1.1	EUT upright - restricted band
1735.735	49.5	h	80.8	-31.3	Pk	196	1.6	EUT upright
1735.735	37.5	h	60.8	-23.3	Avg	196	1.6	EUT upright
2169.720	51.6	h	80.8	-29.2	Pk	124	1.0	EUT upright
2169.720	39.6	h	60.8	-21.2	Avg	124	1.0	EUT upright
2603.705	51.5	h	74.0	-22.5	Pk	115	1.2	EUT upright - restricted band
2603.705	39.5	h	54.0	-14.5	Avg	115	1.2	EUT upright - restricted band
3037.690	52.0	h	80.8	-28.8	Pk	0	1.0	EUT upright-noise floor
3037.690	40.0	h	60.8	-20.8	Avg	0	1.0	EUT upright-noise floor
3471.675	53.5	h	80.8	-27.3	Pk	104	1.5	EUT upright
3471.675	41.5	h	60.8	-19.3	Avg	104	1.5	EUT upright
3905.660	52.0	h	74.0	-22.0	Pk	0	1.0	EUT upright - restricted band
3905.660	40.0	h	54.0	-14.0	Avg	0	1.0	EUT upright - restricted band
867.765	28.5	v	80.8	-52.3	Pk	280	1.0	EUT on its side
867.765	16.5	v	60.8	-44.3	Pk	280	1.0	EUT on its side
1301.750	44.8	v	74.0	-29.2	Pk	204	1.0	EUT on its side - restricted band
1301.750	32.8	v	54.0	-21.2	Avg	204	1.0	EUT on its side - restricted band
1735.735	52.5	v	80.8	-28.3	Pk	121	1.0	EUT on its side
1735.735	40.5	v	60.8	-20.3	Avg	121	1.0	EUT on its side
2169.720	53.6	v	80.8	-27.2	Pk	152	1.0	EUT on its side
2169.720	41.6	v	60.8	-19.2	Avg	152	1.0	EUT on its side
2603.705	51.0	v	80.8	-29.8	Pk	71	1.0	EUT on its side
2603.705	39.0	v	60.8	-21.8	Avg	71	1.0	EUT on its side
3037.690	52.1	v	80.8	-28.7	Pk	134	1.1	EUT on its side
3037.690	40.1	v	60.8	-20.7	Avg	134	1.1	EUT on its side
3471.675	52.0	v	80.8	-28.8	Pk	0	1.0	EUT on its side-noise floor
3471.675	40.0	v	60.8	-20.8	Avg	0	1.0	EUT on its side-noise floor
3905.660	52.0	v	74.0	-22.0	Pk	0	1.0	EUT on its side - restricted band
3905.660	40.0	v	54.0	-14.0	Avg	0	1.0	EUT on its side - restricted band
867.765	53.2	h	80.8	-27.6	Pk	180	1.0	EUT on its side
867.765	41.2	h	60.8	-19.6	Avg	180	1.0	EUT on its side
1301.750	48.6	h	74.0	-25.4	Pk	318	1.0	EUT on its side - restricted band
1301.750	36.6	h	54.0	-17.4	Avg	318	1.0	EUT on its side - restricted band
1735.735	51.9	h	80.8	-28.9	Pk	186	1.3	EUT on its side
1735.735	39.9	h	60.8	-20.9	Avg	186	1.3	EUT on its side
2169.720	55.6	h	80.8	-25.2	Pk	144	1.0	EUT on its side
2169.720	43.6	h	60.8	-17.2	Avg	144	1.0	EUT on its side
2603.705	50.4	h	80.8	-30.4	Pk	124	1.0	EUT on its side
2603.705	38.4	h	60.8	-22.4	Avg	124	1.0	EUT on its side

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EMC Test Data

Client: Savi	Job Number: J47361
Model: SAVI SMR-640P-101	T-Log Number: T47386
Contact: Eugene Schindwein	Proj Eng: Mark Briggs
Spec: FCC 15 B, 15.209, 15.231	Class: A

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3037.690	52.0	h	80.8	-28.8	Pk	0	1.0	EUT on its side-noise floor
3037.690	40.0	h	60.8	-20.8	Avg	0	1.0	EUT on its side-noise floor
3905.660	52.0	h	74.0	-22.0	Pk	0	1.0	EUT on its side - restricted band
3905.660	40.0	h	54.0	-14.0	Avg	0	1.0	EUT on its side - restricted band
867.765	29.3	v	80.8	-51.5	Pk	290	1.0	EUT on its back
867.765	17.3	v	60.8	-43.5	Pk	290	1.0	EUT on its back
1301.750	46.9	v	74.0	-27.1	Pk	173	1.0	EUT on its back - restricted band
1301.750	34.9	v	54.0	-19.1	Avg	173	1.0	EUT on its back - restricted band
1735.735	49.2	v	80.8	-31.6	Pk	183	1.0	EUT on its back
1735.735	37.2	v	60.8	-23.6	Avg	183	1.0	EUT on its back
2169.720	50.8	v	80.8	-30.0	Pk	60	1.0	EUT on its back
2169.720	38.8	v	60.8	-22.0	Avg	60	1.0	EUT on its back
2603.705	51.2	v	80.8	-29.6	Pk	210	1.0	EUT on its back
2603.705	39.2	v	60.8	-21.6	Avg	210	1.0	EUT on its back
3037.690	53.9	v	80.8	-26.9	Pk	0	1	EUT on its back-noise floor
3037.690	41.9	v	60.8	-18.9	Avg	0	1	EUT on its back-noise floor
3471.675	53.9	v	80.8	-26.9	Pk	0	1	EUT on its back-noise floor
3471.675	41.9	v	60.8	-18.9	Avg	0	1	EUT on its back-noise floor
3905.660	55.8	v	74.0	-18.2	Pk	0	1.0	EUT on its back - restricted band
3905.660	43.8	v	54.0	-10.2	Avg	0	1.0	EUT on its back - restricted band
867.765	54.3	h	80.8	-26.5	Pk	40	1.0	EUT on its back
867.765	42.3	h	60.8	-18.5	Avg	40	1.0	EUT on its back
1301.750	47.3	h	74.0	-26.7	Pk	8	1.0	EUT on its back - restricted band
1301.750	35.3	h	54.0	-18.7	Avg	8	1.0	EUT on its back - restricted band
1735.735	52.0	h	80.8	-28.8	Pk	115	1.1	EUT on its back
1735.735	40.0	h	60.8	-20.8	Avg	115	1.1	EUT on its back
2169.720	50.7	h	80.8	-30.1	Pk	189	1.0	EUT on its back
2169.720	38.7	h	60.8	-22.1	Avg	189	1.0	EUT on its back
2603.705	51.9	h	80.8	-28.9	Pk	160	1.1	EUT on its back
2603.705	39.9	h	60.8	-20.9	Avg	160	1.1	EUT on its back
3037.690	53.9	h	80.8	-26.9	Pk	0	1	EUT on its back-noise floor
3037.690	41.9	h	60.8	-18.9	Avg	0	1	EUT on its back-noise floor
3471.675	53.9	h	80.8	-26.9	Pk	215	2.4	EUT on its back
3471.675	41.9	h	60.8	-18.9	Avg	215	2.4	EUT on its back
3905.660	55.8	h	74.0	-18.2	Pk	0	1.0	EUT on its back - restricted band
3905.660	43.8	h	54.0	-10.2	Avg	0	1.0	EUT on its back - restricted band

Note 1: FCC 15.231(a) limit for spurious emissions is 80.8dBuV/m Peak, 60.8dBuV/m average except for signals falling in restricted bands where the limit is the 15.209 general limit.

Note 2: All average measurements calculate from the peak measurement using an average correction factor based on a maximum duty cycle of 25% in any 100mS window.



EMC Test Data

Client: Savi	Job Number: J47361
Model: SAVI SMR-640P-101	T-Log Number: T47386
Contact: Eugene Schindwein	Proj Eng: Mark Briggs
Spec: FCC 15 B, 15.209, 15.231	Class: A

Run #3: Preliminary Radiated Emissions, 30 - 4000 MHz: Transmit Mode (433.92 MHz) - "Wake-Up" Control Signal

The EUT was tested in the orientations that produced the highest signal levels in run #1 for each signal measured:

Fundamental signal and Second Harmonic Tested 5/31/02 by Marissa Faustino all others tested 6/3/02

Fundamental Signal

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	
433.885	79.3	v	100.8	-21.5	Pk	126	1.3	EUT Upright
433.885	56.9	v	80.8	-23.9	Avg	126	1.3	EUT Upright

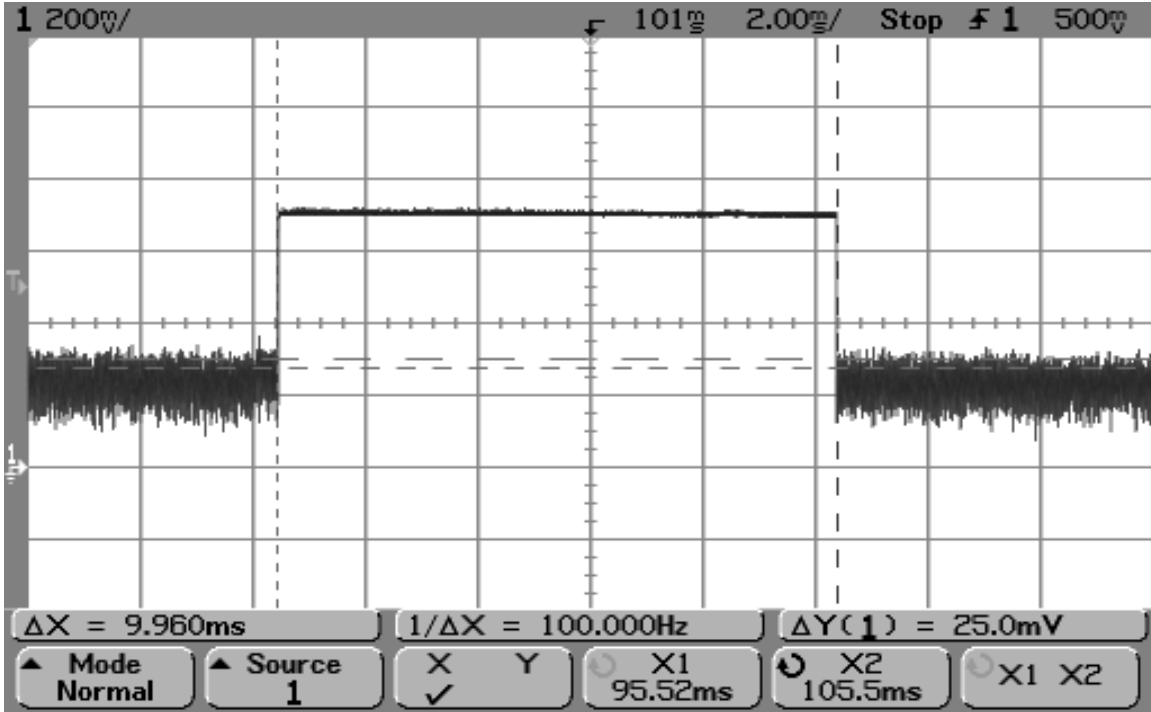
Spurious Signals

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	
2603.705	36.9	h	60.8	-23.9	Avg	115	1.2	EUT upright
1301.750	28.7	h	54.0	-25.3	Avg	178	1.1	EUT upright - restricted band
2603.705	47.4	h	80.8	-33.4	Pk	115	1.2	EUT upright
1301.750	41.1	h	74.0	-32.9	Pk	178	1.1	EUT upright - restricted band
2169.720	41.3	h	60.8	-19.5	Avg	144	1.0	EUT upright
1735.735	41.0	v	60.8	-19.8	Avg	186	1.0	EUT upright
2169.720	48.8	h	80.8	-32.0	Pk	144	1.0	EUT upright
1735.735	46.5	v	80.8	-34.3	Pk	186	1.0	EUT upright
3037.690	38.9	v	60.8	-21.9	Avg	134	1.1	EUT on its side
3037.690	49.0	v	80.8	-31.8	Pk	134	1.1	EUT on its side
3905.660	43.1	h	54.0	-10.9	Avg	0	1.0	EUT on its back - restricted band
3905.660	52.0	h	74.0	-22.0	Pk	0	1.0	EUT on its back - restricted band
3471.675	40.1	h	60.8	-20.7	Avg	215	2.4	EUT on its back
867.765	39.5	h	60.8	-21.3	Avg	93	1.0	EUT on its back
3471.675	52.3	h	80.8	-28.5	Pk	215	2.4	EUT on its back
867.765	41.3	h	80.8	-39.5	Pk	93	1.0	EUT on its back

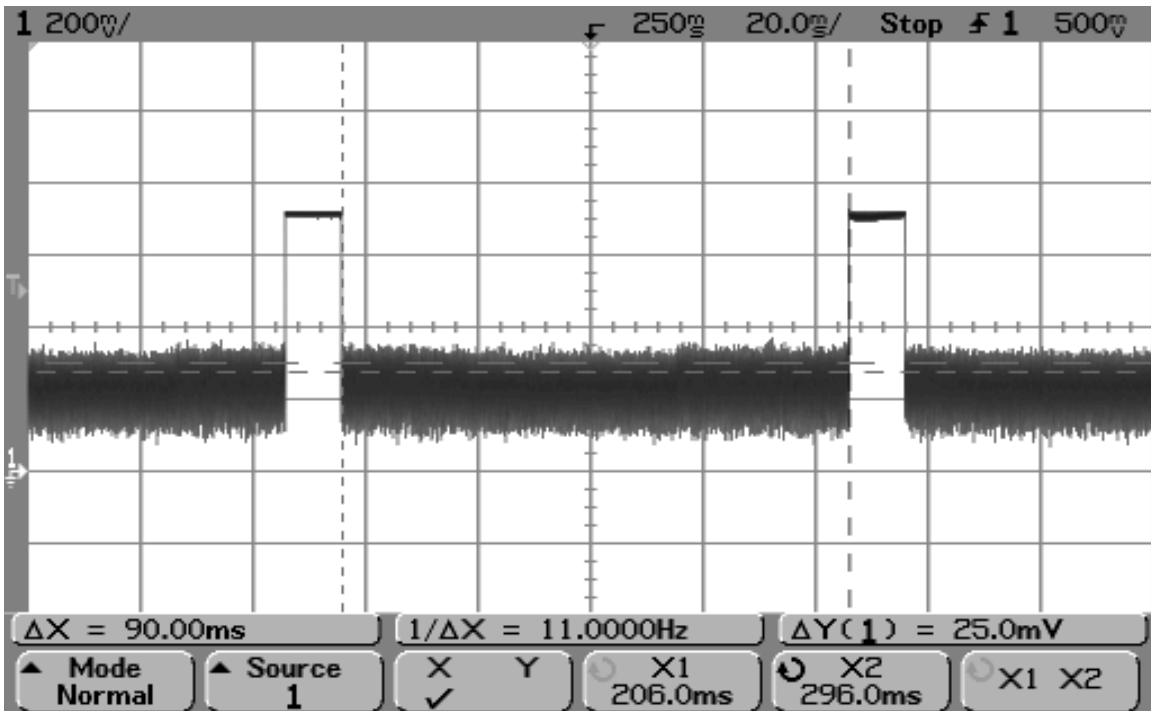
Note 1: FCC 15.231(a) limit for spurious emissions is 80.8dB μ V/m Peak, 60.8dB μ V/m average, except for signals falling in restricted bands where the limit is the 15.209 general limit.

SMR-640P-1XX Duty Cycle/Bandwidth Plots

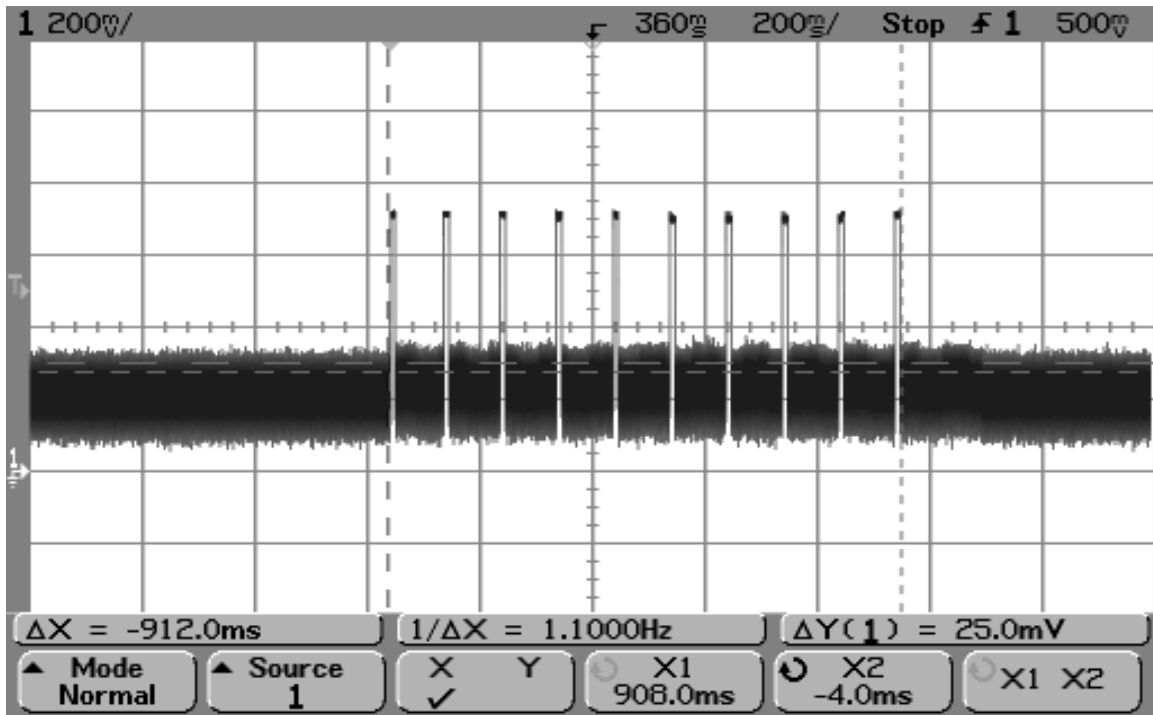
SMR-640P-1XX Single Data Pulse (9.96 msec)



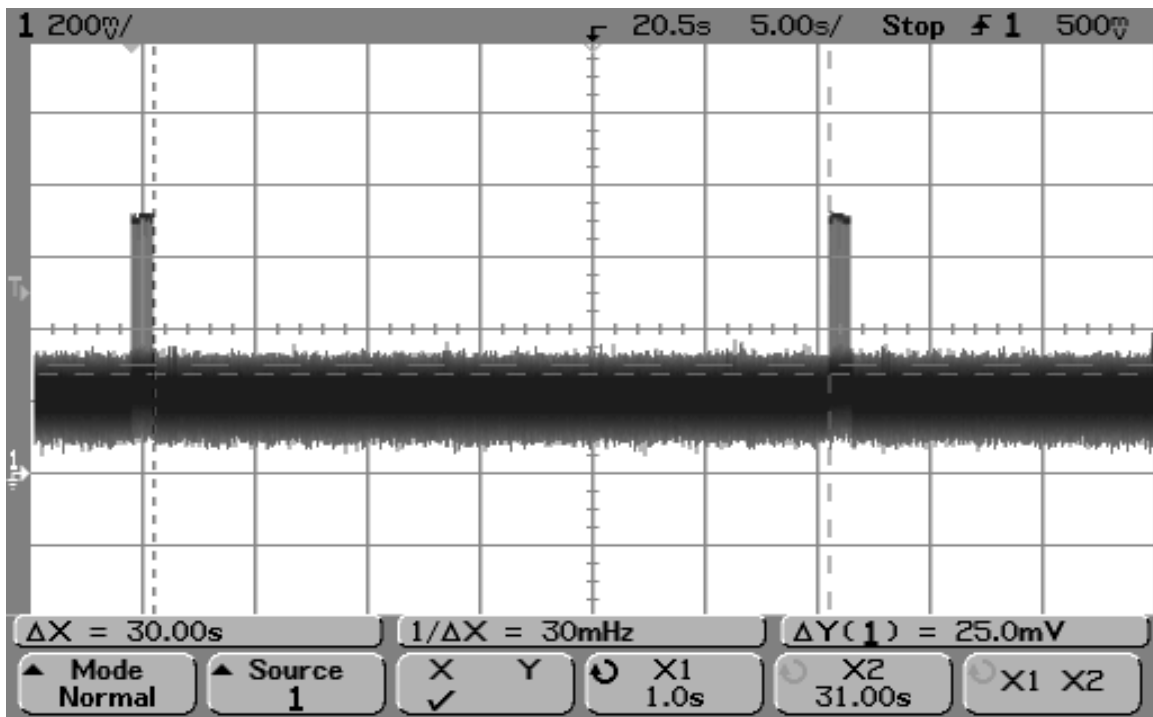
SMR-640P-1XX Data Pulses within 100 msec



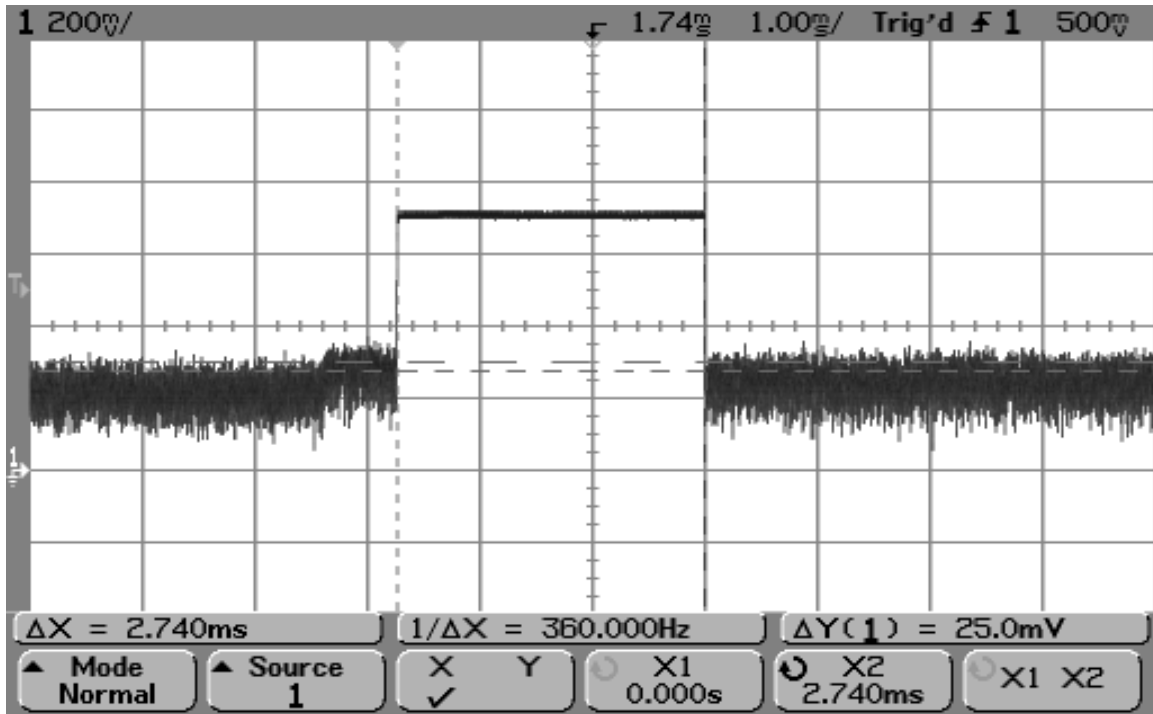
SMR-640P-1XX Data Pulses within 1 second



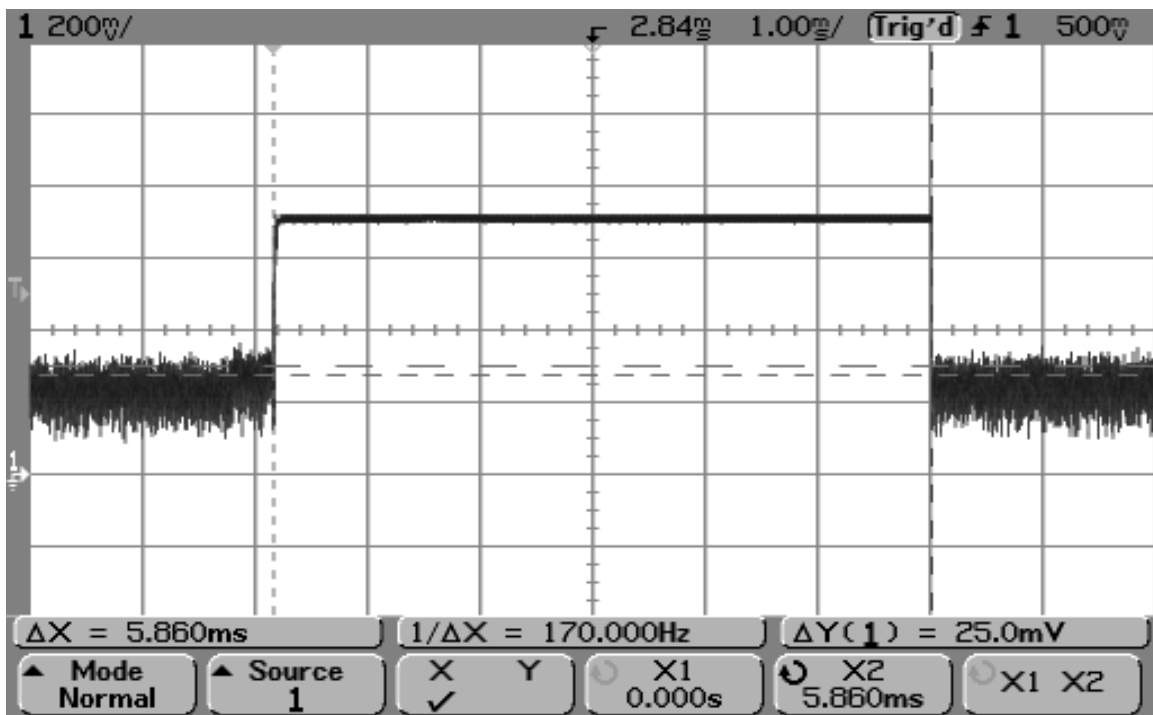
SMR-640P-1XX Data Pulses with 30 second silent period between transmissions



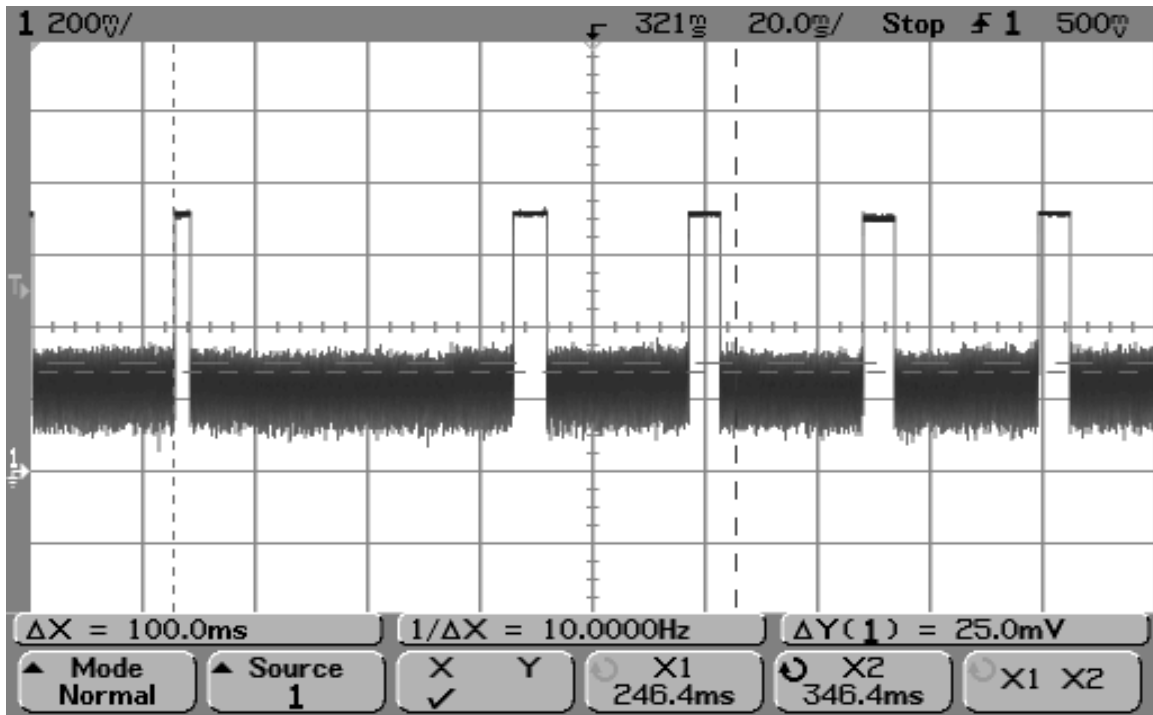
SMR-640P-1XX Single Hello Pulse (2.74 msec)



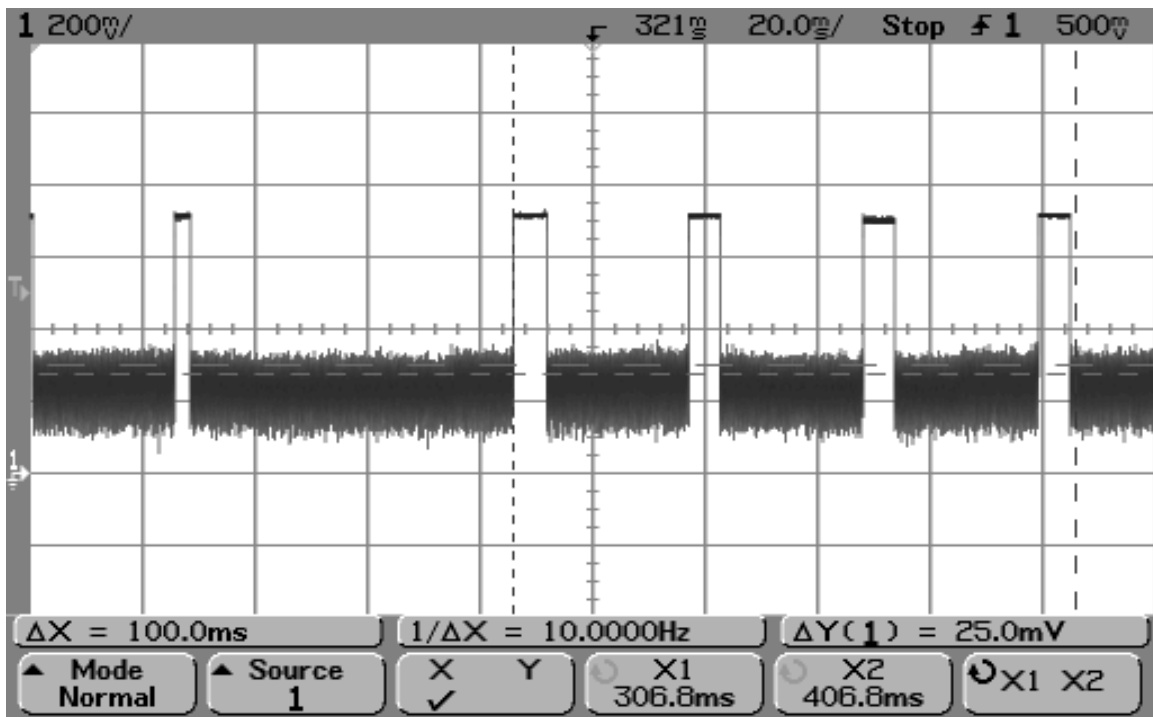
SMR-640P-1XX Single Sleep Pulse (5.86 msec)



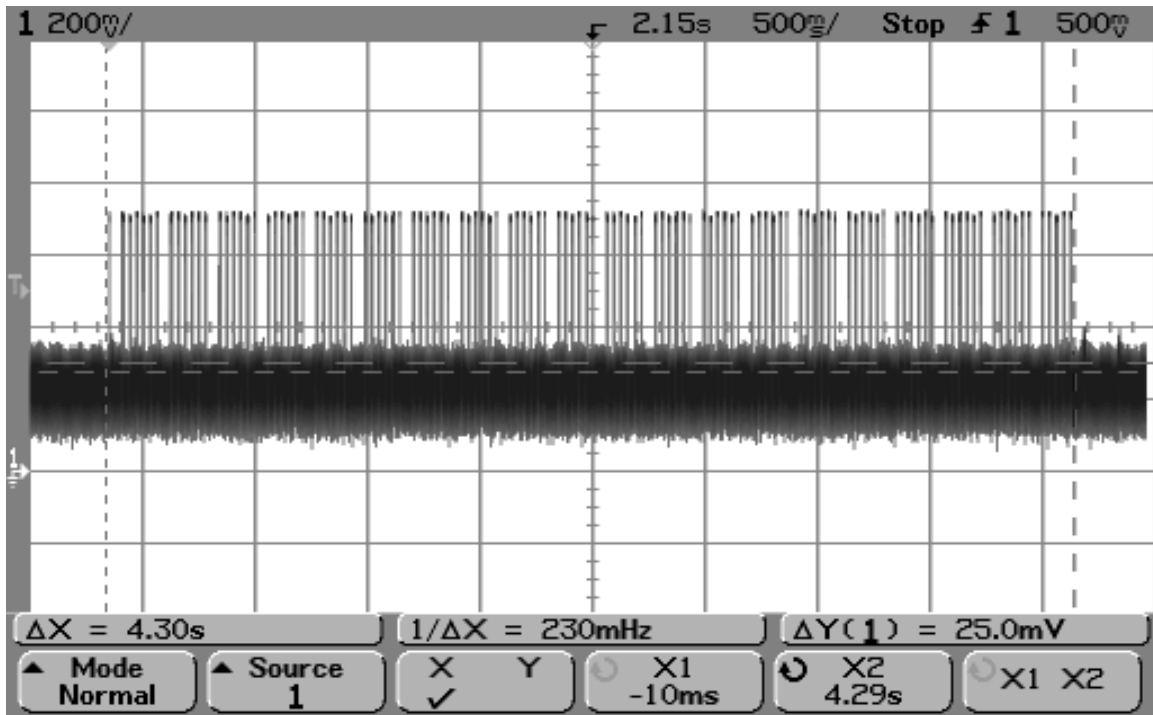
SMR-640P-1XX Maximum Hello and Sleep Pulses within 100 msec period



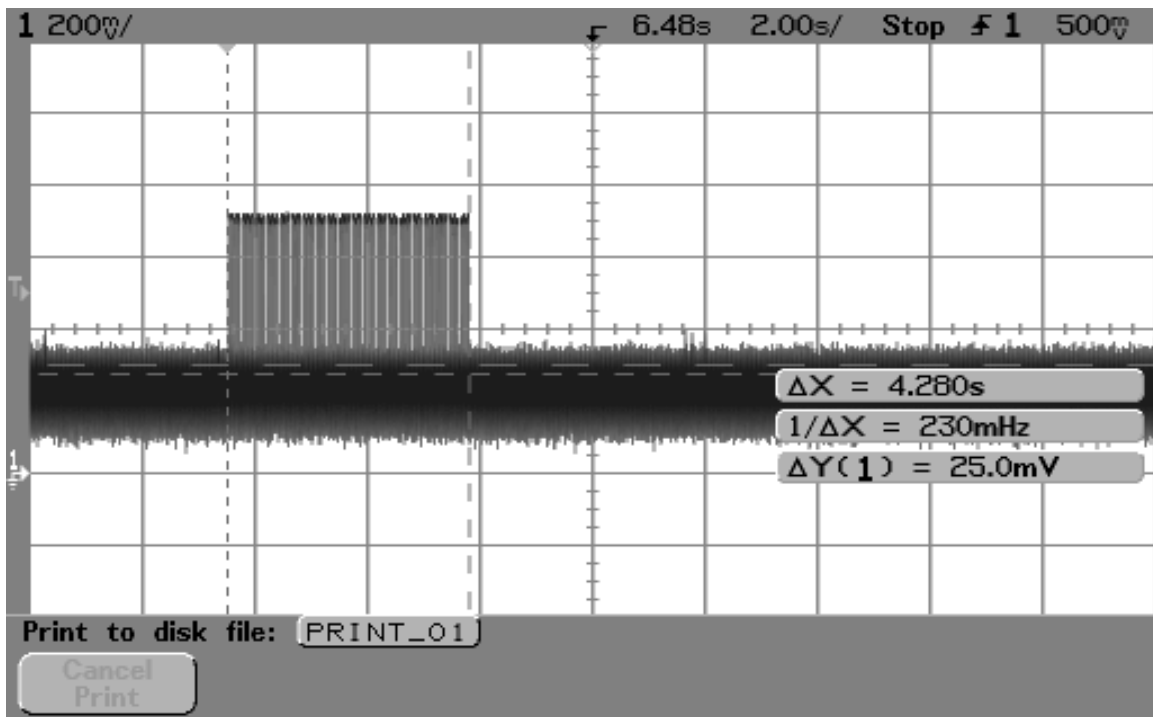
SMR-640P-1XX Maximum Sleep Pulses within 100 msec period



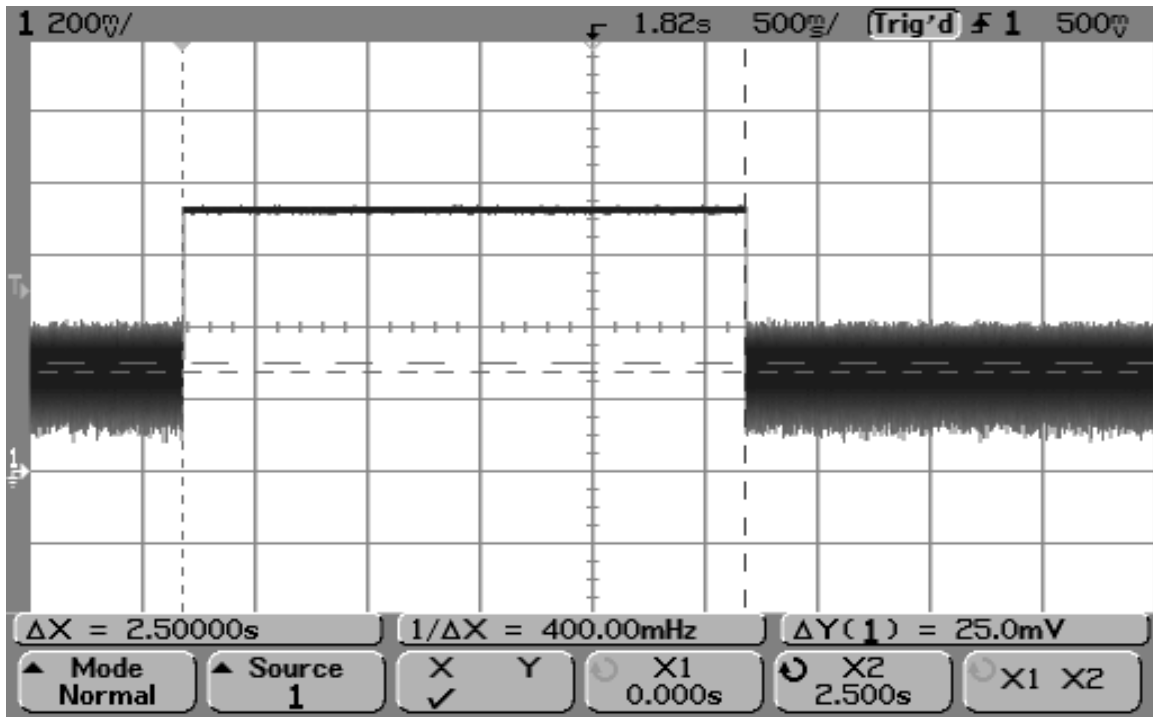
SMR-640P-1XX Hello and Sleep Transmissions within 5 second limit (4.30 sec)



SMR-640P-1XX: Hello and Sleep Transmissions (over 20 second period)



SMR-640P-1XX Wake-Up Pulse of less than 5 seconds (2.5 seconds)



SMR-640P-1XX: 20 dB Bandwidth Measurement

