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TEST REPORT
OF
NORMALIZED SITE ATTENUATION
PERFORMANCE

ETS-Lindgren Project S001431
Report #S001431-1

Prepared for

Eugene Clarke
Datascope Corporation
800 MacArthur Blvd.
Mahwah, NJ 07430

Report prepared by:
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Rick Flores
Service Department Manager
ETS-Lindgren L.P.
May 4, 2004

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1.0 INTRODUCTION

1.1 Introduction to the Datascope Corp., 3 Meter Semi-Anechoic Chamber

On April 29-30, 2004, ETS-Lindgren performed Normalized Site Attenuation measurements in the Datascope Corp., 3 meter, indoor, shielded, semi-anechoic chamber. This facility was previously constructed with the capability of measuring electronic devices that must comply with FCC, Industry Canada, and other international regulations. In addition to this report, Datascope Corp., was provided with all measured data in MS Excel spreadsheet format upon test completion. Testing documented within this report was performed April 29-30, 2004 by Barry Woods, ETS-Lindgren Field Calibration Technician. .

Questions or concerns relating to information contained within this report should be directed to:

Arthur Cook
Field Calibration Supervisor
ETS-Lindgren
Phone: 512-531-6481
Fax: 512-531-6581
E-mail: art.cook@ets-lindgren.com

1.2 Location of the Datascope Corp., 3 Meter Semi-Anechoic Chamber

The 3 meter Semi-Anechoic Chamber is located at:

1300 MacArthur Blvd.
Mahwah, NJ 07430

Attn: Mr. Eugene Clarke
Phone: 201-995-8373
Fax: 201-995-8614
E-mail: Eugene.Clarke@datascope.com

2.0 PHYSICAL LAYOUT AND THE SITE DESCRIPTION

2.1 Shielded Enclosures

The EMC radiated test facility consists of a RF-shielded enclosure with interior shield to shield dimensions of approximately 28.0 feet long by 20.0 feet wide by 19 feet high and consisting of rigid, steel-clad, wood core modular panels with steel framing. In the shielded enclosure, the faces of the panels are galvanized and the chamber is self-supporting. The framing/joining system channels are made of 1/8 inch zinc plated steel, and have serrations running lengthwise along each side of the contacting surface. Screw fasteners, 4 inches on center, are zinc-plated and fasten the steel framing to the modular panels, thus forming the shielded enclosure. At all corner intersections of walls, a specially fabricated one-piece corner section completes the assembly.

Lighting in the semi-anechoic chamber consists of six (6) incandescent floodlight fixtures..

A shielded door is provided for personnel and equipment access into the Semi-Anechoic Chamber.

Door specifications:

Chamber door	4' X 7'	Brass Knife	100dB	Swing (single leaf)

HVAC is provided by four integral honeycomb wave-guide air vents mounted in chamber's ceiling. The semi-anechoic chamber is capable of meeting RF attenuation levels of over 100dB throughout the frequency range of 30 MHz to 10 GHz, so that testing performed within the chamber does not interfere with other testing activities at the facility, and vice-versa.

2.2 Turntable and Ground Plane

The turntable is an electrically driven EMCO Model 2087-2.03 electrically-powered turntable with two-meter diameter and capable of supporting a uniformly distributed load of up to 2000 lb. The turntable is grounded around its circumference with continuous metallic brush to the semi-anechoic chamber floor by a grounding ring. The electrically driven turntable does not introduce conducted or radiated electrical noise above the ambient levels existing with the chamber. The turntable rotation is controlled by an EMCO Model 2090 Multi-device Controller with IEEE-488 data/control for automation.

Interconnecting cables may be routed along an access area through the turntable's center bearing. A sleeve is provided to prevent the cables from rubbing against the main bearing when the turntable is in motion.

The chamber's twelve (12) inch raised ground plane consists of a continuous metallic surface with vinyl top surface finishing.

2.3 Antenna Mast

An EMCO Model 2075 electrically powered, air-polarized, antenna tower mast is used in the chamber. This mast features computerized remote control of both the scanning height and the antenna polarization. It is also controlled by an EMCO Model 2090 Multi-device Controller with IEEE-488 data/control for automation.

2.4 Power Facilities

Power is supplied on separate circuits to the chamber and control area. All power filters provide a minimum of 100 dB attenuation over a frequency range of 14 kHz to 10 GHz when tested per MIL STD 220A.

2.5 Control Area

The control area is a shielded room attached to the chamber with a connector panel for RF, fiber optic and control cables mounted in the chamber's wall near the floor.

2.6 Anechoic Absorbers

The anechoic design consists of broadband hybrid EMC absorber, *FerroSorb ™*, designated as *FS-400* by ETS-Lindgren, covering the endwall behind the turntable and *FS-600* covering a specular region of the ceiling and each sidewall. The absorbing material is a combination of dielectric foam absorber and

magnetic ferrite tile materials. The remaining wall and ceiling areas are treated with ETS-Lindgdren's *FT-1500* ferrite tile absorber material.

2.7 Quiet Zone and Test Range Position

The quiet zone for the 3m test range is a cylinder two (2) meters in diameter per volumetric quiet zone testing requirement specified in ANSI C63.4-2001. All five test positions of the test volume (i.e. center front, back, left, and right) were measured and included in this report

The chamber's primary 3 meter test range axis is positioned from the turntable's center to a point 2.64m from the chamber's sidewall (door side), as shown in Figure 20.

3.0 NORMALIZED SITE ATTENUATION TEST METHOD PER ANSI C63.4-2001

3.1 Test Method

The swept frequency method with broadband antennas (per ANSI C63.4-2001), was employed to perform Normalized Site Attenuation testing of the Semi-Anechoic Chamber. Test equipment used is listed in Table 1, network analyzer settings are listed in Table 2.

The reference signal level is first measured by connecting the coaxial cables before the site attenuation measurement. The reference signal is stored in the vector-network analyzer and the coaxial cables are then connected to the transmit and receive antennas, respectively. A constant projection separation of 3 meters is kept between the transmit and receive antennas with the spacing being measured from the center of Biconical and Log-periodic antennas. The received signal is then maximized while the receiving antenna is scanned from 1 to 4 meters. The maximum received signal during height scan is used to compute the Normalized Site Attenuation.

$$NSA(dB) = V_{Direct} - V_{Received}^{Max} - AF_{Ts} - AF_{Rs}$$

Where:

V_{Direct} *reference signal level in dBμV/meter with cables connected directly*

$V_{Received}^{Max}$ *maximum received signal level in dBμV/meter during height scan*

AF_{Ts} *antenna factor of the transmitting antenna in dB / meter.*

AF_{Rs} *antenna factor of the receiving antenna in dB / meter.*

The factors for these antennas are listed in Figures 17-19. The measured NSA is then compared to the theoretical NSA derived from an ideal open area site to obtain NSA deviations.

3.2 Measured Data

The measured NSA data obtained by using the swept-frequency method is shown in Figures 1 to 8 for each polarization and each transmit antenna height.

Biconical antennas are used to conduct the test between 30-200 MHz, Log-periodic antennas from 200-1000 MHz. Data is presented in 1 MHz intervals in the attached graphs.

The test data for the 3 meter range with a 2.0 meter diameter test volume demonstrated a better than ±3.1dB normalized site attenuation deviation from the theoretical Normalized Site Attenuation (30-1000 MHz), derived from an ideal open test site

All normalized site attenuation test data at all test positions derived from the measurements in the semi-anechoic chamber are within ±4 dB deviation from theoretical NSA derived from an ideal open test site as specified in ANSI C63.4, 2001.

3.3 Extended Frequency Range NSA Testing

Additional Normalized Site Attenuation testing was performed from 1-3 GHz as per Datascope Corporation's request. This was accomplished using ANSI C63.4 2001 methodology as a standard has yet to be defined for performance of Normalized Site Attenuation measurements above 1 GHz. EMCO Model 3148 Log-periodic and General Instrument Model A6100 Quad-Ridge Horn antennas were used during these measurements. Results from the extended frequency testing are presented in the attached graphs in 50 MHz intervals.

The test data for the 3 meter range with a 2.0 meter diameter test volume demonstrated a better than ±3.2dB normalized site attenuation deviation from the theoretical Normalized Site Attenuation (1-3 GHz), derived from an ideal open test site

4.0 TEST EQUIPMENT LIST

Test equipment for conducting normalized site attenuation test is shown in Table 1. Network Analyzer settings used during NSA Testing are recorded in Table 2.

All instrumentation is calibrated on a yearly basis by A2LA accredited laboratories. The antennas are calibrated in accordance with ANSI C63.5-1988. All instrument and antenna calibrations are traceable to NIST.

Appendix A.1

Tables

Table 1.

Test equipment used for measuring Normalized Site Attenuation:

TYPE OF EQUIPMENT	MODEL NUMBER	MANUFACTURER	ANNUAL CALIBRATION DUE DATE
NSA Measurement Software	WinCal™ Ver .90	ETS-Lindgren	NA
Laptop Computer with Windows 2000	Latitude	Dell Computer	NA
Vector Network Analyzer	HP 8753B S/N: 2828A04448	Hewlett Packard	October 02, 2004
S-parameter test set	HP 85046A S/N: 2729A02889	Hewlett Packard	October 02, 2004
Biconical Antenna 30-200 MHz	EMCO 3110B S/N: 9701-2861	ETS-Lindgren	June 4, 2004
Biconical Antenna 30-200 MHz	EMCO 3110B S/N: 9701-2862	ETS-Lindgren	June 4, 2004
Log Periodic Antenna 200-2000 MHz	EMCO 3148 S/N: CL073	ETS-Lindgren	April 28, 2005
Log Periodic Antenna 200-2000 MHz	EMCO 3148 S/N: CL486	ETS-Lindgren	April 28, 2005
Quad-Ridge Horn Antenna 2-3 GHz	A6100 S/N: C76700	General Instrument	September 11, 2004
Quad-Ridge Horn Antenna 2-3 GHz	A6100 S/N: C76800	General Instrument	September 11, 2004
Antenna Positioner Controller	EMCO 2190	ETS-Lindgren	NA
Antenna Positioner **(provided by Datascope)**	EMCO 2075	ETS-Lindgren	NA
Ferrite Beaded Cable used with Tx and Rx antennas	EMCO 106561	ETS-Lindgren	NA
Temperature/Humidity Monitor	CP650 S/N: 0301492	Oakton	February 2, 2005

Table 2.

Network Analyzer settings used during Normalized Site Attenuation Testing

NETWORK ANALYZER TYPE	TEST FREQUENCY BAND	IF BANDWIDTH SETTING	# OF DATA POINTS MEASURED
HP 8753B	30-300 MHz	300 Hz B/W	801 pts.
HP 8753B	300-1000 MHz	300 Hz B/W	801 pts.
HP 8753B	1-3 GHz	300 Hz B/W	1601 pts.

Table 3.

Environmental conditions during Normalized Site Attenuation Testing.

DATE	TIME	TEMP (deg. F)	HUMIDITY
Apr 28 2004	7:59	72.8	47.0
Apr 28 2004	8:59	74.0	46.0
Apr 28 2004	10:00	74.0	43.5
Apr 28 2004	11:00	74.6	41.5
Apr 28 2004	12:00	74.6	39.5
Apr 28 2004	13:00	75.2	39.0
Apr 28 2004	14:00	77.6	43.0
Apr 28 2004	15:00	78.8	40.5
Apr 28 2004	16:01	78.2	40.5
Apr 28 2004	17:01	77.6	41.5
Apr 29 2004	8:03	70.4	36.5
Apr 29 2004	9:03	71.0	38.5
Apr 29 2004	10:04	71.0	30.5
Apr 29 2004	11:04	71.6	34.0
Apr 29 2004	12:04	71.6	28.5

Appendix A.2

Photographs

Photo 1. 3m Normalized Site Attenuation Range

Photo 2. 3m Normalized Site Attenuation Range (alternate view)

Photo 3. Anechoic absorber material storage at chamber side-wall opposite entry door.

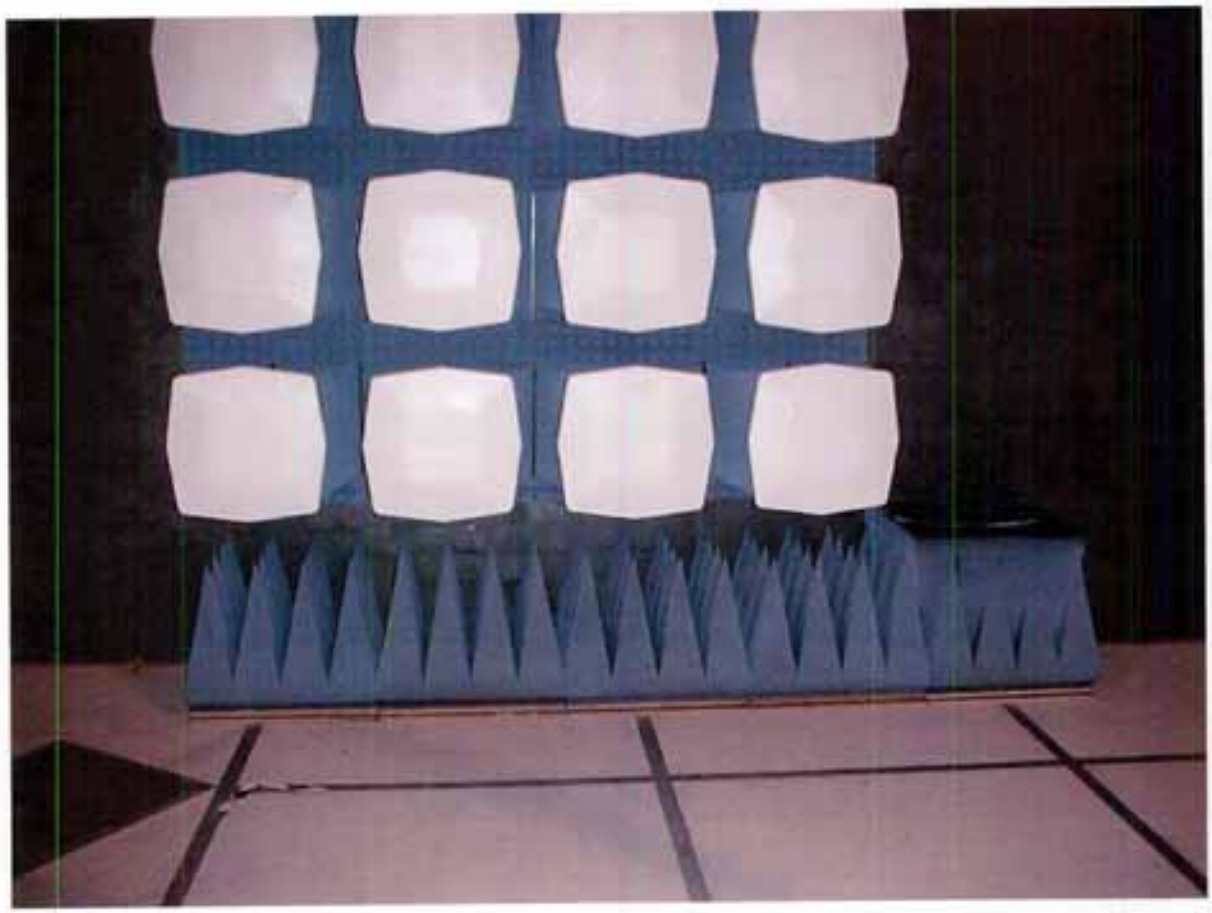


Photo 4. Anechoic absorber material storage at chamber side-wall nearest entry door.

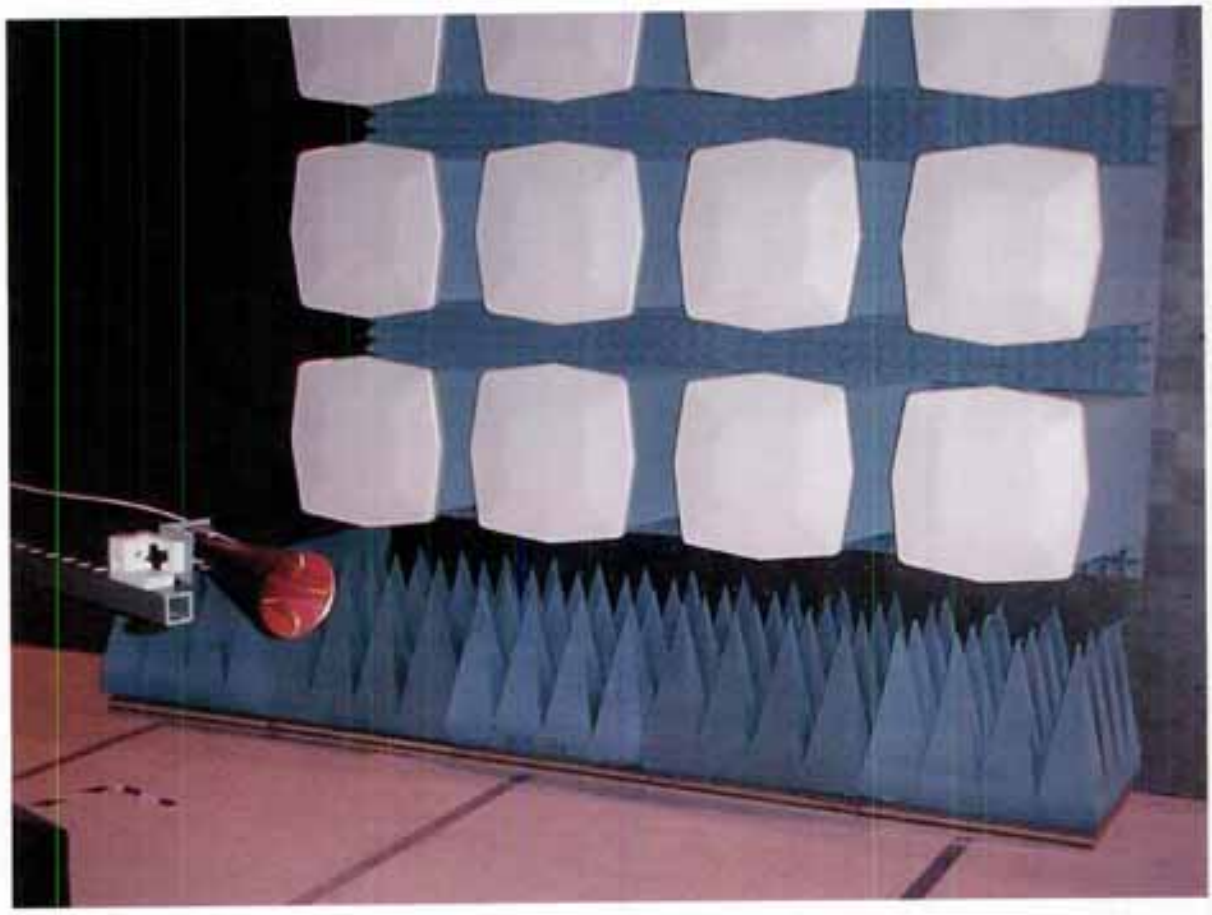


Photo 5. Anechoic absorber material storage at chamber end-wall.

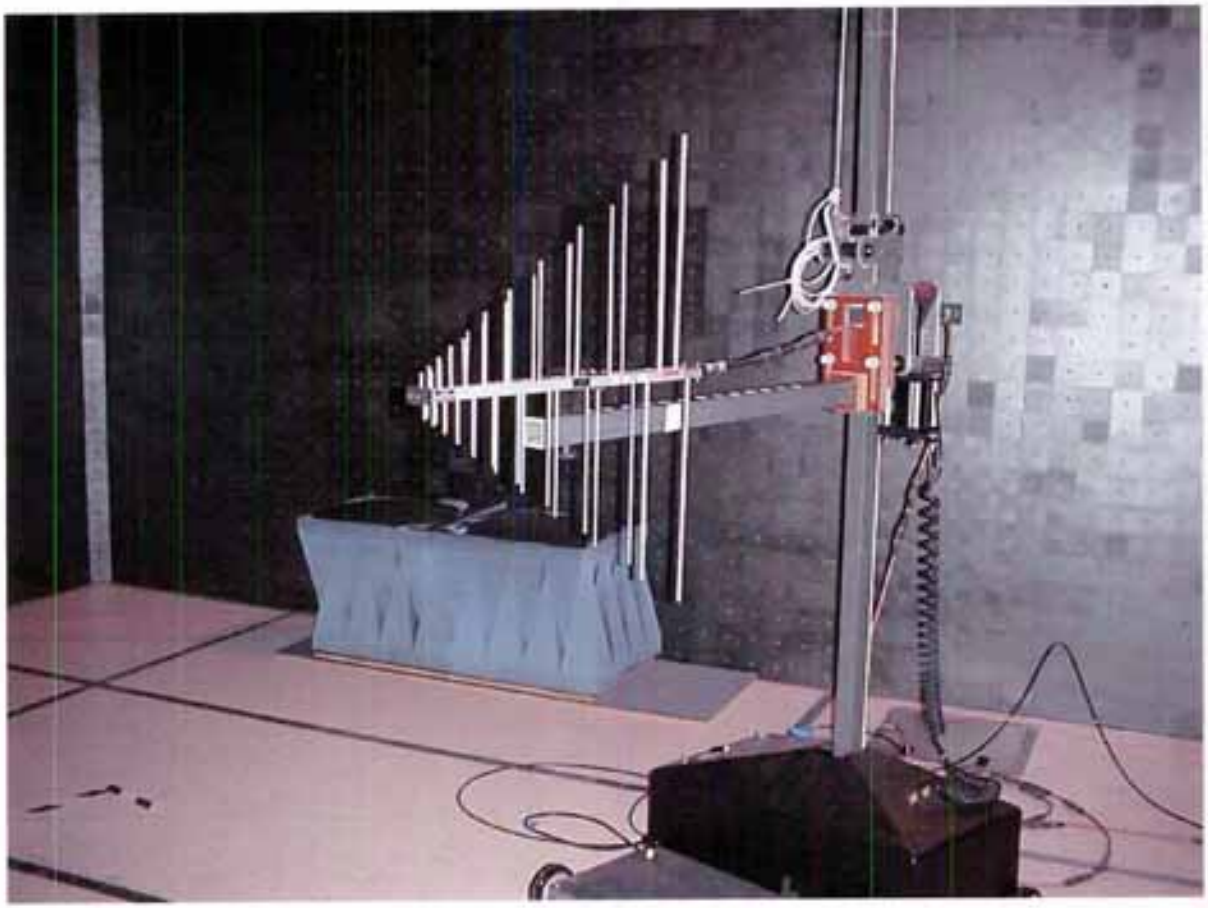


Photo 6. Camera position during Normalized Site Attenuation Testing

Appendix A.3

Normalized Site Attenuation Data, Combined Antenna Factors, NSA Test Range Diagram

Fig. 1. 3m Range, Measured NSA Horiz. Pol.. D=3m, Tx=1m, QzD= 2.0m.

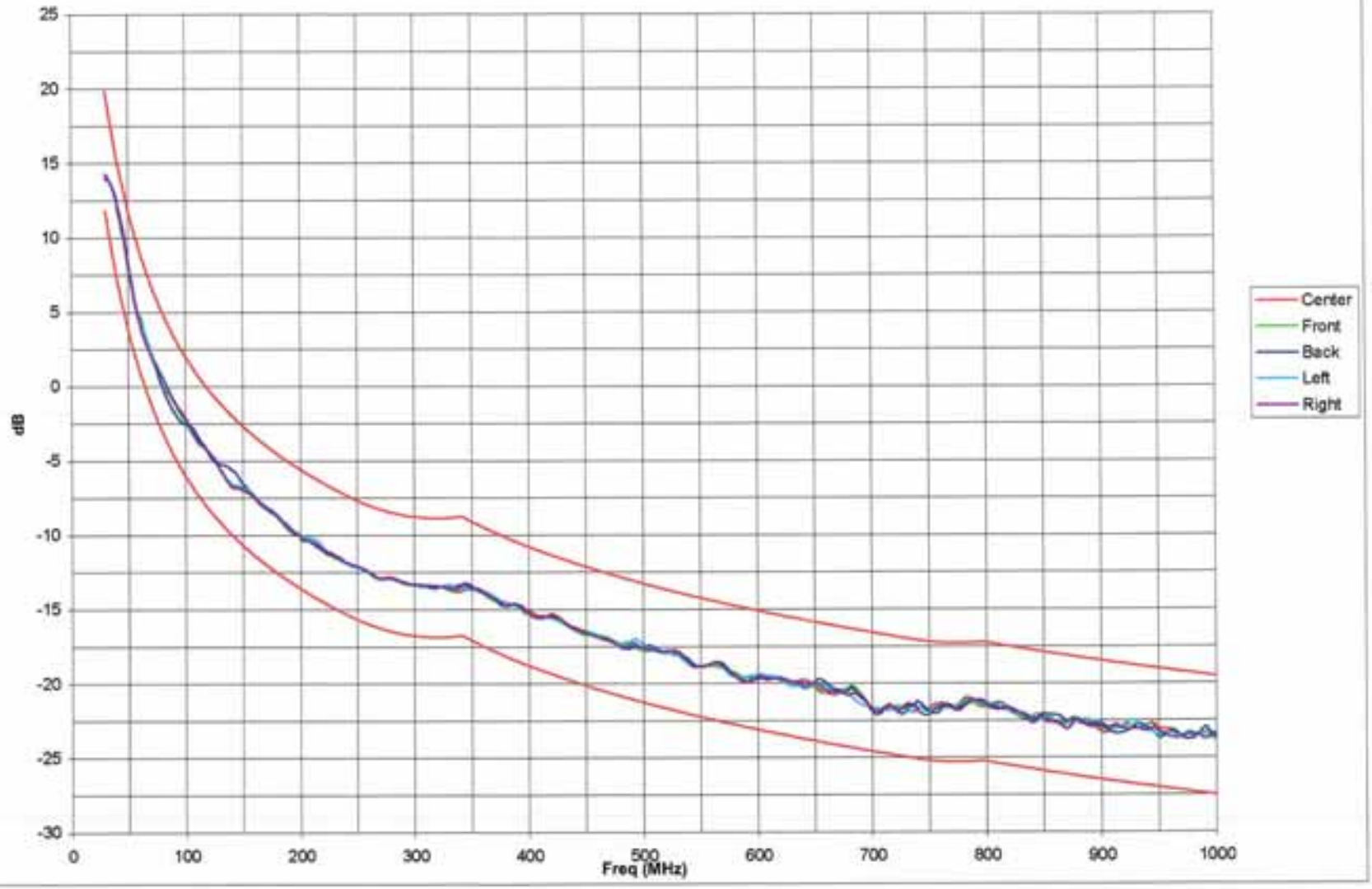


Fig. 2. 3m Range, Measured Delta NSA Horiz. Pol.. D=3m, Tx=1m, QzD= 2.0m.

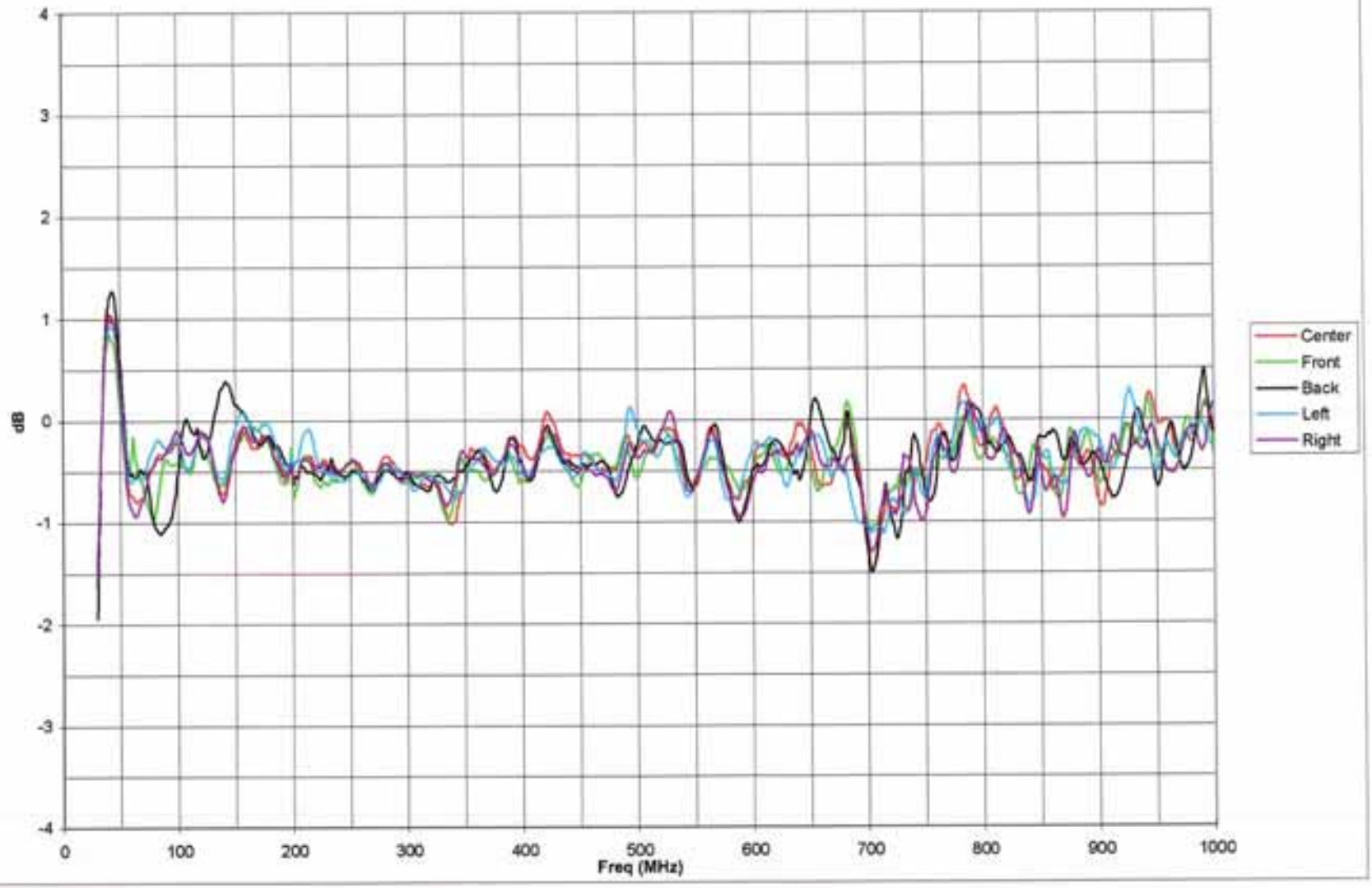


Fig. 3. 3m Range, Measured NSA Vert. Pol.. D=3m, Tx=1m, QzD= 2.0m.

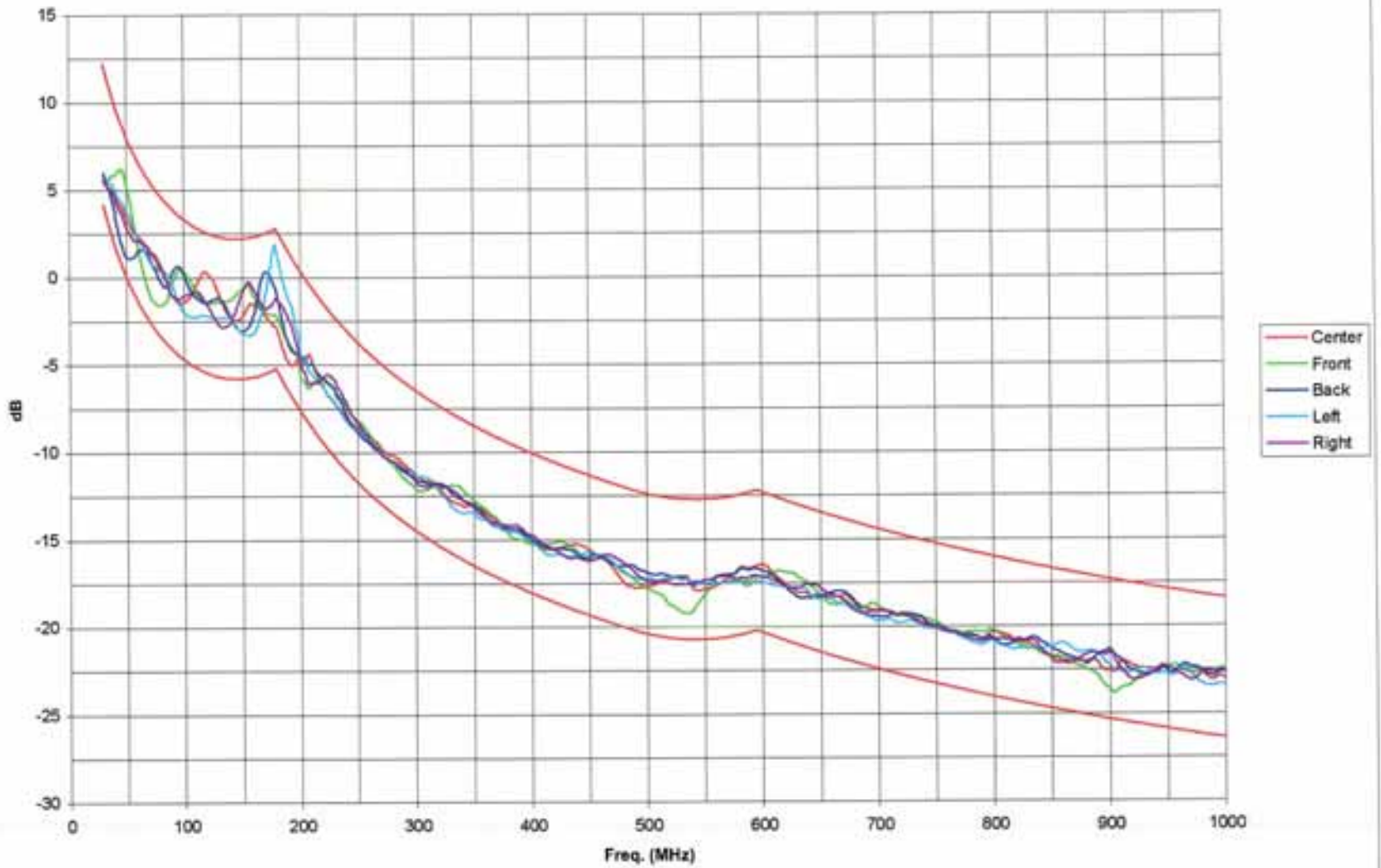


Fig. 4. 3m Range, Measured Delta NSA Vert. Pol.. D=3m, Tx=1m, QzD= 2.0m

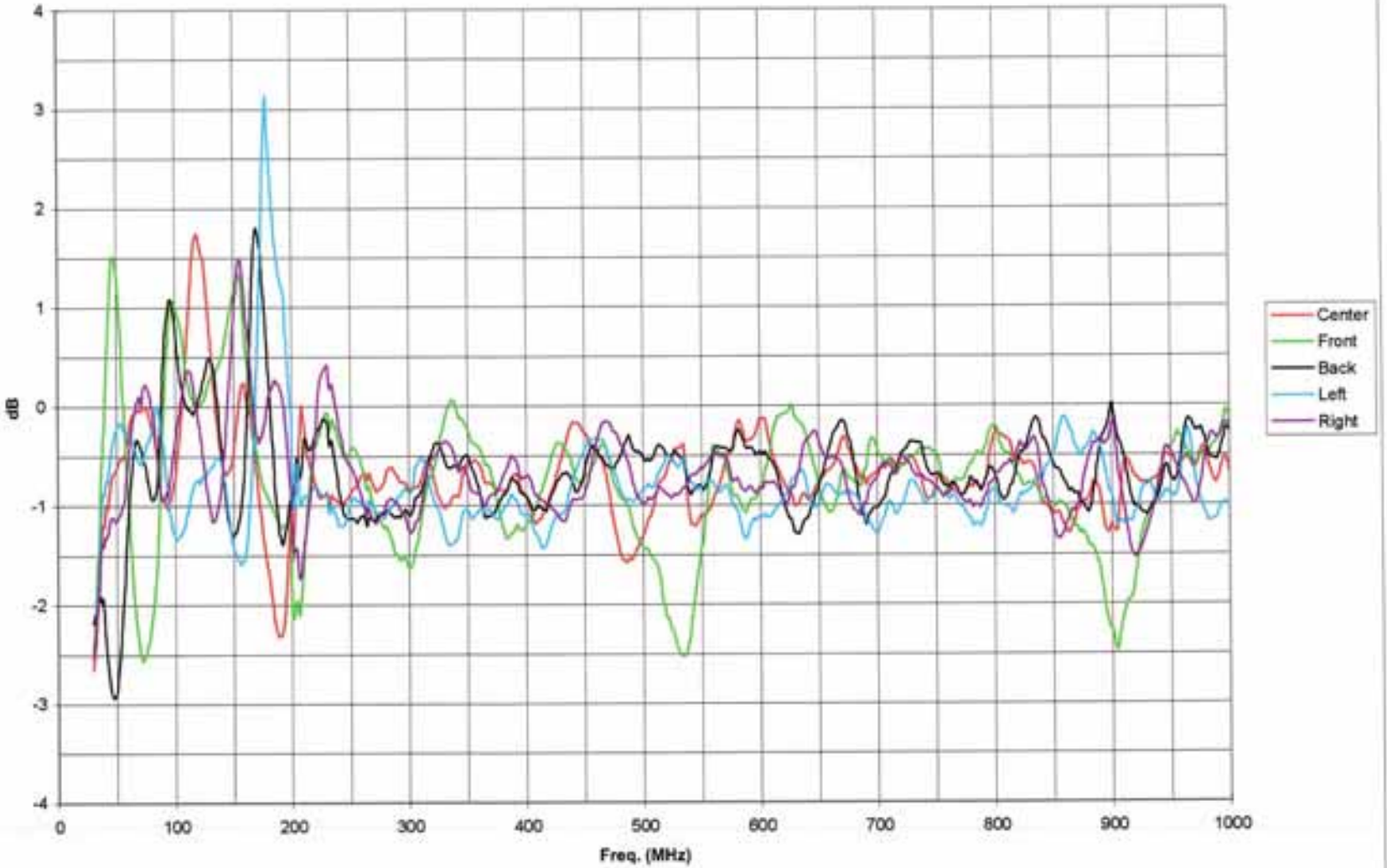


Fig. 5. 3m Range, Measured NSA Vert. Pol.. D=3m, Tx=1.5m, QzD= 2.0m

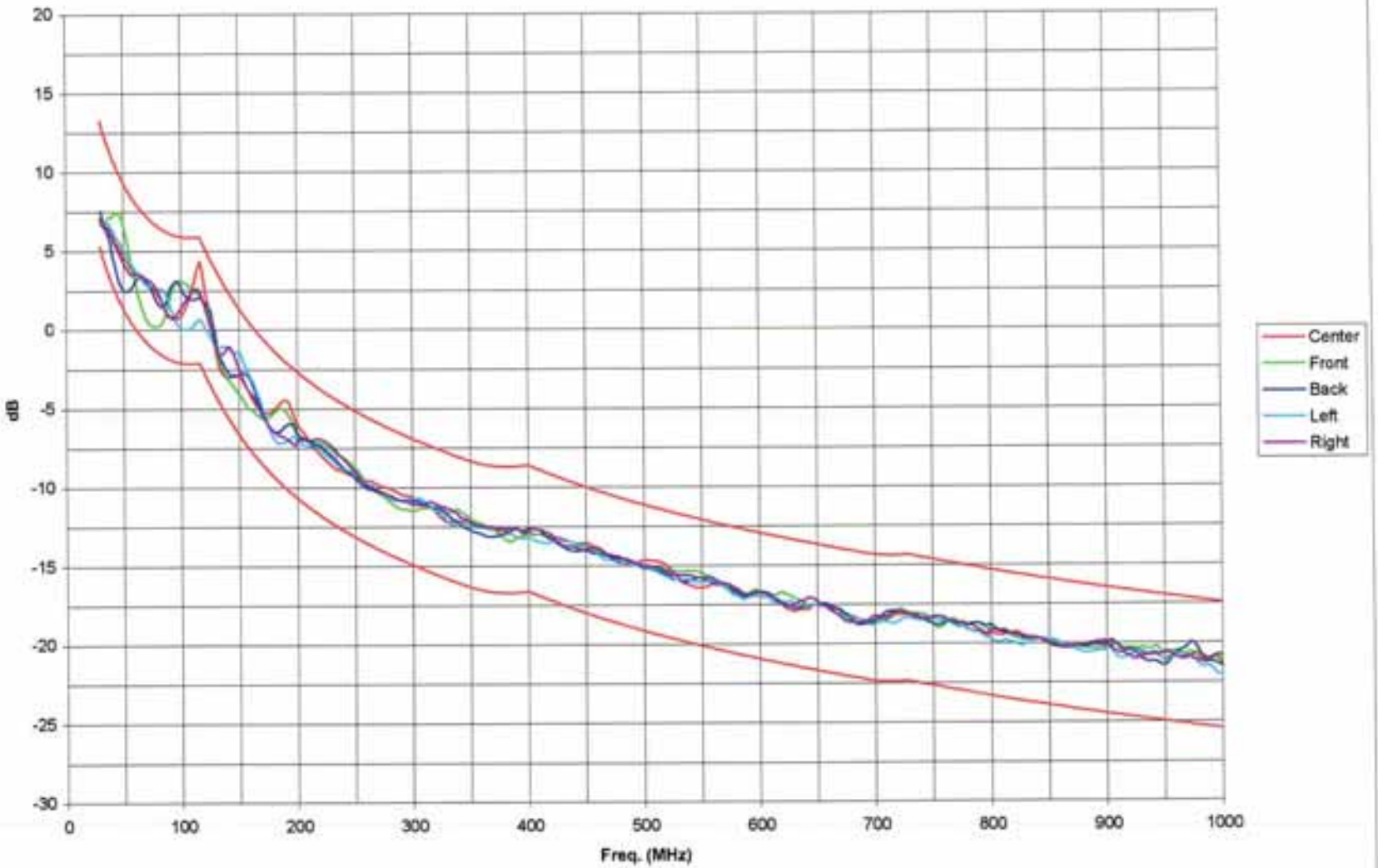


Fig. 6. 3m Range, Measured Delta NSA Vert. Pol.. D=3m, Tx=1.5m, QzD= 2.0m.

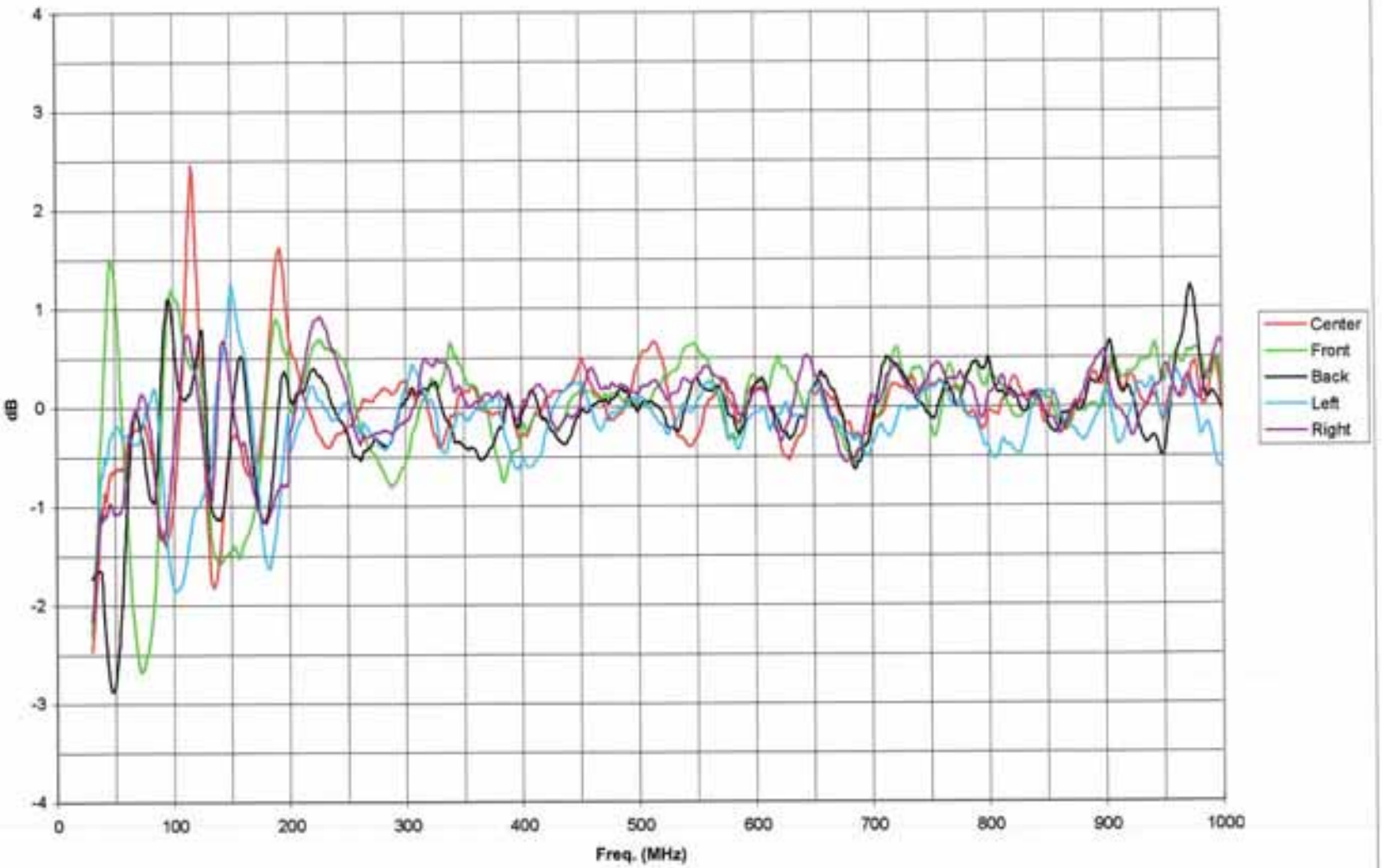


Fig. 7. 3m Range, Measured NSA Horiz. Pol.. D=3m, Tx=2m, QzD= 2.0m.

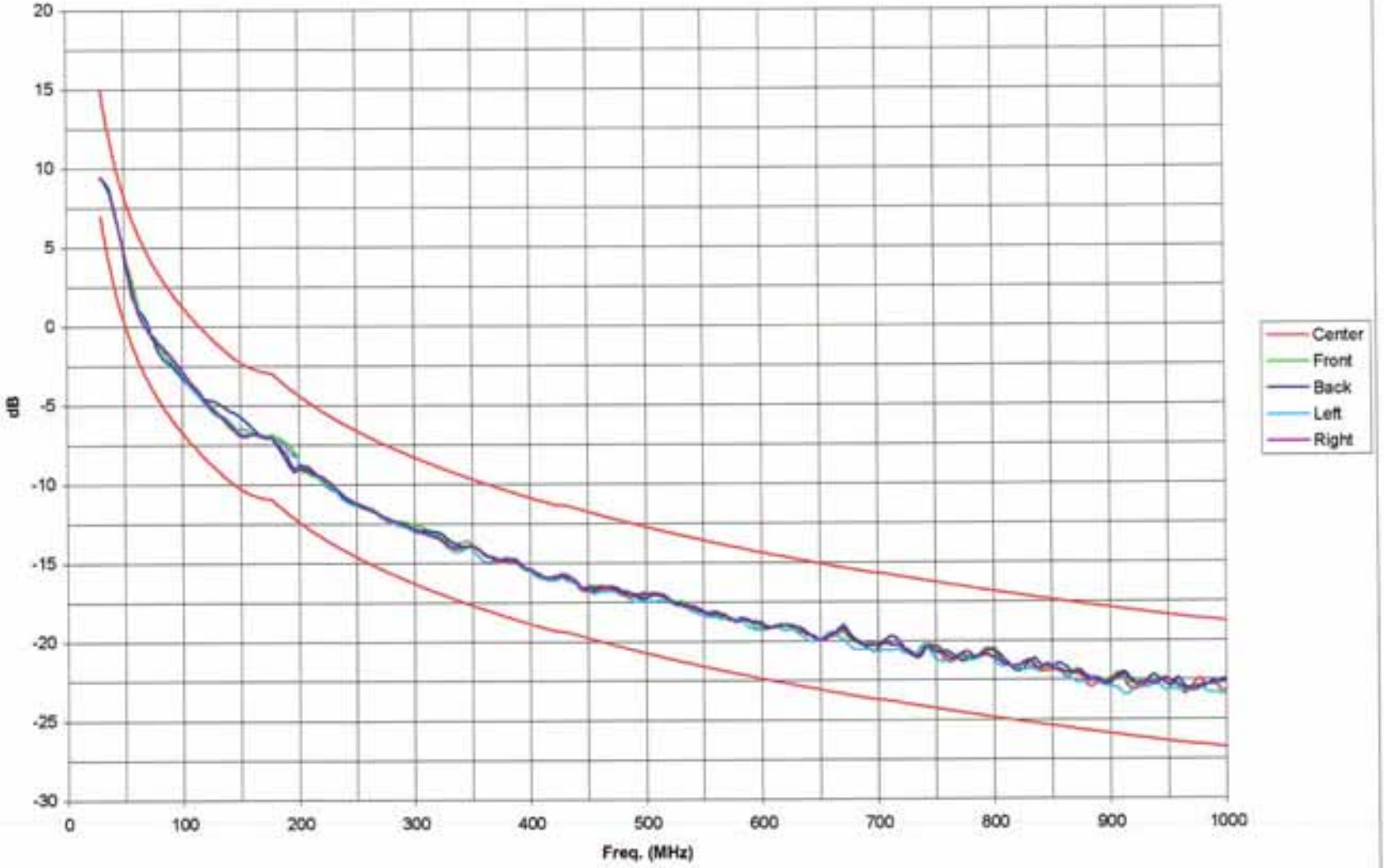


Fig. 8. 3m Range, Measured Delta NSA Horiz. Pol.. D=3m, Tx=2m, QzD= 2.0m.

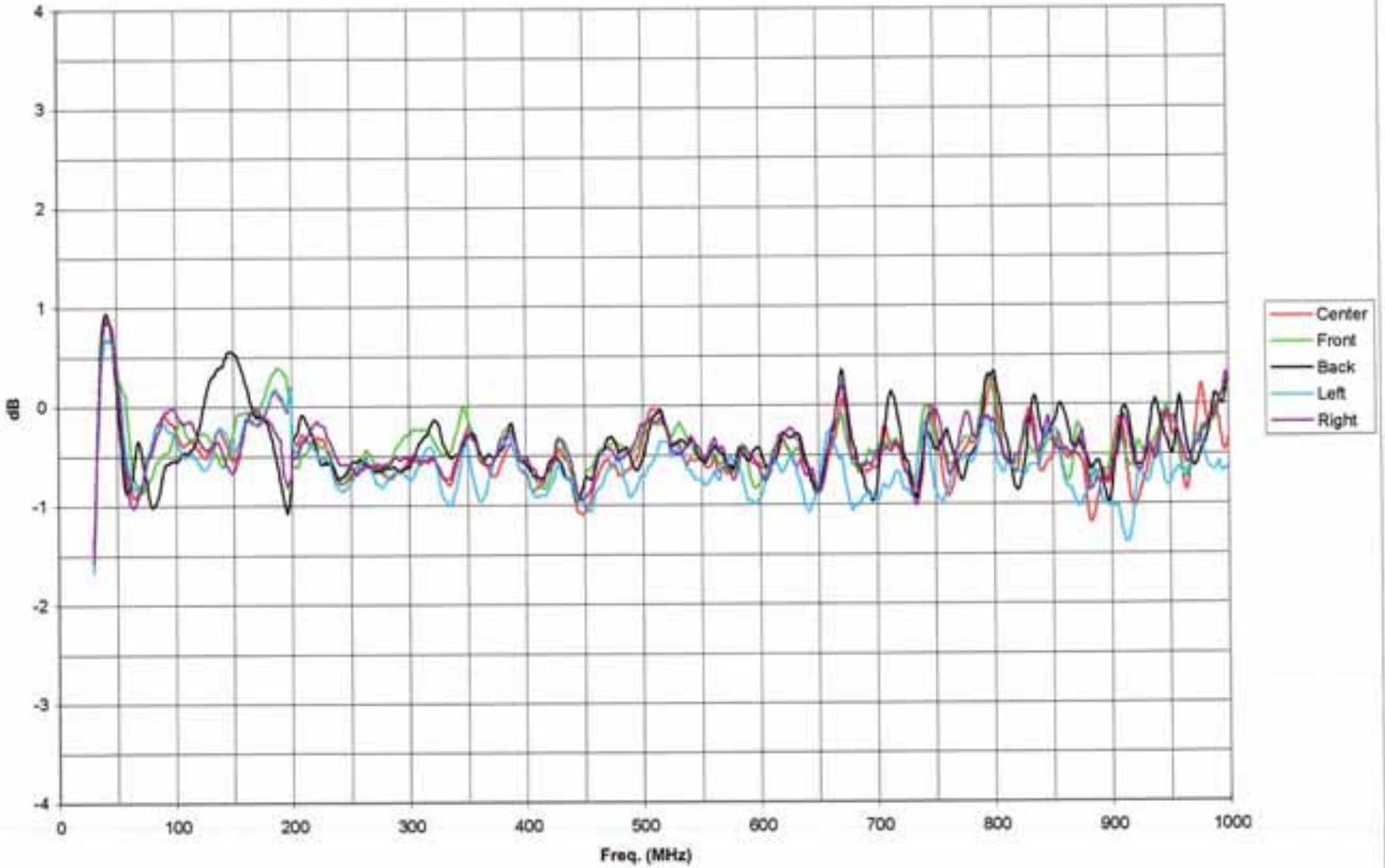


Fig. 9. 3m Range, Measured NSA Horiz. Pol.. D=3m, Tx=1m, QzD= 2.0m. (1-3 GHz)

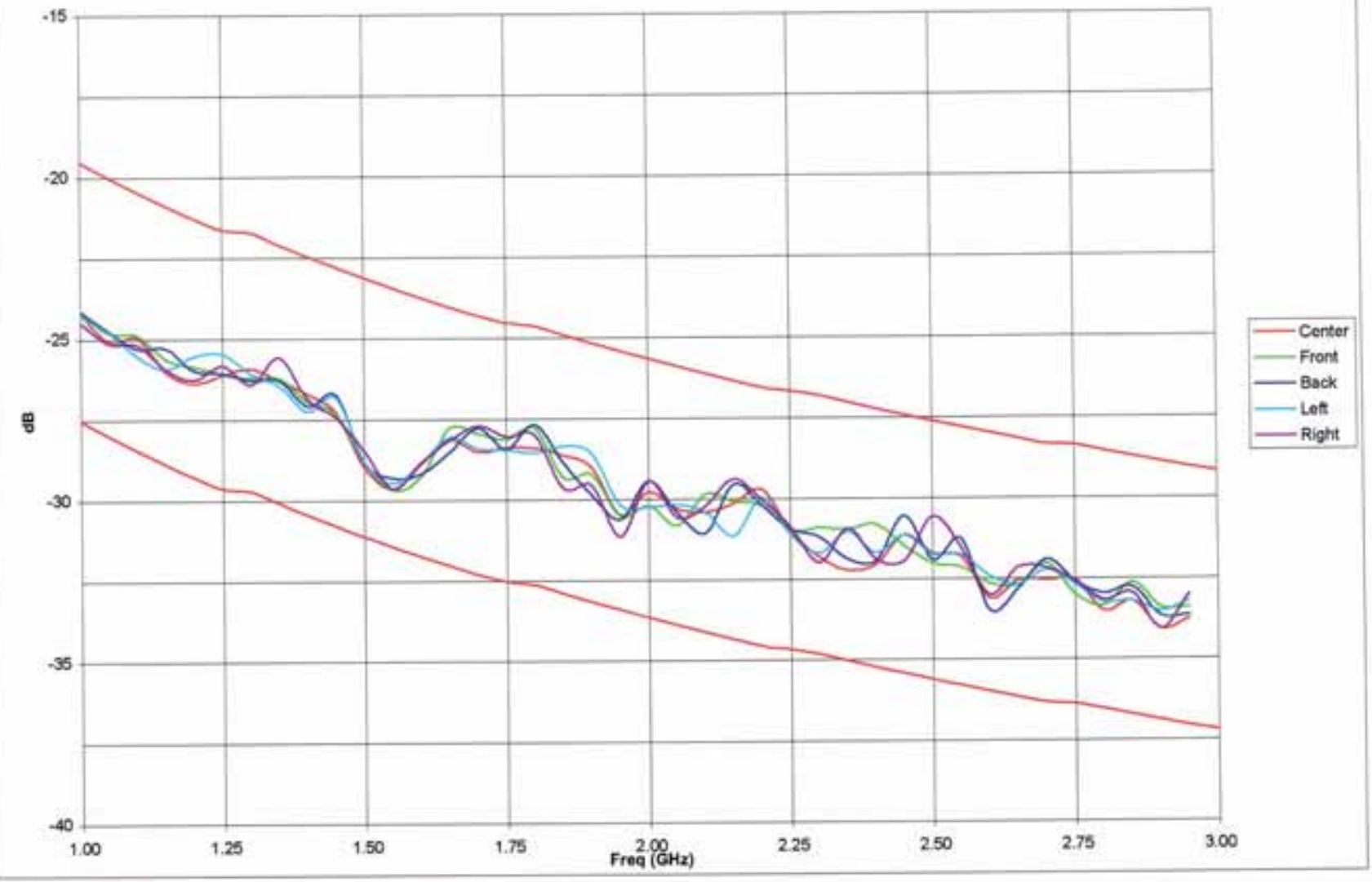


Fig. 10. 3m Range, Measured Delta NSA Horiz. Pol. D=3m, Tx=1m, QzD= 2.0m. (1-3 GHz)

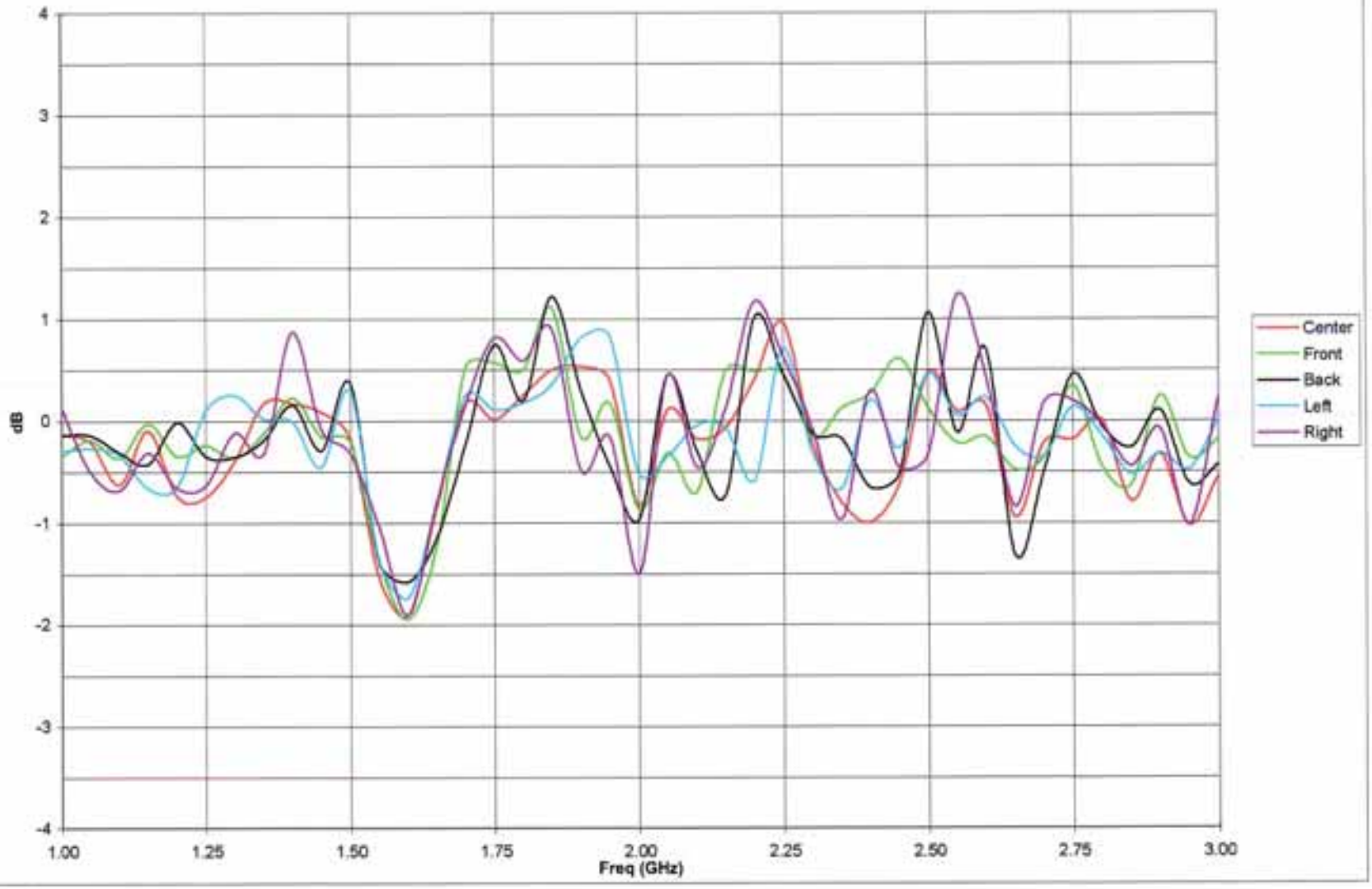


Fig. 11. 3m Range, Measured NSA Vert. Pol.. D=3m, Tx=1m, QzD= 2.0m. (1-3 GHz)

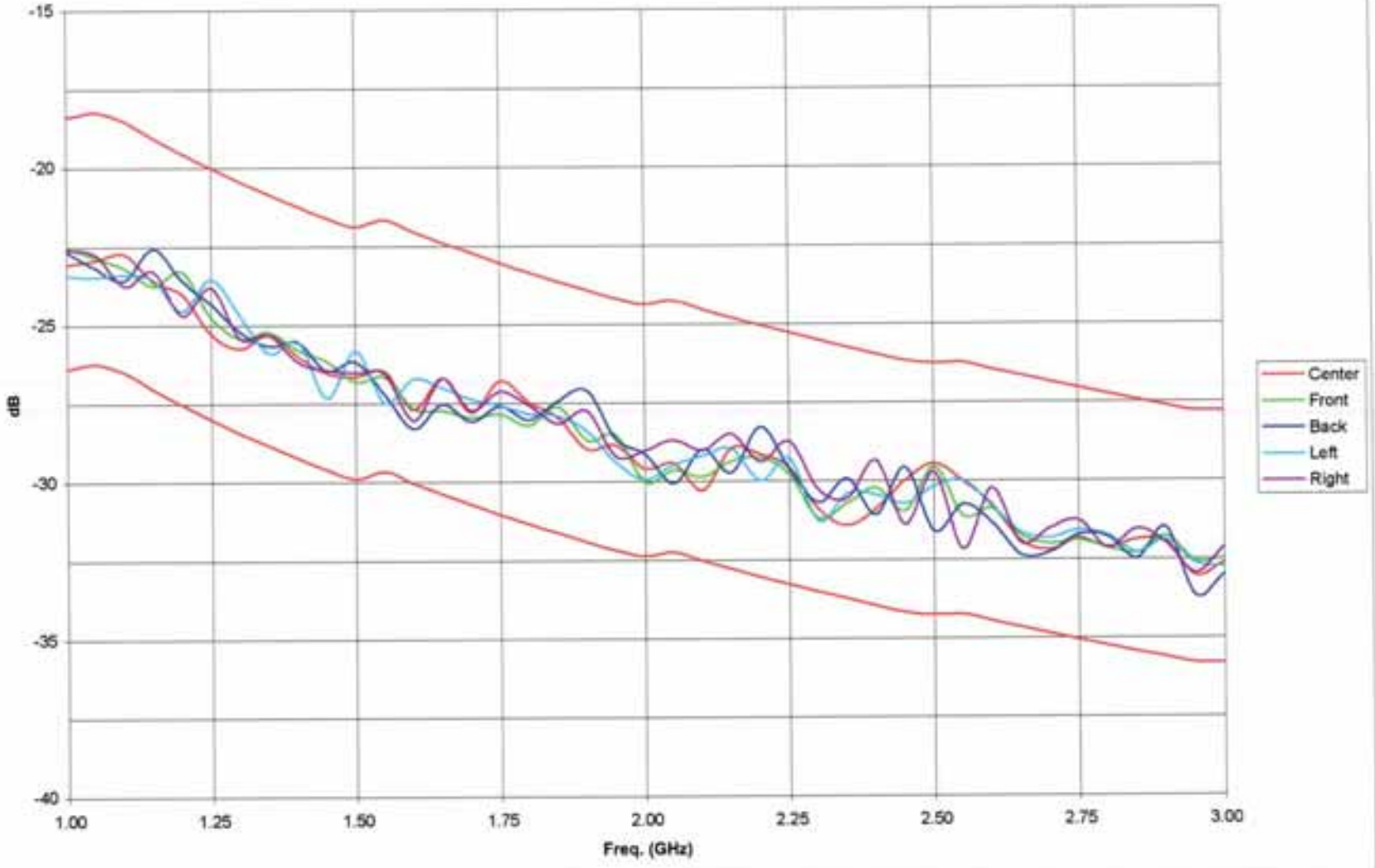


Fig. 12. 3m Range, Measured Delta NSA Vert. Pol.. D=3m, Tx=1m, QzD= 2.0m. (1-3 GHz

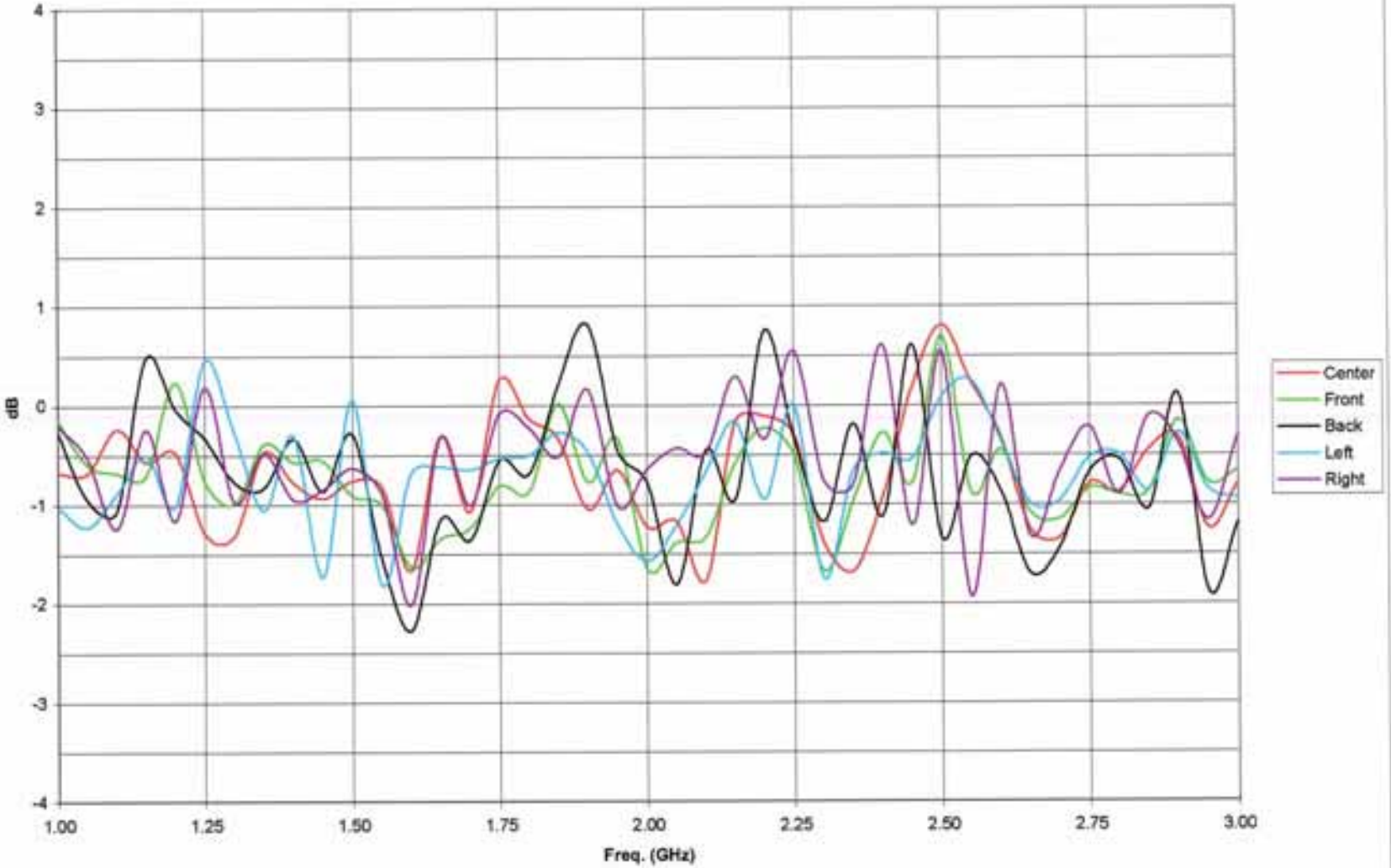


Fig. 13. 3m Range, Measured NSA Vert. Pol.. D=3m, Tx=1.5m, QzD= 2.0m. (1-3 GHz)

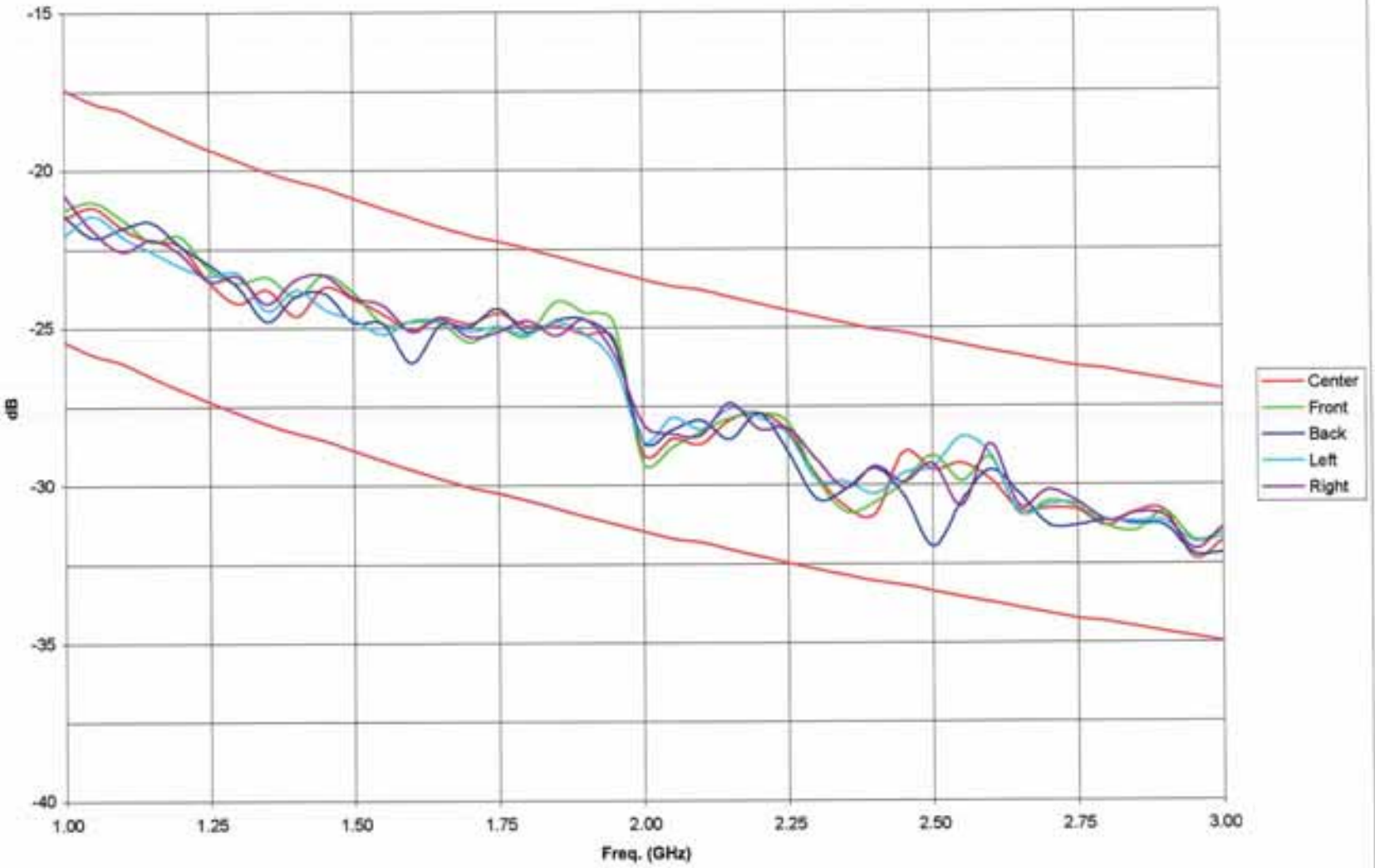


Fig. 14. 3m Range, Measured Delta NSA Vert. Pol.. D=3m, Tx=1.5m, QzD= 2.0m. (1-3 GHz)

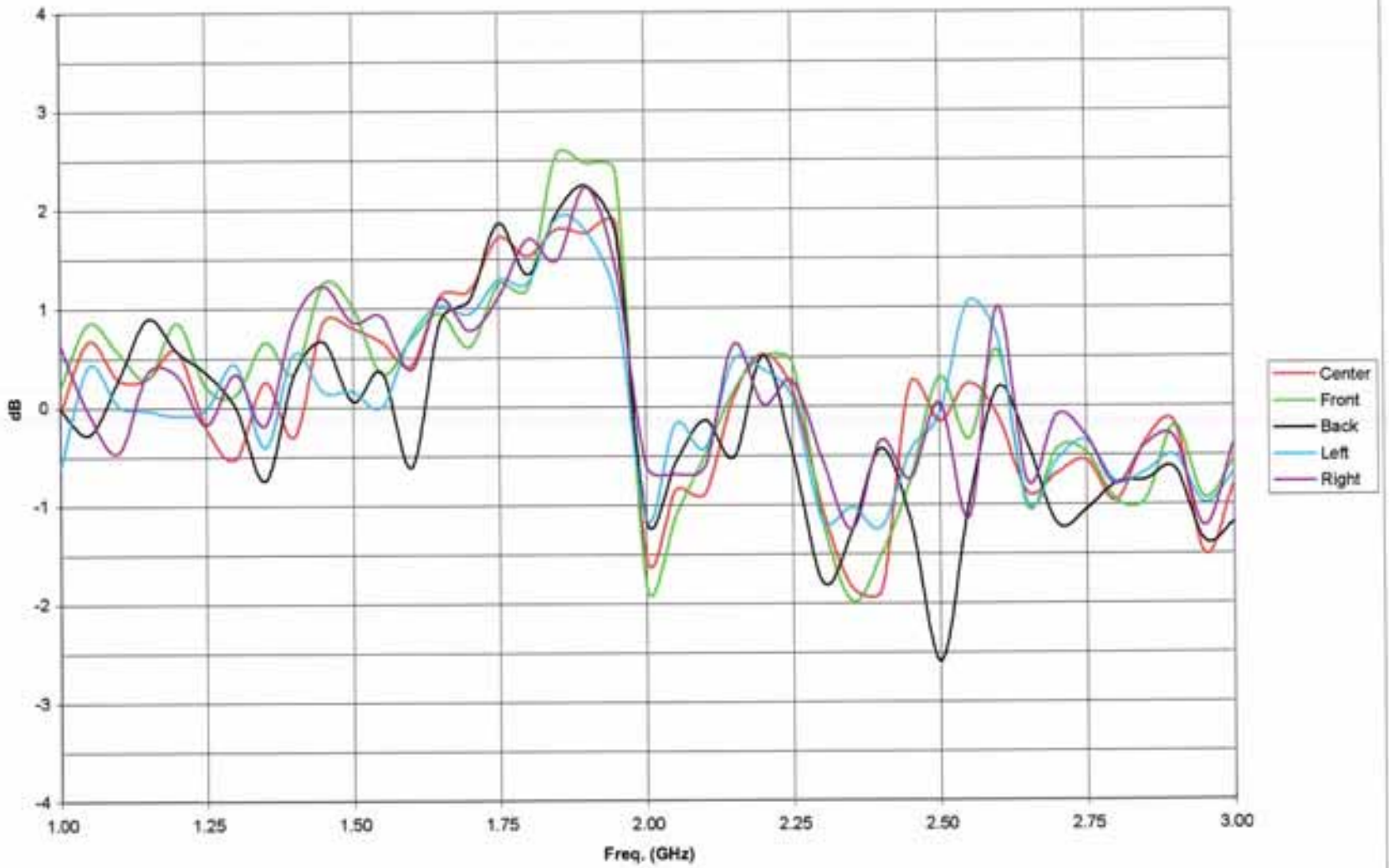


Fig. 15. 3m Range, Measured NSA Horiz. Pol.. D=3m, Tx=2m, QzD= 2.0m. (1-3 GHz)

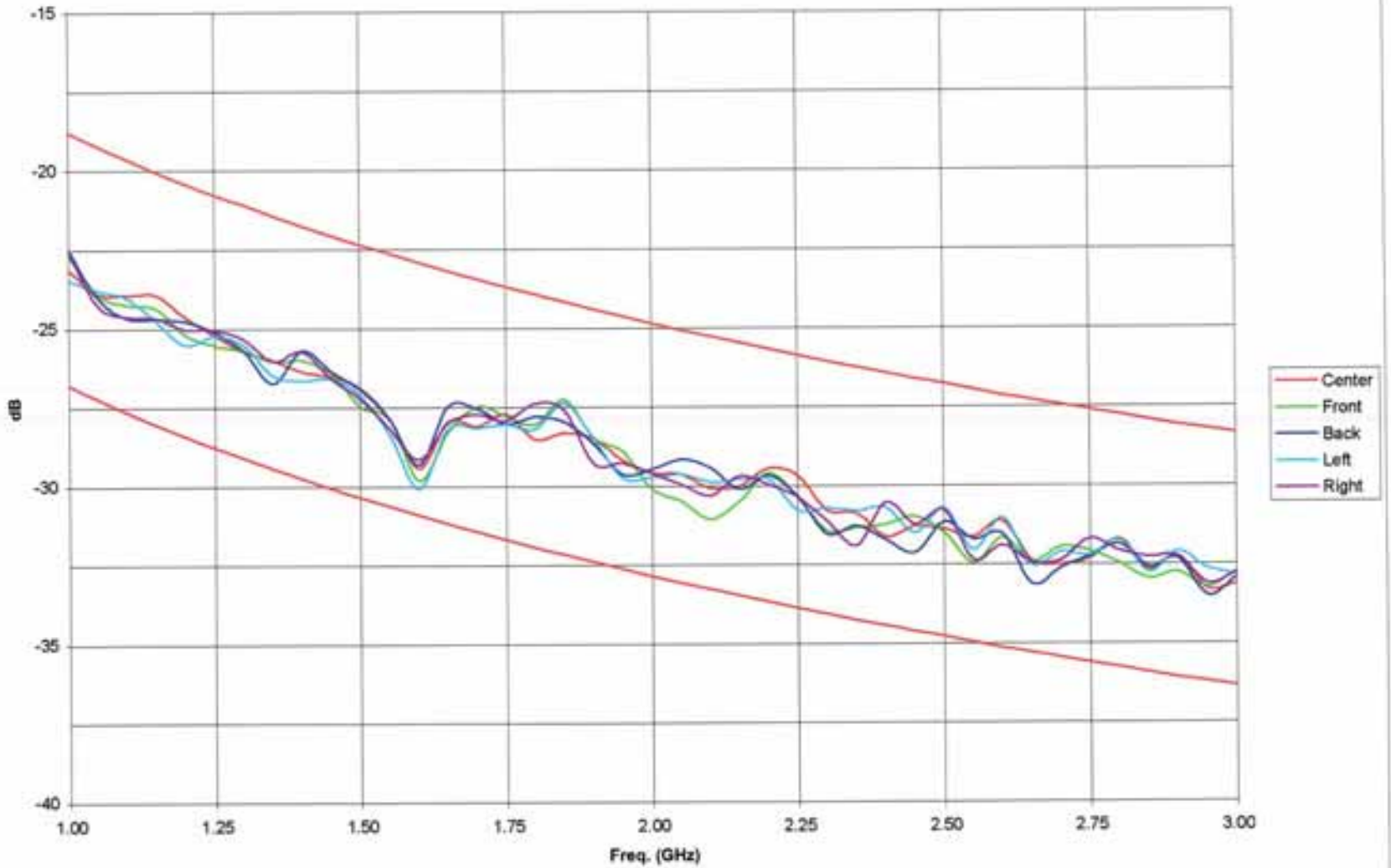


Fig. 16. 3m Range, Measured Delta NSA Horiz. Pol.. D=3m, Tx=2m, QzD= 2.0m. (1-3 GHz)

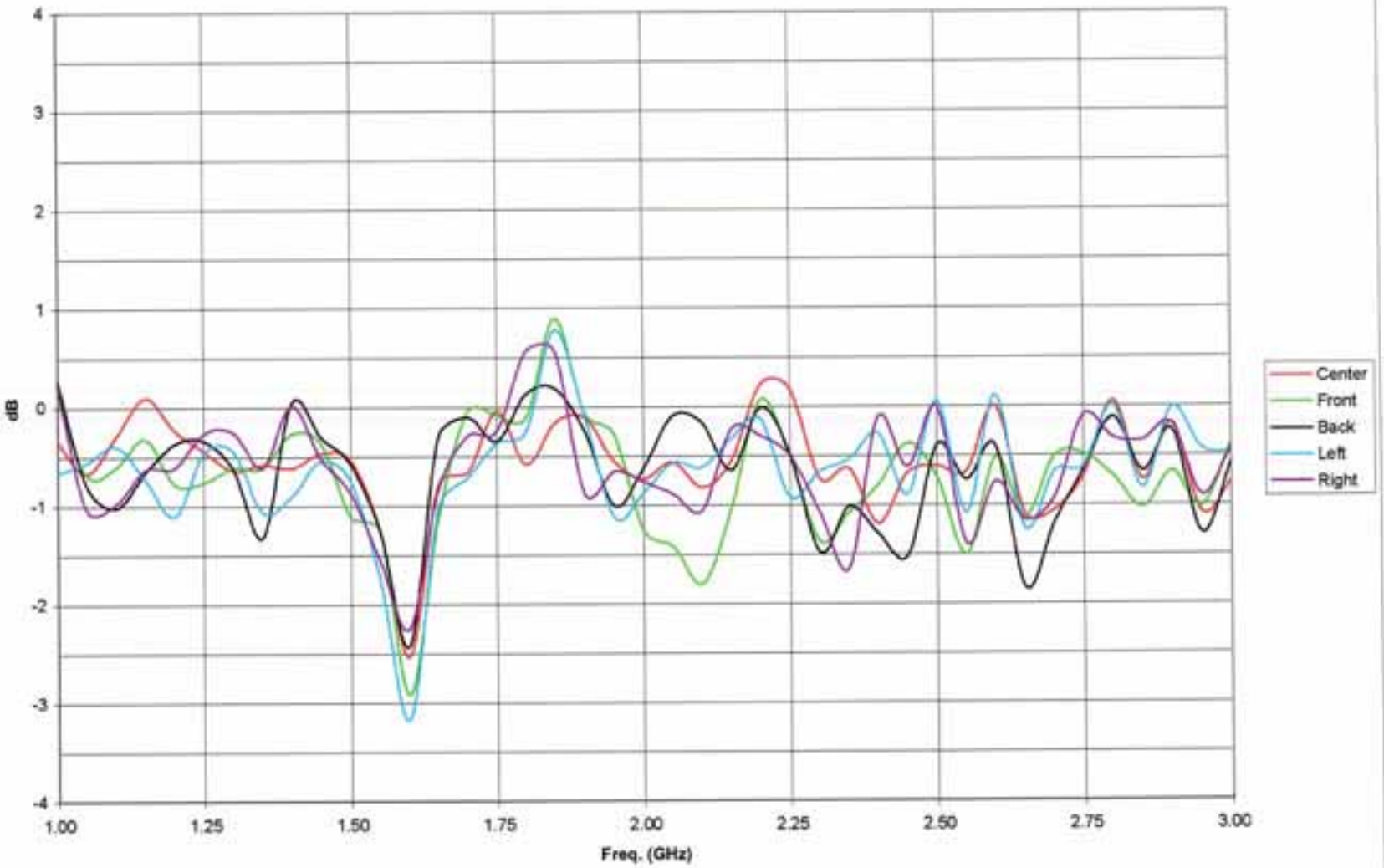


Fig. 17. Combined 3m antenna factors for the two EMCO Model 3110B Biconical antennas calibrated at the ETS-Lindgren 50 x 80m Open Area Test Site, Cedar Park, TX.

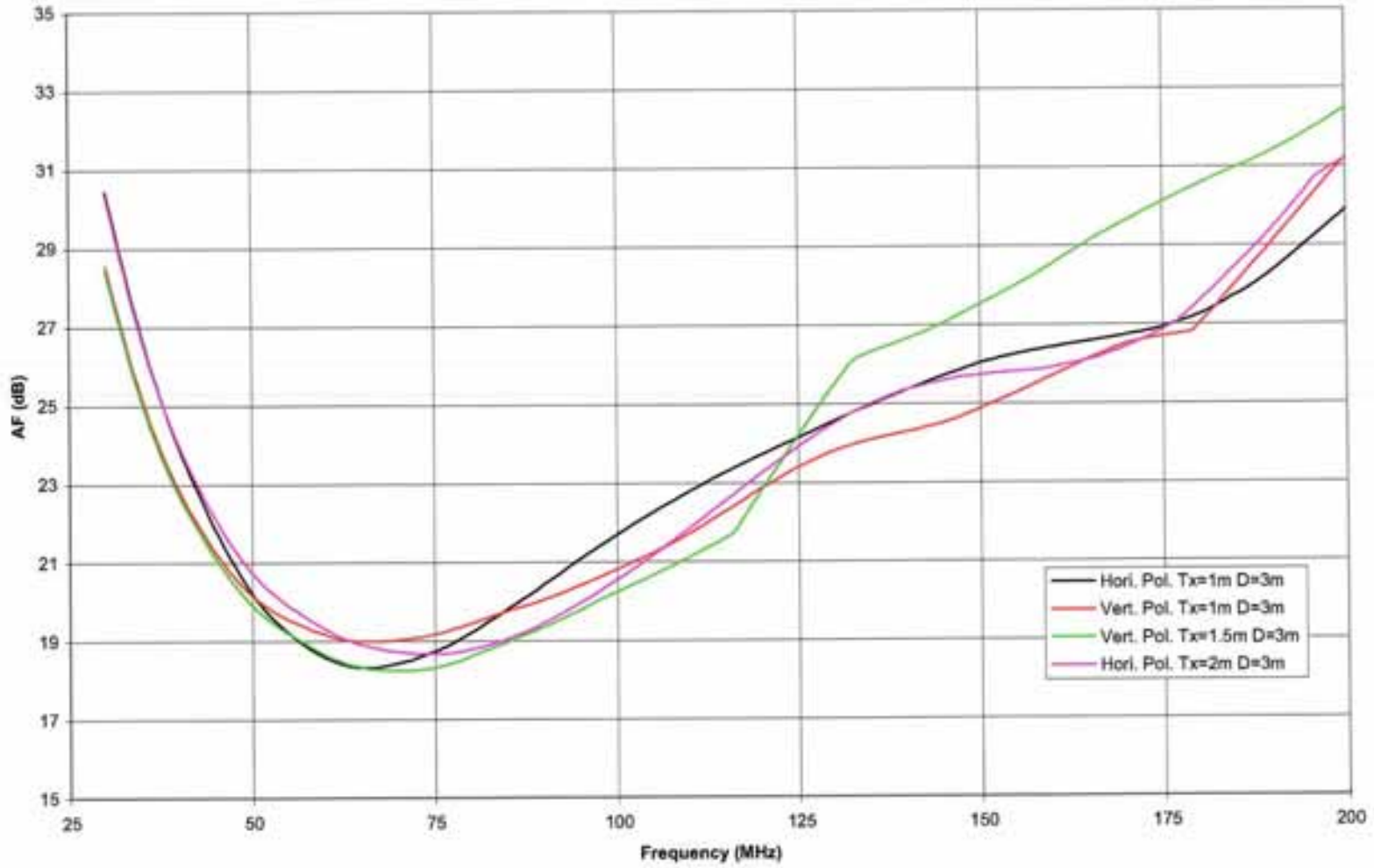


Fig. 18. Combined 3m antenna factors for the two EMCO Model 3148 Log-periodic antennas calibrated at the ETS-Lindgren 50 x 80m Open Area Test Site, Cedar Park, TX.

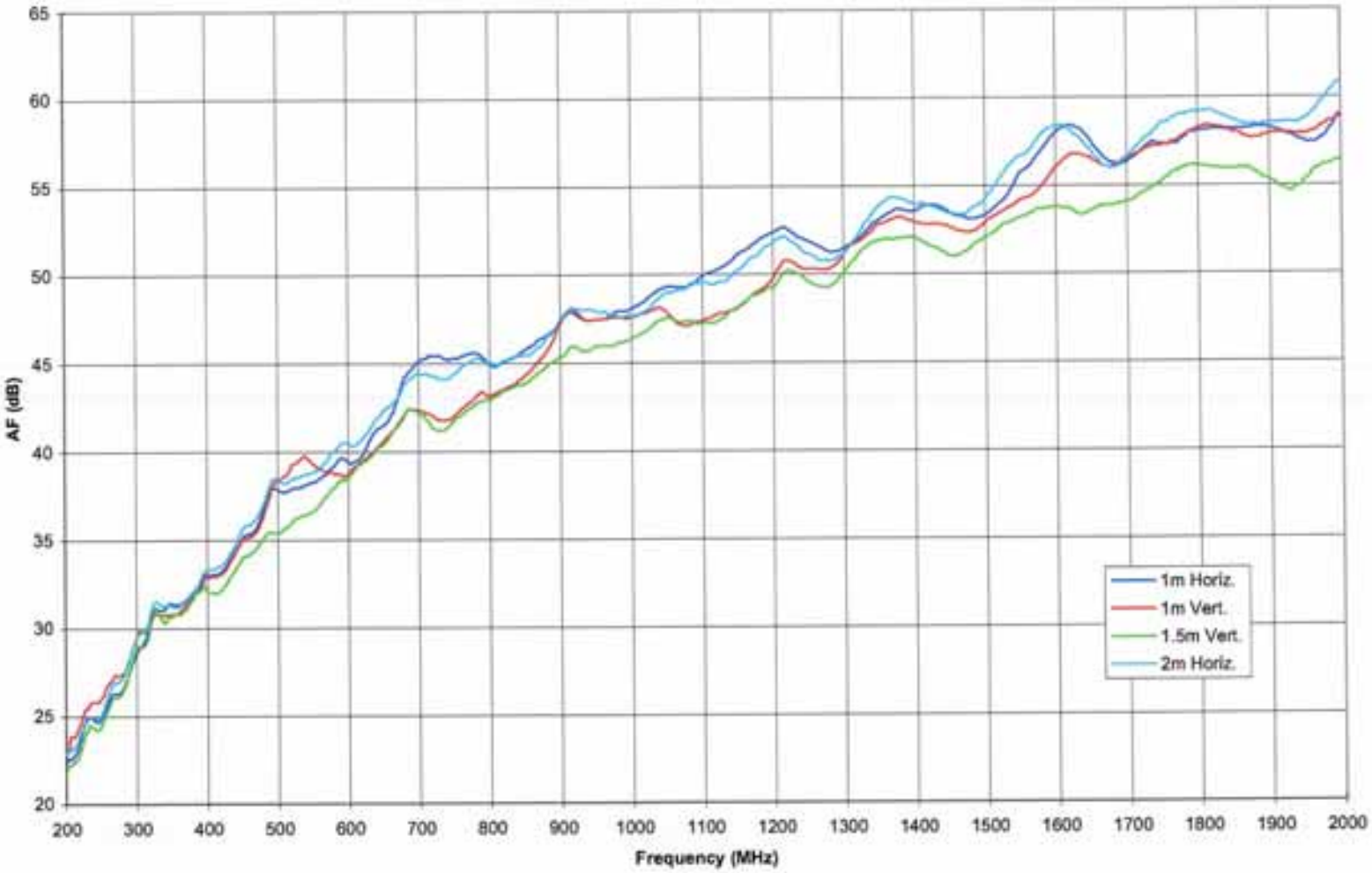


Fig. 19. Combined 3m antenna factors for the two General Instruments Model A6100 Quad-Ridge Horn antennas calibrated at the ETS-Lindgren 50 x 80m Open Area Test Site, Cedar Park, TX.

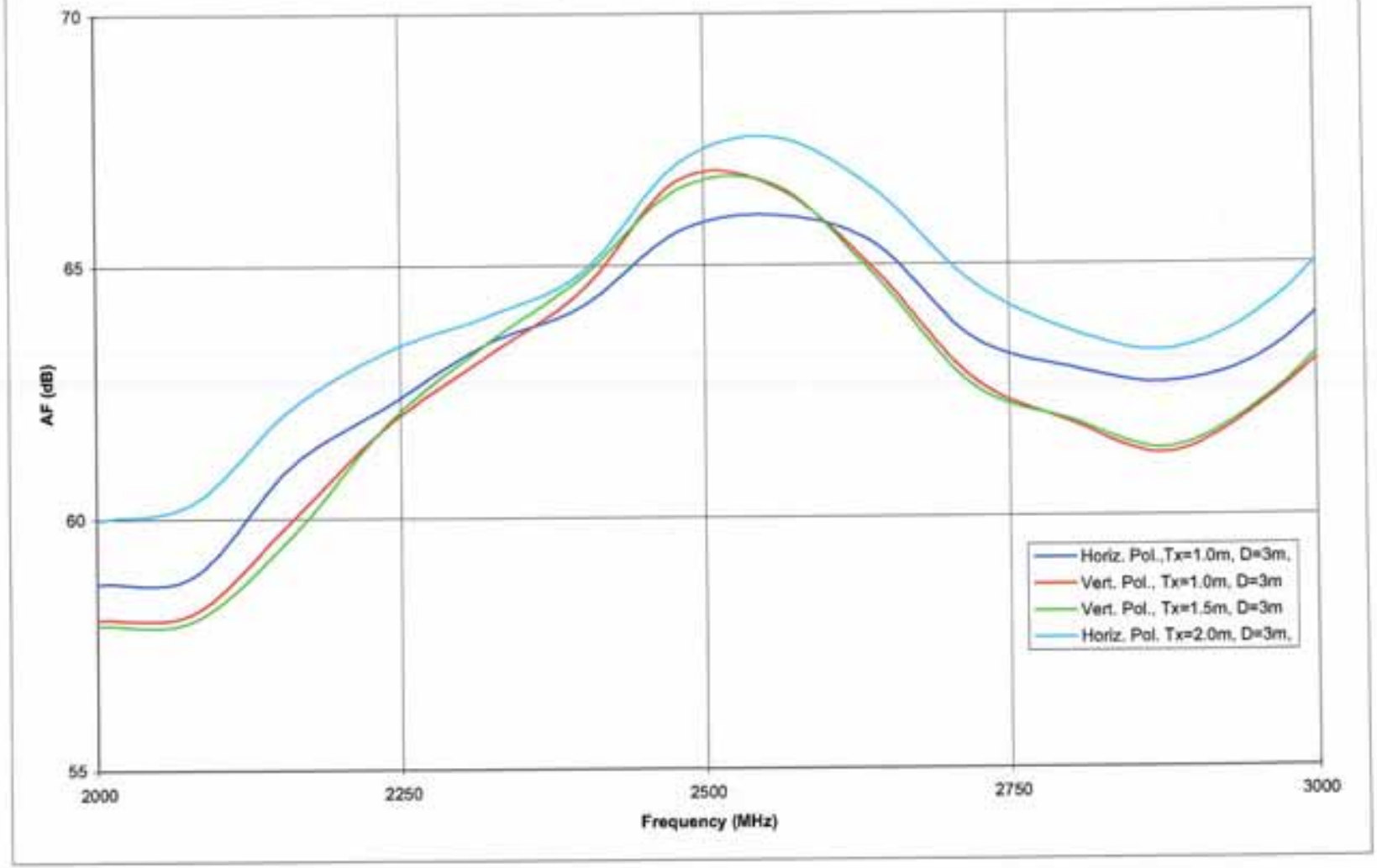
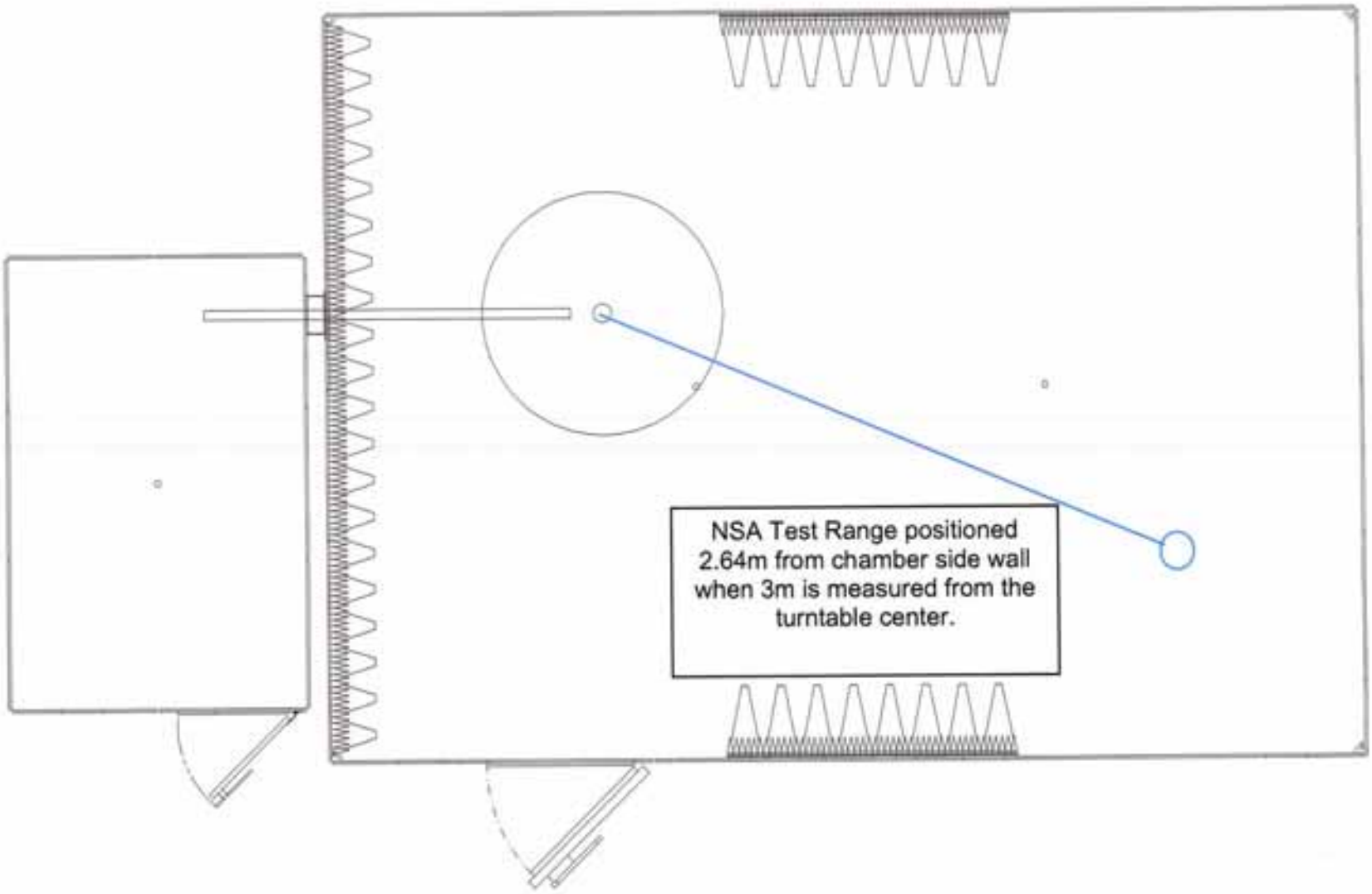


Figure 20. Normalized Site Attenuation Test Range Diagram.



ETS·LINDGREN™
An ESCO Technologies Company

1301 Arrow Point Drive
Cedar Park, TX 78613
(512) 531-6400

CERTIFICATE OF NORMALIZED SITE ATTENUATION CALIBRATION

Certificate #: S001431-1A-C

The facility identified below has been tested in compliance with the following standards:

ANSI C63.4 - 2001 Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

Environment: The Semi-anechoic facility under test has been tested with environmental conditions ranging from 50 to 90 deg F and relative humidity less than 90%. Environmental conditions for the test facility are recorded in this document's associated test report.

Facility Manufacturer:	ETS-Lindgren	**Facility Type:**	3m Semi-Anechoic Chamber
Serial/Asset Number:	NA	**ETS-Lindgren Tracking Number:**	S001431
Customer/Location:	Datascope Corporation 1300 MacArthur Blvd. Mahway, NJ 07430	**Calibration Completed:**	April 30, 2004
Test Distance/Quiet Zone/ Frequency:	3 Meters / 2.0 Meter Quiet Zone / 1-3 GHz		
Comments:			
Required Performance:	+/- 4.0 dB deviation from theoretical NSA as per ANSI C63.4-2001 Methodology		
Measured Peformance:	+/- 3.2 dB deviation from theoretical NSA as per ANSI C63.4 2001 Methodology		

Data verified by:
Arthur Cook
Field Calibration Supervisor

Attested on May 4, 2004 by:
Rick Flores
Service Department Manager

ETS·LINDGREN™
An ESCO Technologies Company

1301 Arrow Point Drive
Cedar Park, TX 78613
(512) 531-6400

ACCREDITED
Lab Code 1207.01

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Certificate #: S001431-1-C

The facility identified below has been tested in compliance with the following standards:

ANSI C63.4 - 2001 Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

Environment: The Semi-anechoic facility under test has been tested with environmental conditions ranging from 50 to 90 deg F and relative humidity less than 90%. Environmental conditions for the test facility are documented in this document's associated test report.

Facility Manufacturer:	ETS-Lindgren	**Facility Type:**	3m Semi-Anechoic Chamber
Serial/Asset Number:	NA	**ETS-Lindgren Tracking Number:**	S001431
Customer/Location:	Datascope Corporation 1300 MacArthur Blvd. Mahwah, NJ 07430	**Calibration Completed:**	April 30, 2004
Test Distance/Quiet Zone/ Frequency:	3 Meters / 2.0 Meter Quiet Zone / 30-1000 MHz		
Comments:	Annual Normalized Site Attenuation Validation		
Required Performance:	+/- 4.0 dB deviation from theoretical NSA as per ANSI C63.4-2001		
Measured Peformance:	+/- 3.1 dB deviation from theoretical NSA as per ANSI C63.4 2001		
Normalized Site Attenuation Measurement Uncertainty (95% confidence level)	30-200 MHz (Biconical Antennas) ±0.15 dB 200-300 MHz (Biconical or Log-Periodic Antennas) ±0.29 dB 300-1000 MHz (Log-Periodic Antennas) ±0.55 dB		

Data verified by:
Arthur Cook
Field Calibration Supervisor

Attested on May 4, 2004 by:
Rick Flores
Field Service/Calibration Manager