EMC TEST REPORT

For an

IntelliTrack Communicator

Client:
Salient Systems, Inc. (Div. of Portec Rail)
4393-K Tuller Road
Dublin, Ohio 43017
United States of America

Testing Laboratory:
F-Squared Laboratories
16740 Peters Road
Middlefield, Ohio 44062
United States of America

The **IntelliTrack Communicator, model ITC001 (battery powered)** was tested to the following Directive and Standards, and the results are summarized on page 3. The testing commenced on Dec. 20, 2010 and was completed on Dec. 21, 2010.

R&TTE Directive (1999/5/EC)

Standards:

- **EN 55024:1998, including A1:2001 and A2:2003,** Information Technology Equipment-Immunity Characteristics Limits and Methods of Measurement
  - **EN 61000-4-2:1995 edition** - Electromagnetic Compatibility-Part 4: Testing and measurement techniques - Section 2: Electrostatic discharge immunity test
  - **EN 61000-4-3:2002 edition** - Electromagnetic Compatibility-Part 4: Testing and measurement techniques - Section 3: Radiated, radio-frequency, electromagnetic field immunity test
- **EN 301 489-1 v1.8.1:2008 - Electromagnetic Compatibility and Radio Spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements**
- **EN 55022:2006,** Information technology equipment - radio disturbance characteristics - Limits and methods of measurement
- **Federal Register CFR 47, Part 15, subpart B:2007**
- **ICES-003, Issue 4, February 2004**
- **Australian and New Zealand Standard AS/NZS CISPR 22:2004**

Evaluation Conducted by:

Michael Toth
EMC Project Engineer

Report Reviewed by:

Russell Beattie
EMC Technical Manager

TABLE OF CONTENTS

Section

GENERAL REPORT SUMMARY

This electromagnetic emission and immunity test report was generated by F-Squared Laboratories. The test report is based on testing performed by F-Squared Laboratories personnel according to the measurement procedures described in the test specifications given below and in the Test Procedures section of this report.

SECTION	TEST	RESULTS
8	Electrostatic Discharge	Pass
9	Radiated Immunity	Pass
10	Radiated Emissions	Pass

This report replaces all previously issued reports and/or antecedent report revisions issued under this job number.

1.0 ADMINISTRATIVE DATA

1.1 Management of Test Sample

The test sample was inventoried at the F-Squared facility and returned to Salient Sytems, Inc. according to the agreement between F-Squared Laboratories and the Client.

1.2 Abbreviations and Acronyms

The following abbreviations and acronyms may be used in this document.

AM	Amplitude Modulation
BCI	Bulk Current Injection
CDN	Coupling/Decoupling Network
EFT	Electrical Fast Transients
EMC	Electromagnetic Compatibility
EMIC	Electromagnetic Injection Clamp
EN	European Norm
ESD	Electrostatic Discharge
EUT	Equipment Under Test
GRP	Ground Reference Plane
HCP	Horizontal Coupling Plane
IEC	International Electrotechnical Commission
kHz	kiloHertz
LISN	Line Impedance Stabilization Network
MHz	MegaHertz
OATS	Open Area Test Site
RF	Radio Frequency
VCP	Vertical Coupling Plane

1.3 Document History

Document Number	Description	Issue Date	Approved By
F2LQ4215-01E	First Issue	Jan. 6, 2010	R. Beattie

2.0 DESCRIPTION OF THE TEST CONFIGURATIONS

2.1 Performance Criteria

The following Performance Criteria is determined from EN 301 489-3 v1.4.1 :2002, Class 3, Type 1.

SPECIFICATION	MINIMUM PERFORMANCE CRITERION
EN 61000-4-2	B
EN 61000-4-3	A

Performance Criterion A: The apparatus shall continue to operate as intended both during and after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended.

Performance Criterion B: The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended.

Performance Criterion C: Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls.

3.0 LISTS OF EUT, ACCESSORIES AND TEST EQUIPMENT

3.1 Equipment Under Test (EUT):

Device	Manufacturer	Model Number	Serial Number
IntelliTrack Communicator	Salient Systems, Inc.	ITC001	01901

3.2 Accessories (Support Equipment):

Device	Manufacturer	Model Number	Serial Number
iPod Touch	Apple	MC540LL	C3WDGKLADCP7
RSM Module	Salient Systems, Inc.	RSM Rev. 3	RSM 0531
RSM Module	Salient Systems, Inc.	RSM Rev. 3	RSM 0539

3.3 Cables:

Cable Function	Length	Shielded (Yes/No)
USB	<3.0 meters	No

4.0 MODE OF OPERATION

EUT was set up in a normal operation, with the EUT receiving information from RSM Modules and transmitting it to an iPod Touch via Bluetooth. EUT was battery powered.

5.0 METHOD OF MONITORING

EUT was monitored visually by watching the two LED's on the front panel. One was a constant on and the other was continuously blinking. Also verified that the data transmitted to the iPod Touch.

6.0 IMMUNITY PASS/FAIL CRITERIA

The following shall constitute susceptibility:

- If the EUT shuts down;
- If the EUT stops sending or receiving information via Bluetooth.

7.0 REQUIRED MODIFICATIONS

No modifications were made to the EUT.

8.0 ELECTROSTATIC DISCHARGE TEST

8.1 Electrostatic Discharge (ESD) Test Procedure

The ESD generator and discharge gun were used to conduct the tests outlined below. The waveform conforms to EN 61000-4-2:1995. The generator was used to simulate electrostatic discharges to the EUT.

A horizontal coupling plane (HCP) conforming to the dimensions of EN 61000-4-2:1995 was placed on a non-conductive table 0.8 meter above the ground reference plane (GRP). The HCP was connected to the GRP via two 470 kohm resistors. The EUT was placed on non-conductive material 0.5 mm above the HCP. The vertical coupling plane (VCP) was connected to the GRP through two 470 kohm resistors and positioned 10 cm from the appropriate face of the EUT, as required.

During the test, three different methods were used to determine if the equipment was susceptible to ESD: direct contact, air discharge and indirect discharge.

The direct contact method was used on all exposed conductive surfaces. Each point was contacted 10 consecutive times in the positive polarity and 10 consecutive times in the negative polarity with an electrostatic discharge from the ESD Gun.

The indirect discharge method was used on one point of the horizontal coupling plane (HCP) and to one point on the vertical coupling plane (VCP) located 10 cm from the edge of the EUT on all four sides of the EUT.

The air discharge method was used on all exposed non-conductive materials. These materials were scanned with the tip of the ESD gun. If the gun discharged at any point, 10 consecutive discharges in both positive and negative polarities were then made to that point.

Test Equipment Used:

Equipment Type	Asset Number	Manufacturer	Model	Serial Number	Calibration Due Date
Temp/Hum. Recorder	CL119	Extech	RH520	H005869	Nov. 16, 2011
ESD Immunity Tester	CL076	EMC-Partner	ESD3000	213	June 23, 2011

8.2 Electrostatic Discharge Test Data Sheet

Test Date:	Dec. 20, 2010	**Test Engineer:**	M. Toth
Standard:	EN 55024:1998, inc. A1:2001 & A2:2003	**Air Temperature:**	20.2° C
Minimum Performance Criterion:	B	**Relative Humidity:**	45%

Conductive Surfaces:

Discharge Point	Levels (kV)	Method	Achieved Performance Criterion	Pass/Fail
No Discharge Points	± 2, 4	Contact	N/A	N/A

Coupling Planes:

Discharge Point	Levels (kV)	Method	Achieved Performance Criterion	Pass/Fail
Vertical Coupling Plane – Right Side	± 2, 4	Contact	A	Pass
Vertical Coupling Plane – Left Side	± 2, 4	Contact	A	Pass
Vertical Coupling Plane – Front Side	± 2, 4	Contact	A	Pass
Vertical Coupling Plane – Back Side	± 2, 4	Contact	A	Pass
Horizontal Coupling Plane – Right Side	± 2, 4	Contact	A	Pass
Horizontal Coupling Plane – Left Side	± 2, 4	Contact	A	Pass
Horizontal Coupling Plane – Front Side	± 2, 4	Contact	A	Pass
Horizontal Coupling Plane – Back Side	± 2, 4	Contact	A	Pass

Non-Conductive Surfaces:

Attempted Discharge Point	Levels (kV)	Method	Achieved Performance Criterion	Pass/Fail
Seams	± 2, 4 8	Air	No Discharge	Pass
Label	± 2, 4 8	Air	No Discharge	Pass
LED's	± 2, 4 8	Air	No Discharge	Pass

The EUT was scanned over the non-conductive surfaces with an ESD Gun. Please refer to the photographs on pages 11-14 for details. "C" denotes a contact discharge point. "A" denotes a point where a discharge was observed during a scan of a non-conductive surface. Absence of any Air Discharge points indicates no arc was drawn through the insulated surfaces.

8.3 Photograph of the Electrostatic Discharge Test Setup

Front View of the EUT During the Electrostatic Discharge Test

Right Side View of the Receiver During the Electrostatic Discharge Test

Left Side View of the EUT During the Electrostatic Discharge Test

Top View of the Receiver During the Electrostatic Discharge Test

Bottom View of the Power Supply During the Electrostatic Discharge Test

HCP


10
cm
IntelliTrack Communicator
U.S. Pat. No. 7,502,670
Contains FCC ID: PH411B
Contains FCC ID: OUR XBEE/OUR XBEEPRO

VCP


10
cm
01
IntelliTrack Communicator
U.S. Pat. No. 7,502,670
Contains FCC ID: PH411B
Contains FCC ID: OUR XBEE/OUR XBEEPRO

9.0 RADIATED IMMUNITY TEST

9.1 Radiated Immunity Test Procedure

The Equipment Under Test (EUT) was placed in a semi-anechoic chamber on a 0.8-meter high non-conductive table. A broadband antenna was placed 1.2 meters from the EUT and was used to radiate RF energy at the EUT in both horizontal and vertical polarities.

The RF energy consisted of a signal that was stepped at 1% increments through the frequency ranges of 80 MHz to 1000 MHz, 1400 MHz to 2000 MHz, and 2000 MHz to 2700 MHz, at a rate slower than the reaction time of the EUT. The signal was 80% AM modulated with a 1 kHz sine wave and had a minimum calibrated field strength of 3.0/1.0 volts/meter at the surface of the EUT as specified in the following test data sheet. The EUT was exposed to the RF energy on four different surfaces (front, rear, left and right sides).

The test setup conformed to figure 2 of EN 61000-4-3:2002.

Test Equipment Used:

Equipment Type	Asset Number	Manufacturer	Model	Serial Number	Calibration Due Date
Shield Room	CL014	Shielding Resources	3 Meter	001	Feb. 28, 2011
Temp/Hum. Recorder	CL118	Extech	RH520	H005870	Dec. 17, 2011
Antenna 1-Chamber	0142	ETS/EMCO	3142B	9811-1330	Dec. 31, 2010
Antenna, Horn	CL098	Emco	3115	9809-5580	Oct. 7, 2011
Amplifier	0171	Instruments for Industry	SMX 100	2158-1096	Verified
Power Meter and Power Sensor	CL055	Hewlett Packard	436A, 8482H	2512A21615, 2704A05784	June 23, 2011
Signal Generator	0213	Hewlett Packard	8648C	3623A03444	Sept. 29, 2012
Amplifier	Electro Rent 93182	Ophir	5163	1014	Nov. 15, 2011

9.2 Radiated Immunity Test Data Sheet

Test Date:	Dec. 20, 2010	**Test Engineer:**	M. Toth
Standard:	EN 55024:1998, inc. A1:2001 & A2:2003	**Air Temperature:**	20.3° C
Minimum Performance Criterion:	A	**Relative Humidity:**	42%

Side of EUT Exposed to Antenna	Antenna Polarization	Frequency Range	Minimum Calibrated RF Field Strength	Achieved Performance Criterion	Pass/Fail
Front	Horizontal	80 MHz to 1000 MHz	3.0 V/m	A	Pass
Right Side	Horizontal	80 MHz to 1000 MHz	3.0 V/m	A	Pass
Rear	Horizontal	80 MHz to 1000 MHz	3.0 V/m	A	Pass
Left Side	Horizontal	80 MHz to 1000 MHz	3.0 V/m	A	Pass
Front	Vertical	80 MHz to 1000 MHz	3.0 V/m	A	Pass
Right Side	Vertical	80 MHz to 1000 MHz	3.0 V/m	A	Pass
Rear	Vertical	80 MHz to 1000 MHz	3.0 V/m	A	Pass
Left Side	Vertical	80 MHz to 1000 MHz	3.0 V/m	A	Pass

Side of EUT Exposed to Antenna	Antenna Polarization	Frequency Range	Minimum Calibrated RF Field Strength	Achieved Performance Criterion	Pass/Fail
Front	Horizontal	1400 MHz to 2000 MHz	3.0 V/m	A	Pass
Right Side	Horizontal	1400 MHz to 2000 MHz	3.0 V/m	A	Pass
Rear	Horizontal	1400 MHz to 2000 MHz	3.0 V/m	A	Pass
Left Side	Horizontal	1400 MHz to 2000 MHz	3.0 V/m	A	Pass
Front	Vertical	1400 MHz to 2000 MHz	3.0 V/m	A	Pass
Right Side	Vertical	1400 MHz to 2000 MHz	3.0 V/m	A	Pass
Rear	Vertical	1400 MHz to 2000 MHz	3.0 V/m	A	Pass
Left Side	Vertical	1400 MHz to 2000 MHz	3.0 V/m	A	Pass

Side of EUT Exposed to Antenna	Antenna Polarization	Frequency Range	Minimum Calibrated RF Field Strength	Achieved Performance Criterion	Pass/Fail
Front	Horizontal	2000 MHz to 2700 MHz	1.0 V/m	A	Pass
Right Side	Horizontal	2000 MHz to 2700 MHz	1.0 V/m	A	Pass
Rear	Horizontal	2000 MHz to 2700 MHz	1.0 V/m	A	Pass
Left Side	Horizontal	2000 MHz to 2700 MHz	1.0 V/m	A	Pass
Front	Vertical	2000 MHz to 2700 MHz	1.0 V/m	A	Pass
Right Side	Vertical	2000 MHz to 2700 MHz	1.0 V/m	A	Pass
Rear	Vertical	2000 MHz to 2700 MHz	1.0 V/m	A	Pass
Left Side	Vertical	2000 MHz to 2700 MHz	1.0 V/m	A	Pass

9.3 Photograph(s) of the Radiated Immunity Test Setup

Front View

Rear View

Right Side View

Left Side View

10.0 RADIATED EMISSIONS TEST

10.1 Radiated Emissions Test Procedure

The EUT was initially placed in a semi-anechoic chamber, and wide band characterization measurements were performed to determine the frequencies at which significant emissions occurred.

The equipment was installed on a 0.8-meter high non-conductive turntable on an Open Area Test Site (OATS) as described in EN 55022:2006. A receiving antenna was located 10.0/3.0 meters from the edge of the Equipment under Test (EUT). The antenna was attached to an antenna mast that allowed the antenna height to be adjusted from 1.0 to 4.0 meters above the ground plane.

The equipment was then fully exercised with all cabling attached to the EUT. While the equipment was energized, the receiving antenna was scanned from 1.0 meter to 4.0 meters in both vertical and horizontal polarities while the turntable was adjusted 360 degrees to determine the maximum field strength. During the test, frequencies identified as being generated by the EUT in the frequency range of 30 MHz to 1800 MHz were measured. The highest levels were recorded along with antenna polarity. These levels were then compared to the Class A limits specified in EN 55022:2006 and EN 301 489-1 v1.8.1:2008.

Test Equipment Used:

Equipment Type	Asset Number	Manufacturer	Model	Serial Number	Calibration Due Date
Shield Room	CL014	Shielding Resources	3 Meter	001	Feb. 28, 2011
Temp/Hum. Recorder	CL119	Extech	RH520	H005869	Nov. 16, 2011
OATS	CL017	Compliance Labs	N/A	001	Aug. 26, 2011
Spectrum Analyzer	CL129	Hewlett Packard	8591E	3246A00780	Nov. 24, 2011
Receiver	0145	Rohde & Schwarz	Display, EASI-0-804-8932-52; RF Unit, ESMI-RF 1032-5640-53	84982/015; 849152/005	May 14, 2011
Antenna 1-Chamber	0142	ETS/EMCO	3142B	9811-1330	Dec. 31, 2010
Antenna 2-OATS	0105	Sunol Sciences	JB1	A101101	July 22, 2011
Pre-Amplifier	0197	Hewlett Packard	8447D	1726A01006	Dec. 31, 2010

10.2 Radiated Emissions Test Data Sheet

Test Date:	Dec. 20, 2010	**Test Engineer:**	M. Toth
Standards:	EN 55022:2006; EN 301 489-1 v1.8.1:2008; Federal Register CFR 47, Part 15, subpart B:2007; ICES-003, Issue 4, February 2004 AS/NZS CISPR 22:2004	**Air Temperature:**	20.2°C
Limits:	Class A, Class B	**Relative Humidity:**	41%
Distance:	10.0 meters		

EN 55022, Class A (10m)

Frequency (MHz)	Antenna Polarization	Reading (dBµV)	Cable Loss & Antenna Factor (dB)	Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
33.140000	V	1.2	18.5	19.7	40.0	-20.3
37.010000	H	0.3	16.6	16.9	40.0	-23.1
39.670000	V	6.8	13.8	20.6	40.0	-19.4
47.990000	H	5.7	9.7	15.4	40.0	-24.6
76.540000	V	5.9	9.2	15.1	40.0	-24.9
108.870000	V	3.8	14.2	18.0	40.0	-22.0
109.010000	H	6.7	14.7	21.4	40.0	-18.6
198.850000	H	1.2	15.1	16.3	40.0	-23.7
220.650000	V	2.6	13.8	16.4	40.0	-23.6
253.850000	H	2.7	14.7	17.4	47.0	-29.6
259.900000	V	1.9	18.7	20.6	47.0	-26.4
601.780000	H	4.5	23.6	28.1	47.0	-18.9

EN 55022, Class B (10m)

Frequency (MHz)	Antenna Polarization	Reading (dBµV)	Cable Loss & Antenna Factor (dB)	Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
33.140000	V	6.7	18.5	25.2	30.0	-4.8
37.900000	H	12.2	16.1	28.3	30.0	-1.7
39.670000	V	10.1	13.8	23.9	30.0	-6.1
47.990000	H	16.8	9.7	26.5	30.0	-3.5
76.540000	V	14.9	9.3	24.2	30.0	-5.8
108.890000	V	2.6	14.1	16.7	30.0	-13.3
109.010000	H	11.8	14.7	26.5	30.0	-3.5
198.850000	H	2.0	15.1	17.1	30.0	-12.9
220.650000	V	6.3	14.2	20.5	30.0	-9.5
253.850000	H	3.8	14.7	18.5	37.0	-18.5
359.900000	V	2.2	18.6	20.8	37.0	-16.2
601.780000	H	4.5	23.6	28.1	37.0	-8.9

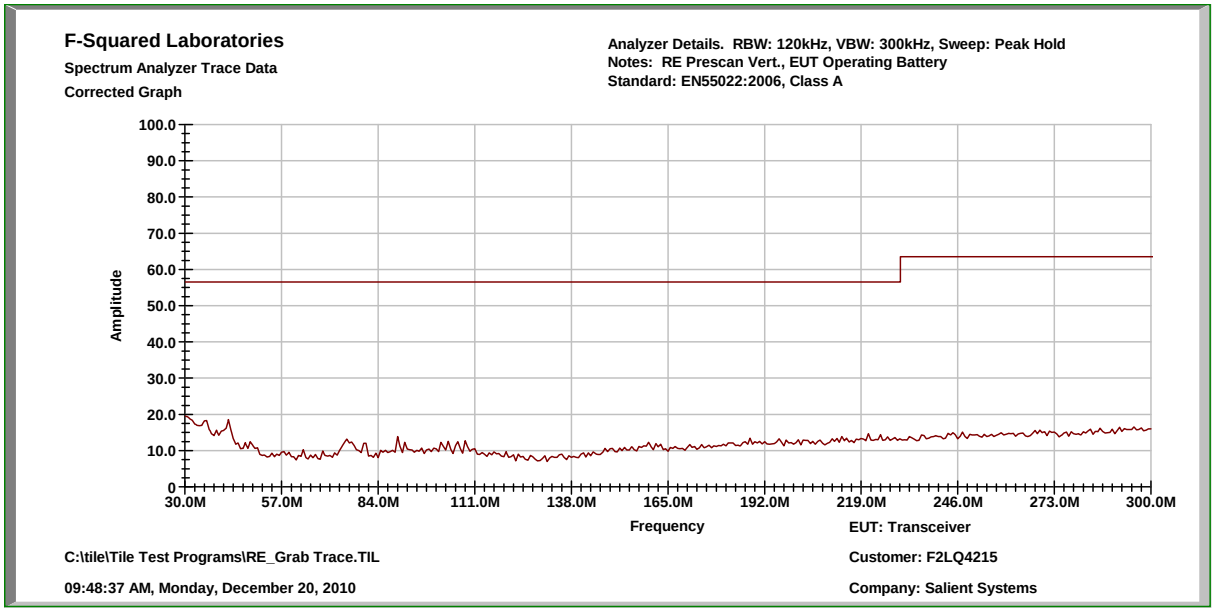
EN 301 489-1, 6 GHz (3m)

Frequency (MHz)	Antenna Polarization	Reading (dBµV)	Cable Loss & Antenna Factor (dB)	Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1500.040000	V	25.6	0.7	26.3	54.0	-27.7
2000.000000	H	25.6	5.1	30.7	54.0	-23.3
2249.960000	V	25.6	6.4	32.0	54.0	-22.0
500.040000	H	25.6	6.7	32.3	54.0	-21.7
2500.040000	V	25.6	6.7	32.3	54.0	-21.7
2500.040000	V	25.6	6.7	32.3	54.0	-21.7
3000.000000	H	25.6	8.0	33.6	54.0	-20.4
3249.960000	H	25.6	9.9	35.5	54.0	-18.5
3500.040000	V	25.6	10.1	35.7	54.0	-18.3
3750.000000	H	25.6	11.3	36.9	54.0	-17.1
4000.000000	V	25.6	12.1	37.7	54.0	-16.3
4500.040000	H	25.6	12.2	37.8	54.0	-16.2
4500.040000	H	25.6	12.2	37.8	54.0	-16.2
5000.000000	H	25.6	13.0	38.6	54.0	-15.4
5000.000000	H	25.6	13.0	38.6	54.0	-15.4
5000.000000	H	25.6	13.0	38.6	54.0	-15.4

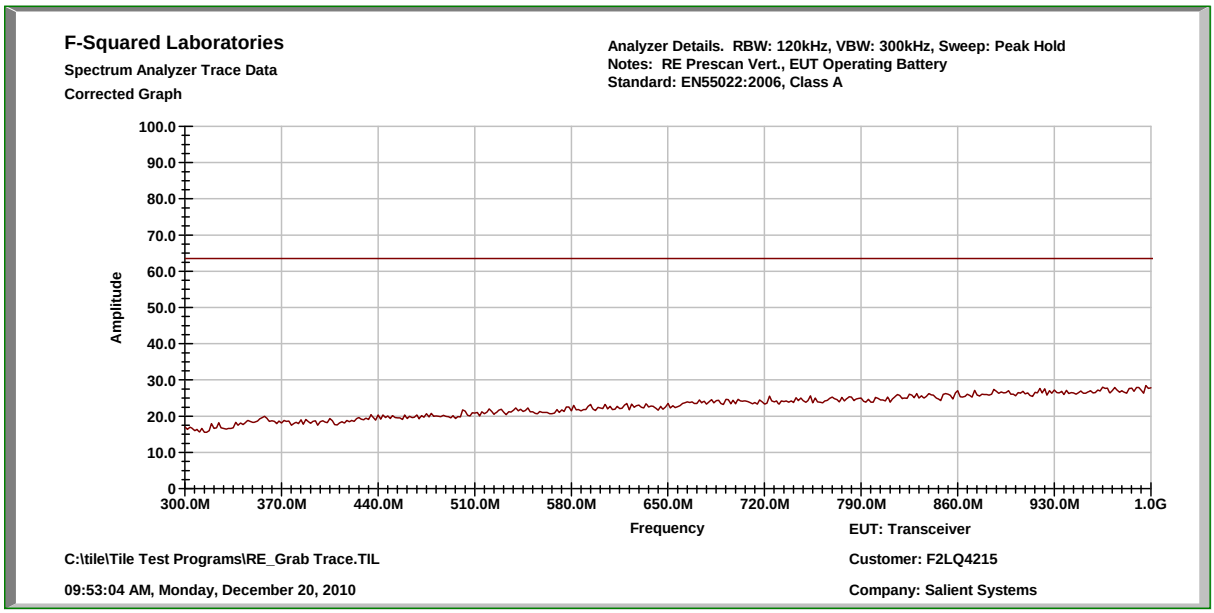
FCC Part 15, 13 GHz (10m)

Frequency (MHz)	Antenna Polarization	Reading (dBµV)	Cable Loss & Antenna Factor (dB)	Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1549.960000	H	25.3	1.5	26.8	49.5	-22.7
2024.960000	H	25.4	5.0	30.4	49.5	-19.1
2024.960000	V	25.6	5.0	30.6	49.5	-18.9
2500.040000	H	25.3	6.7	32.0	49.5	-17.5
3249.960000	H	25.3	9.9	35.2	49.5	-14.3
4000.000000	H	25.3	12.1	37.4	49.5	-12.1
4500.040000	H	25.3	12.2	37.5	49.5	-12.0
5000.000000	H	25.3	13.0	38.3	49.5	-11.2
5900.000000	H	25.4	13.3	38.7	49.5	-10.8
6800.000000	H	25.6	13.8	39.4	49.5	-10.1
7800.000000	H	21.5	14.2	35.7	49.5	-13.8
8800.000000	H	20.8	15.0	35.8	49.5	-13.7
10000.000000	H	21.3	15.4	36.7	49.5	-12.8
10900.000000	H	23.6	16.0	39.6	49.5	-9.9
12500.000000	H	20.4	16.7	37.1	49.5	-12.4
13000.000000	H	17.5	17.3	34.8	49.5	-14.7

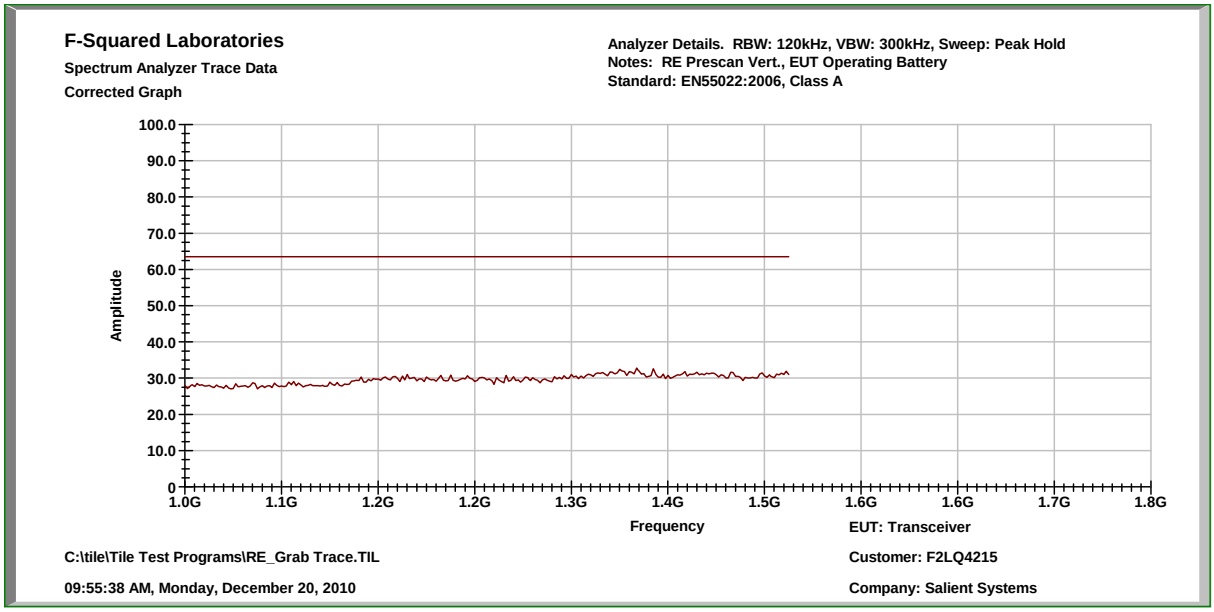
Characterization Scan: 30 MHz to 300 MHz, Vertical



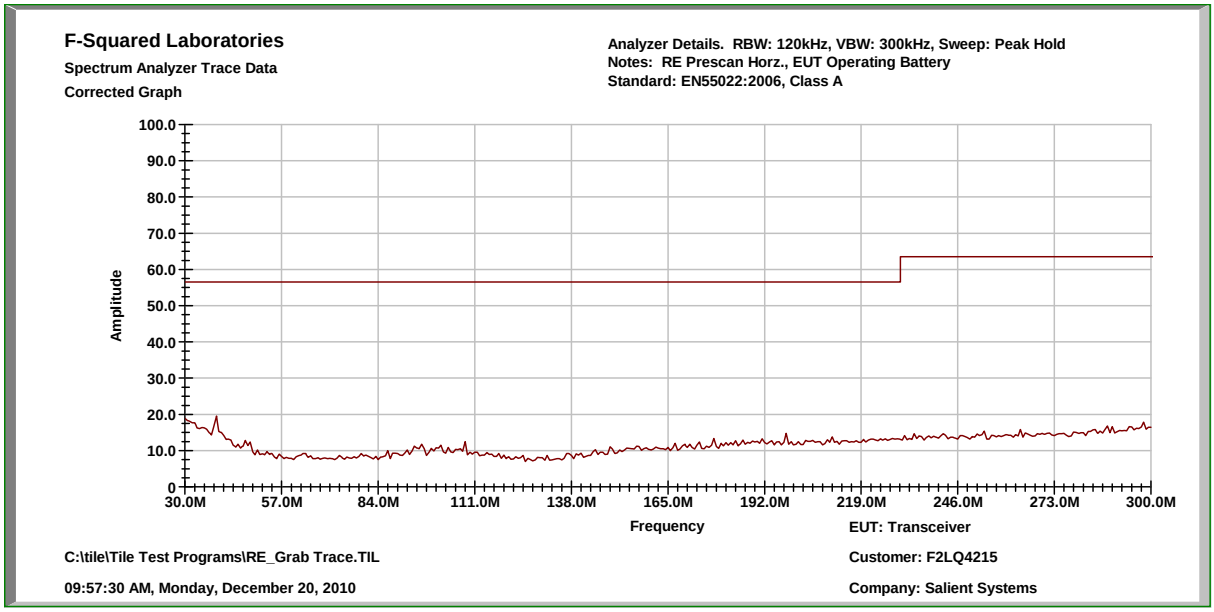
Characterization Scan: 300 MHz to 1000 MHz, Vertical



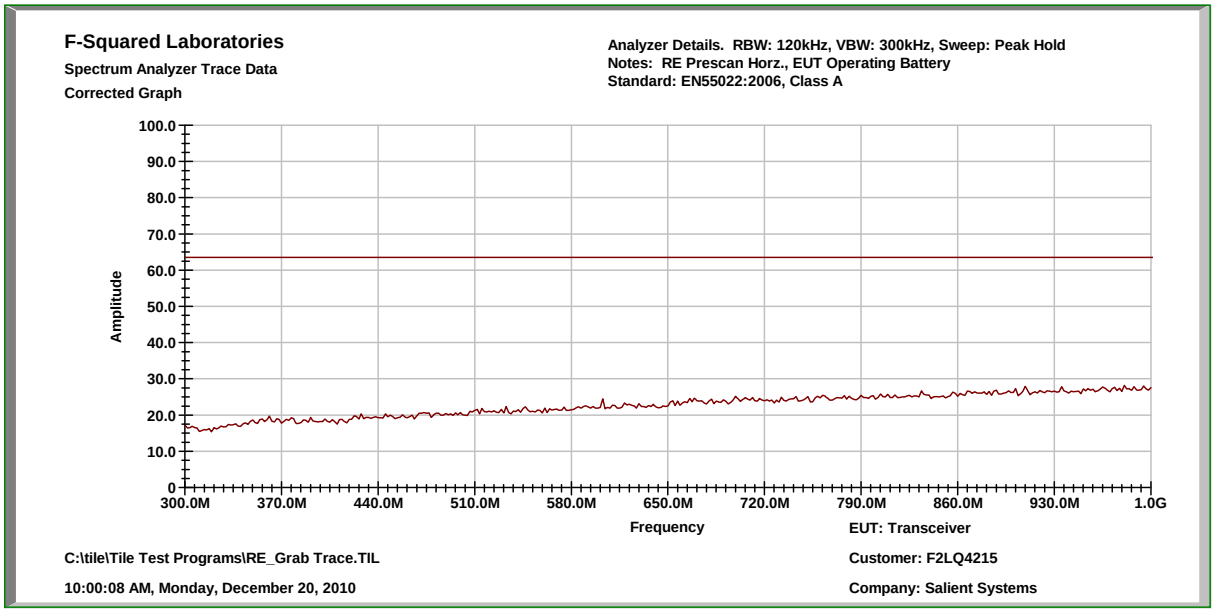
Characterization Scan: 1000 MHz to 1800 MHz, Vertical



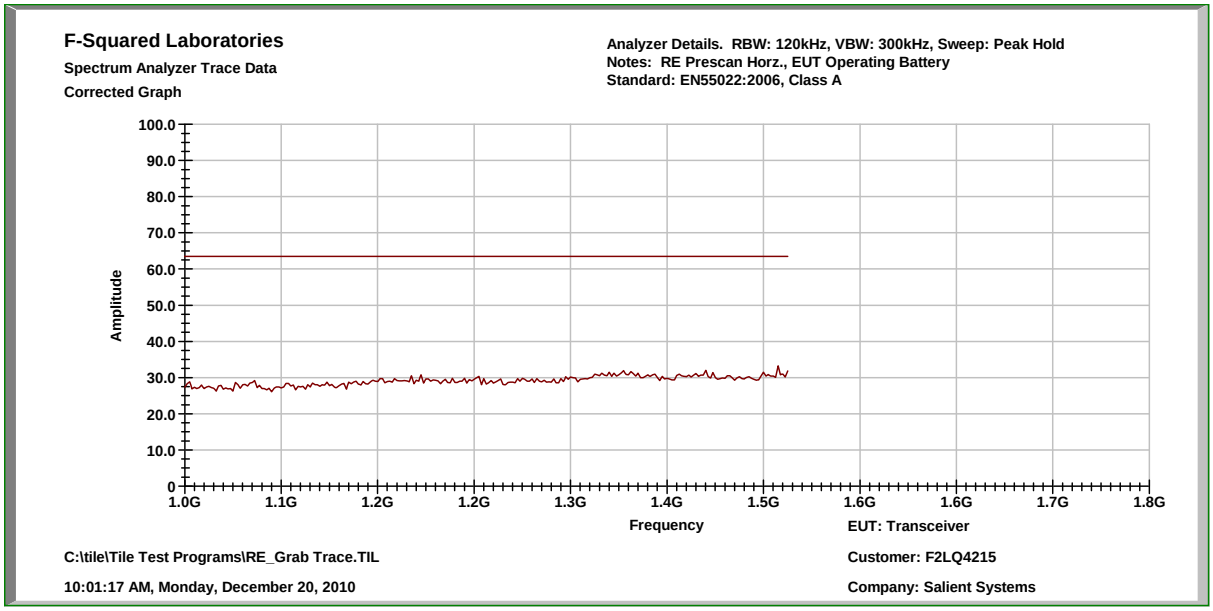
Characterization Scan: 30 MHz to 300 MHz, Horizontal



Characterization Scan: 300 MHz to 1000 MHz, Horizontal



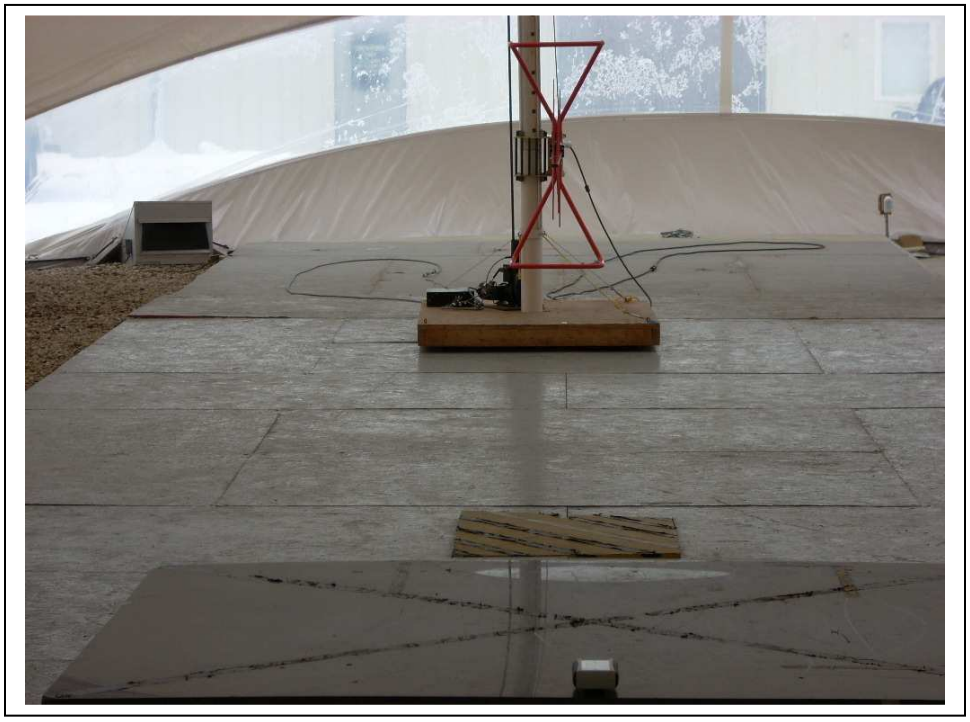
Characterization Scan: 1000 MHz to 1800 MHz, Vertical



10.3 Photograph(s) of Radiated Emissions Test Setup

Pre-scan

OATS – 10m



OATS – 3m