Normalized Site Attenuation Test Report

Test Specification	**NORMALIZED SITE ATTENUATION (NSA)** Range 30 MHz – 1GHz using the methods of ANSI C63.4-2009; EN 50147-2 (1997); CISPR 16-1-4 (2010) Part 1-4;
Test date	29 February 2012
Project ID Numbers	SIS # 1176-NSA
Test range	3 meters
Chamber type	Semi-anechoic, 3-meter chamber
Chamber address	**Weatherford Production Optimization** 22001 north Park Drive Kingwood, TX 77339
Report prepared for	**Panashield, Inc** 185 W. Norwalk Road, #R Norwalk, CT 06850
Test conclusion	The chamber meets and exceeds all specified performance requirements for pre-conformance use.
Performed and attested by	Robbie Tuttle, Operations Manager, SHIELDING INTEGRITY SERVICES, INC 

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1. General

1.1. Chamber type

The test was conducted in a 3 meter, semi-anechoic, pre-compliance chamber.

1.2. Specification and standards

This test program is intended to determine and verify Normalized Site Attenuation (NSA) performance as a fully compliant FCC listed test chamber. The test method is established and described by the American National Standards Institute (ANSI) publication C63.4, as a means of determining the suitability of the chamber for use as a fully compliant ATS. The chamber must provide a controlled environment for performing competent and repeatable radio frequency emissions testing of newly developed commercial electronic devices. The Normalized Site Attenuation (NSA) was performed in compliance with these specifications and documents.

ANSI C63.4-2009	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment
CISPR 16-1-4 (2010)	Normalized Site Attenuation (NSA) - 30 MHz - 1 GHz: radio disturbance and immunity measurement apparatus and methods - Part 1-4
IEC/CISPR 25 Ed. 3.0 b:2008-03	Radio disturbance characteristics for the protection of receivers used on board vehicles, boats, and on devices – Limits and methods of measurement
EN 50147-2 (1997)	Anechoic Chambers – Alternative Test Site suitability with respect to site attenuation.

and Shielding Integrity Services methodology

1.3. Purpose

The fundamental components of the facility are the radio frequency shielded enclosure of certain volumetric dimensions, lined with an anechoic treatment which is designed to provide a volume of space with a predictable EMI environment, free of significant standing waves and nulls. This volume of space is an area extending to 2 meters high over the test volume. Standing waves and nulls are points of signal convergences due to reflections combined with the effect of the parent enclosure. As each chamber is unique in design or installation, the chamber must be tested and proven to meet design and contractual commitments.

Ferrite tile and other anechoic materials were carefully applied over all interior wall and ceiling surfaces as to shroud exposed metallic components and disrupt reflective properties. The ground plane is an exposed RF reflective surface.

The purpose of this test is to demonstrate that the chamber is performing as expected of a fully compliant FCC 3-meter range chamber in regard to ANSI C63.4 performance. The results of the measurements should verify the close correlation of chamber Normalized Site Attenuation (NSA) measurement factors with identical measurements made at the reference OATS (Open Area Test Site). ANSI C63.4 requirements for certification as an alternate test site are +/-4 dB.

1.4. Measurement uncertainty

The combined measurement uncertainty for the SIS NSA test is reached by applying a root-sum-squared algorithm to the uncertainty values of the individual components. Taking the highest value among each test equipment set and including an operator uncertainty of 1dB, this results in a measurement uncertainty value of ≤ 1.50 dB for NSA tests as conducted by SIS.

2. Normalized Site Attenuation (NSA)

2.1. OATS Reference

The performance of the chamber was determined using antenna factors captured at the high reliability OATS located at ETS-Lindgren an A2LA accredited reference site.

2.2. NSA Standard Test procedure

After set up, the equipment was allowed sufficient warm up time. The spectrum or network analyzer frequency span was set and frequency accuracy was confirmed.

A direct circuit of test cables and impedance matching attenuators was made with tracking source and spectrum or network analyzer settings maximized for measurement conditions. To eliminate the unpredictable and non-reoccurring frequency sensitive variations in RF cables, attenuators and connectors, a continuous frequency sweep was transmitted through the circuit to establish a basic reference power value (Vdirect) prior to introducing the antennas to the circuit. Vdirect values are integrated with the measurement data. Extreme care was taken to assure proper RF power level balancing with the test signal being well above the spectrum/network analyzer noise floor. Without changing equipment settings, the pair of antennas was then introduced in the circuit and spaced at a 3-meter separation. The spectrum/network analyzer was set to the “MAX HOLD-TRACE A” mode. One antenna was scanned in height over the ground plane starting at 1 meter in height up to 2.0 meters (horizontal and vertical) while maximum amplitudes of the displayed bandwidth were captured. The analyzer “TRACE A” amplitude vs. frequency data (Vsite) was then recorded by the computer program and subtracted from the cable cal (Vdirect) and the combined antenna factors (CombinedAcf). The combined antenna factor data was added to the measurement. The result was the Normalized Site Attenuation NSA.

3. Project Scope Information

3.1. NSA Test parameters

The chamber system has been tested to verify performance and has been confirmed to operate within the following limits.

Performance requirements:	+/- 6 dB of deviation from 30 MHz–200 MHz +/- 4 db of deviation from 200 MHz–1 GHz		
Offset angle from centerline	0 degree offset (Centerline)		
Test volume	1.2 meters		
Test frequency range/antenna type	3 meters	30 MHz – 200 MHz : Biconical Antenna 200 MHz – 1 GHz : Log Periodic Antenna	
Receive antenna scan height	1 meter – 2.2 meters (Limited scan height).		
ANSI C63.4/FCC TX Antenna setup	Polarization: HORIZONTAL		Polarization: VERTICAL
(Height over turntable)	1 meter		1 meter
	2 meter		1.5 meter

3.2. Test equipment

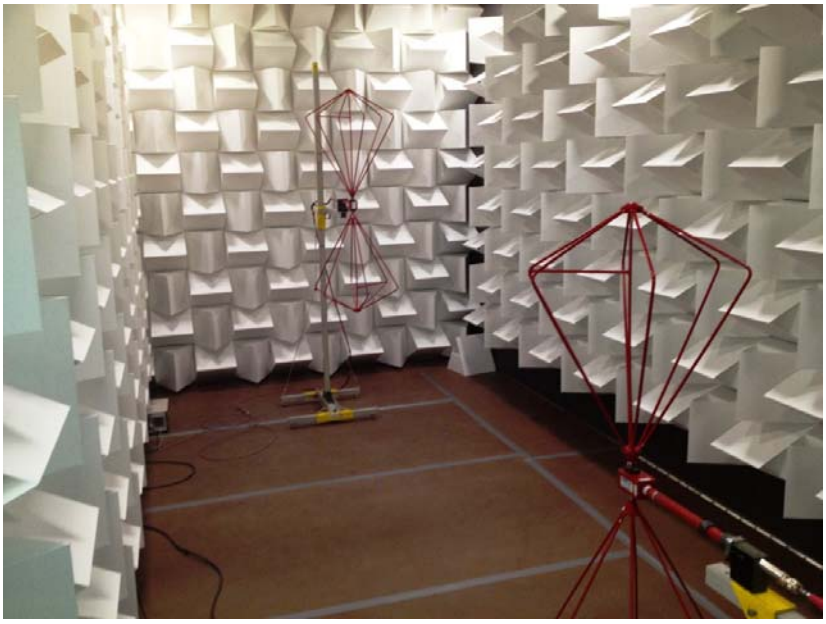
When applicable, test equipment used for this project was in current calibration, traceable to the United States National Institute of Standards and Technology (NIST).

Instrument	Mfg/Type	Serial Number	Range of device (Range used)	Due calibration
Biconical Antenna	EMCO 3110C	119301,104504	20 MHz–300 MHz (30 MHz–200 MHz)	29 Mar 2012
Log Periodic Antenna	EMCO 3148B	104831,104832	200 MHz–2 GHz (200 MHz–1 GHz)	1 Jun 2012
Network Analyzer	Advantest R3770	150201779	300 kHz–20 GHz (30 MHz–1 GHz)	13 May 2012
IBM compatible computer with HPIB instrument controller and proprietary measurement software				

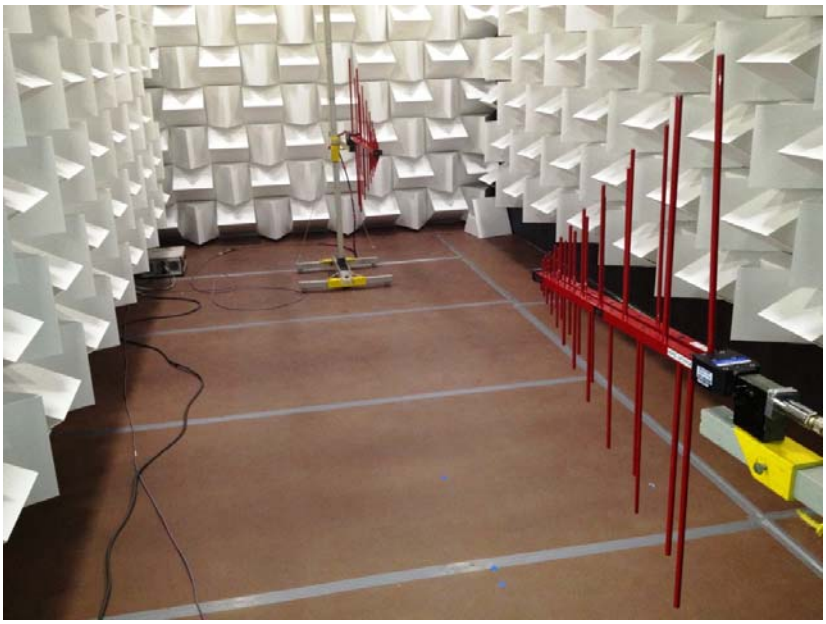
3.3. Conclusions

This pre-compliance chamber meets all specified performance requirements.

4. Test Site Photographs



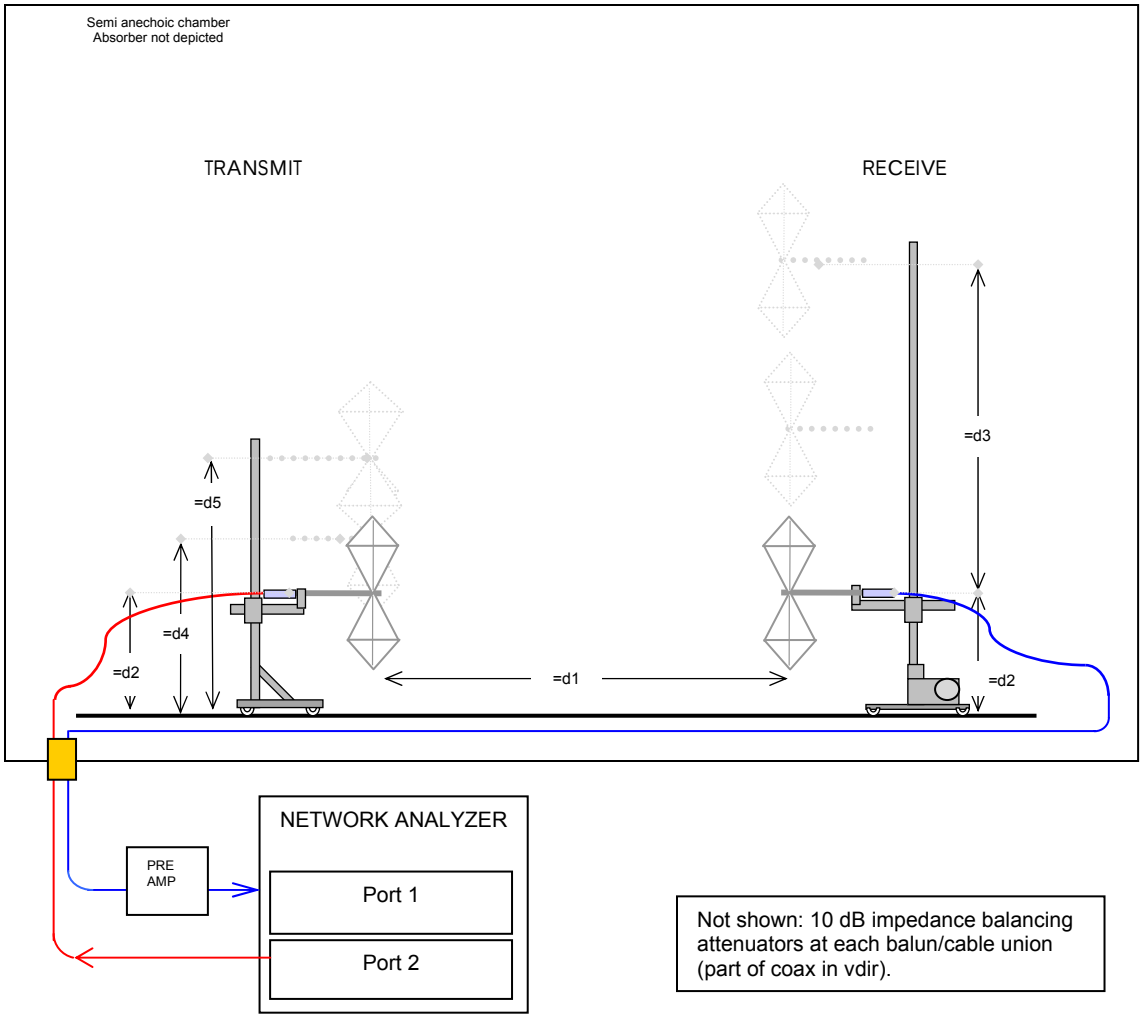
Biconical Configuration



Log Periodic Configuration

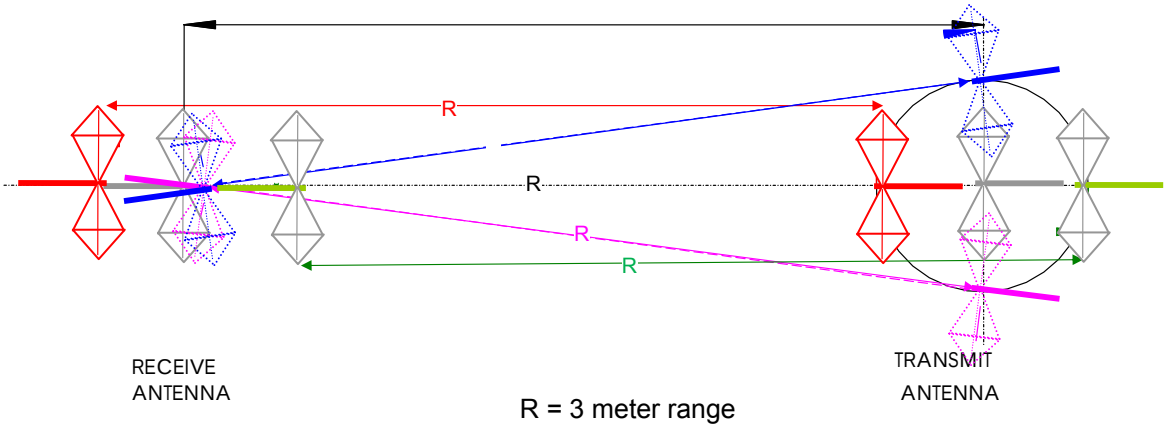
5. NSA measurement configurations

5.1. Figure 1: Standard NSA test equipment set up: Lateral view

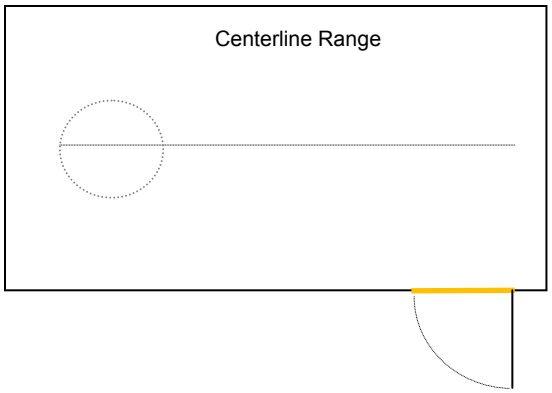


Value		*Location*	*Polarization*
d1 =	Range Length	Antenna to Antenna	Horizontal/Vertical
d2 =	1 m	Fixed over ground plane	Horizontal/Vertical
d3 =	1m – 2.2 m	Scanned over ground plane	Horizontal/Vertical
d4 =	1.5m	Fixed over ground plane	Vertical
d5 =	2 m	Fixed over ground plane	Horizontal

5.2. Figure 2: Standard NSA test equipment set up: Vertical view

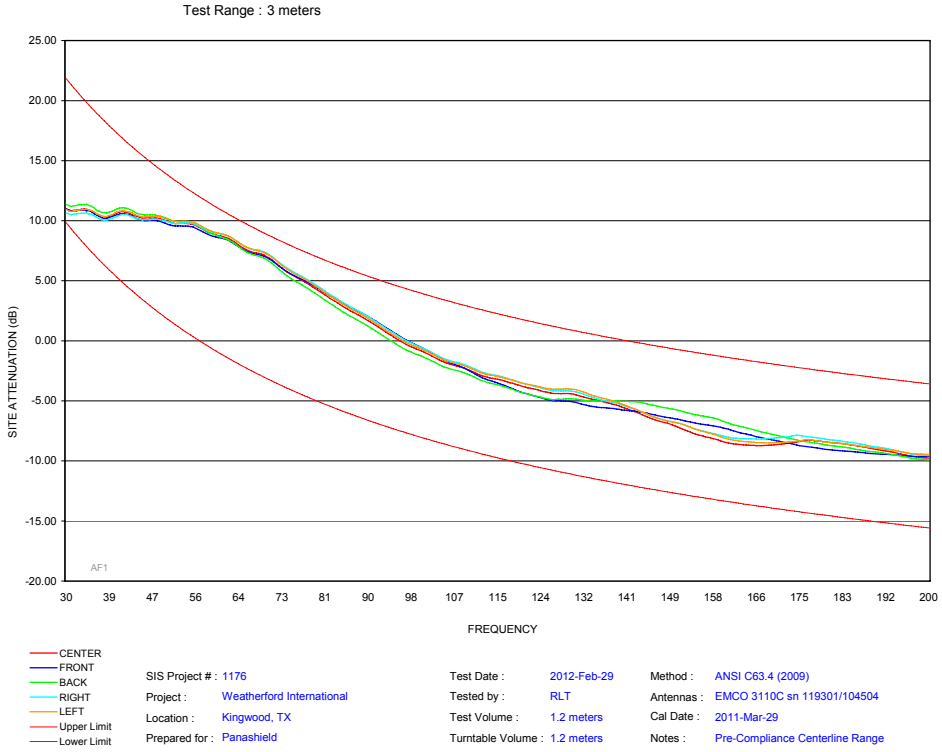


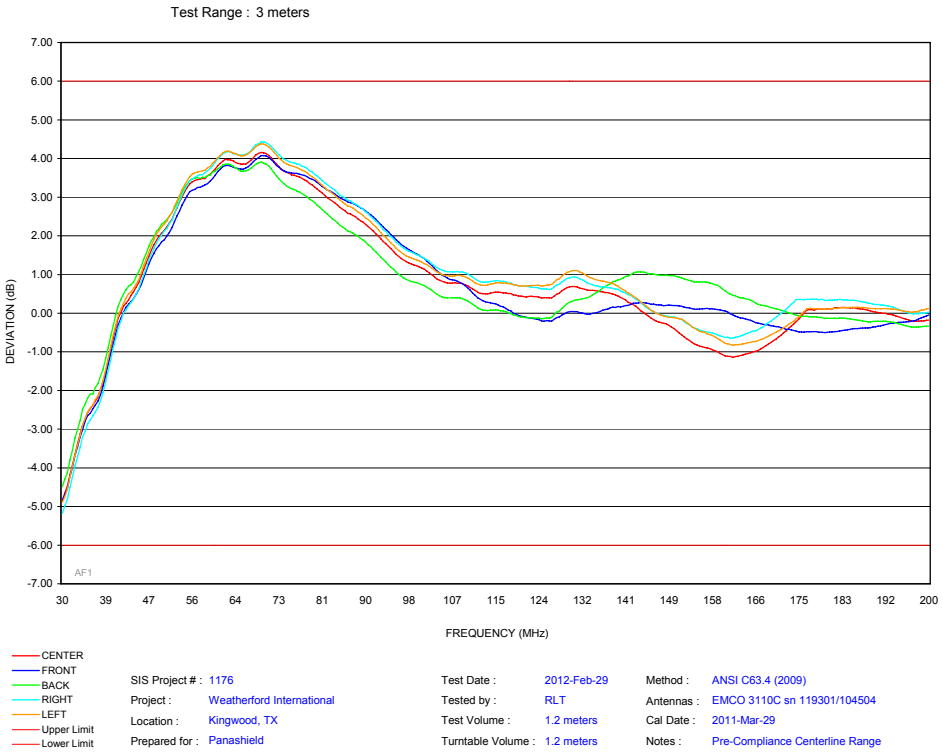
5.3. Figure 3: Chamber and range configuration as needed to repeat NSA



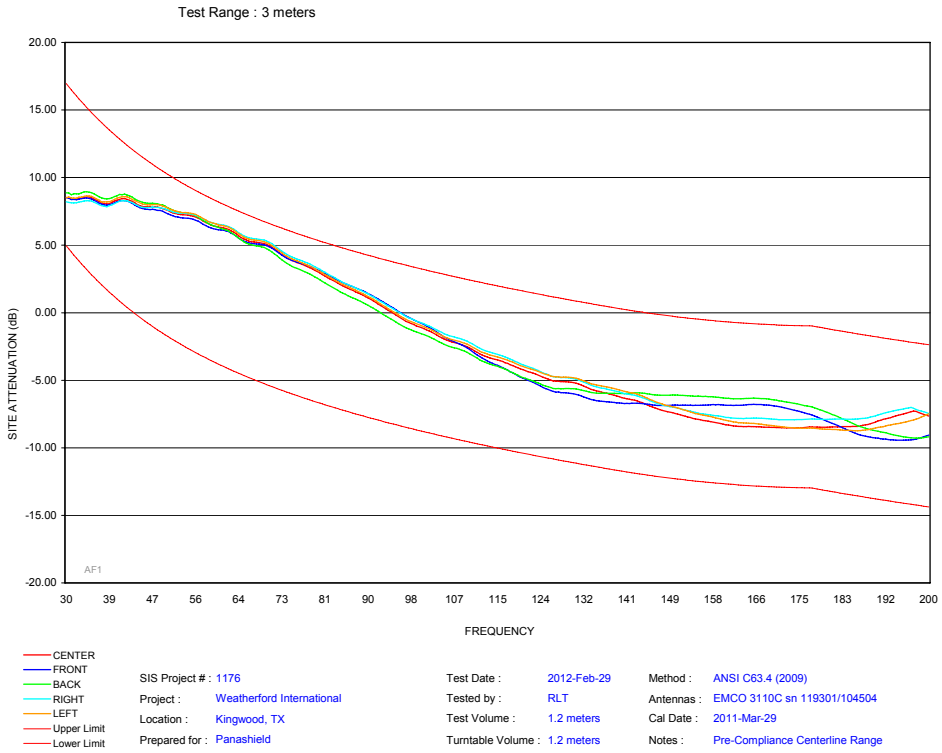
6. Data graphs

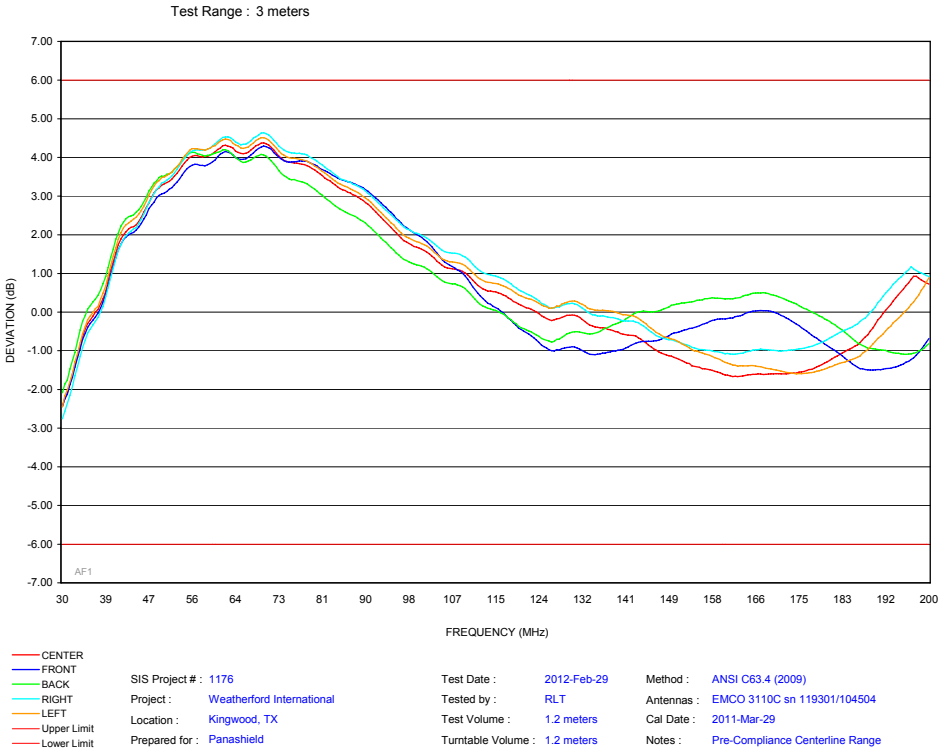
6.1. Horizontal Polarization: 30 MHz–200 MHz at 1 meter TX height



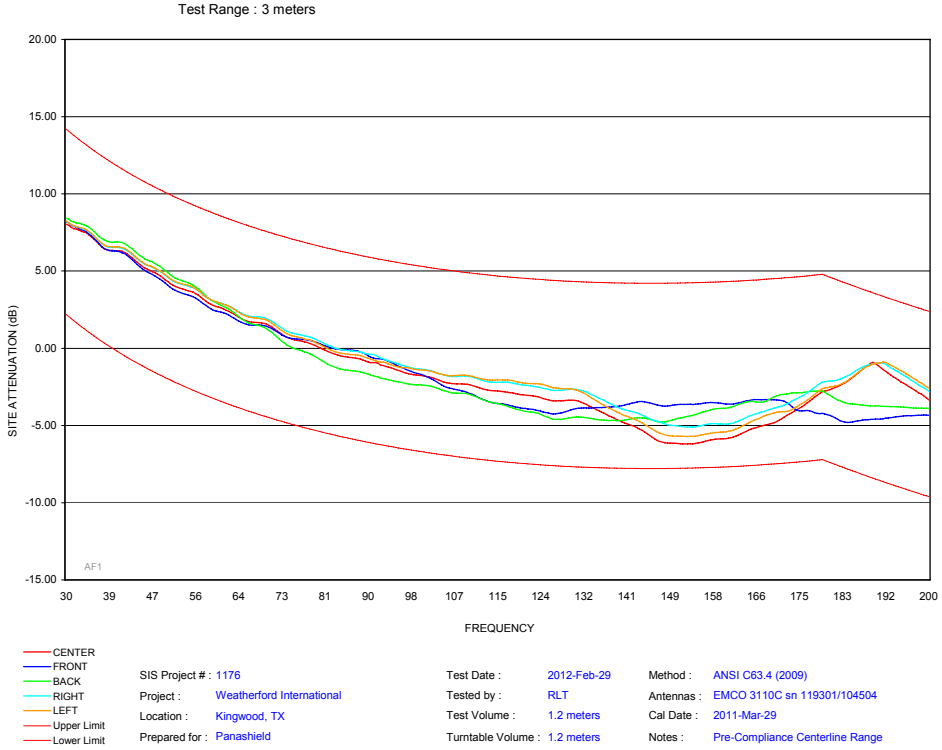


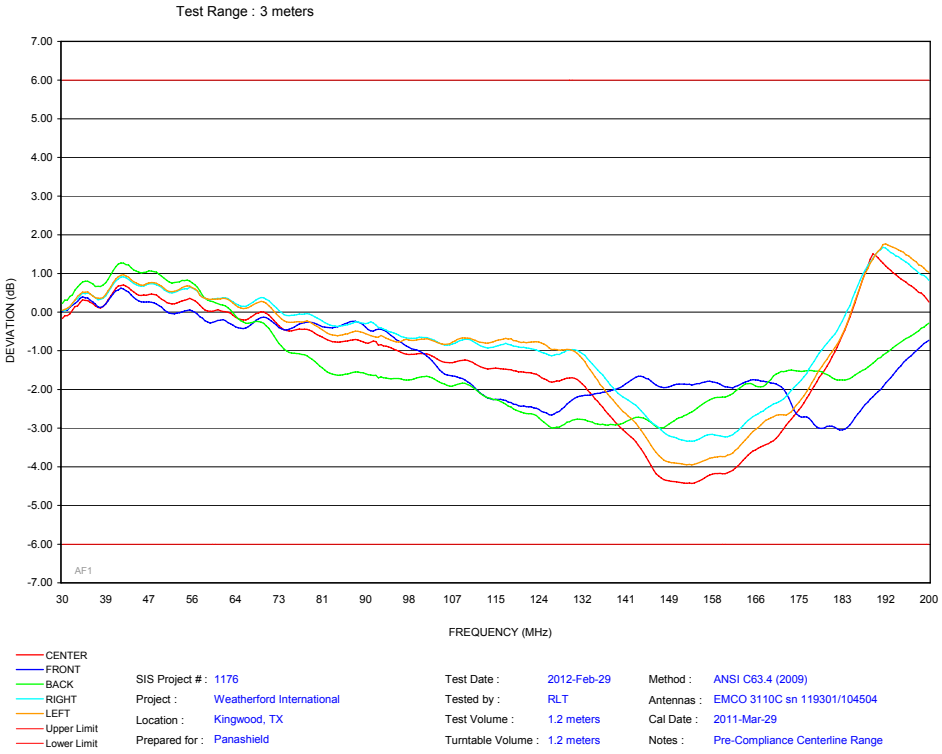
6.2. Horizontal Polarization: 30 MHz–200 MHz at 2 meter TX height



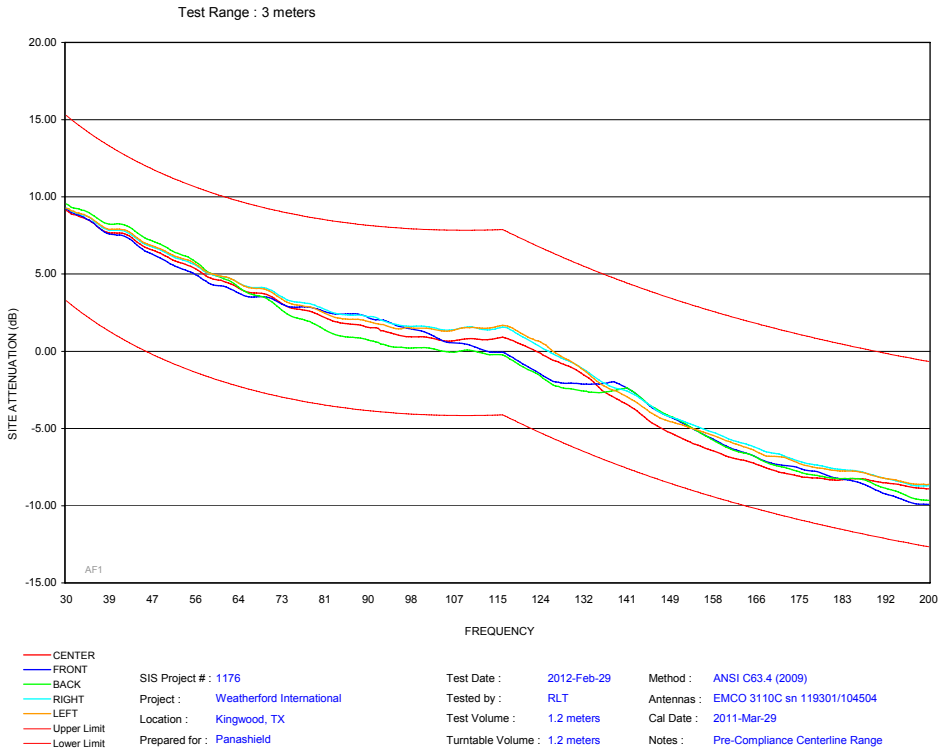


6.3. Vertical Polarization: 30 MHz–200 MHz at 1 meter TX height





6.4. Vertical Polarization: 30 MHz–200 MHz at 1.5 meter TX height



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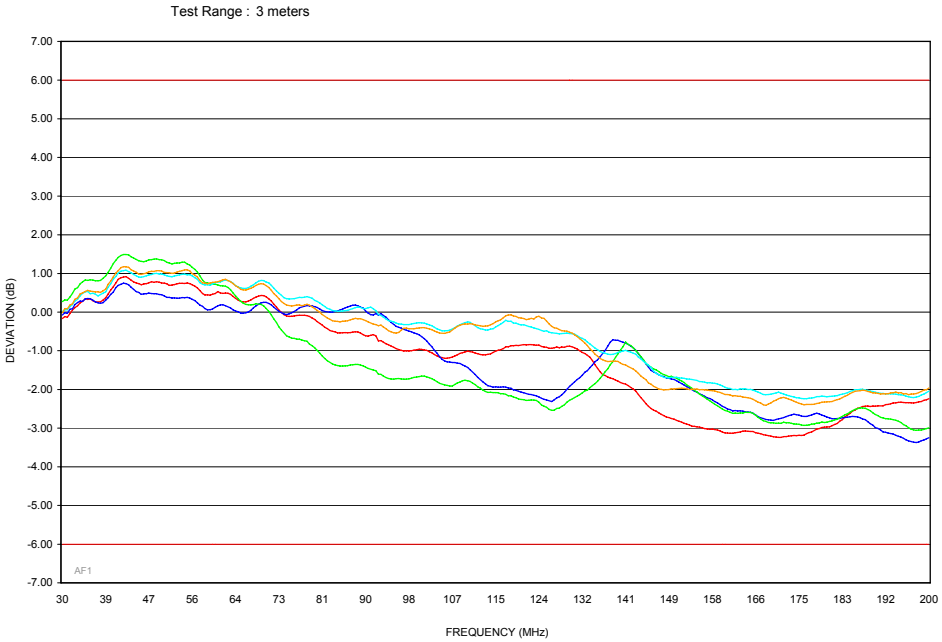
SIS Project # :	1176	Test Date :	2012-Feb-29	Method :	ANSI C63.4 (2009)
Project :	Weatherford International	Tested by :	RLT	Antennas :	EMCO 3110C sn 119301/104504
Location :	Kingwood, TX	Test Volume :	1.2 meters	Cal Date :	2011-Mar-29
Prepared for :	Panashield	Turntable Volume :	1.2 meters	Notes :	Pre-Compliance Centerline Range



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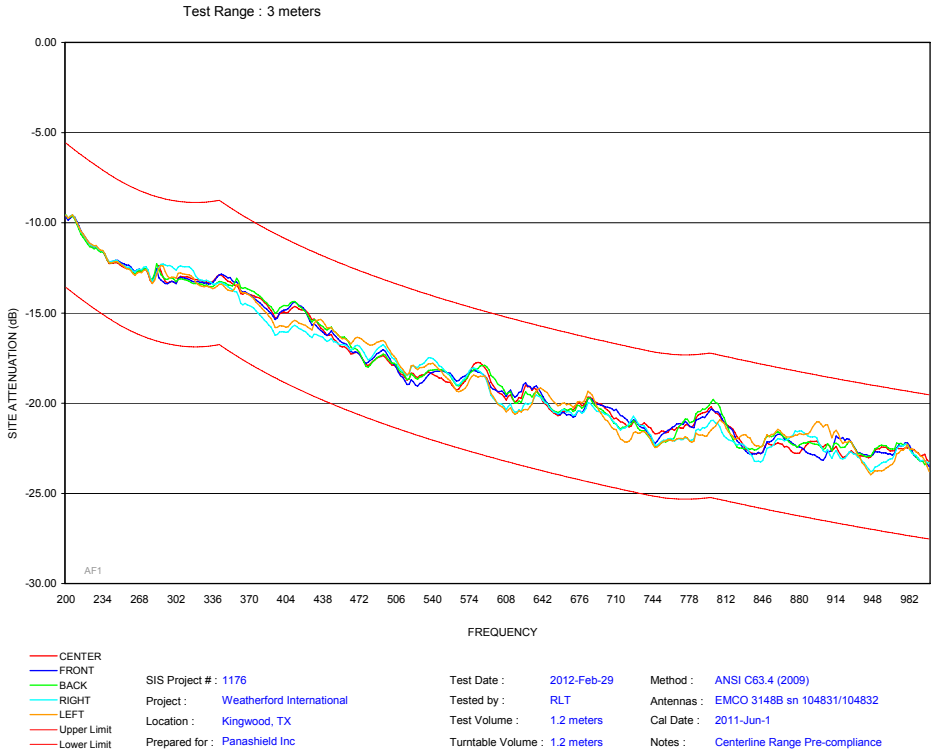
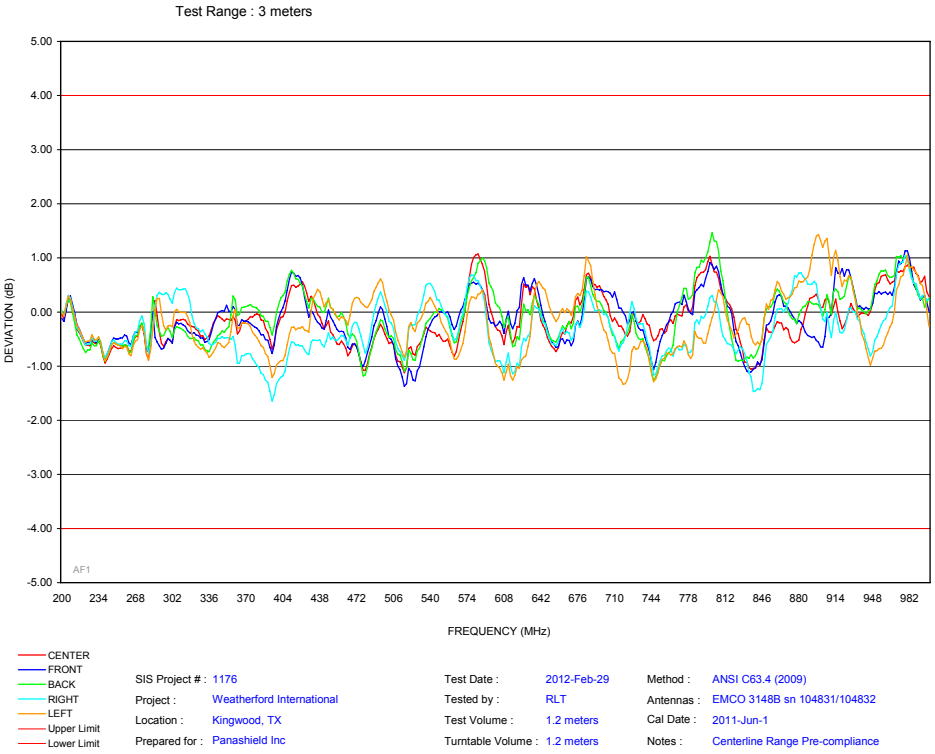
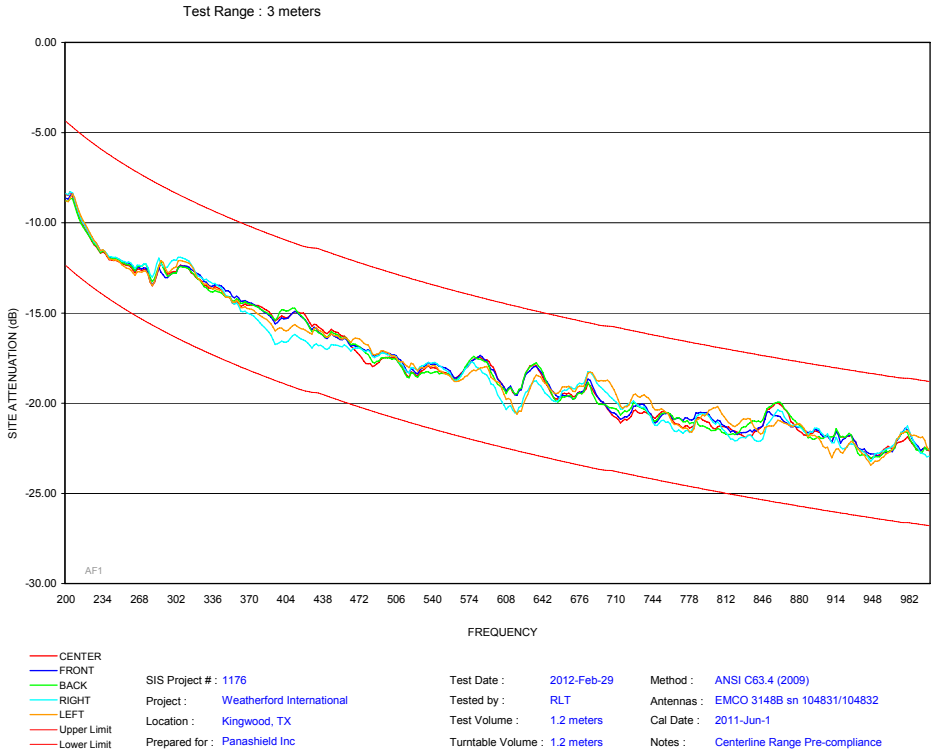
Project :	Weatherford International	Tested by :	RLT	Antennas :	EMCO 3110C sn 119301/104504
Location :	Kingwood, TX	Test Volume :	1.2 meters	Cal Date :	2011-Mar-29
Prepared for :	Panashield	Turntable Volume :	1.2 meters	Notes :	Pre-Compliance Centerline Range

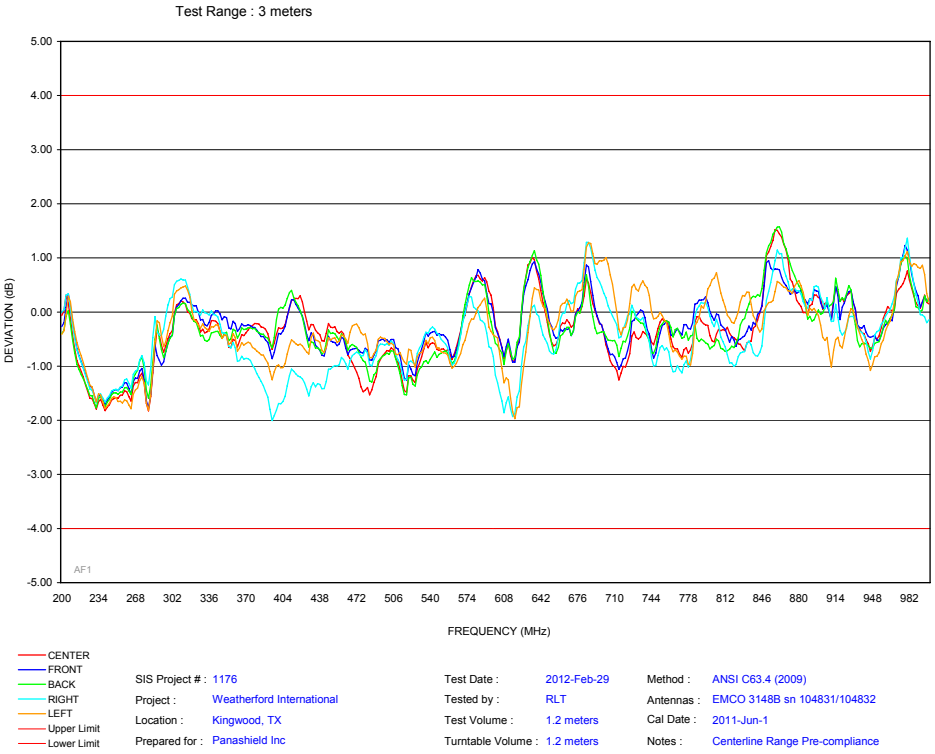
6.5. Horizontal Polarization: 200 MHz–1 GHz at 1 meter TX height



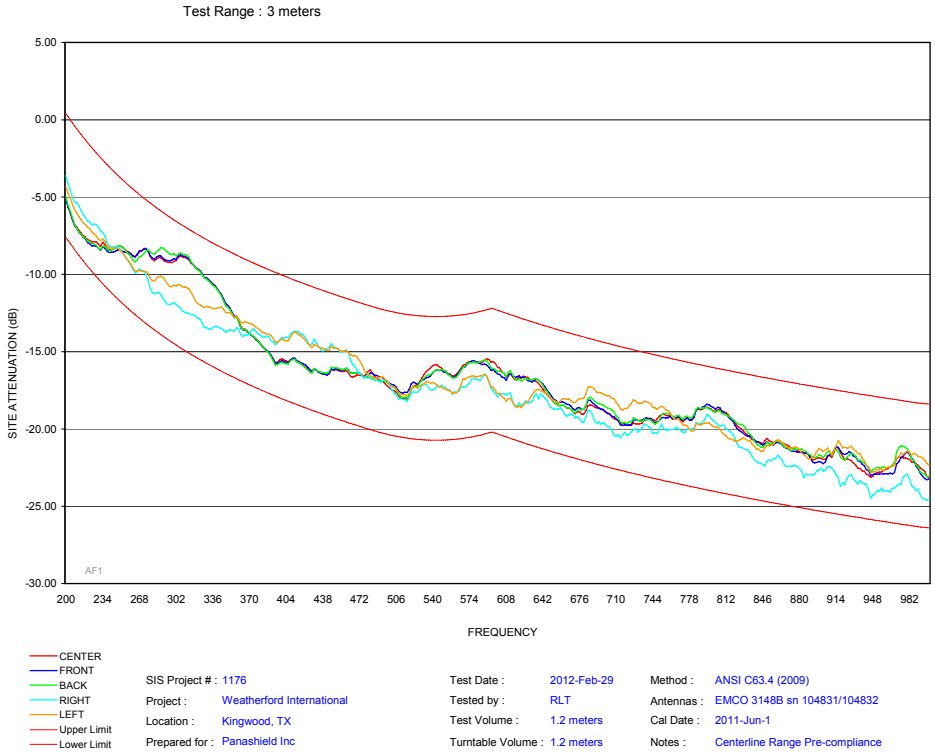


6.6. Horizontal Polarization: 200 MHz–1 GHz at 2 meter TX height





6.7. Vertical Polarization: 200 MHz–1 GHz at 1 meter TX height



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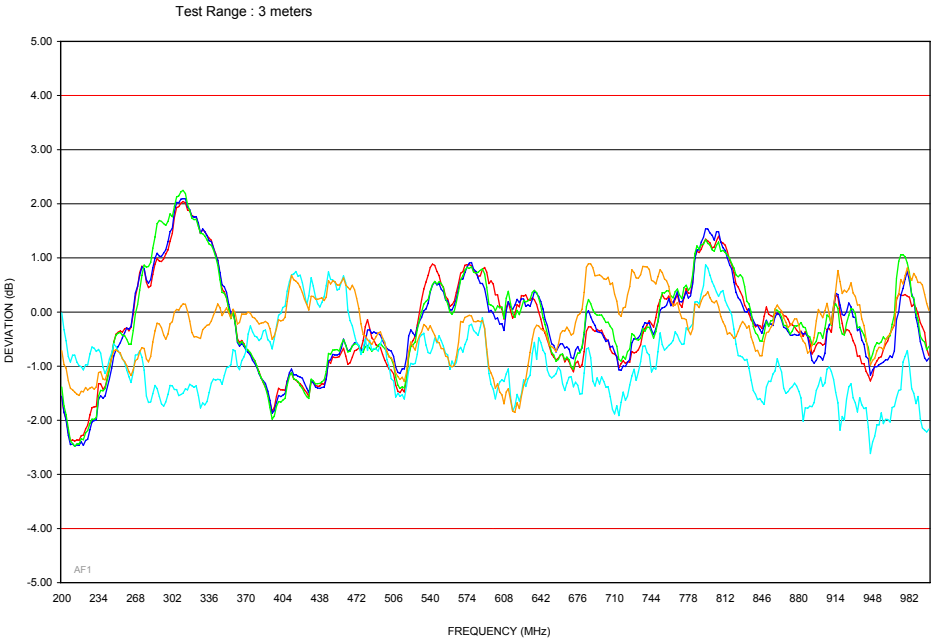
SIS Project # :	1176	Test Date :	2012-Feb-29	Method :	ANSI C63.4 (2009)
Project :	Weatherford International	Tested by :	RLT	Antennas :	EMCO 3148B sn 104831/104832
Location :	Kingwood, TX	Test Volume :	1.2 meters	Cal Date :	2011-Jun-1
Prepared for :	Panashield Inc	Turntable Volume :	1.2 meters	Notes :	Centerline Range Pre-compliance



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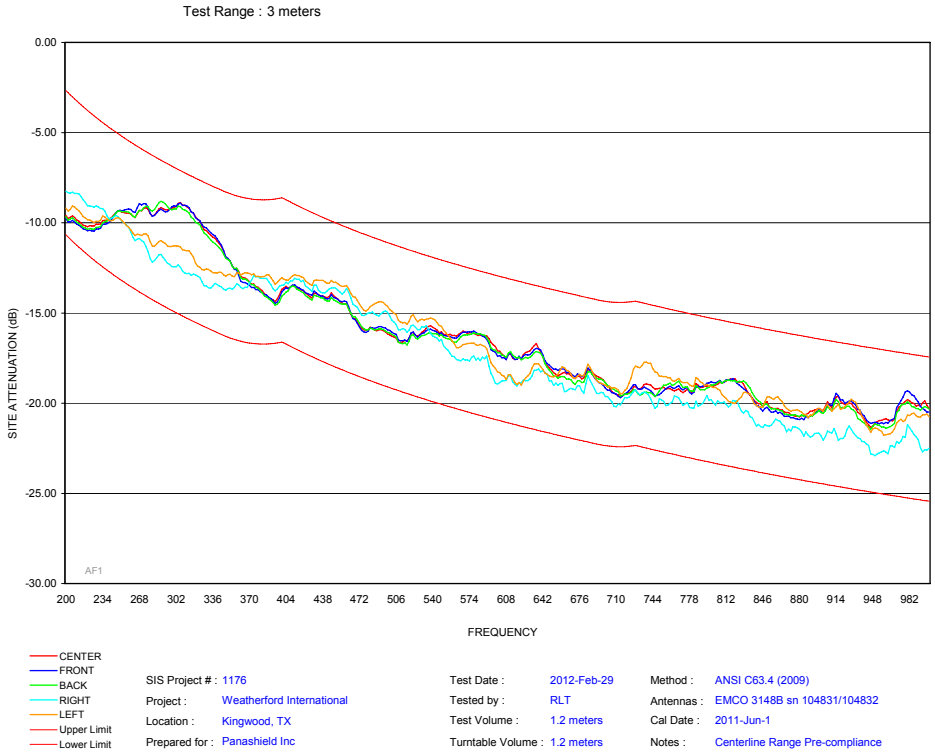
SIS Project # :	1176	Test Date :	2012-Feb-29	Method :	ANSI C63.4 (2009)
Project :	Weatherford International	Tested by :	RLT	Antennas :	EMCO 3148B sn 104831/104832
Location :	Kingwood, TX	Test Volume :	1.2 meters	Cal Date :	2011-Jun-1
Prepared for :	Panashield Inc	Turntable Volume :	1.2 meters	Notes :	Centerline Range Pre-compliance

6.8. Vertical Polarization: 200 MHz–1 GHz at 1.5 meter TX height



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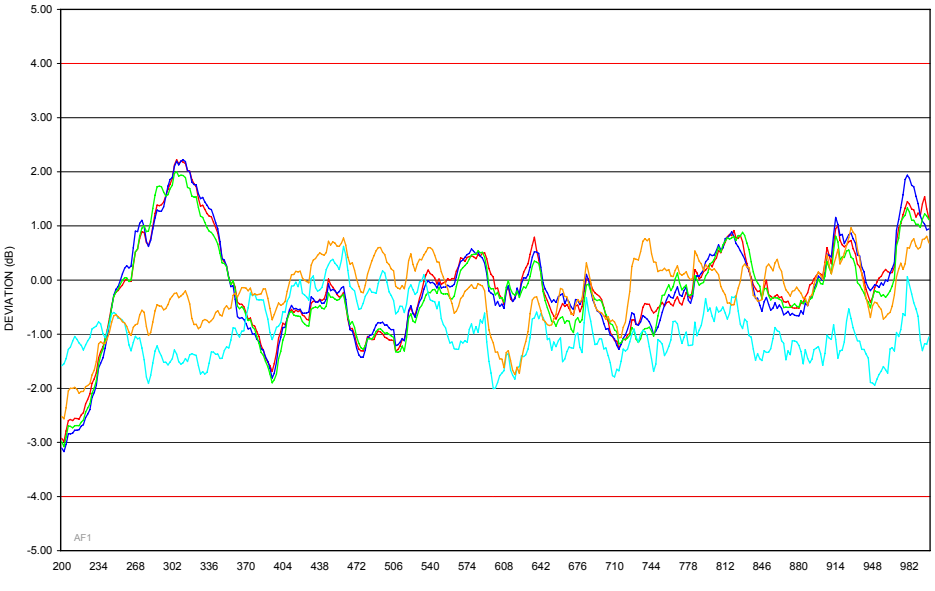
Location :	Kingwood, TX	Test Volume :	1.2 meters	Cal Date :	2011-Jun-1
Prepared for :	Panashield Inc	Turntable Volume :	1.2 meters	Notes :	Centerline Range Pre-compliance



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Prepared for :	Panashield Inc	Turntable Volume :	1.2 meters	Notes :	Centerline Range Pre-compliance

1 METER HORIZONTAL

MHz	Theo	Vdir	AF1	Raw Center	Raw Front	Raw Back	Raw Right	Raw Left	CSA Center	CSA Front	CSA Back	CSA Right	CSA Left	NSA Center	NSA Front	NSA Back	NSA Right	NSA Left	DEV Center	DEV Front	DEV Back	DEV Right	DEV Left
30	15.83	-20.44	30.04	-61.46	-61.49	-61.83	-61.13	-61.43	41.02	41.05	41.39	40.69	40.98	10.98	11.00	11.35	10.65	10.94	-4.85	-4.83	-4.48	-5.18	-4.89
35	13.40	-20.62	26.62	-58.07	-57.99	-58.44	-57.78	-58.08	37.45	37.37	37.82	37.16	37.46	10.83	10.75	11.20	10.54	10.84	-2.57	-2.65	-2.19	-2.86	-2.55
40	11.29	-20.82	24.21	-55.68	-55.52	-56.00	-55.42	-55.76	34.86	34.70	35.18	34.60	34.94	10.65	10.49	10.97	10.39	10.73	-0.64	-0.80	-0.32	-0.90	-0.56
45	9.44	-20.94	22.38	-53.55	-53.37	-53.84	-53.39	-53.63	32.61	32.43	32.90	32.45	32.69	10.23	10.05	10.52	10.07	10.31	0.79	0.61	1.08	0.63	0.87
50	7.80	-21.08	20.81	-51.83	-51.58	-52.04	-51.80	-52.00	30.75	30.51	30.96	30.73	30.92	9.95	9.70	10.15	9.92	10.11	2.14	1.90	2.35	2.12	2.31
55	6.34	-21.19	19.56	-50.44	-50.24	-50.52	-50.51	-50.63	29.24	29.05	29.33	29.32	29.43	9.68	9.49	9.77	9.76	9.87	3.34	3.15	3.43	3.42	3.53
60	5.03	-21.36	18.91	-49.02	-48.86	-48.97	-49.20	-49.24	27.67	27.51	27.62	27.85	27.88	8.75	8.59	8.70	8.93	8.97	3.73	3.57	3.67	3.90	3.94
70	2.77	-21.62	18.40	-46.91	-46.85	-46.64	-47.20	-47.13	25.30	25.23	25.02	25.58	25.51	6.90	6.83	6.62	7.18	7.11	4.13	4.07	3.86	4.41	4.35
80	0.89	-21.83	19.05	-44.98	-45.16	-44.56	-45.32	-45.20	23.15	23.33	22.73	23.49	23.37	4.10	4.27	3.68	4.44	4.32	3.21	3.39	2.79	3.55	3.43
90	-0.69	-22.04	20.09	-43.68	-44.03	-43.21	-44.01	-43.86	21.64	21.99	21.17	21.97	21.81	1.55	1.89	1.08	1.88	1.72	2.24	2.59	1.77	2.57	2.42
100	-2.04	-22.28	21.42	-42.86	-43.16	-42.42	-43.15	-43.01	20.58	20.87	20.14	20.87	20.73	-0.84	-0.55	-1.28	-0.55	-0.70	1.20	1.50	0.76	1.49	1.35
120	-4.24	-22.79	23.38	-42.38	-41.85	-41.83	-42.63	-42.64	19.59	19.07	19.05	19.85	19.85	-3.79	-4.31	-4.33	-3.53	-3.53	0.44	-0.08	-0.10	0.70	0.71
140	-5.95	-23.47	24.86	-42.75	-42.56	-43.29	-42.92	-42.99	19.28	19.09	19.82	19.46	19.52	-5.58	-5.78	-5.05	-5.41	-5.34	0.37	0.18	0.91	0.54	0.61
160	-7.36	-23.75	25.92	-41.21	-42.37	-42.90	-41.69	-41.54	17.46	18.62	19.14	17.94	17.79	-8.46	-7.30	-6.78	-7.99	-8.14	-1.10	0.05	0.58	-0.63	-0.78
180	-8.55	-23.89	26.67	-42.12	-41.51	-41.89	-42.35	-42.11	18.23	17.63	18.00	18.46	18.22	-8.44	-9.05	-8.68	-8.22	-8.45	0.11	-0.50	-0.13	0.33	0.10
200	-9.58	-24.24	29.87	-44.35	-44.48	-44.19	-44.56	-44.65	20.11	20.24	19.95	20.32	20.41	-9.76	-9.62	-9.91	-9.55	-9.46	-0.18	-0.05	-0.34	0.03	0.12
200	-9.58	-24.44	21.80	-36.61	-36.54	-36.69	-36.67	-36.66	12.17	12.10	12.24	12.22	12.22	-9.62	-9.70	-9.55	-9.57	-9.57	-0.04	-0.12	0.03	0.01	0.00
300	-12.77	-26.42	27.34	-40.46	-40.47	-40.63	-41.22	-40.74	14.04	14.05	14.21	14.81	14.32	-13.30	-13.29	-13.13	-12.53	-13.02	-0.53	-0.52	-0.36	0.24	-0.25
400	-14.78	-28.12	33.33	-46.46	-46.55	-46.80	-45.42	-45.74	18.34	18.43	18.68	17.30	17.62	-14.99	-14.90	-14.65	-16.04	-15.71	-0.21	-0.12	0.13	-1.26	-0.93
500	-17.26	-28.43	35.70	-46.38	-46.61	-46.48	-46.88	-47.07	17.95	18.17	18.04	18.45	18.64	-17.75	-17.53	-17.66	-17.25	-17.06	-0.49	-0.27	-0.40	0.01	0.20
600	-19.10	-30.12	40.64	-51.40	-51.40	-51.84	-50.76	-50.72	21.27	21.28	21.71	20.63	20.59	-19.37	-19.36	-18.93	-20.01	-20.05	-0.27	-0.26	0.17	-0.91	-0.95
700	-20.58	-30.75	44.51	-54.97	-55.06	-54.71	-54.64	-54.35	24.22	24.30	23.96	23.89	23.60	-20.29	-20.20	-20.55	-20.62	-20.91	0.29	0.37	0.03	-0.05	-0.34
800	-21.26	-30.81	46.31	-56.73	-56.73	-57.32	-56.17	-55.75	25.92	25.92	26.52	25.36	24.95	-20.39	-20.39	-19.79	-20.95	-21.36	0.87	0.87	1.47	0.31	-0.10
900	-22.48	-32.61	48.60	-58.81	-58.08	-58.78	-58.81	-60.04	26.21	25.48	26.17	26.21	27.44	-22.40	-23.13	-22.43	-22.40	-21.16	0.09	-0.64	0.05	0.09	1.32
1000	-23.53	-34.91	47.64	-59.31	-59.03	-59.28	-59.25	-58.75	24.40	24.13	24.37	24.34	23.84	-23.24	-23.52	-23.27	-23.30	-23.80	0.29	0.01	0.26	0.23	-0.27

2 METER HORIZONTAL

MHz	Theo	Vdir	AF1	Raw Center	Raw Front	Raw Back	Raw Right	Raw Left	CSA Center	CSA Front	CSA Back	CSA Right	CSA Left	NSA Center	NSA Front	NSA Back	NSA Right	NSA Left	DEV Center	DEV Front	DEV Back	DEV Right	DEV Left
30	10.96	-20.44	29.91	-58.88	-58.87	-59.22	-58.56	-58.86	38.43	38.43	38.78	38.11	38.42	8.52	8.52	8.87	8.20	8.50	-2.43	-2.44	-2.09	-2.76	-2.45
35	8.81	-20.62	26.52	-55.65	-55.55	-56.03	-55.40	-55.76	35.03	34.93	35.41	34.78	35.14	8.51	8.41	8.88	8.26	8.61	-0.29	-0.39	0.08	-0.54	-0.19
40	7.02	-20.82	24.25	-53.39	-53.27	-53.71	-53.22	-53.54	32.57	32.46	32.90	32.41	32.72	8.32	8.21	8.65	8.16	8.47	1.30	1.19	1.63	1.14	1.45
45	5.52	-20.94	22.59	-51.39	-51.25	-51.70	-51.34	-51.58	30.45	30.30	30.76	30.39	30.64	7.86	7.71	8.17	7.80	8.05	2.34	2.20	2.65	2.29	2.53
50	4.24	-21.08	21.23	-49.87	-49.63	-50.06	-49.92	-50.04	28.79	28.55	28.99	28.84	28.97	7.56	7.32	7.76	7.61	7.74	3.32	3.08	3.52	3.37	3.50
55	3.15	-21.19	20.28	-48.62	-48.38	-48.74	-48.76	-48.81	27.43	27.19	27.54	27.56	27.61	7.15	6.91	7.26	7.28	7.33	4.00	3.76	4.12	4.14	4.19
60	2.19	-21.36	19.66	-47.36	-47.15	-47.33	-47.57	-47.51	26.00	25.80	25.97	26.21	26.16	6.34	6.13	6.31	6.55	6.49	4.15	3.94	4.11	4.35	4.30
70	0.60	-21.62	18.82	-45.40	-45.32	-45.08	-45.65	-45.53	23.78	23.71	23.46	24.04	23.92	4.96	4.88	4.64	5.21	5.09	4.35	4.28	4.04	4.61	4.49
80	-0.70	-21.83	18.77	-43.53	-43.68	-43.03	-43.81	-43.65	21.70	21.85	21.20	21.98	21.82	2.93	3.08	2.43	3.21	3.04	3.63	3.78	3.13	3.90	3.74
90	-1.80	-22.04	19.23	-42.26	-42.60	-41.71	-42.55	-42.38	20.22	20.56	19.67	20.50	20.34	0.99	1.32	0.43	1.27	1.10	2.79	3.12	2.23	3.07	2.90
100	-2.76	-22.28	20.37	-41.55	-41.86	-41.10	-41.90	-41.69	19.26	19.58	18.81	19.62	19.41	-1.10	-0.79	-1.56	-0.75	-0.96	1.66	1.97	1.21	2.02	1.80
120	-4.40	-22.79	23.01	-41.58	-40.96	-41.00	-41.95	-41.82	18.79	18.17	18.21	19.16	19.03	-4.22	-4.85	-4.80	-3.85	-3.98	0.18	-0.45	-0.41	0.54	0.42
140	-5.76	-23.47	25.14	-42.28	-41.89	-42.62	-42.63	-42.79	18.81	18.42	19.15	19.16	19.32	-6.33	-6.72	-5.99	-5.99	-5.83	-0.57	-0.96	-0.23	-0.23	-0.07
160	-6.67	-23.75	25.50	-40.95	-42.40	-42.92	-41.50	-41.28	17.20	18.65	19.17	17.75	17.53	-8.30	-6.85	-6.33	-7.75	-7.97	-1.63	-0.18	0.34	-1.08	-1.30
180	-7.18	-23.89	27.41	-42.83	-43.26	-43.92	-43.41	-42.67	18.94	19.37	20.03	19.52	18.78	-8.47	-8.04	-7.39	-7.90	-8.63	-1.29	-0.86	-0.20	-0.71	-1.45
200	-8.37	-24.24	30.96	-47.55	-46.15	-46.02	-47.75	-47.72	23.31	21.91	21.78	23.51	23.48	-7.65	-9.06	-9.19	-7.45	-7.48	0.72	-0.68	-0.81	0.92	0.89
200	-8.37	-24.44	22.40	-38.41	-38.21	-38.07	-38.47	-38.06	13.97	13.77	13.63	14.02	13.62	-8.44	-8.64	-8.78	-8.38	-8.79	-0.06	-0.26	-0.40	-0.01	-0.41
300	-12.30	-26.42	28.32	-42.04	-41.97	-41.95	-42.69	-42.24	15.62	15.55	15.53	16.27	15.82	-12.70	-12.76	-12.79	-12.05	-12.50	-0.40	-0.46	-0.48	0.25	-0.19
400	-14.87	-28.12	33.62	-46.58	-46.48	-46.92	-45.18	-45.90	18.46	18.36	18.80	17.06	17.78	-15.16	-15.27	-14.82	-16.56	-15.85	-0.29	-0.40	0.05	-1.69	-0.97
500	-16.74	-28.43	36.74	-47.72	-47.92	-47.67	-47.85	-47.89	19.29	19.49	19.24	19.42	19.45	-17.45	-17.25	-17.50	-17.32	-17.28	-0.71	-0.51	-0.76	-0.58	-0.54
600	-18.37	-30.12	41.18	-52.67	-52.64	-52.35	-51.76	-52.48	22.55	22.52	22.23	21.64	22.36	-18.63	-18.66	-18.95	-19.54	-18.83	-0.26	-0.29	-0.58	-1.17	-0.45
700	-19.72	-30.75	44.17	-54.81	-54.83	-54.84	-55.56	-56.16	24.06	24.08	24.09	24.81	25.41	-20.12	-20.09	-20.08	-19.37	-18.76	-0.40	-0.38	-0.36	0.35	0.96
800	-20.86	-30.81	46.40	-55.81	-56.25	-55.70	-56.14	-56.94	25.00	25.45	24.89	25.34	26.13	-21.40	-20.95	-21.51	-21.06	-20.27	-0.53	-0.09	-0.64	-0.20	0.60
900	-21.91	-32.61	48.87	-59.83	-59.74	-59.53	-59.84	-59.33	27.22	27.14	26.92	27.24	26.72	-21.65	-21.73	-21.95	-21.63	-22.15	0.26	0.17	-0.04	0.27	-0.24
1000	-22.79	-34.91	47.00	-59.27	-59.34	-59.37	-58.97	-59.30	24.36	24.43	24.46	24.06	24.39	-22.64	-22.57	-22.54	-22.94	-22.61	0.15	0.22	0.26	-0.14	0.19

1 METER VERTICAL

MHz	Theo	Vdir	AF1	Raw Center	Raw Front	Raw Back	Raw Right	Raw Left	CSA Center	CSA Front	CSA Back	CSA Right	CSA Left	NSA Center	NSA Front	NSA Back	NSA Right	NSA Left	DEV Center	DEV Front	DEV Back	DEV Right	DEV Left
30	8.20	-20.44	28.22	-56.70	-56.87	-57.08	-56.90	-56.91	36.25	36.43	36.64	36.45	36.47	8.03	8.21	8.42	8.23	8.24	-0.16	0.01	0.23	0.04	0.05
35	6.91	-20.62	25.21	-53.03	-53.11	-53.54	-53.24	-53.26	32.41	32.49	32.92	32.62	32.64	7.21	7.28	7.71	7.41	7.44	0.30	0.37	0.80	0.50	0.52
40	5.81	-20.82	23.20	-50.33	-50.30	-50.90	-50.54	-50.59	29.52	29.49	30.08	29.73	29.77	6.32	6.29	6.89	6.53	6.58	0.51	0.48	1.07	0.72	0.76
45	4.86	-20.94	21.70	-47.94	-47.79	-48.54	-48.19	-48.22	26.99	26.85	27.59	27.24	27.28	5.29	5.15	5.90	5.55	5.58	0.43	0.29	1.04	0.69	0.72
50	4.02	-21.08	20.69	-46.09	-45.85	-46.66	-46.37	-46.40	25.01	24.77	25.59	25.29	25.33	4.32	4.08	4.89	4.60	4.63	0.30	0.06	0.87	0.57	0.61
55	3.28	-21.19	19.90	-44.73	-44.44	-45.18	-45.01	-45.05	23.54	23.24	23.99	23.82	23.85	3.64	3.34	4.09	3.92	3.95	0.36	0.06	0.80	0.64	0.67
60	2.62	-21.36	19.51	-43.53	-43.24	-43.74	-43.83	-43.82	22.18	21.89	22.38	22.48	22.46	2.67	2.38	2.87	2.97	2.95	0.04	-0.25	0.24	0.34	0.33
70	1.51	-21.62	19.06	-42.15	-42.03	-41.82	-42.51	-42.41	20.53	20.42	20.21	20.89	20.79	1.48	1.36	1.15	1.83	1.74	-0.03	-0.14	-0.35	0.33	0.23
80	0.60	-21.83	19.35	-41.20	-41.47	-40.45	-41.63	-41.42	19.37	19.64	18.62	19.80	19.59	0.02	0.29	-0.73	0.45	0.24	-0.58	-0.32	-1.33	-0.15	-0.37
90	-0.12	-22.04	19.79	-40.91	-41.26	-40.10	-41.43	-41.13	18.87	19.22	18.06	19.39	19.09	-0.93	-0.57	-1.74	-0.40	-0.70	-0.81	-0.45	-1.62	-0.28	-0.58
100	-0.70	-22.28	20.67	-41.18	-41.25	-40.57	-41.60	-41.55	18.90	18.97	18.29	19.32	19.26	-1.77	-1.70	-2.38	-1.35	-1.40	-1.07	-1.01	-1.68	-0.65	-0.71
120	-1.46	-22.79	22.43	-42.21	-41.32	-41.17	-42.84	-42.97	19.42	18.53	18.38	20.05	20.18	-3.01	-3.89	-4.05	-2.37	-2.25	-1.55	-2.43	-2.59	-0.91	-0.79
140	-1.78	-23.47	24.25	-42.90	-44.03	-43.07	-43.74	-43.37	19.43	20.57	19.60	20.28	19.90	-4.83	-3.69	-4.65	-3.98	-4.35	-3.05	-1.91	-2.87	-2.20	-2.57
160	-1.68	-23.75	25.51	-43.40	-45.65	-45.38	-44.35	-43.85	19.65	21.90	21.63	20.60	20.09	-5.86	-3.61	-3.88	-4.91	-5.42	-4.18	-1.93	-2.20	-3.23	-3.73
180	-1.33	-23.89	26.86	-48.01	-46.46	-47.80	-48.61	-48.19	24.12	22.57	23.91	24.72	24.30	-2.73	-4.29	-2.95	-2.14	-2.56	-1.40	-2.96	-1.61	-0.81	-1.23
200	-3.61	-24.24	30.97	-51.87	-50.88	-51.33	-52.43	-52.64	27.63	26.64	27.09	28.19	28.40	-3.34	-4.33	-3.89	-2.78	-2.57	0.26	-0.73	-0.28	0.82	1.03
200	-3.61	-24.44	22.00	-41.27	-41.28	-41.45	-42.82	-42.12	16.83	16.84	17.01	18.38	17.68	-5.17	-5.16	-4.99	-3.62	-4.32	-1.57	-1.56	-1.38	-0.02	-0.71
300	-10.48	-26.42	28.50	-45.75	-45.92	-46.25	-43.08	-44.22	19.33	19.51	19.83	16.66	17.80	-9.17	-8.99	-8.66	-11.83	-10.69	1.31	1.49	1.81	-1.35	-0.22
400	-14.04	-28.12	33.07	-45.74	-45.61	-45.50	-47.09	-47.01	17.62	17.49	17.38	18.97	18.89	-15.45	-15.58	-15.69	-14.10	-14.18	-1.41	-1.54	-1.65	-0.06	-0.14
500	-16.38	-28.43	36.77	-47.84	-48.15	-48.07	-47.94	-48.09	19.41	19.71	19.64	19.51	19.66	-17.36	-17.06	-17.13	-17.26	-17.11	-0.97	-0.67	-0.74	-0.88	-0.72
600	-16.32	-30.12	39.28	-53.40	-52.96	-53.11	-51.48	-51.67	23.28	22.83	22.98	21.36	21.55	-16.00	-16.45	-16.30	-17.92	-17.73	0.32	-0.13	0.02	-1.60	-1.41
700	-18.43	-30.75	41.34	-53.23	-53.20	-53.55	-52.38	-54.28	22.48	22.45	22.80	21.63	23.53	-18.86	-18.89	-18.55	-19.71	-17.81	-0.43	-0.47	-0.12	-1.28	0.61
800	-20.03	-30.81	44.12	-56.08	-56.32	-56.05	-55.46	-55.10	25.28	25.51	25.24	24.65	24.29	-18.84	-18.61	-18.88	-19.47	-19.83	1.18	1.42	1.15	0.56	0.19
900	-21.33	-32.61	47.98	-58.69	-58.43	-58.88	-58.06	-59.23	26.08	25.83	26.27	25.45	26.63	-21.90	-22.16	-21.71	-22.53	-21.36	-0.57	-0.83	-0.39	-1.21	-0.03
1000	-22.39	-34.91	47.09	-58.80	-58.75	-58.97	-57.44	-59.63	23.89	23.84	24.06	22.53	24.72	-23.20	-23.24	-23.03	-24.56	-22.36	-0.80	-0.85	-0.63	-2.16	0.03

1.5 METER VERTICAL

MHz	Theo	Vdir	AF1	Raw Center	Raw Front	Raw Back	Raw Right	Raw Left	CSA Center	CSA Front	CSA Back	CSA Right	CSA Left	NSA Center	NSA Front	NSA Back	NSA Right	NSA Left	DEV Center	DEV Front	DEV Back	DEV Right	DEV Left
30	9.28	-20.44	28.06	-57.62	-57.70	-58.05	-57.80	-57.76	37.17	37.26	37.61	37.36	37.32	9.11	9.20	9.55	9.30	9.26	-0.16	-0.07	0.27	0.02	-0.02
35	8.04	-20.62	25.09	-54.08	-54.11	-54.58	-54.29	-54.32	33.46	33.49	33.96	33.67	33.70	8.37	8.40	8.87	8.57	8.61	0.33	0.35	0.82	0.53	0.57
40	7.00	-20.82	23.09	-51.56	-51.42	-52.16	-51.75	-51.82	30.75	30.61	31.35	30.94	31.00	7.66	7.52	8.26	7.85	7.91	0.66	0.52	1.26	0.85	0.91
45	6.11	-20.94	21.53	-49.32	-49.09	-49.91	-49.49	-49.57	28.38	28.15	28.97	28.55	28.63	6.85	6.62	7.44	7.02	7.10	0.73	0.51	1.33	0.91	0.99
50	5.35	-21.08	20.42	-47.59	-47.26	-48.18	-47.81	-47.87	26.52	26.19	27.10	26.73	26.80	6.10	5.77	6.69	6.32	6.38	0.75	0.42	1.33	0.96	1.03
55	4.69	-21.19	19.63	-46.25	-45.88	-46.73	-46.48	-46.58	25.06	24.69	25.54	25.29	25.39	5.43	5.06	5.91	5.66	5.76	0.74	0.37	1.22	0.97	1.07
60	4.13	-21.36	19.10	-45.07	-44.71	-45.30	-45.34	-45.36	23.71	23.35	23.95	23.98	24.00	4.61	4.25	4.85	4.88	4.90	0.48	0.13	0.72	0.76	0.77
70	3.22	-21.62	18.42	-43.65	-43.51	-43.35	-44.03	-43.94	22.04	21.89	21.73	22.42	22.33	3.62	3.47	3.32	4.00	3.91	0.40	0.25	0.10	0.78	0.69
80	2.57	-21.83	18.53	-42.69	-43.06	-41.94	-43.21	-42.98	20.86	21.23	20.11	21.38	21.15	2.33	2.69	1.58	2.85	2.62	-0.25	0.12	-0.99	0.28	0.05
90	2.14	-22.04	18.91	-42.48	-43.07	-41.64	-43.21	-42.84	20.43	21.02	19.60	21.16	20.80	1.52	2.11	0.69	2.25	1.89	-0.62	-0.03	-1.45	0.11	-0.25
100	1.90	-22.28	19.89	-43.12	-43.49	-42.41	-43.81	-43.67	20.83	21.21	20.13	21.52	21.38	0.94	1.32	0.24	1.63	1.50	-0.96	-0.59	-1.67	-0.27	-0.41
120	1.25	-22.79	22.65	-45.84	-44.62	-44.43	-46.36	-46.54	23.05	21.83	21.64	23.57	23.75	0.40	-0.82	-1.00	0.92	1.10	-0.85	-2.07	-2.26	-0.33	-0.15
140	-1.51	-23.47	26.18	-46.29	-47.36	-47.24	-47.13	-46.79	22.83	23.89	23.78	23.66	23.32	-3.36	-2.29	-2.41	-2.52	-2.86	-1.84	-0.78	-0.89	-1.01	-1.35
160	-3.66	-23.75	28.10	-45.08	-45.73	-45.66	-46.26	-46.07	21.32	21.98	21.90	22.50	22.31	-6.78	-6.12	-6.20	-5.60	-5.79	-3.12	-2.47	-2.54	-1.94	-2.13
180	-5.33	-23.89	29.88	-45.48	-45.73	-45.60	-46.25	-46.13	21.59	21.84	21.71	22.37	22.24	-8.29	-8.04	-8.17	-7.52	-7.64	-2.97	-2.72	-2.85	-2.19	-2.32
200	-6.66	-24.24	32.56	-47.90	-46.89	-47.15	-48.10	-48.17	23.66	22.65	22.91	23.85	23.93	-8.90	-9.91	-9.65	-8.71	-8.63	-2.24	-3.25	-2.99	-2.04	-1.96
200	-6.66	-24.44	22.24	-37.09	-36.91	-37.03	-38.44	-37.50	12.65	12.47	12.59	13.99	13.06	-9.59	-9.77	-9.65	-8.25	-9.18	-2.92	-3.11	-2.99	-1.58	-2.52
300	-10.92	-26.42	28.06	-45.33	-45.42	-45.24	-42.05	-43.21	18.91	19.00	18.83	15.63	16.79	-9.15	-9.06	-9.23	-12.43	-11.27	1.77	1.86	1.68	-1.51	-0.35
400	-12.61	-28.12	33.10	-47.53	-47.39	-47.16	-47.76	-48.18	19.41	19.27	19.04	19.64	20.06	-13.69	-13.83	-14.06	-13.46	-13.04	-1.08	-1.22	-1.45	-0.85	-0.42
500	-15.14	-28.43	35.71	-47.93	-48.18	-48.03	-48.97	-49.33	19.50	19.74	19.60	20.54	20.90	-16.21	-15.97	-16.11	-15.17	-14.81	-1.08	-0.83	-0.97	-0.03	0.33
600	-16.94	-30.12	40.32	-53.35	-53.04	-53.23	-51.51	-52.17	23.22	22.92	23.11	21.39	22.05	-17.10	-17.40	-17.21	-18.93	-18.27	-0.16	-0.46	-0.28	-2.00	-1.33
700	-18.35	-30.75	42.04	-53.94	-53.63	-53.92	-53.17	-53.78	23.19	22.88	23.17	22.42	23.03	-18.85	-19.16	-18.87	-19.62	-19.01	-0.50	-0.80	-0.52	-1.27	-0.66
800	-19.31	-30.81	45.12	-56.86	-57.06	-56.94	-55.95	-56.79	26.05	26.26	26.13	25.14	25.99	-19.07	-18.86	-18.99	-19.98	-19.13	0.25	0.45	0.33	-0.67	0.18
900	-20.46	-32.61	46.55	-58.81	-58.73	-58.63	-57.34	-58.78	26.21	26.12	26.03	24.73	26.18	-20.34	-20.43	-20.52	-21.82	-20.37	0.11	0.03	-0.07	-1.36	0.09
1000	-21.44	-34.91	46.14	-60.74	-60.56	-60.73	-58.56	-60.30	25.83	25.65	25.82	23.65	25.39	-20.31	-20.49	-20.32	-22.49	-20.75	1.13	0.95	1.12	-1.05	0.69

ACCREDITED
Calibration Laboratory
Certificate 1207.01

ETS·LINDGREN™
An ESCO Technologies Company

1301 Arrow Point Drive
Cedar Park, Texas 78613
(512) 531-6498

Cert I.D.: 85223

Certificate of Calibration Conformance

The instrument identifed below has been individually calibrated in compliance with the following standard(s):

ANSI C63.5 - 2006, American National Standard for Electromagnetic Compatibility-Radiated Emission Measurements in Electromagnetic Interference (EMI) Control-Calibration of Antennas, American National Standards Institute, Inc.

Environment: Laboratory MTE is maintained in a temperature controlled environment with ambient conditions from 18 to 28 C, relative humidity less than 90%. The instrument under test has been calibrated on an open air test site (OATS) with environment temperature conditions ranging from 0 to 40 C which has no known influences on measurement quality.

Manufacturer:	ETS-Lindgren	**Operating Range:**	200 - 2000 MHz
Model Number:	3148B.	**Instrument Type:**	Log Periodic (NSA measurement)
Serial Number/ ID:	*00104831 / 00104832*	**Date Code:**	
Tracking Number:	**S000022319**	**Alternate ID:**	
Date Completed:	01-Jun-11	**Customer:**	SHIELDING INTEGRITY SERVICES (CO)
Test Type:	3, 5 and 10 Meter, Custom, Normalized Site Attenuation		

Calibration Uncertainty: k=2, (95% Confidence Level)	03m	200 MHz - 1000 MHz, +/- .5 dB; 1000 MHz - 2000 MHz, +/- 1.0 dB
	10m	200 MHz - 1000 MHz, +/- .5 dB; 1000 MHz - 2000 MHz, +/- 1.0 dB

Test Remarks: TX: 00104831, RX: 00104832.

Calibration Traceability: All Measuring and Test Equipment (M/TE) identified below are traceable to the SI units through the National Institute for Standards and Technology (NIST). Calibration Laboratory and Quality System controls are compliant with ISO/IEC 17025-2005 and ANSI/NCSL Z540-1-1994.

Standards and Equipment Used:

Make / Model / Name / S/N / Recall Date				
Anritsu	MS4623A	Network Analyzer	992201	18-Mar-12

Condition of Instrument Upon Receipt:
In Tolerance to Internal Quality Standards

On Release:
In Tolerance to Internal Quality Standards

Calibration Completed By
Maria Lopez, Cal Lab Technician

Attested and Issued on 01-Jun-11
Richard Goodlow, Calibration Supervisor

ACCREDITED
Calibration Laboratory
Certificate 1207.01

ETS-LINDGREN
An ESCO Technologies Company

1301 Arrow Point Drive
Cedar Park, Texas 78613
(512) 531-6498

Cert I.D.: 84224

Certificate of Calibration Conformance

The instrument identifed below has been individually calibrated in compliance with the following standard(s):

ANSI C63.5 - 2006, American National Standard for Electromagnetic Compatibility-Radiated Emission Measurements in Electromagnetic Interference (EMI) Control-Calibration of Antennas, American National Standards Institute, Inc.

Environment: Laboratory MTE is maintained in a temperature controlled environment with ambient conditions from 18 to 28 C, relative humidity less than 90%. The instrument under test has been calibrated on an open air test site (OATS) with environment temperature conditions ranging from 0 to 40 C which has no known influences on measurement quality.

Manufacturer:	ETS-Lindgren	**Operating Range:**	30 - 200MHz
Model Number:	3110C.	**Instrument Type:**	Biconical (NSA measurements)
Serial Number/ ID:	*00119301 / 00104504*	**Date Code:**	
Tracking Number:	**S000022035**	**Alternate ID:**	
Date Completed:	29-Mar-11	**Customer:**	SHIELDING INTEGRITY SERVICES (CO)
Test Type:	3, 5 and 10 Meter, Custom, Normalized Site Attenuation		

Calibration Uncertainty: 03m +/- .5 dB
k=2, (95% Confidence Level)
10m +/- .5 dB

Test Remarks: TX: 00119301, RX: 00104504

Calibration Traceability: All Measuring and Test Equipment (M/TE) identified below are traceable to the National Institute for Standards and Technology (NIST). Calibration Laboratory and Quality System controls are compliant with ISO/IEC 17025-2005.

Standards and Equipment Used:

Make / Model / Name / S/N / Recall Date				
Anritsu	MS4623A	Network Analyzer	992201	04-Apr-11

Condition of Instrument Upon Receipt:
In Tolerance to Internal Quality Standards

On Release:
In Tolerance to Internal Quality Standards

Calibration Completed By
Maria Lopez, Cal Lab Technician

Attested and Issued on 29-Mar-11
James C. Psencik, VP of Engineering

Mountain Metrology and Repair, Inc.

Certificate of Calibration

Certificate #: **160160** **Date:** 5/13/2011

Customer Number:	100147	Contact Name:	ROBBIE TUTTLE
Company Name:	SHIELDING INTEGRITY SERVICE	Phone Number:	719-635-7719
Location:	MMR	Purchase Order:	CREDIT CARD
Work Requested:	ECAL Data NONE	Physical Condition:	OK

Mfg: ADV	Model: R3770	Nomenclature: ANALYZER, NETWORK
Serial #: 150201779	ID#: 150201779	MMR#: SHIS201779

Calibration

Calibration Cycle:	12	Calibration Tech:	019
Condition Received:	IN TOLERANCE	Condition Returned:	IN TOLERANCE
Temperature:	20 +/- 2 Degrees C	Humidity:	45 +/- 2% RH
Calibration Date:	5/13/2011	Calibration Due Date:	5/13/2012
Calibration Procedure:	MFG'S	Rev:	

Notes: PERFORMANCE TEST ONLY; TEST TO 18GHZ; CONFORMS TO METRICT TEST CAL 185724 DATA

Standards Used

Asset Number	Mfg	Model	Due Date	NIST Trace#
MMRE0003	HPC	3457A	12/22/2011	158840
MMRE0013	HPC	355D	5/11/2012	160122
MMRE0044	HPC	8481A	10/12/2011	158119
MMRE0064	HPC	436A	9/27/2011	158007
MMRE0073	EIPM	548A/005/006	11/19/2011	158532
MMRE0109	HPC	85032B	9/ 6/2011	157898

This calibration was performed using standards traceable to the National Institute of Standards and Technology (NIST) or an acceptable physical standard and is compliant with ANSI/NCSL-Z540 and ISO 17025. Unless otherwise noted, all instruments are returned in tolerance, meet or exceed manufacturers' specifications, calibrated to an uncertainty ratio of 4:1 or better.

Repair

Problem Description:
Corrective Action:

Parts Replaced

Part Number	Description	Part Number	Description

Certified By:

"Assuring Accuracy In The Tools Our Customers Depend On"
Mountain Metrology and Repair, Inc. - 1405 Potter Dr. - Colorado Springs, CO 80909
(719) 442-0004 - Fax: (719) 442-0006