FCC CFR47 PART 15 SUBPART C
INDUSTRY CANADA RSS-210 ISSUE 8

CERTIFICATION TEST REPORT

FOR

VLF RADIO TRANSMITTER

FCC ID: XV9-SES37020

IC ID: 8714A-SES37020

MODEL NUMBER: 37020

REPORT NUMBER: 12U14323-3

ISSUE DATE: APRIL 02, 2012

Prepared for
STORE ELECTRONIC SYSTEMS (SES)
39 RUE DE MONTIGNY
ARGENTEUIL
ARGENTEUIL 95100, FRANCE

Prepared by
COMPLIANCE CERTIFICATION SERVICES (UL CCS)
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Revision History

Rev.	Issue Date	Revisions	Revised By
--	04/02/12	Initial Issue	Tom Cokenias

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: STORE ELECTRONIC SYSTEMS (SES)
39 RUE DE MONTIGNY ARGENTEUIL
ARGENTEUIL 95100, FRANCE

EUT DESCRIPTION: VLF RADIO TRANSMITTER

MODEL: 37020

SERIAL NUMBER: S37020000068

DATE TESTED: 19-20 March 2012

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart E	Pass
INDUSTRY CANADA RSS-210 Issue 8 Annex 9	Pass
INDUSTRY CANADA RSS-GEN Issue 3	Pass

Compliance Certification Services (UL CCS) tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL CCS based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL CCS will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For UL CCS By:

MENGISTU MEKURIA
EMC TEST ENGINEER
UL CCS

Tested By:

TOM COKENIAS
Principal Consultant
UL CCS

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2009, FCC CFR 47 Part 2, FCC CFR 47 Part 15, FCC 06-96, RSS-GEN Issue 3, and RSS-210 Issue 8.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

UL CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://www.ccsemc.com.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	3.52 dB
Radiated Disturbance, 30 to 1000 MHz	4.94 dB

Uncertainty figures are valid to a confidence level of 95%.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a VLF transmitter used in stores to program electronic price tags located on shelves. The transmitter can operate in either one of two modes: QPSK, CF = 36 kHz, and FSK (NRZ), CF=38.4 kHz, +/- 1.8 kHz excursion. The EUT is designed for small stores, gas stations, strip mall stores, and the like.

5.2. DESCRIPTION OF AVAILABLE ANTENNAS

The transmitter antenna is a simple wire loop antenna, in rectangles strung around the periphery of the area containing the shelves with the price tags. The pattern is a rectangle, the standard configuration used in actual installations.

The antenna wire is a UL approved type AWM Style 1015 single-conductor multi-strand wire.

The product was tested in situ at 3 different locations with 3 different antenna loop routings:

47280 Kato Street (South Side):	11.63m x 7.5m
47280 Kato Street (North Side):	11.4m x 7.5m
47173 Benicia Street:	3.75m x 7.5m

For the AC line conducted test, a small loop dummy load was attached to the TX antenna port.

5.3. SOFTWARE AND FIRMWARE

Firmware: EMTQPSKV116
Driver: JEEGY M12

5.4. WORST-CASE CONFIGURATION AND MODE

The EUT consists of a transmitter and loop antenna. The pc controls the transmitter. The EUT, once powered, will start transmitting the VLF signal; there is only one operating mode.

During tests the antenna current was set to the maximum value of 2 A p-p, (0.707 RMS).

6. DESCRIPTION OF TEST SETUP

6.1. SUPPORT EQUIPMENT AND CABLING

SUPPORT EQUIPMENT

Device Type	Manufacturer	Model Number	Serial Number	FCC ID
PC	Acer	Veriton M460	MAC1: 00-21-97-D4-3E-8B	DoC
Monitor	Acer	P196HQV	ETLQ800003042018548501	DoC
Keyboard	Acer	PR1101	KBPS20P169108A11EFHU01	DoC
Mouse	Acer	M-S0004-O	LZ042AR03B1	DoC

CABLES

Cable	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
RS232	Serial	2	D9	shielded	4m	N/A
Power	AC	1	IEC connector	unshielded	1.5m	N/A
Ant	ANT1&2	1	Screwdown	Single conductor	Varies	N/A

CLIENT EQUIPMENT

Description	Mfr	Model Number	Serial	Cal Date	Cal Due
Current probe	Tektronix	P6201	X005097	03/02/12	03/02/13

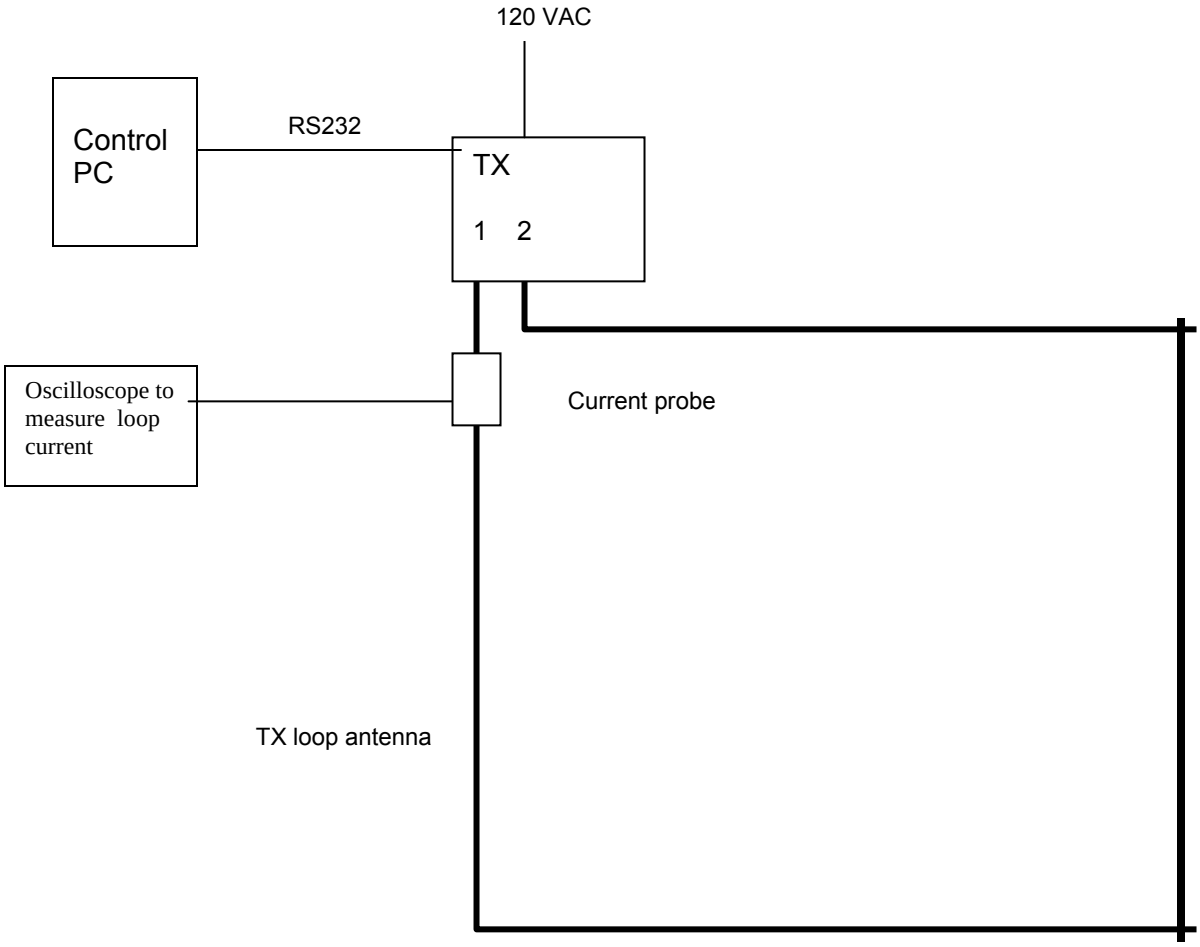
6.2. TEST MODE

TEST SETUP

The EUT consists of a transmitter and loop antenna.. For all tests, the TX output was set to produce an antenna loop current of 2 A p-p
(0.707A RMS), which per the manufacturer is the maximum level for operation in actual installations.

6.3. TEST SETUP

6.3.1. TEST DIAGRAM



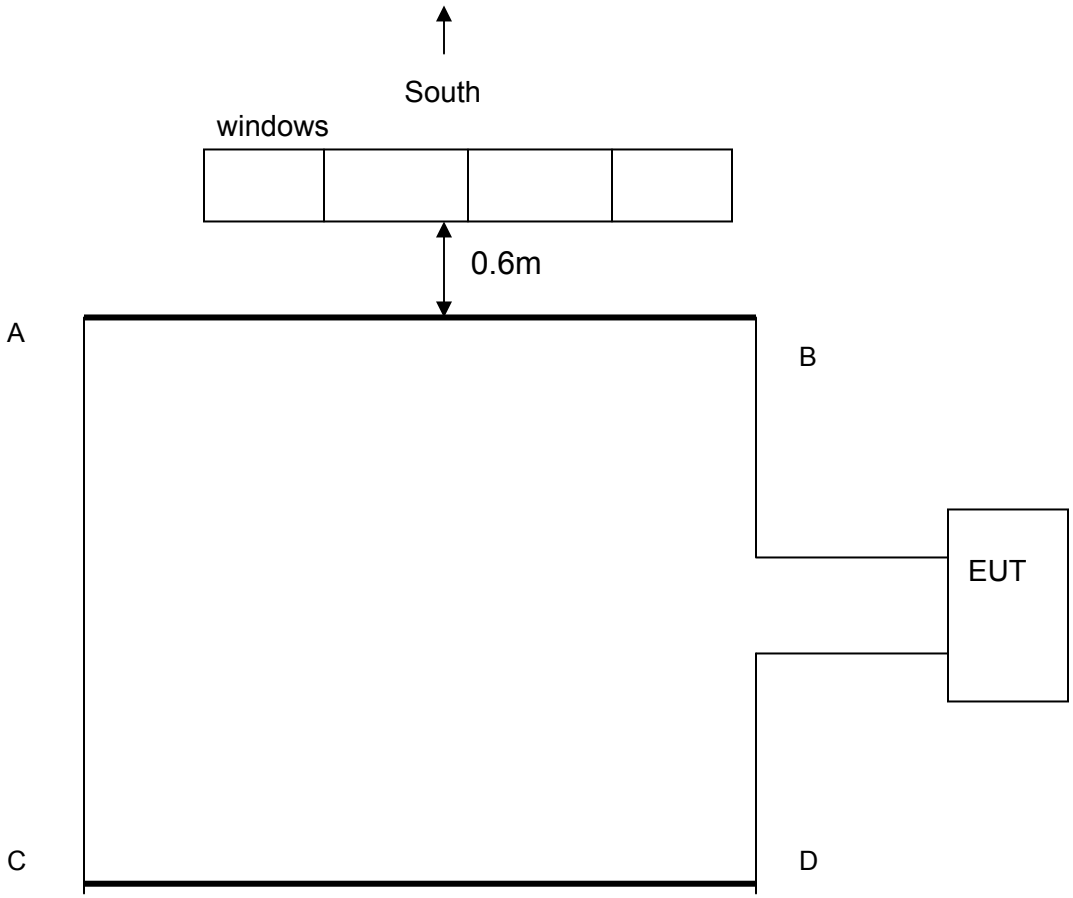
KATO STREET SOUTH TX LOOP ANTENNA

6.3.2. KATO STREET NORTH TX LOOP ANTENNA

6.3.3. 47173 Benicia Street Loop ANTENNA

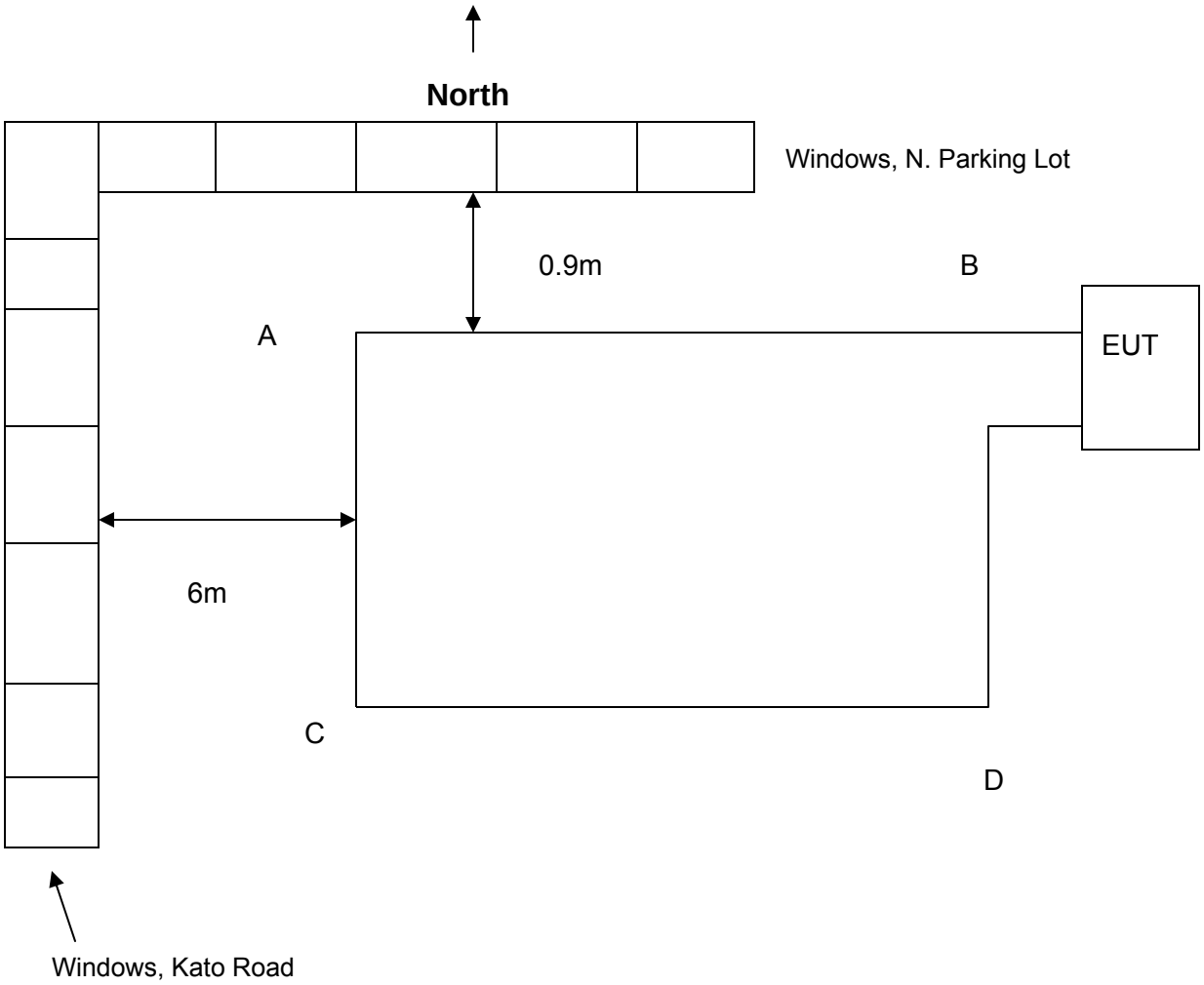
6.4. TEST LOCATIONS

6.4.1. SOUTH KATO LOOP DIAGRAM



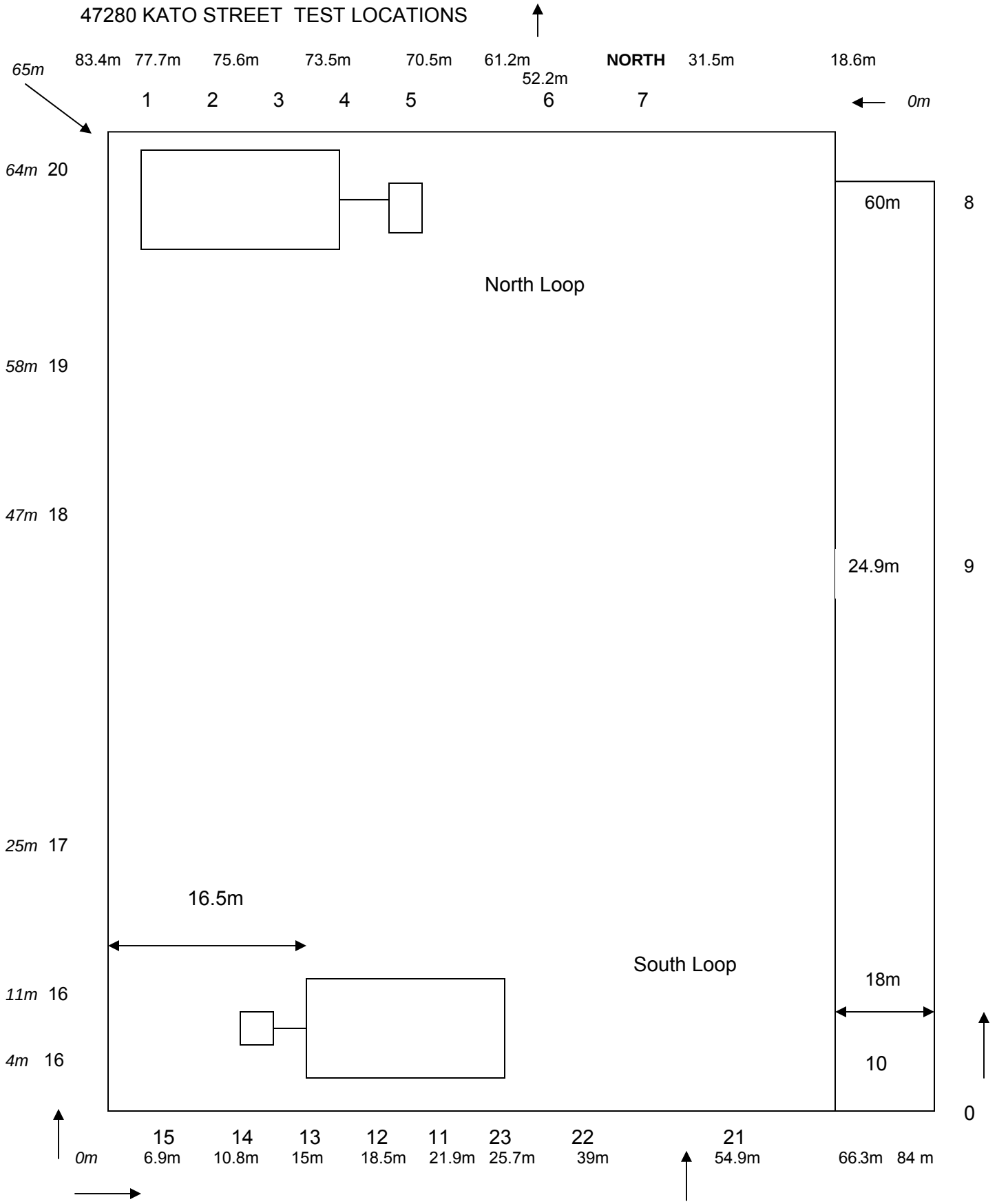
A-B: 11.63m
B-D: 7.5 m

6.4.2. NORTH KATO LOOP DIAGRAM

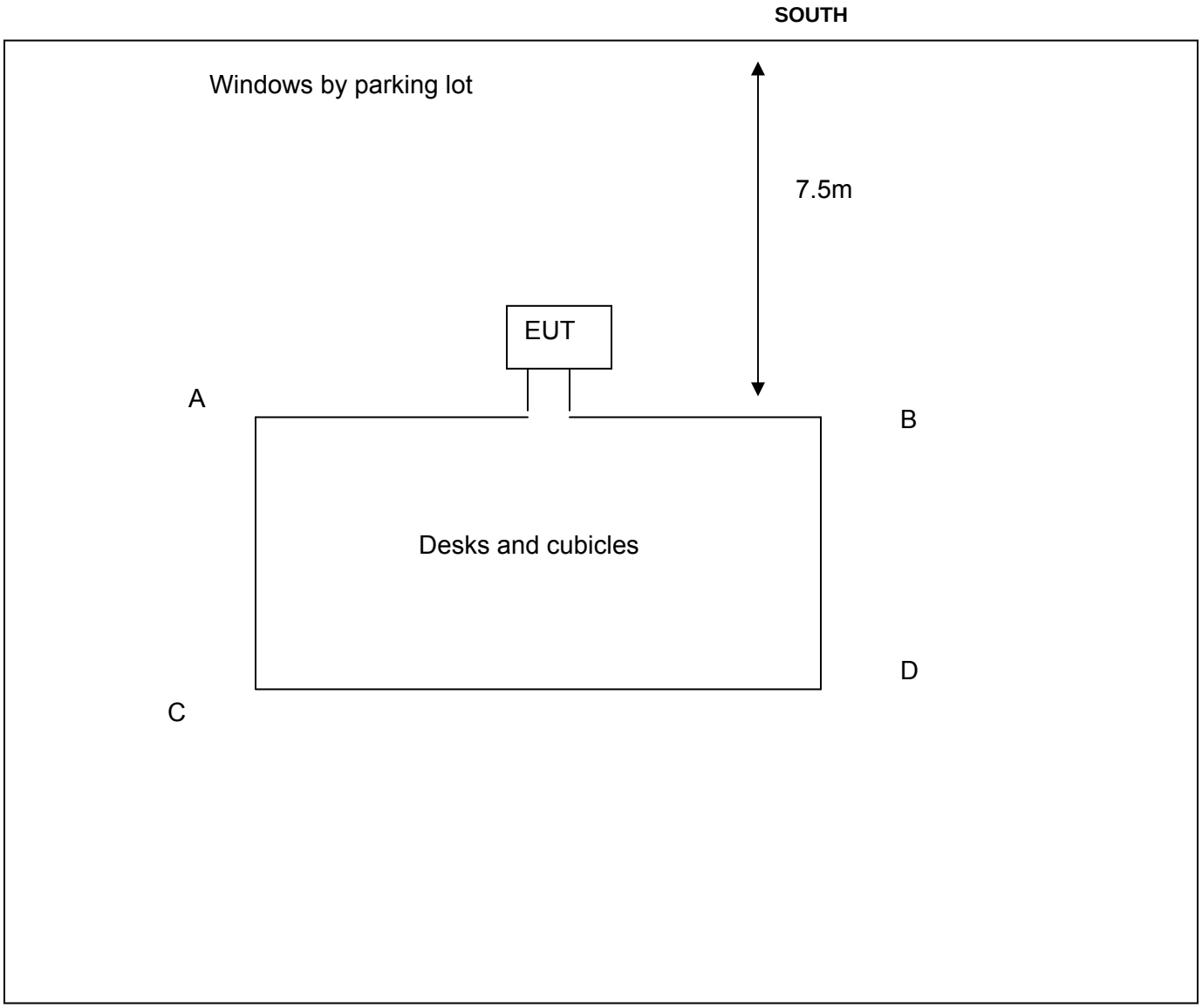


A-B: 11.63m
B-D: 7.5m

47280 KATO STREET TEST LOCATIONS

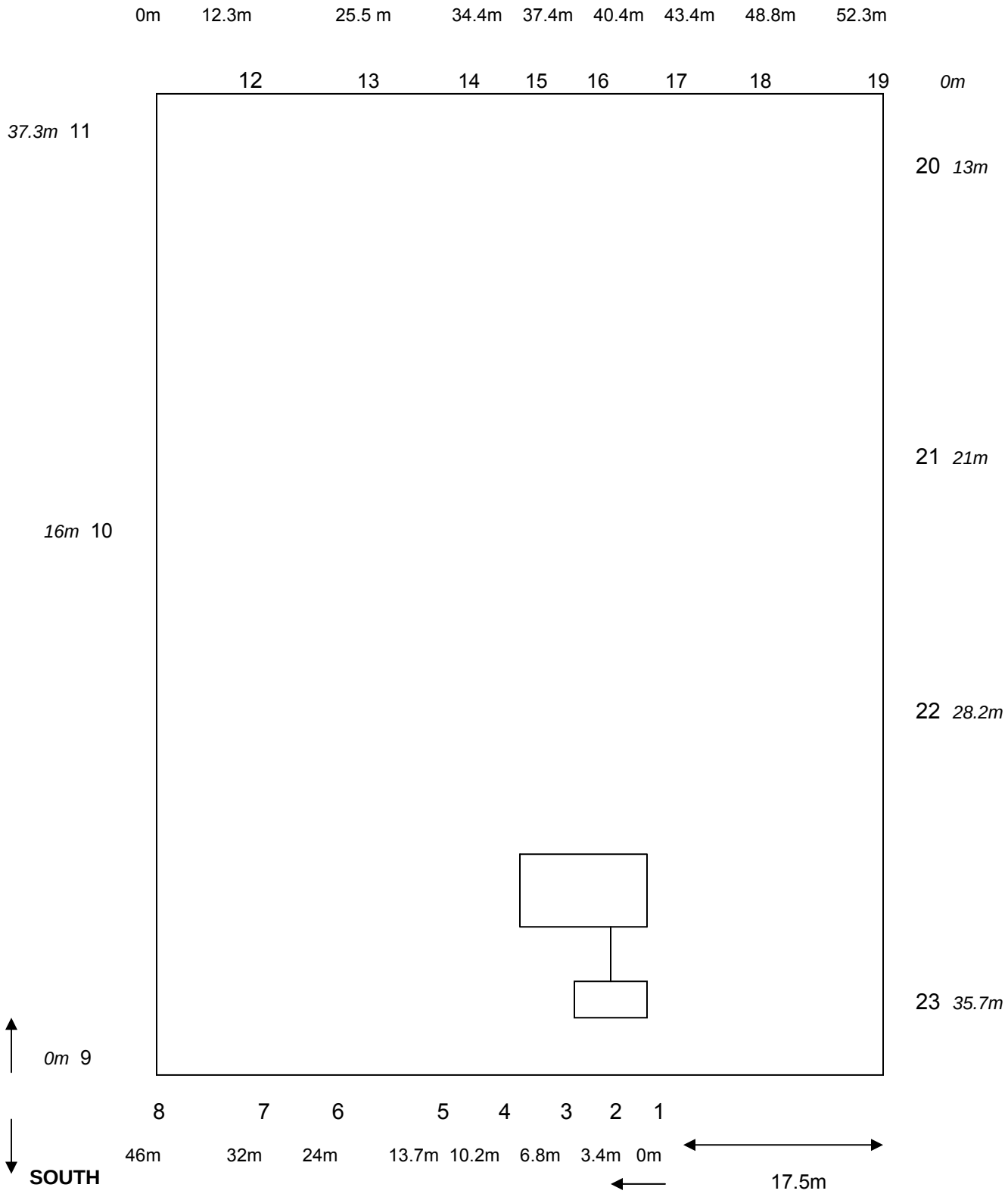


6.4.3. 47173 BENICIA STREET LOOP DIAGRAM



A-B: 7.5m
A-C: 3.75m

47173 BENICIA STREET TEST LOCATIONS



7. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST AND MEASUREMENT EQUIPMENT

Chamber A

TEST EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Asset Number**	**Cal Due**
Spectrum Analyzer, 26.5 GHz	Agilent / HP	E4440A	C01179	2/16//2013
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01011	07/16/12
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00885	11/11/12
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00558	11/11/12
Antenna, Horn, 18 GHz	EMCO	3115	C00945	10/06/12
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01052	07/12/12

Line Conducted

TEST EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**Cal Due**
LISN, 30 MHz	FCC	LISN-50/250-25-2	2023	11/17/12
LISN, 10 kHz ~ 30 MHz	Solar	8012-50-R-24-BNC	8379443	CNR
EMI Test Receiver, 7 GHz	R & S	ESCI7	100773	07/05/12

In Situ

TEST EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Asset Number**	**Cal Due**
Spectrum Analyzer, 26.5 GHz	Agilent	E4407B	T12	04/30/12
Antenna, Loop	ETS	6502	T35	02/11/13

8. APPLICABLE LIMITS AND TEST RESULTS

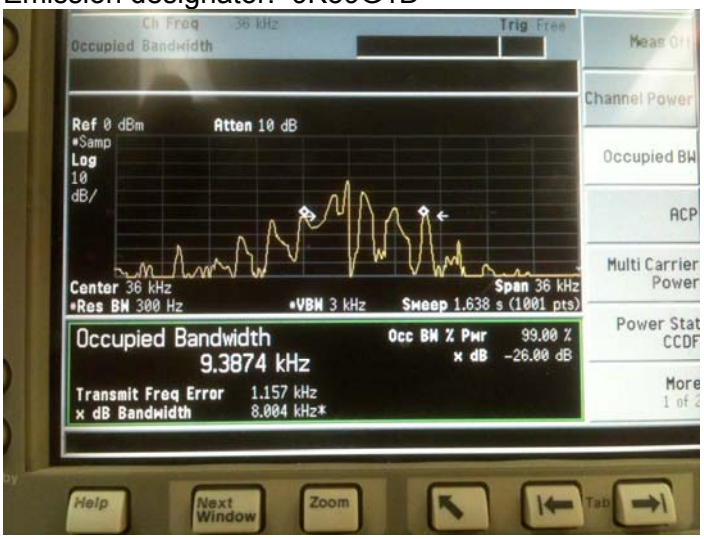
8.1 99% OCCUPIED BANDWIDTH

TEST PROCEDURE

A small pickup loop was placed near the TX loop and was connected to the spectrum analyzer by a 3m length of coax cable. The transmitter was set to transmit continuously. The spectrum analyzer 99% OCC BW internal function was activated.

LIMIT NONE. For reporting purposes only

QPSK modulation
Emission designator: 9K39G1D



FSK modulation
Emission designator: 4K64F1D

8.2 RADIATED EMISSIONS

TEST PROCEDURE

ANSI C63.4

The frequency range was investigated from 9 kHz to 1000 MHz.

Testing was performed at 3 different installations, located in two different buildings. Field strength was measured at 20-23 different radials around each installation.

Preliminary testing was performed at 3 m separation distance from the loop, inside the building, to search for spurious and harmonic emissions between 9 kHz – 30 MHz. For 30-1000 MHz, testing was performed in an anechoic chamber using a dummy load antenna.

LIMIT

§15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (m)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	24000/F(kHz)	30
1.705–30.0	30	30
30–88	100	3
88 to 216	150	3
216 to 960	200	3
Above 960 MHz	500	3
Note: The lower limit shall apply at the transition frequency.		

RESULTS

0.15 TO 30 MHz (WORST-CASE CONFIGURATION)

FSK Modulation

FCC Part 15.209
FSK Modulation: Loop Antenna Measurement At Open Field below 30 MHz

Company: SES
Project #: 12SC02540
Model #: 37020
Tester: T. Cokenias
Date: 19-20 March 2012

Frequency	Reading A	Measurement Distance A	Field Strength A	Reading B	Measurement Distance B	Field Strength B	Antenna Factor	Distance Factor	Limit Distance	Field Strength at Limit Distance	Limit	Delta	Notes (Pk/QP/AV, etc.)
(MHz)	(dBu/V)	(m)	(dBuV/m)	(dBu/V)	(m)	(dBuV/m)	(dB/m)	(dB/decade)	(m)	(dBuV/m)	(dBuV/m)	(dB)	
Loop Antenna Maximized over all 3 planes: XY, YZ, and ZX:													
0.0366	63.9	10	76.50				12.60	40.00	300	17.42	36.33	-18.9	KatoSouth Loc11
0.042	64.05	10	76.23				12.18	40.00	300	17.15	35.14	-18.0	
0.0366	71.38	10	83.98				12.60	40.00	300	24.90	36.33	-11.4	KatoNorth Loc5
0.042	72.8	10	84.98				12.18	40.00	300	25.90	35.14	-9.2	
0.0366	49.86	10	62.46				12.60	40.00	300	3.38	36.05	-32.7	47173Benicia Loc3
0.042	50.92	10	63.10				12.18	40.00	300	4.02	36.05	-32.0	
No other emissions detected													

Notes: In accordance with 15.31 (f) (2):
For each frequency at which a measurement is made at only one distance, the square of an inverse linear distance extrapolation factor (40 dB/decade) is applied.
For each frequency at which measurements are made at two distances, the applied extrapolation factor is calculated from these two measurements.

QPSK Modulation

FCC Part 15.209
QPSK Modulation: Loop Antenna Measurement At Open Field below 30 MHz

Company: SES
Project #: 12SC02540
Model #: 37020
Tester: T. Cokenias
Date: 19-20 March 2012

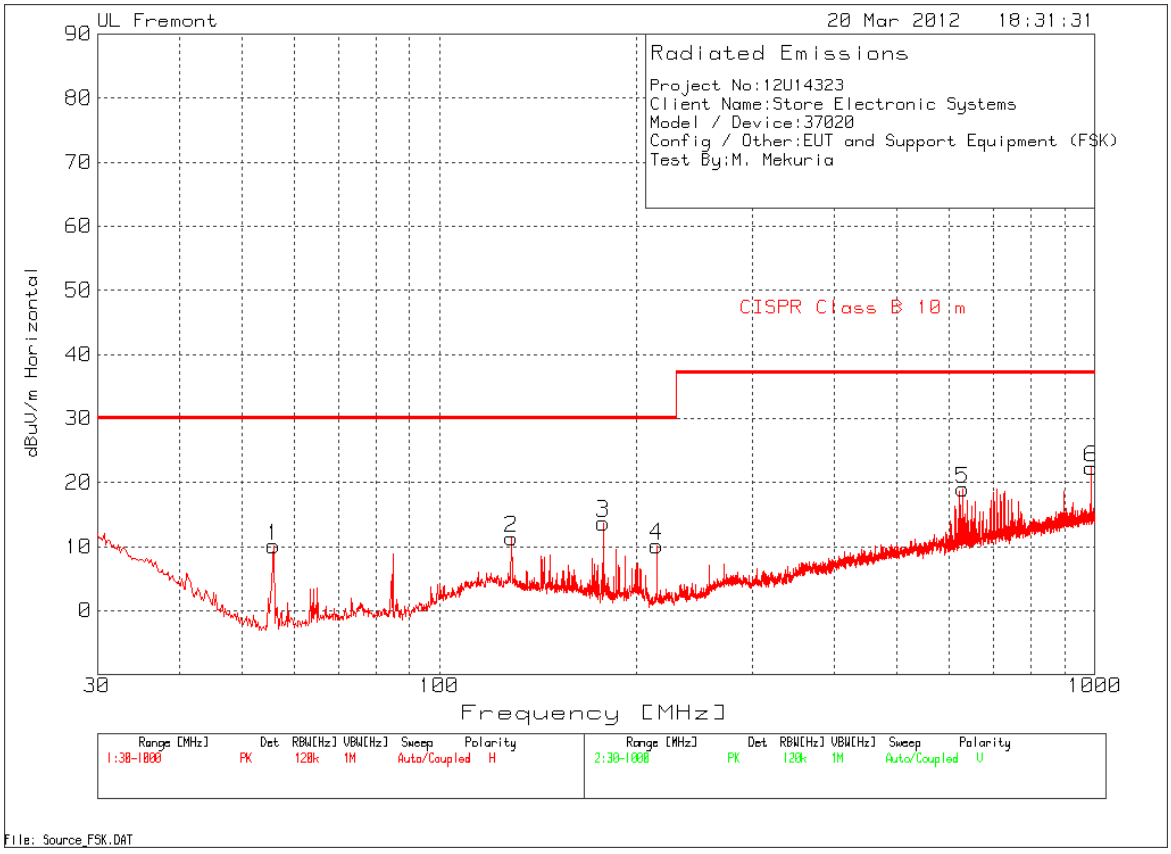
Frequency	Reading	Measurement	Field Strength	Reading	Measurement	Field Strength	Antenna	Distance	Limit	Field Strength	Limit	Delta	Notes
	A	Distance A	A	B	Distance B	B	Factor	Factor	Distance	at Limit Distance			(Pk/QP/AV, etc.)
(MHz)	(dBu/V)	(m)	(dBuV/m)	(dBu/V)	(m)	(dBuV/m)	(dB/m)	(dB/decade)	(m)	(dBuV/m)	(dBuV/m)	(dB)	
Loop Antenna Maximized over all 3 planes: XY, YZ, and ZX:													
0.036	64.1	10	76.28				12.18	40.00	300	17.20	36.48	-19.3	KatoSouth Loc11
0.036	71.44	10	83.62				12.18	40.00	300	24.54	36.48	-11.9	KatoNorth Loc5
0.036	49.86	10	62.04				12.18	40.00	300	2.96	36.48	-33.5	47173Benicia Loc3
No other emissions detected													

Notes: In accordance with 15.31 (f) (2):
For each frequency at which a measurement is made at only one distance, the square of an inverse linear distance extrapolation factor (40 dB/decade) is applied.
For each frequency at which measurements are made at two distances, the applied extrapolation factor is calculated from these two measurements.

SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)

Tx FSK

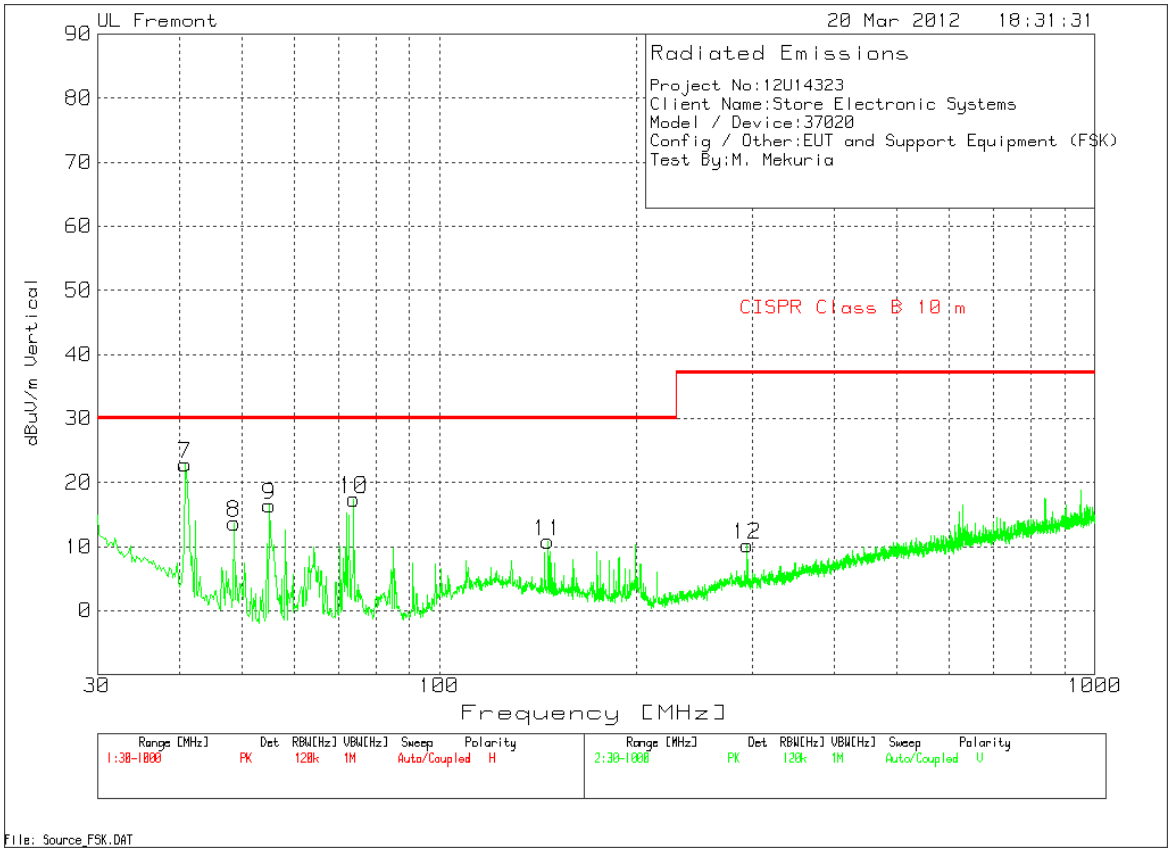
HORIZONTAL PLOT



SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)

Tx FSK

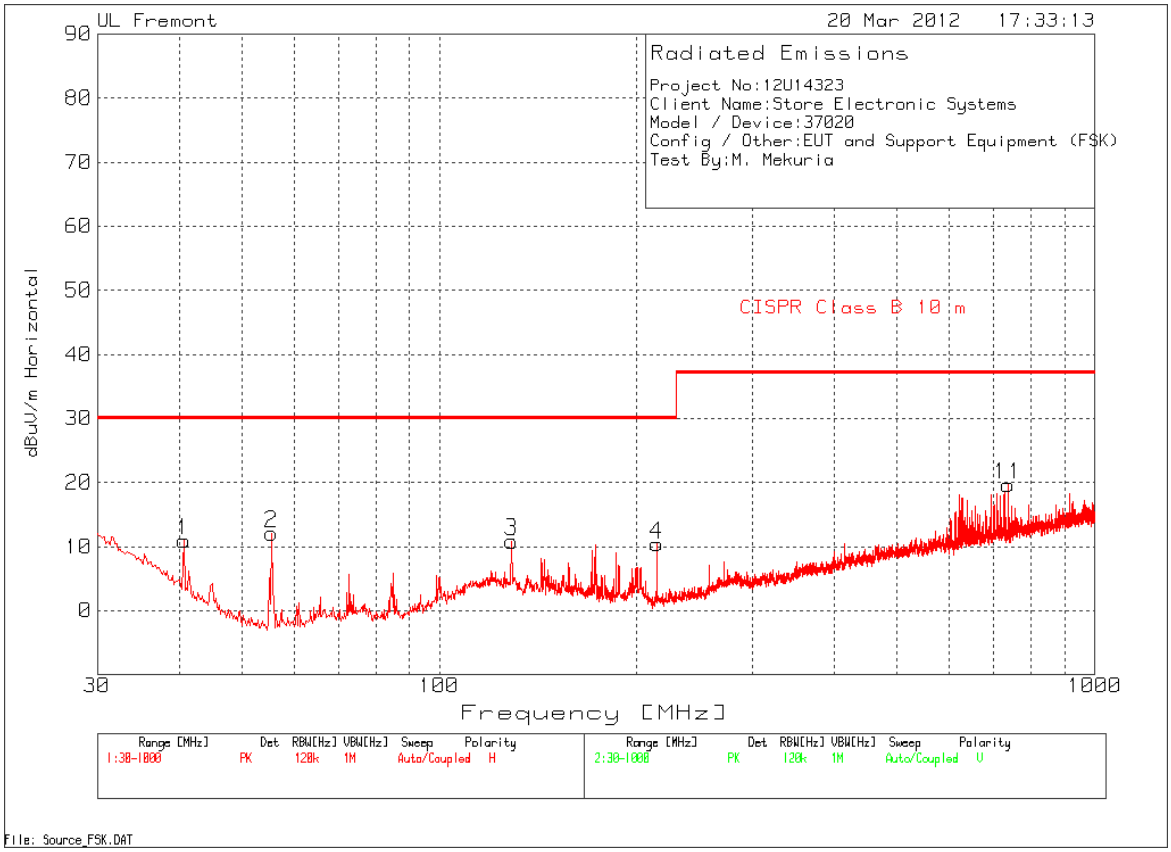
VERTICAL PLOT



SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)

Tx QPSK

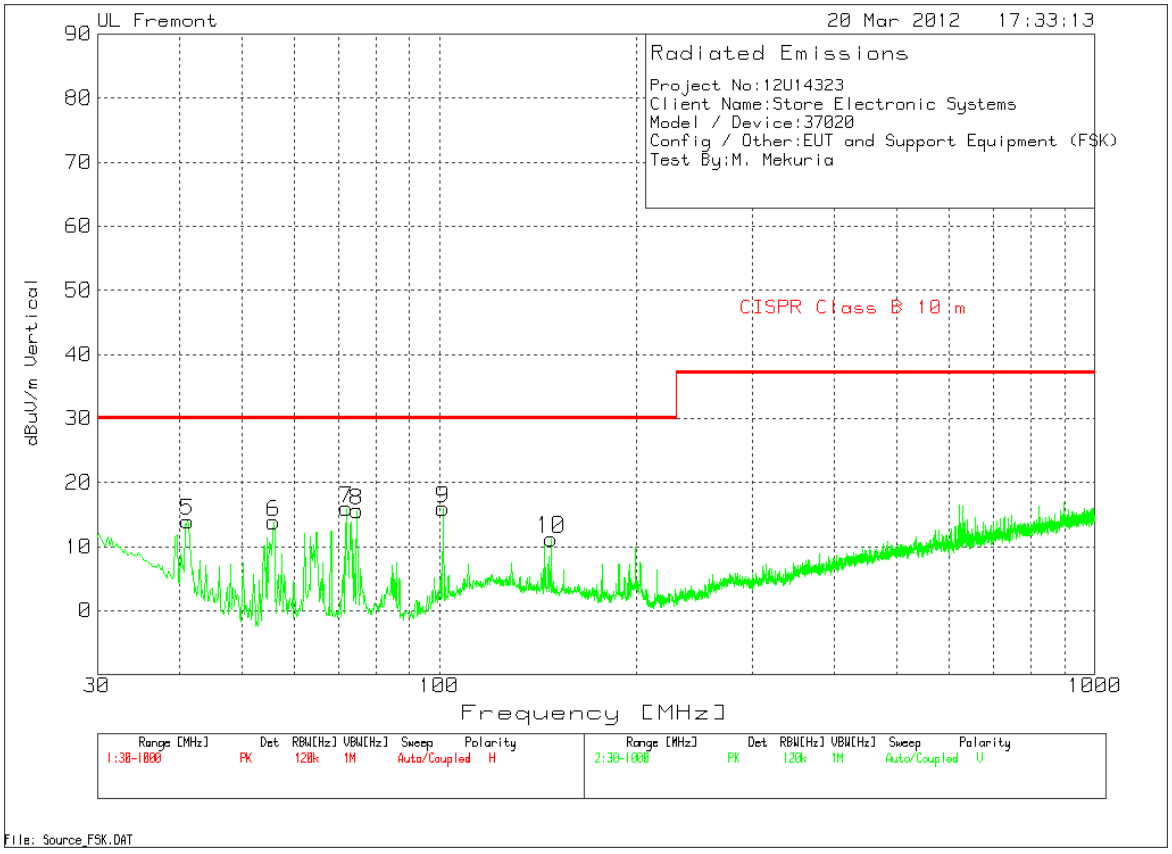
HORIZONTAL PLOT



SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)

Tx QPSK

VERTICAL PLOT



8.3 AC MAINS LINE CONDUCTED EMISSIONS

TEST PROCEDURE

ANSI C63.4

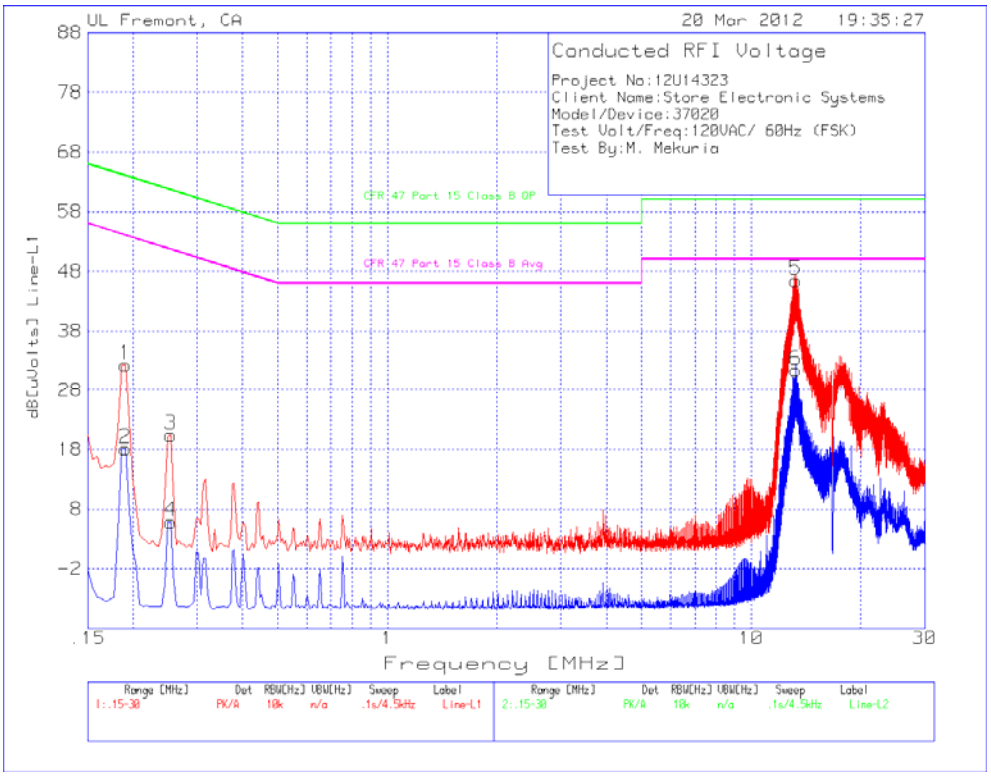
LIMIT

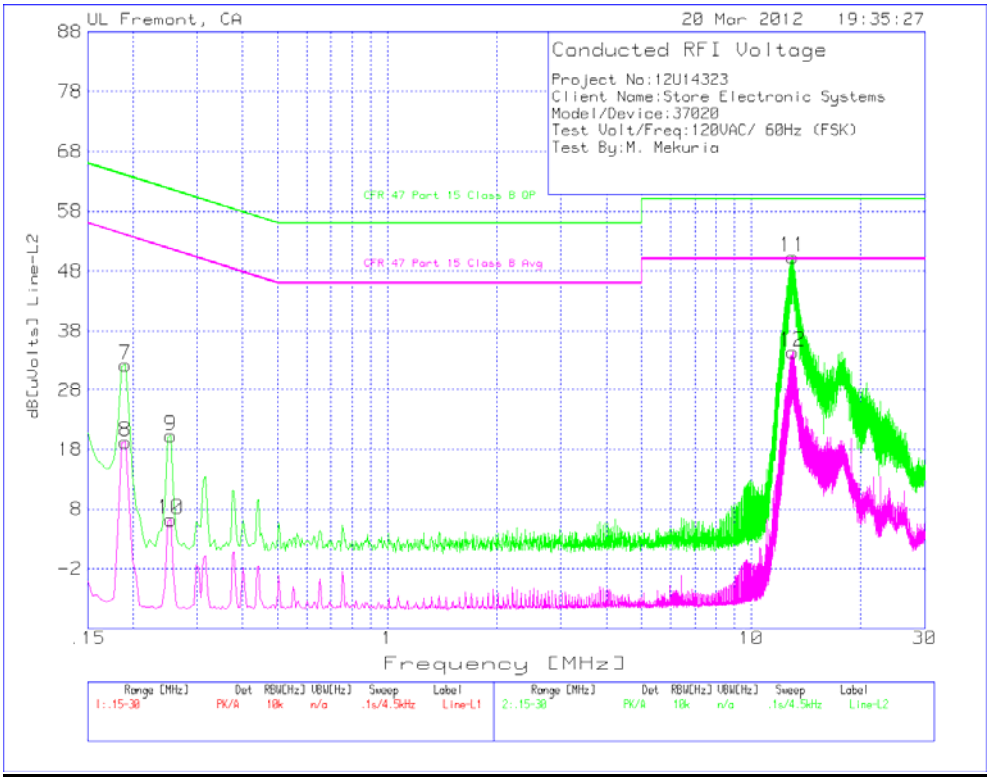
§15.207 (a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency of emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5	56	46
5 to 30	60	50
* Decreases with the logarithm of the frequency.		

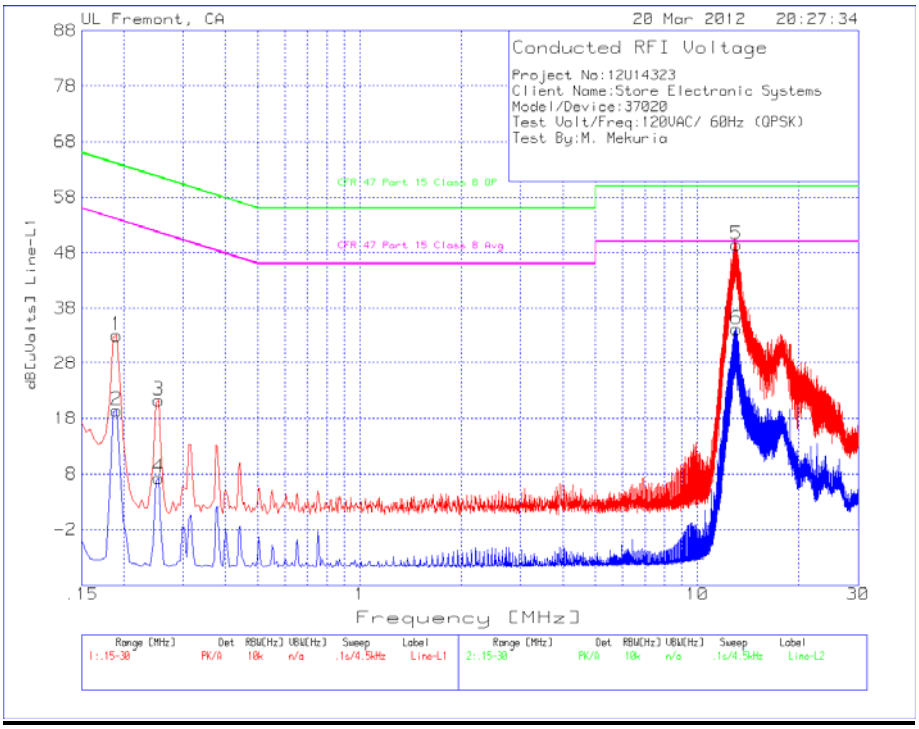
RESULTS

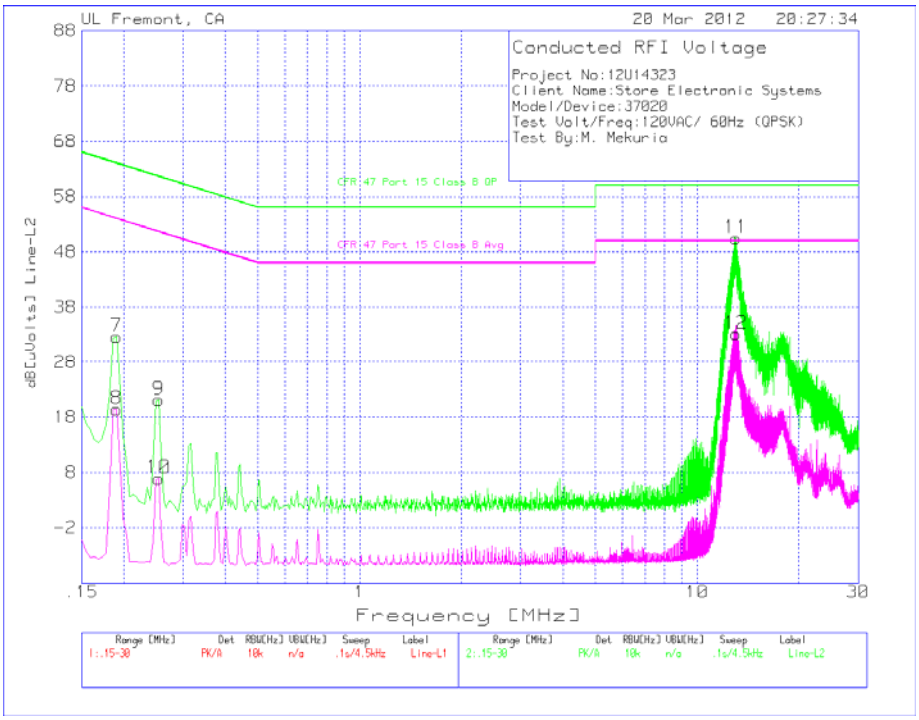
Tx FSK




UL Fremont, CA
20 Mar 2012 19:35:27
Conducted RFI Voltage
Project No:12U14323
Client Name:Store Electronic Systems
Model/Device:37020
Test Volt/Freq:120VAC/ 60Hz (FSK)
Test By:M. Mekuria
CFR 47 Part 15 Class B QP
CFR 47 Part 15 Class B Avg
dB[uVolts] Line-L2
Frequency [MHz]
.15
1
10
30
88
78
68
58
48
38
28
18
8
-2
Range [MHz] Det RBW[Hz] VBW[Hz] Sweep Label
1:.15-30 PK/A 10k n/a .1s/4.5kHz Line-L1
Range [MHz] Det RBW[Hz] VBW[Hz] Sweep Label
2:.15-30 PK/A 10k n/a .1s/4.5kHz Line-L2

Tx QPSK


UL Fremont, CA
20 Mar 2012 20:27:34
Conducted RFI Voltage
Project No:12U14323
Client Name:Store Electronic Systems
Model/Device:37020
Test Volt/Freq:120VAC/ 60Hz (QPSK)
Test By:M. Mekuria
CFR 47 Part 15 Class B QP
CFR 47 Part 15 Class B Avg
dB[uVolts] Line-L1
Frequency [MHz]
.15
1
10
30
88
78
68
58
48
38
28
18
8
-2
Range [MHz] Det RBW[Hz] VBW[Hz] Sweep Label
1:.15-30 PK/A 10k n/a .1s/4.5kHz Line-L1
Range [MHz] Det RBW[Hz] VBW[Hz] Sweep Label
2:.15-30 PK/A 10k n/a .1s/4.5kHz Line-L2


UL Fremont, CA
20 Mar 2012 20:27:34
Conducted RFI Voltage
Project No:12U14323
Client Name:Store Electronic Systems
Model/Device:37020
Test Volt/Freq:120VAC/ 60Hz (QPSK)
Test By:M. Mekuria
CFR 47 Part 15 Class B QP
CFR 47 Part 15 Class B Avg
dBC(uVolts) Line-L2
88
78
68
58
48
38
28
18
8
-2
.15
1
10
30
Frequency [MHz]
7
8
9
10
11
12
Range (MHz) Det RBW(Hz) VBW(Hz) Sweep Label
1:.15-30 PK/A 10k n/a .1s/4.5kHz Line-L1
Range (MHz) Det RBW(Hz) VBW(Hz) Sweep Label
2:.15-30 PK/A 10k n/a .1s/4.5kHz Line-L2