EMISSION TEST REPORT

Report Number: 3191230BOX-001

Project Number: 3191230

Testing performed on the

Ground Penetration Radar

Model: MINISIR

To

FCC Part 15 Subpart F – Ultra-Wideband Operation

For

Geophysical Survey Systems, Inc.

Test Performed by:	Test Authorized by:
Intertek – ETL SEMKO	Geophysical Survey Systems, Inc.
70 Codman Hill Road	12 Industrial Way
Boxborough, MA 01719	Salem, NH 03079

Prepared by: _____ Date: 09/29/09
Kouma Sinn, Sr. Project Engineer

Reviewed by: _____ Date: 09/29/09
Jeff Goulet

1.0 Job Description

1.1 Client Information:

This equipment under test (EUT) has been tested at the request of:

Company:	Geophysical Survey Systems, Inc. 12 Industrial Way Salem, NH 03079
Contact:	Alan Schutz
Telephone:	(603) 893-1109
Fax:	(603) 889-3984
Email:	alan.s@geophysical.com

1.2 Equipment Under Test:

Equipment Type:	Ground Penetration Radar
Model Number(s):	MINISIR
Serial number(s):	Jeff
Manufacturer:	Geophysical Survey Systems, Inc.
EUT receive date:	09/28/09
EUT received condition:	A production unit was received with no visible damage
Test start date:	09/28/09
Test end date:	09/28/09

1.3 Test Plan Reference: ANSI C63.4-2003, FCC Part 15 Subpart F

1.4 Test Configuration:

1.4.1 EUT Voltage Range:

The EUT powers from internal battery

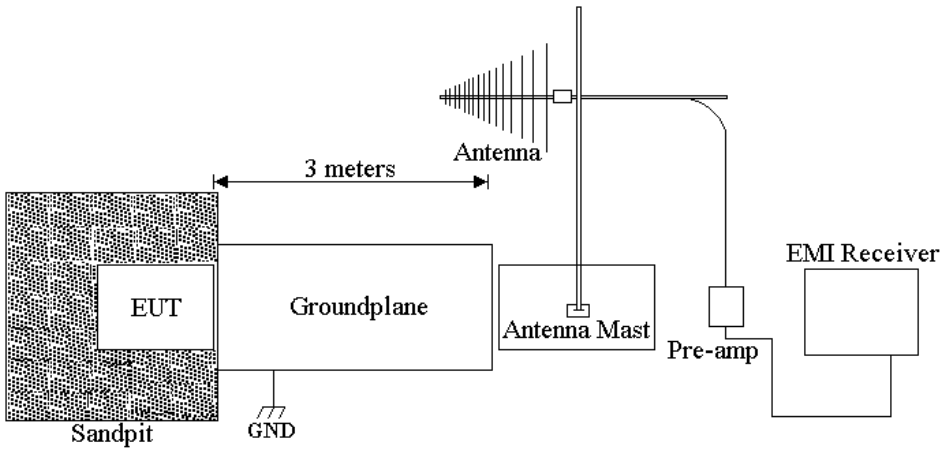
1.4.2 Cables:

Description	Shielding	Connector	Length (m)	Qty.
None				

1.4.3 Support Equipment:

Description	Manufacturer	Model	Serial No.
None			

1.4.4 Block Diagram:



1.5 Mode(s) of Operation:

The EUT was continuous transmitting and collecting data during testing.

1.6 Modifications Required For Compliance:

None

2.0 Test Summary:

TEST STANDARD	RESULTS	
FCC Part 15 Subpart F – Ultra-Wideband Operation		
SUB-TEST	**TEST PARAMETER**	**PASS/FAIL**
Radiated Emissions	Emissions below 15.509	Pass
10 dB Bandwidth	15.503(d): The UWB bandwidth is the frequency band bounded by the points that are 10 dB below the highest radiated emission, as based on the complete transmission system including the antenna. The fractional bandwidth shall be equal to or greater than 0.20 or has a UWB bandwidth equal to or greater than 500 MHz, regardless of the fractional bandwidth.	Pass
Line Conducted Emissions	N/A	N/A

REVISION SUMMARY – The following changes have been made to this Report:

Date	Project No.	Project Handler	Page(s)	Item	**Description of Change**

3.0 Sample Calculations:

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG
Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

Level in μV/m = [10(32 dBμV/m)/20] = 39.8 μV/m

The following is how net line-conducted readings were determined:

NF = RF + LF + CF + AF
Where NF = Net Reading in dBμV
RF = Reading from receiver in dBμV
LF = LISN Correction Factor in dB
CF = Cable Correction Factor in dB
AF = Attenuator Loss Factor in dB

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$
Where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 dBμV
$UF = 10^{(49.1\ dB\mu V / 20)}$ = 285.1 μV

4.0 Measurement Uncertainty:

For radiated emissions, U_{lab} (4.9 dB at 3m and 4.2 dB at 10m) < U_{CISPR} (5.2 dB), which is the reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

For conducted emissions, U_{lab} (3.2 dB in worst case) < U_{CISPR} (3.6 dB), which is the reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

5.0 Site Description:

Test Site(s): 1 (Sandpit)

The sandpit test site used during testing was made in according with Part 15 Subpart F. The test site was constructed with a dimension of 16.40ft x 16.40ft x 30 inches deep. The whole area was filled with dry sand. The equipment under test (EUT) was placed directly on the sand while the receiving antenna was placed at a distance of 3m from the closest point of the EUT. A groundplane with a dimension of 15.75ft x 19.50ft was placed between the EUT and receiving antenna and connected to earth ground via a ground rod.

6.0 Testing Procedure

The system was configured for testing in a typical fashion (as a customer would normally use it), and in the confines as outlined in ANSI C63.4 (2003).

All support equipment was remotely located. The EUT was placed directly on the sand 3 meters away from the receiving antenna with groundplane in between.

Initial testing was performed to maximize the emissions. The system was rotated every 45° and cables were oriented to get the worst emissions, the antenna height was varied from 1 meter to 4 meters above the ground, and the antenna polarization was changed. The EUT azimuth of maximum emissions was recorded. The worst-case orientation will be used in the final testing.

Test Results: Pass

Test Standard: FCC Part 15 Subpart F – Ultra-Wideband Operation

Test: Radiated Emissions

Performance Criterion: Not Applicable

Test Environment:

Environmental Conditions During Testing:		Ambient (°C):	See data tables	Humidity (%):	See data tables	Pressure (hPa):	See data tables
Pretest Verification Performed		Yes		Equipment under Test:		MINISIR	
Test Engineer(s):	Kouma Sinn			EUT Serial Number:		Jeff	
Engineer's Initials:	KPS	Date Test Performed:	09/28/09	Reviewer's Initials:	JG	Date Reviewed:	09/29/09

Maximum Test Disturbance Parameters: Emissions below the limits specified in 15.209

Test Equipment Used:

TEST EQUIPMENT LIST					
Item	**Equipment Type**	**Make**	**Model No.**	**Serial No.**	**Next Cal. Due**
1	HORN ANTENNA	EMCO	3115	9610-4980	02/25/2010
2	High Frequency Cable	Megaphase	TM40-K1K1-197	8148601-001	12/10/2009
3	High Frequency Cable 40GHz	Megaphase	TM40 K1K1 80	CBL030	12/10/2009
4	Weather Station	Davis Instruments	7400	PE80519A61	06/10/2010
5	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	12/01/2009
6	9kHz to 3GHz EMI Test Receiver	Rohde & Schwartz	ESCI 1166.5950K03	100067	02/17/2010
7	100MHz-40GHz Preamp	MITEQ	NSP4000-NFG	1260417	04/03/2010
8	RG223 50ohm Coaxial Cable	Intertek	BNC-30	CBLBNC6	02/25/2010
9	ANTENNA	EMCO	3142	9701-1116	12/02/2009

Software Utilized:

Name	Manufacturer	Version
Excel 2003	Microsoft	(11.8231.8221) SP3
EMI Boxborough.xls	Intertek	4/17/09

Test Details:

Test Point	Standard Limit (as published)	Compliance Level	Pass/Fail N/A	Comment
EUT Enclosure	Per 15.209	Emissions below 15.209 limits	Pass	None

Test Results:

Radiated Emissions From 30-960MHz

Radiated Emissions

Company: Geophysical Survey Systems, Inc. Antenna & Cables: N Bands: N, LF, HF, SHF
Model #: MINISIR Antenna: LOG1 12-02-2009 V3.txt LOG1 12-02-2009 H3.txt
Serial #: Jeff Cable(s): CBLBNC6 02-25-10.txt NONE.
Engineers: Kouma sinn Location: 1 Barometer: DAV001 Filter: NONE
Project #: 3186354 Date(s): 09/28/09
Standard: FCC Part 15 Subpart F Temp/Humidity/Pressure: 18C 80% 999mbar
Receiver: ROS002 Limit Distance (m): 3
PreAmp: PRE9 04-03-10.txt Test Distance (m): 3
PreAmp Used? (Y or N): N Voltage/Frequency: Battery powered Frequency Range: 30-960MHz
Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)
Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
	Model: MINISIR, Serial: Jeff. EUT operating at 1.2GHz										
QP	V	30.000	5.00	16.90	1.19	0.00	0.00	23.09	40.00	-16.91	120/300 kHz
QP	V	88.000	15.00	7.82	1.77	0.00	0.00	24.59	40.00	-15.41	120/300 kHz
QP	V	53.852	9.50	8.34	1.48	0.00	0.00	19.32	40.00	-20.68	120/300 kHz
QP	V	216.000	14.10	11.48	2.48	0.00	0.00	28.06	43.50	-15.44	120/300 kHz
QP	V	230.000	10.90	11.90	2.54	0.00	0.00	25.34	46.00	-20.66	120/300 kHz
QP	V	233.974	24.90	12.06	2.56	0.00	0.00	39.52	46.00	-6.48	120/300 kHz
QP	V	259.968	18.85	12.90	2.67	0.00	0.00	34.42	46.00	-11.58	120/300 kHz
QP	V	285.960	23.50	13.73	2.79	0.00	0.00	40.01	46.00	-5.99	120/300 kHz
QP	V	337.956	24.20	14.77	3.02	0.00	0.00	41.98	46.00	-4.02	120/300 kHz
QP	V	363.956	20.20	15.26	3.13	0.00	0.00	38.59	46.00	-7.41	120/300 kHz
QP	V	389.952	27.20	15.36	3.25	0.00	0.00	45.81	46.00	-0.19	120/300 kHz
QP	V	415.950	18.72	15.91	3.37	0.00	0.00	38.00	46.00	-8.00	120/300 kHz
QP	V	441.943	18.60	16.95	3.50	0.00	0.00	39.04	46.00	-6.96	120/300 kHz
QP	V	463.240	14.20	17.83	3.60	0.00	0.00	35.63	46.00	-10.37	120/300 kHz
QP	V	500.000	9.50	18.90	3.79	0.00	0.00	32.19	46.00	-13.82	120/300 kHz
QP	V	600.000	5.00	19.30	4.28	0.00	0.00	28.58	46.00	-17.42	120/300 kHz
QP	V	700.000	4.50	20.40	4.71	0.00	0.00	29.61	46.00	-16.39	120/300 kHz
QP	V	800.000	4.50	21.80	5.14	0.00	0.00	31.44	46.00	-14.56	120/300 kHz
QP	V	900.000	5.50	23.20	5.35	0.00	0.00	34.05	46.00	-11.96	120/300 kHz
QP	V	960.000	5.70	23.24	5.47	0.00	0.00	34.41	46.00	-11.59	120/300 kHz

Test Results Continued:

Radiated Emissions From 960MHz-18GHz

Radiated Emissions

Company: Geophysical Survey Systems, Inc. Antenna & Cables: LF Bands: N, LF, HF, SHF
Model #: MINISIR Antenna: HORN3 V1m 02-25-10.txt HORN3 H1m 02-25-10.txt
Serial #: Jeff Cable(s): MEG005 12-10-2009.txt CBL030 12-10-09.txt
Engineers: Kouma sinn Location: 1 Barometer: DAV001 Filter: NONE
Project #: 3186354 Date(s): 09/28/09
Standard: FCC Part 15 Subpart F Temp/Humidity/Pressure: 22 65% 989mbar
Receiver: ROS001 Limit Distance (m): 3
PreAmp: PRE9 04-03-10.txt Test Distance (m): 1
PreAmp Used? (Y or N): Y Voltage/Frequency: Battery powered Frequency Range: 960MHz-18GHz
Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)
Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth	
	Model: MINISIR, Serial: Jeff. EUT operating at 1.2GHz at 1 meter											
RMS	V	960.000	29.11	24.00	2.53	27.84	9.50	18.30	29.90	-11.60	1/3MHz	
RMS	V	961.920	34.30	24.01	2.53	27.84	9.50	23.50	29.90	-6.40	1/3MHz	
RMS	V	971.000	29.70	24.06	2.55	27.83	9.50	18.97	29.90	-10.93	1/3MHz	
RMS	V	977.700	35.7	24.09	2.56	27.82	9.50	25.02	29.90	-4.88	1/3MHz	
RMS	V	987.930	40.0	24.14	2.57	27.81	9.50	29.40	29.90	-0.50	1/3MHz	
RMS	V	1000.000	31.8	24.20	2.59	27.80	9.50	21.24	29.90	-8.66	1/3MHz	
RMS	V	1039.000	40.00	24.34	2.64	27.80	9.54	29.64	29.90	-0.26	1/3MHz	
RMS	V	1192.000	30.70	24.89	2.84	27.81	9.50	21.12	29.90	-8.78	1/3MHz	
RMS	V	1360.000	28.8	25.50	3.06	27.83	9.50	20.03	43.90	-23.87	1/3MHz	
RMS	V	2600.000	26.6	29.31	4.79	27.92	9.50	23.29	53.90	-30.61	1/3MHz	NF
RMS	V	3000.000	27.0	30.45	5.00	27.95	9.50	25.00	53.90	-28.90	1/3MHz	NF
RMS	V	6330.000	27.4	35.51	7.44	27.62	9.50	33.24	53.90	-20.66	1/3MHz	NF
RMS	V	10000.0000	24.4	40.35	9.69	26.30	9.50	38.66	53.90	-15.24	1/3MHz	NF
RMS	V	13000.0000	24.8	40.46	11.31	26.36	9.50	40.71	43.90	-3.19	1/3MHz	NF
1164-1240MHz, 1559-1610MHz at 1 meter												
RMS	V	1164.000	5.7	24.79	2.80	27.81	9.50	-3.98	19.90	-23.88	1/3kHz	
RMS	V	1180.000	19.7	24.85	2.82	27.81	9.50	10.09	19.90	-9.81	1/3kHz	
RMS	V	1196.000	5.3	24.91	2.84	27.81	9.50	-4.22	19.90	-24.12	1/3kHz	
RMS	V	1217.000	4.4	24.98	2.87	27.82	9.50	-5.06	19.90	-24.96	1/3kHz	
RMS	V	1240.000	4.8	25.06	2.90	27.82	9.50	-4.55	19.90	-24.45	1/3kHz	
RMS	V	1559.800	7.6	26.23	3.31	27.84	9.50	-0.20	19.90	-20.10	1/3kHz	
RMS	V	1562.000	4.6	26.24	3.31	27.84	9.50	-3.19	19.90	-23.09	1/3kHz	
RMS	V	1585.000	2.96	26.32	3.34	27.84	9.54	-4.76	54.00	-58.76	1/3kHz	
RMS	V	1610.000	3.50	26.42	3.37	27.85	9.54	-4.10	54.00	-58.10	1/3kHz	

Test Results Continued:

Highest Emissions Above 960MHz

Radiated Emissions

Company:	Geophysical Survey Systems, Inc.		Antenna & Cables:	LF	Bands: N, LF, HF, SHF
Model #:	MINISIR		Antenna:	HORN3 V1m 02-25-10.txt	HORN3 H1m 02-25-10.txt
Serial #:	Jeff		Cable(s):	MEG005 12-10-2009.txt	CBL030 12-10-09.txt
Engineers:	Kouma sinn	Location: 1	Barometer:	DAV001	Filter: NONE
Project #:	3186354	Date(s): 09/28/09			
Standard:	FCC Part 15 Subpart B Class B		Temp/Humidity/Pressure:	22	65% 989mbar
Receiver:	ROS001	Limit Distance (m): 3			
PreAmp:	PRE9 04-03-10.txt	Test Distance (m): 1			

PreAmp Used? (Y or N): Y Voltage/Frequency: Battery powered Frequency Range: 960MHz-18GHz

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
Model: MINISIR, Serial: Jeff. EUT operating at 1.2GHz at 1 meter. Highest Emission above 960MHz											
PK	V	1139.879	48.46	24.70	2.77	27.81	9.54	38.58	70.76	-32.18	3/10MHz

The highest radiated emission occurs, f_M, above 960MHz, there is a limit on the peak level of the emissions contained within a 50MHz bandwidth centered on f_M. That limit is 0 dBm EIRP which is 95 dBuV/m in field strength. The resolution bandwidth of 3MHz was used so, the new limit is 95.2-20*LOG(3MHz/50MHz) = 95.2-24.437 = 70.763 dBuV/m.

Setup Photo

Test Results: Pass

Test Standard: FCC Part 15 Subpart F – Ultra-Wideband Operation

Test: 10 dB Bandwidth

Performance Criterion: Not Applicable

Test Environment:

Environmental Conditions During Testing:		Ambient (°C):	22	Humidity (%):	65	Pressure (hPa):	989
Pretest Verification Performed		Yes		Equipment under Test:		MINISIR	
Test Engineer(s):	Kouma Sinn			EUT Serial Number:		Jeff	
Engineer's Initials:	KPS	Date Test Performed:	09/28/09	Reviewer's Initials:	JG	Date Reviewed:	09/29/09

Maximum Test Disturbance Parameters: 15.503(d): The UWB bandwidth is the frequency band bounded by the points that are 10 dB below the highest radiated emission, as based on the complete transmission system including the antenna. The fractional bandwidth shall be equal to or greater than 0.20 or has a UWB bandwidth equal to or greater than 500 MHz, regardless of the fractional bandwidth.

Test Equipment Used:

TEST EQUIPMENT LIST					
Item	**Equipment Type**	**Make**	**Model No.**	**Serial No.**	**Next Cal. Due**
1	Weather Station	Davis Instruments	7400	PE80519A61	06/10/2010
2	9kHz to 3GHz EMI Test Receiver	Rohde & Schwartz	ESCI 1166.5950K03	100067	02/17/2010
3	ANTENNA	EMCO	3142	9701-1116	12/02/2009
4	RG223 50ohm Coaxial Cable	Intertek	BNC-30	CBLBNC6	02/25/2010

Software Utilized:

None

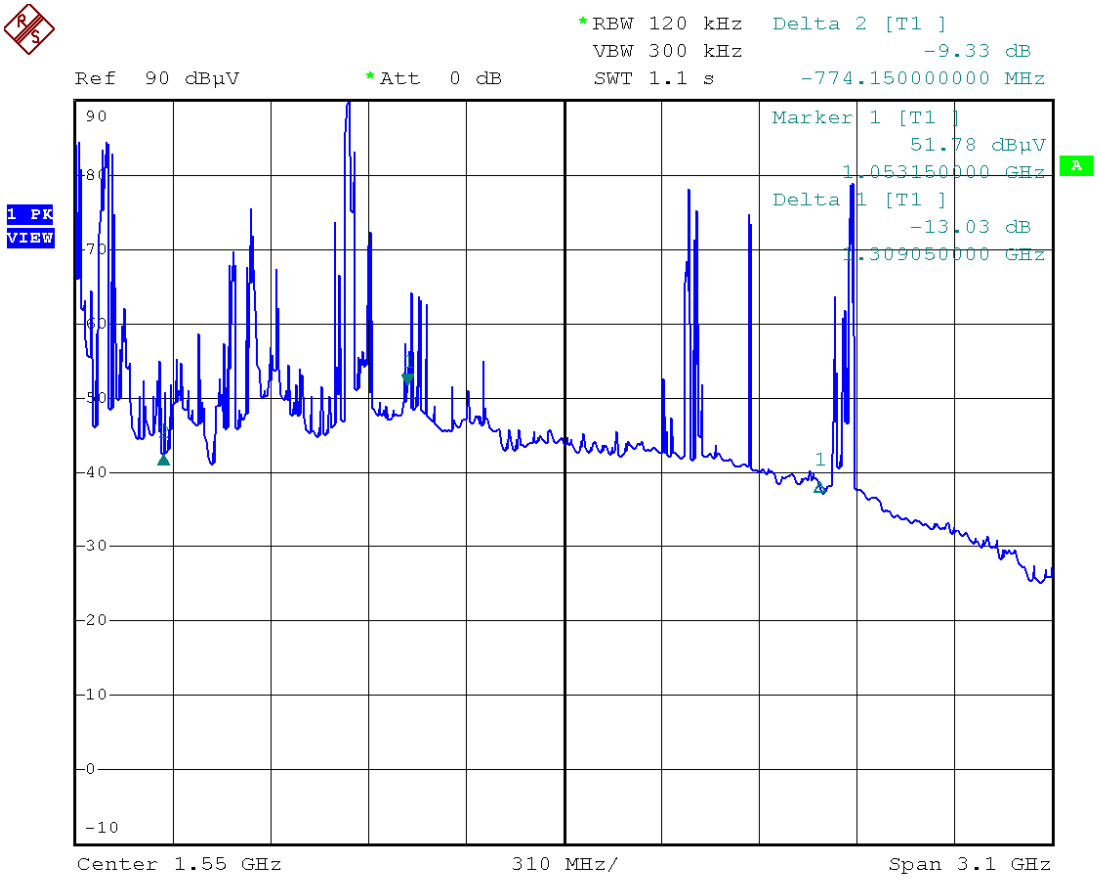
Test Details:

Test Point	Standard Limit (as published)	Compliance Level	Pass/Fail N/A	Comment
Highest Peak	Per Standard	Per Standard	Pass	See notes

Notes: The measured 10dB bandwidth is greater than 500MHz, therefore, the EUT met the requirement.

Test Results:

10dB Bandwidth



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10dB Bandwidth Photo