SCOPE

An electromagnetic emissions test has been performed on the Savi Technology RF Relays model RFR-200/100 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.

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 model RFR-200/100 and therefore apply only to the tested sample. The sample was selected and prepared by Vikram Verma 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 model RFR-200/100 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 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 model RFR-200/100. 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.

Conducted Emissions, 0.15-30.0 MHz, Sorted by Margin, 120 V, 60 Hz
System Transmitting On Low Channel

Frequency MHz	Level dBuV	Power Lead	FCC B Limit	FCC B Margin	Detector Function	Comments
26.8205	42.8	Neutral	48.0	-5.2	QP	Not Broad Band
8.9533	40.0	Line 1	48.0	-8.0	QP	Not Broad Band
16.7007	40.0	Neutral	48.0	-8.0	QP	Not Broad Band
8.9575	29	Neutral	48.0	-19.0	QP	Note 1
27.0814	28.8	Line 1	48.0	-19.2	QP	Note 1
18.6705	26.5	Line 1	48.0	-21.5	QP	Note 1
9.1048	26.5	Line 1	48.0	-21.5	QP	Note 1
20.1228	26.9	Line 1	48.0	-21.1	QP	Note 1

Note 1: According to FCC part 15.207(b) this emissions is consider to be broadband. Therefore, this level measured with QP detector has been reduced by 13dB.

LIMITS OF ANTENNA CONDUCTED POWER

The EUT incorporates a transmitter that has already received FCC approval. As the approved transmitters are remaining within their original enclosures the conducted emissions from the antenna port were not measured. The original reports and associated test data are included in an exhibit of this report.

LIMITS OF RADIATED INTERFERENCE FIELD STRENGTH

The EUT incorporates a transmitter that has already received FCC approval. As the approved transmitters are remaining within their original enclosures the conducted emissions from the antenna port were not measured. The original reports and associated test data are included in an exhibit of this report.

LIMITS OF POWER AND BANDWIDTH

The EUT incorporates a transmitter that has already received FCC approval. As the approved transmitters are remaining within their original enclosures the conducted emissions from the antenna port were not measured. The original reports and associated test data are included in an exhibit of this report.

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Savi Technology model RFR-200 and RFR-100 are RF Relays which include an RF Modem, 2.4 GHz Up/Down Converter, 9 dBi omni-directional antenna, power supply and serial interface. The RF Modem and Up/Down Converter are devices which have existing FCC approval. These devices have not been modified and are contained within their original enclosures. The RFR-100 uses a Patton Model 2085 RS232 to RS485 converter to provide an external RS485 interface to the Relay. The RFR-200 uses a CTI Products network combiner module to provide a LONWorks interface to the Relay.

Preliminary tests (T28267, T28126) showed that the RFR-100, (passive RS232 to RS 485 interface) had lower emissions than the RFR-200 (active RS232 to LonWorks). For this reason the RFR-200 was tested on the OATS. The RFR-200 was considered worst case with respect to radiated and conducted emissions of the RFR family. The sample was received and tested on September 8, 1998. The EUT consisted of the following component(s):

Manufacturer/Model/Description	Serial Number	FCC ID Number
Savi Technology RFR-200 RF Relay	7030	KL7-RELAY-V1

ENCLOSURE

The EUT enclosure is primarily constructed of fiberglass. It measures approximately 23 cm wide by 20 cm deep by 30 cm high.

INPUT POWER

The EUT input is rated at 120/240, 50/60 Hz. The EUT contained the following input power components during emissions testing:

Description	Manufacturer	Model
100-240V AC Power Supply	Computer Product	NFN40-7610

SUBASSEMBLIES

The Savi Technology model RFR-200/100 contained the following subassembly modules during emissions testing:

Manufacturer/Description	Assembly #	Rev.	Serial Number
Savi Tech. Regulator Board	810-01630-001	D	None
Antenna 9dBi Omni-Directional	-	-	-
Utilicom UDC2.4B-0 Up/Down Converter *4	-	-	UC001515
Utilicom ISM2.4-1C64 RF Modem*3	-	-	UC003047
CTI Products Network Combiner Module *1	Model: NCB/RF-A3P9-JB	-	1142
Patton RS232 to RS485 interface adapter *2	Model: 2085	-	None

*1 This was used in the RFR-200
*2 This subassembly is used in the RFR-100. Test results for the RFR-100 are not contained in this report as preliminary tests showed that the RFR-200 had higher emissions.
*3 The Utilicom modem has already been approved by the FCC under FCC ID LFO-ISM900. The modem is also manufactured by SafeTran Systems and is marketed under the FCC ID:LTY53311.
*4 The Utilicom Up/Down converter has already been approved by the FCC under FCC ID LFO-ISM2400.

SUPPORT EQUIPMENT

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

Manufacturer/Model/Description	Serial Number	FCC ID Number
Savi Tech. SR-14R-006 SaviReader 410R	3803	
Compaq Lap Top Computer	None visible	

EXTERNAL I/O CABLING

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

Cable Description	Length (m)	From Unit/Port	To Unit/Port
092887 Shielded RF Cable	20.0	EUT Antenna port	Up/Down Converter
092887 Shielded RF Cable	0.4	Antenna	Up/Down Converter
4 Conductor Unshielded Cable	30.0	EUT LonWorks	SaviReader 410R
4 Conductor Unshielded Cable	30.0	EUT LonWorks	Not Terminated

TEST SOFTWARE

The EUT contained LonWorks software running during testing which continuously exercised the system by sending information between the EUT and the remote Savi-Reader via the wireless connection. The transceiver was configured to transmit on either low, center or high channel for conducted emissions testing as noted in test run description.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on September 8, 1998 at the Elliott Laboratories Open Area Test Site #1 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 and 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.

POWER METER

A power meter and thermister mount are used for all output power measurements from transmitters as they provides a broadband indication of the power output. The power meter used was the Hewlett Packard model 432A, S/N 992-05509 and the thermister mount was the Hewlett Packard model 478A, S/N 46397.

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.

The antenna calibration factors are included in site factors which are 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 to 1000 MHz. 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.

CONDUCTED EMISSIONS FROM ANTENNA PORT

Direct measurements are performed with the antenna port of the EUT connected to either the power meter or spectrum analyzer via a suitable attenuator and/or filter. These are used to ensure that the front end of the measurement instrument is not overloaded by the fundamental transmission.

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

Test Equipment List - SVOATS#1

	Manufacturer/Description		Model	Asset #	Interval	Last Cal	Cal Due
☐	Elliott Laboratories	FCC / CISPR LISN	LISN-3, OATS	304	12	6/24/98	6/24/99
☑	EMCO	Biconical Antenna, 30-300 MHz	3110B	363	12	4/8/98	4/8/99
☐	EMCO	Double Ridge Horn Antenna, 1-18	3115	487	12	6/18/98	6/18/99
☐	EMCO	Double Ridge Horn Antenna, 1-18	3115	786	12	11/13/97	5/13/99
☑	EMCO	Log Periodic Antenna, 0.3-1 GHz	3146A	364	12	4/8/98	4/8/99
☐	Hewlett Packard	Power Meter	432A	259, (F304)	12	3/10/98	3/10/99
☐	Hewlett Packard	Thermistor Mount	478A	652	12	3/10/98	3/10/99
☐	Hewlett Packard	Microwave Preamplifier, 1-26.5	8449B	263, (F303)	12	6/8/98	6/8/99
☐	Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	12	11/10/97	11/10/98
☐	Hewlett Packard	Spectrum Analyzer	8563E	284, (F194)	24	1/14/98	1/14/2000
☐	Hewlett Packard	EMC Receiver /Analyzer	8595EM	780	24	10/24/97	10/24/99
☐	Hewlett Packard	EMC Receiver /Analyzer	8595EM	787	12	10/27/97	10/27/98
☐	Narda West	High Pass Filter	HPF 180	821	12	2/20/98	2/20/99
☐	Narda-West	EMI Filter 2.4 GHz, High Pass	60583 HPF-161	248	12	4/27/98	4/27/99
☐	Narda-West	EMI Filter 5.6 GHz, High Pass	60583 HXF370	247	12	4/27/98	4/27/99
☑	Rohde & Schwarz	Test Receiver, 0.009-30 MHz	ESH3	215, (F197)	12	1/16/98	1/16/99
☑	Rohde & Schwarz	10 dB Pad / Pulse Limiter	ESH3 Z2	372	12	6/22/98	6/22/99
☑	Rohde &Schwarz	Test Receiver, 20-1300MHz	ESVP	273	12	8/6/98	8/6/99
☐	Solar Electronics	High Pass Filter, fc = 8 kHz	7930-8.0	277	12	7/1/98	7/18/99

File Number: T28130

Date: 9/3/98

Engr: Rudy

EXHIBIT 2: Test Data Log Sheets

ELECTROMAGNETIC EMISSIONS

TEST LOG SHEETS

AND

MEASUREMENT DATA

T28189 ***6 Pages***

Client:	Savi Technology	Date:	9/8/98	Test Engr:	Rudy Suy
Product:	RFR-200	File:	T28189	Proj. Eng:	Mark Briggs
Objective:	Final Qualification	Site:	SVOATS #1	Contact:	Gene Schlindwein
Spec:	FCC part 15	Page:	1 of 6	Approved:	MB
Revision	1.0				

Ambient Conditions	
Temperature:	13 °C
Humidity:	80 %

Test Objective

The objective of this test session is to perform final qualification testing the EUT defined below relative to the specification(s) defined above. Radiated emissions was compared to FCC A and Conducted emissions was compared to FCC B. Originally test was performed under T28130.

Test Summary

Run #1 - Conducted Emissions, 0.15-30.0 MHz, 120V, 60Hz, Sorted by Margin **High Channel.**

PASS Results: FCC B -7.4 dB QP @ 8.9526 MHz Line

Run #2 - Conducted Emissions, 0.15-30.0 MHz, 120V, 60Hz, Sorted by Margin **Center Channel.**

PASS Results: FCC B -6.9 dB QP @ 8.9576 MHz Neutral

Run #3 - Conducted Emissions, 0.15-30.0 MHz, 120V, 60Hz, Sorted by Margin **Low Channel.**

PASS Results: FCC B -5.2 dB QP @ 26.8205 MHz Neutral

Client:	Savi Technology	Date:	9/8/98	Test Engr:	Rudy Suy
Product:	RFR-200	File:	T28189	Proj. Eng:	Mark Briggs
Objective:	Final Qualification	Site:	SVOATS #1	Contact:	Gene Schlindwein
Spec:	FCC part 15	Page:	2 of 6	Approved:	MB
Revision	1.0				

Equipment Under Test (EUT) General Description

The RFR-200 and RFR-100 are RF Relays which includes an RF Modem, 2.4 GHz Up/Down Converter, and 9 dBi omni-directional antenna. They are designed to transmit spread spectrum signals back and forth to other RF Relays. The RFR-100 uses a Patton Model 2085 RS232 to RS485 converter to provide an external RS485 interface to the Relay. The RFR-200 uses a CTI Products network combiner module to provide a LONWorks interface to the Relay.

Preliminary tests (T28267, T28126) showed that the RFR-100, (passive RS232 to RS 485 interface) had lower emissions than the RFR-200 (active RS232 to LonWorks). For this reason the RFR-200 was tested on the OATS. The RFR-200 was considered worst case with respect to radiated and conducted emissions of the RFR family.

Normally, the EUT would be mounted to a pole during operation. For the purpose of testing, the EUT was treated as table top equipment.

Equipment Under Test (EUT)

Manufacturer/Model/Description	Serial Number	FCC ID Number
Savi Technology RFR-200 RF Relay	7030	KL7-RELAY-V1

Power Supply and Line Filters

Description	Manufacturer	Model
100-240V AC Power Supply	Computer Product	NFN40-7610

Printed Wiring Boards in EUT

Manufacturer/Description	Assembly #	Rev.	Serial Number	Crystals (MHz)
None	-	-	-	

Client:	Savi Technology	Date:	9/8/98	Test Engr:	Rudy Suy
Product:	RFR-200	File:	T28189	Proj. Eng:	Mark Briggs
Objective:	Final Qualification	Site:	SVOATS #1	Contact:	Gene Schlindwein
Spec:	FCC part 15	Page:	3 of 6	Approved:	MB
Revision	1.0				

Subassemblies in EUT

Manufacturer/Description	Assembly Number	Rev.	Serial Number
Savi Tech. Regulator Board	810-01630-001	D	None
Antenna 9dBi Omni-Directional	-	-	-
Utilicom UDC2.4B-0 Up/Down Converter	-	-	UC001515
Utilicom ISM2.4-1C64 RF Modem	-	-	UC003047
CTI Products Network Combiner Module *1	Model: NCB/RF-A3P9-JB	-	1142
Patton RS232 to RS485 interface adapter *2	Model: 2085	-	None

*1 This was used in the RFR-200

*2 This subassembly is used in the RFR-100. Test results for the RFR-100 are not contained in this report as preliminary tests showed that the RFR-200 had higher emissions.

EUT Enclosure(s)

The EUT enclosure is primarily constructed of fiberglass. It measures approximately 23 cm wide by 20 cm deep by 30 cm high.

EMI Suppression Devices (filters, gaskets, etc.)

Description	Manufacturer	Part Number
None	-	-

Local Support Equipment

Manufacturer/Model/Description	Serial Number	FCC ID Number
None	-	-

Remote Support Equipment

Manufacturer/Model/Description	Serial Number
Savi Tech. SR-14R-006 SaviReader 410R	3803
Compaq Lap Top Computer	None visible

Interface Cabling

Cable Description	Length (m)	From Unit/Port	To Unit/Port
092887 Shielded RF Cable	20.0	EUT Antenna port	Up/Down Converter
092887 Shielded RF Cable	0.4	Antenna	Up/Down Converter
4 Conductor Unshielded Cable	30.0	EUT LonWorks	SaviReader 410R
4 Conductor Unshielded Cable	30.0	EUT LonWorks	Not Terminated

Note: Internal cabling between the Utilicom Transceiver RS232 port and the CTI Products Network Combiner Module is unshielded. In the RFR-100 the cabling between the transceiver RS232 port and Patton Model 2085 interface is also unshielded.

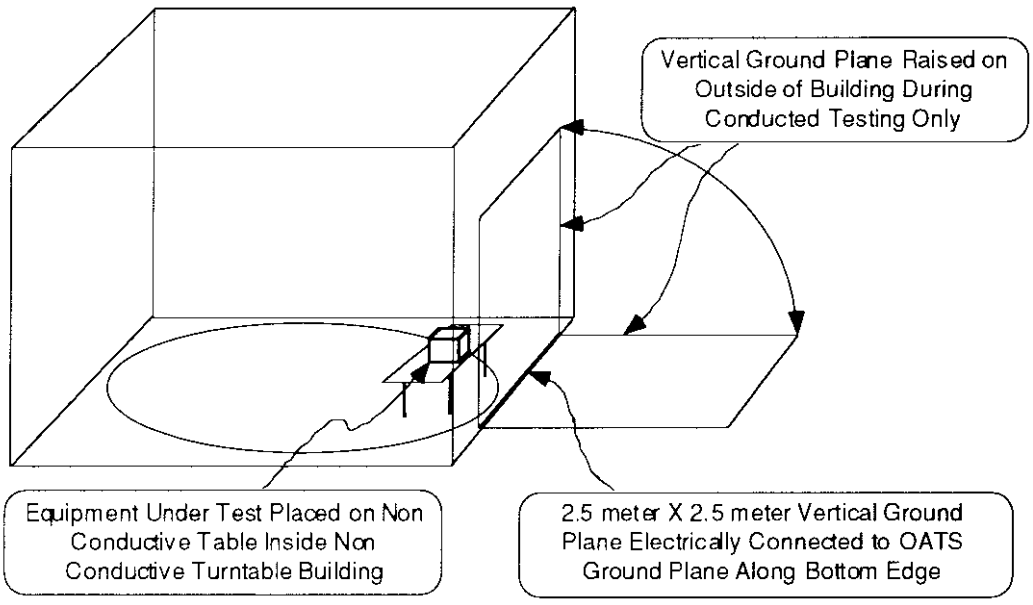
Test Software

The EUT contained LonWorks software running during testing which continuously exercised the system by sending information between the EUT and the remote Savi-Reader via the wireless connection. The transceiver was configured to transmit on either center or high channels for conducted emissions testing as noted in test run description.

General Test Conditions

During radiated testing, the EUT was connected to 120V, 60Hz power input. The EUT was located on the turntable for radiated testing and conducted testing. All remote support equipment was located approximately 30 meters from the EUT with all I/O connections running on top of the ground plane.

During conducted emissions testing, the EUT was connected to either 120V, 60Hz power input as noted. A 2.5 meter X 2.5 meter ground plane was raised to a vertical position 40 cm from the EUT as shown below:



Elliott

EMC Test Log

Client:	Savi Technology	Date:	9/8/98	Test Engr:	Rudy Suy
Product:	RFR-200	File:	T28189	Proj. Eng:	Mark Briggs
Objective:	Final Qualification	Site:	SVOATS #1	Contact:	Gene Schlindwein
Spec:	FCC part 15	Page:	6 of 6	Approved:	MB
Revision	1.0				

Test Data Tables

Run #1 - Conducted Emissions, 0.15-30.0 MHz, 120V, 60Hz, Sorted by Margin
High Channel.

Frequency MHz	Level dBuV	Power Lead	FCC B Limit	FCC B Margin	Detector Function	Comments
8.9526	40.6	Line 1	48.0	-7.4	QP	Not Broad Band
26.8305	40.3	Line 1	48.0	-7.7	QP	Not Broad Band
16.8536	39.9	Line 1	48.0	-8.1	QP	Not Broad Band
0.5024	34.5	Neutral	48.0	-13.5	QP	
0.4528	33.3	Neutral	48.0	-14.7	QP	
9.0966	28.4	Neutral	48.0	-19.6	QP	Note 1
26.8305	28	Neutral	48.0	-20.0	QP	Note 1
20.1228	26.9	Line 1	48.0	-21.1	QP	Note 1

Note 1: According to FCC part 15.207(b) this emissions is consider to be broad band. Therefore, this level measured with QP detector has been reduced by 13dB.

Run #2 - Conducted Emissions, 0.15-30.0 MHz, 120V, 60Hz, Sorted by Margin
Center Channel.

Frequency MHz	Level dBuV	Power Lead	FCC B Limit	FCC B Margin	Detector Function	Comments
8.9576	41.1	Neutral	48.0	-6.9	QP	Not Broad Band
16.5552	40.1	Neutral	48.0	-7.9	QP	Not Broad Band
20.1214	39.3	Line 1	48.0	-8.7	QP	Not Broad Band
27.3345	27.7	Neutral	48.0	-20.3	QP	Note 1
8.7030	27.1	Line 1	48.0	-20.9	QP	Note 1
26.8305	26.7	Line 1	48.0	-21.3	QP	Note 1
9.1048	26.5	Line 1	48.0	-21.5	QP	Note 1

Note 1: According to FCC part 15.207(b) this emissions is consider to be broad band. Therefore, this level measured with QP detector has been reduced by 13dB.

Run #3 - Conducted Emissions, 0.15-30.0 MHz, 120V, 60Hz, Sorted by Margin
Low Channel.

Frequency MHz	Level dBuV	Power Lead	FCC B Limit	FCC B Margin	Detector Function	Comments
26.8205	42.8	Neutral	48.0	-5.2	QP	Not Broad Band
8.9533	40.0	Line 1	48.0	-8.0	QP	Not Broad Band
16.7007	40.0	Neutral	48.0	-8.0	QP	Not Broad Band
8.9575	29	Neutral	48.0	-19.0	QP	Note 1
27.0814	28.8	Line 1	48.0	-19.2	QP	Note 1
18.6705	26.5	Line 1	48.0	-21.5	QP	Note 1

Note 1: According to FCC part 15.207(b) this emissions is consider to be broad band. Therefore, this level measured with QP detector has been reduced by 13dB.

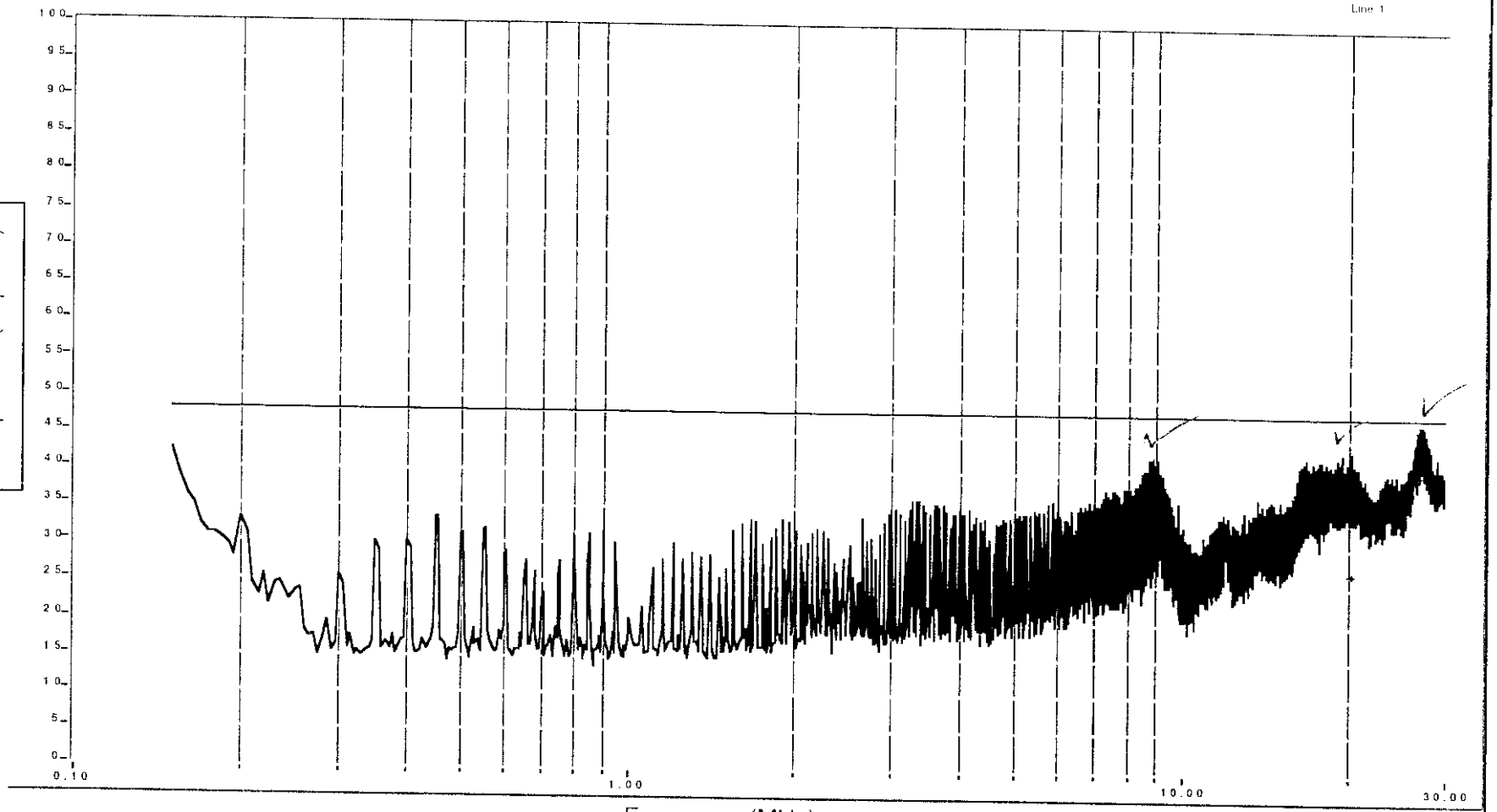
Elliott

SVOATS #1: Savi Technology RFR-200 Run 3

High Channel (code 250)

Spec: FCC B

Mains Lead Line 1



120V, 60Hz. LINE

✓ = EUT

Scan
Peak
Quasi-peak
Average
QuasiPeak Limit 2

9/8/98

Rudy Suy

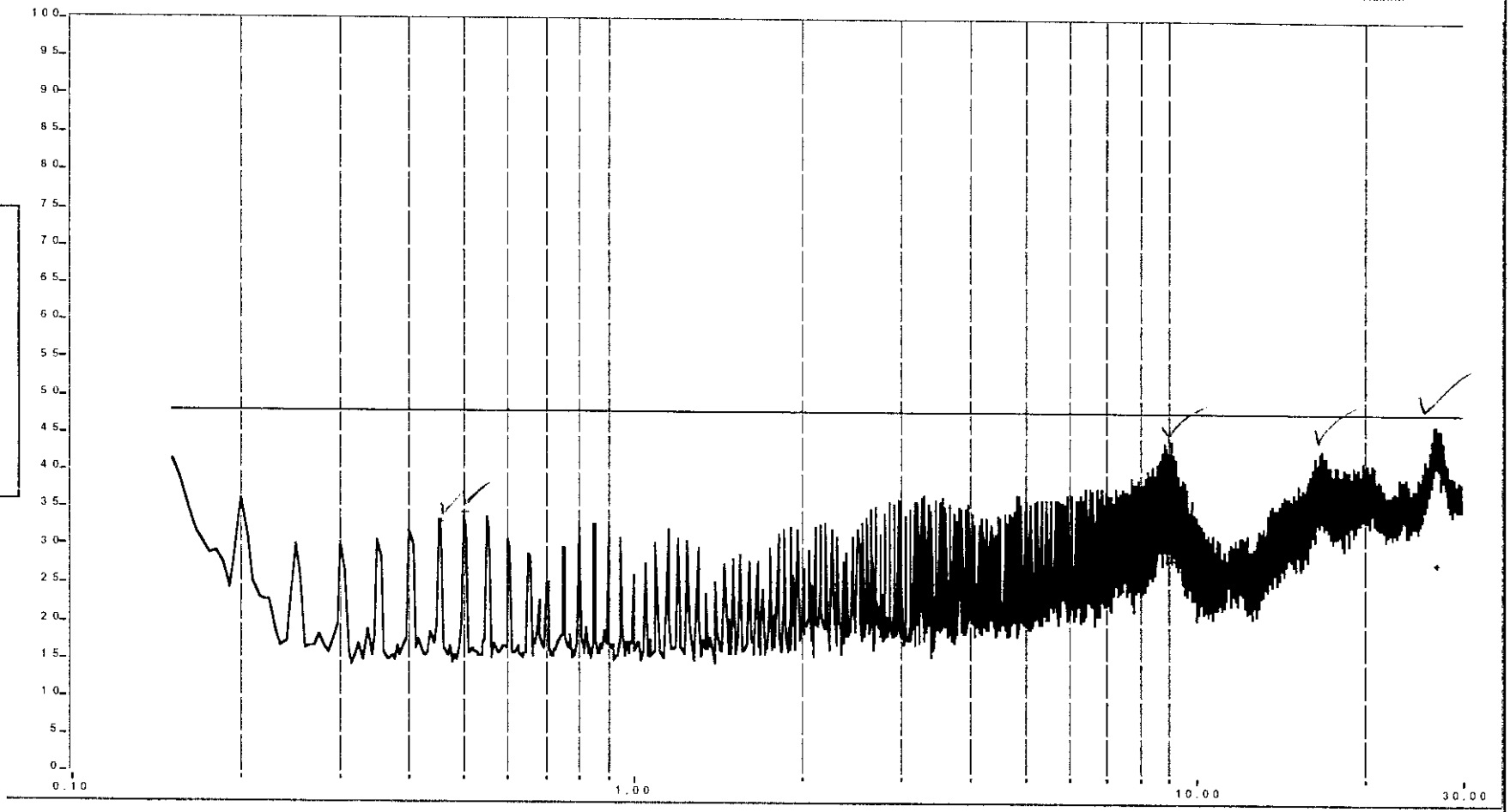
Elliott

SVOATS #1: Savi Technology RFR-200 Run 3

High Channel (code 250)

Spec: FCC B

Mains Lead: Neutral



120V, 60Hz. NEUTRAL

✓ = EUT

Scan
Peak
Quasi-peak
Average
QuasiPeak
Limit 2

9/8/98

Rudy Suy

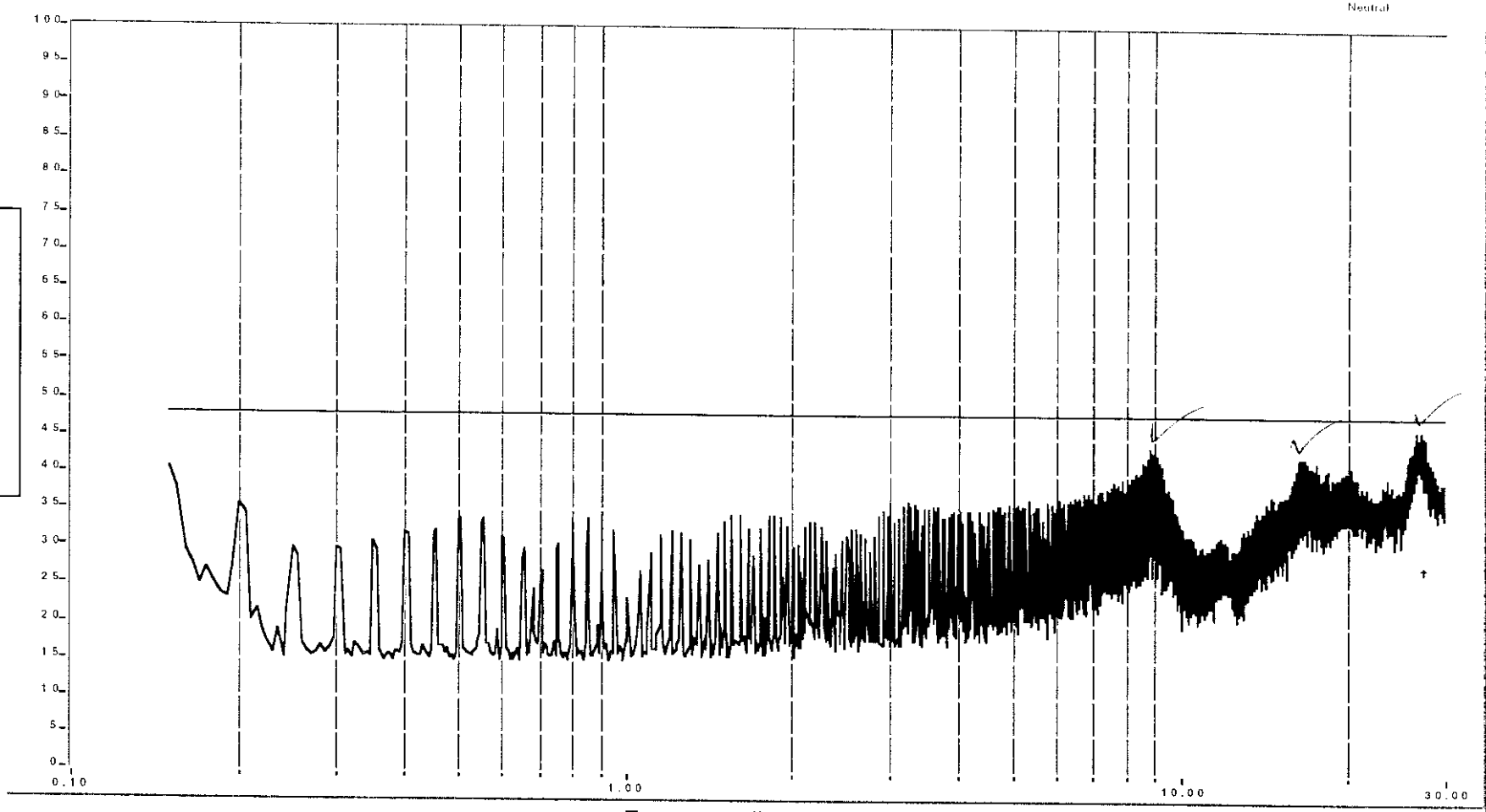
Elliott

SVOATS #1: Savi Technology RFR-200 Run 4

Center Channel (code 125)

Spec: FCC B

Mains Lead: Neutral



120V, 60Hz. NEUTRAL

V = EUT

Scan
Peak
Quasi-peak
Average
QuasiPeak L
Limit 2

9/8/98

Rudy Suy

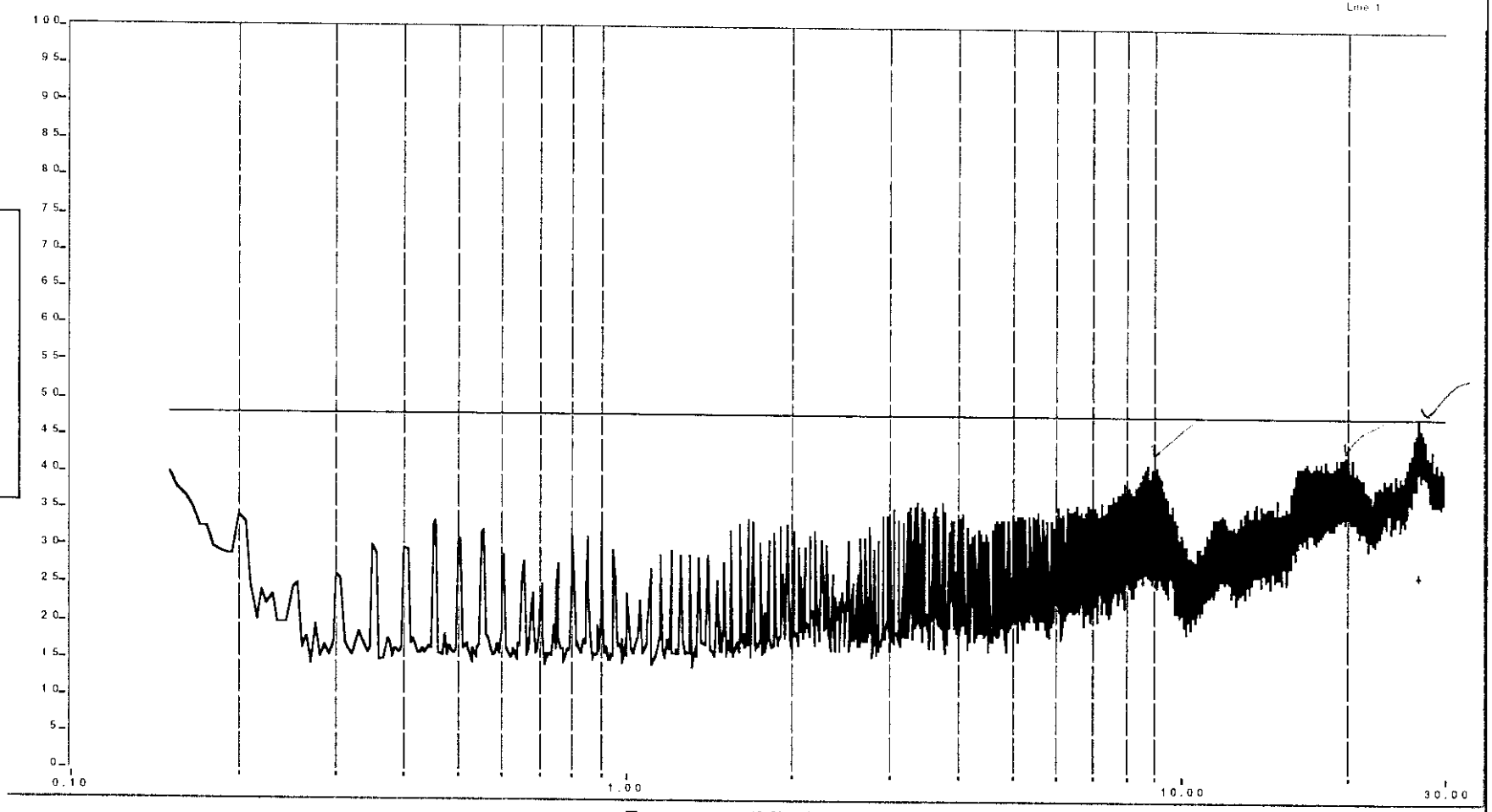
Elliott

SVOATS #1: Savi Technology RFR-200 Run 4

Center Channel (code 125)

Spec: FCC B

Mains Lead Line 1



120V, 60Hz. LINE V = EUT

Scan
Peak
Quasi-peak
Average
QuasiPeak 1
Limit 2

9/8/98

Rudy Suy

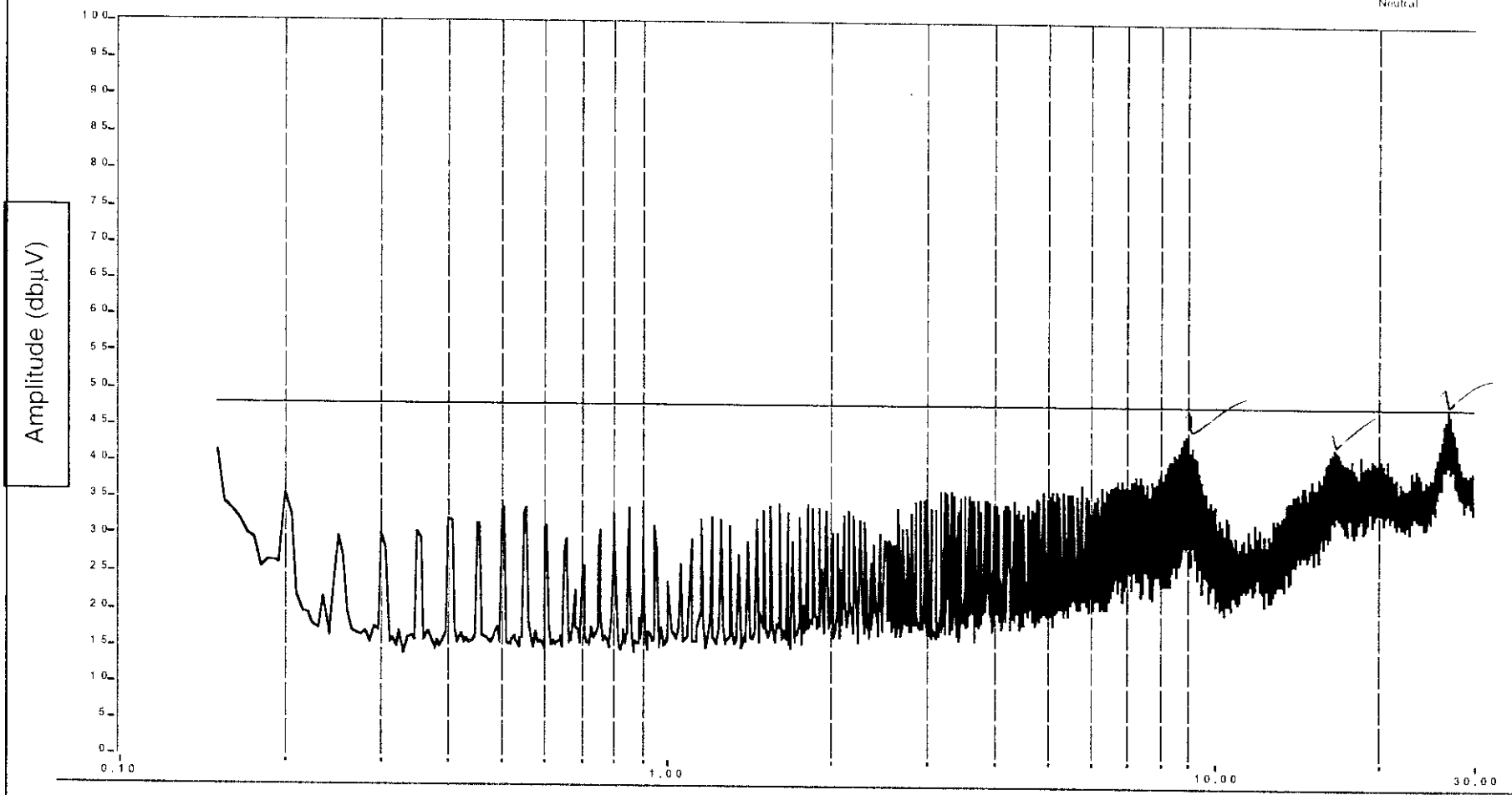
Elliott

SVOATS #1: Savi Technology RFR-200 Run 5

Low Channel (code 10)

Spec: FCC B

Mains Lead: Neutral



120V, 60Hz. NEUTRAL

V = EUT

Scan
Peak
Quasi-peak
Average
QuasiPeak Limit 2

9/8/98

Rudy Suy

Elliott

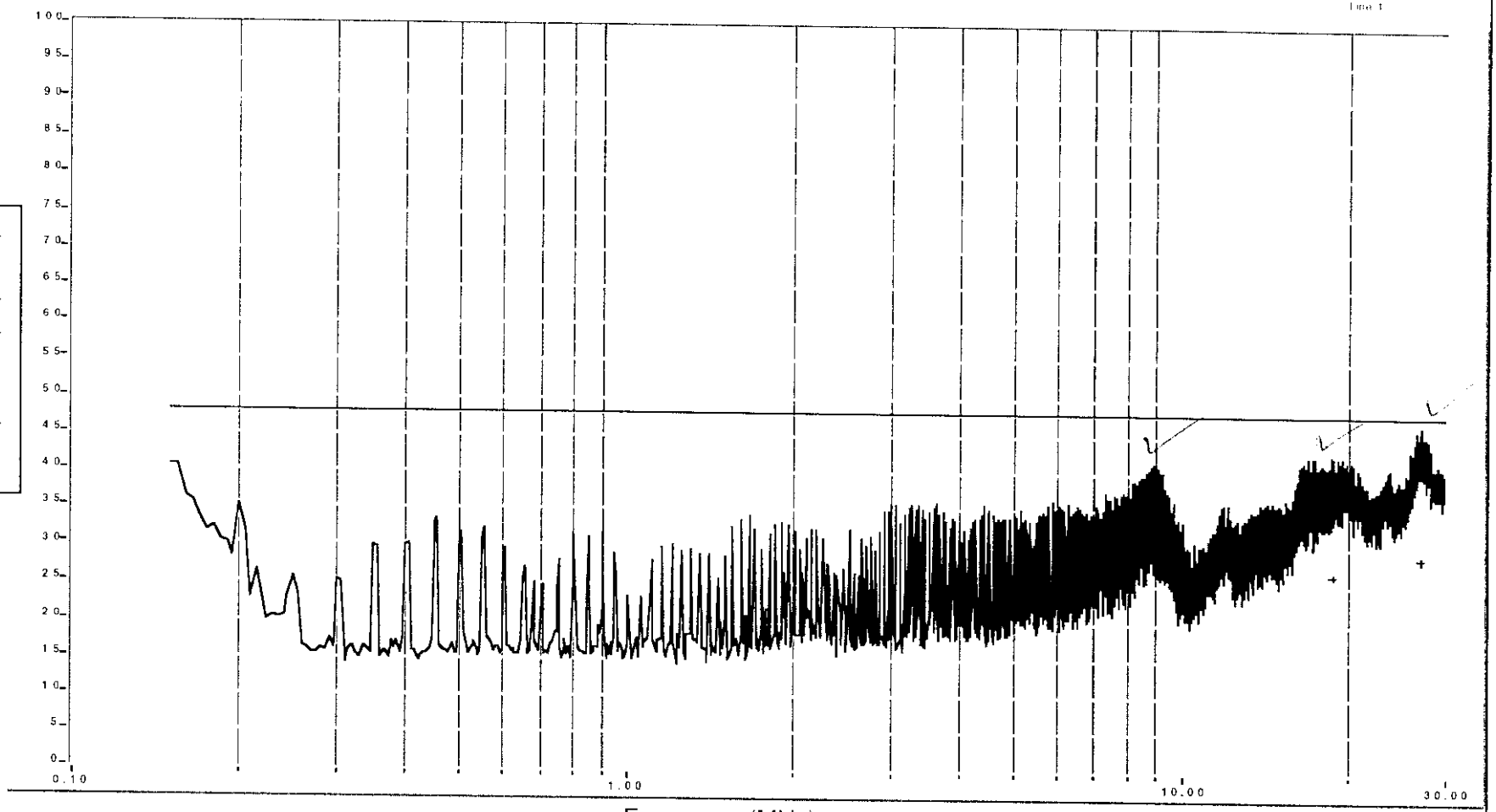
SVOATS #1: Savi Technology RFR-200 Run 5

Low Channel (code 10)

Spec: FCC B

Mains Lead

Line 1



120V, 60Hz. LINE

√= EUT

Scan

Peak

Quasi-peak

Average

QuasiPeak L

Limit 2

9/8/98

Rudy Suy