

Dr. Dominik Müller, May 2014

Test Report

3in and 4in LR250

3in and 4in LR260

Testing of LR250/LR260 to show compliance with the new FCC

Antennas to be characterized:

- 3in and 4in LR250 horn antennas
- 3in and 4in LR260 horn antennas

Measurements:

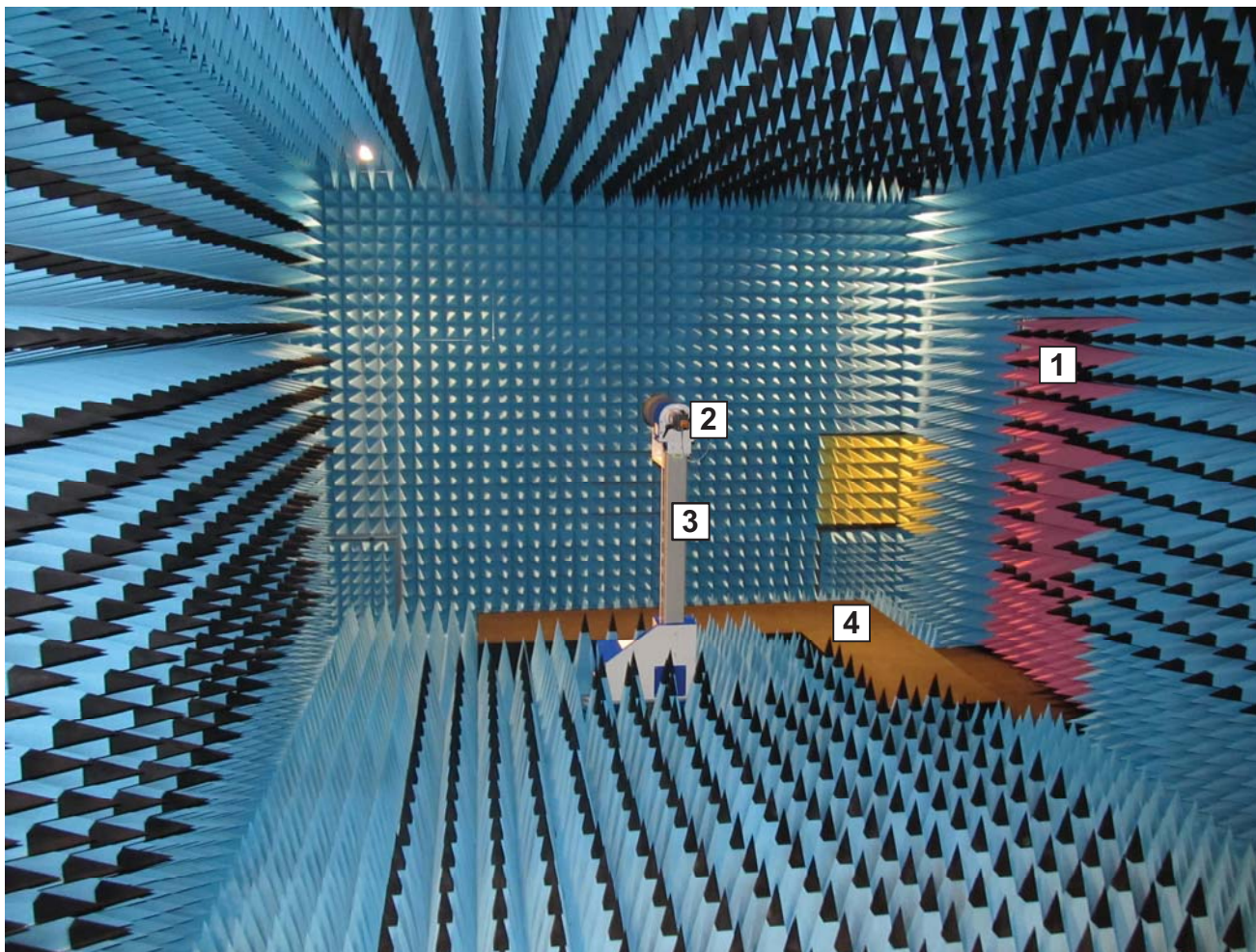
- Antenna beam pattern (normalized radiation pattern for E and H planes at 25 GHz):
 - Azimuth cut at angle 0° , 45° , and 90°
 - Elevation range: -180° to $+180^\circ$ in 0.5° steps
→ Currently measurements just possible in 1.0° steps
- Measurement of -3dB beamwidth (for E and H planes at 25 GHz)

Deliverables:

Test report that includes:

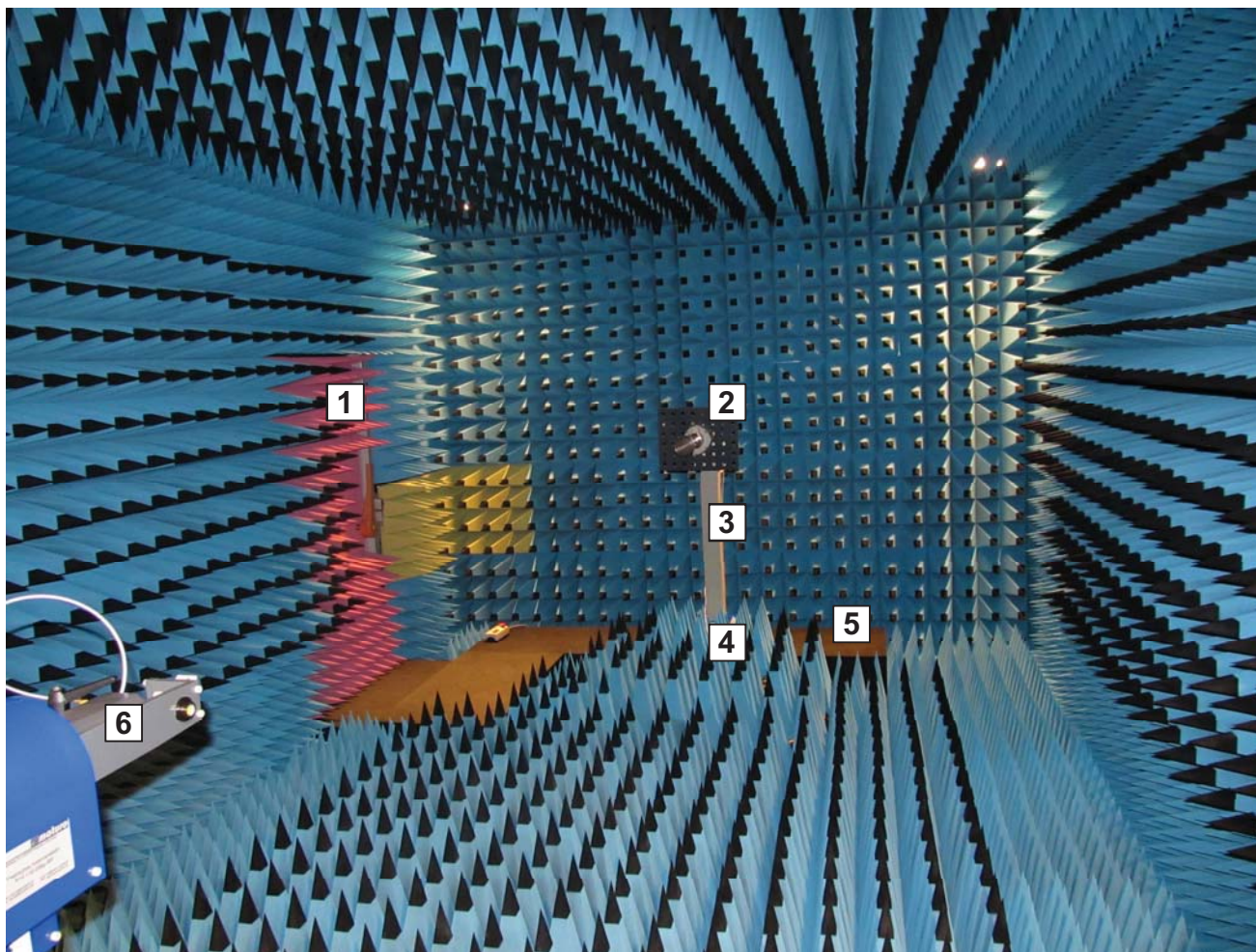
- measurement results as data/graphs
- statement that the antenna meets/does not meet requirements
- diagram and pictures of measurement setup
- calibration expiry date for instruments, chamber certification data and measurement error evaluation

Anechoic Chamber in Munich Perlach

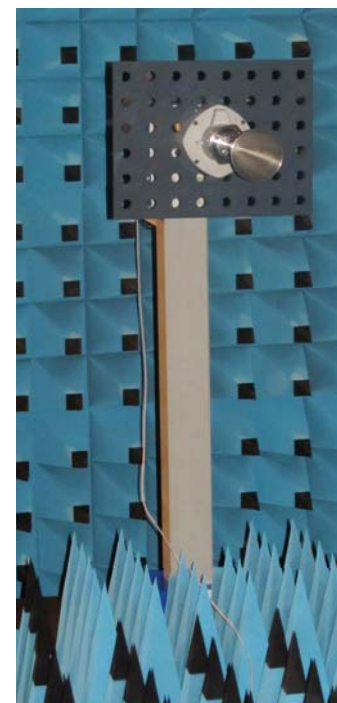


- 1) Door
- 2) Reference horn
- 3) 360° positioner
- 4) Walkway absorber

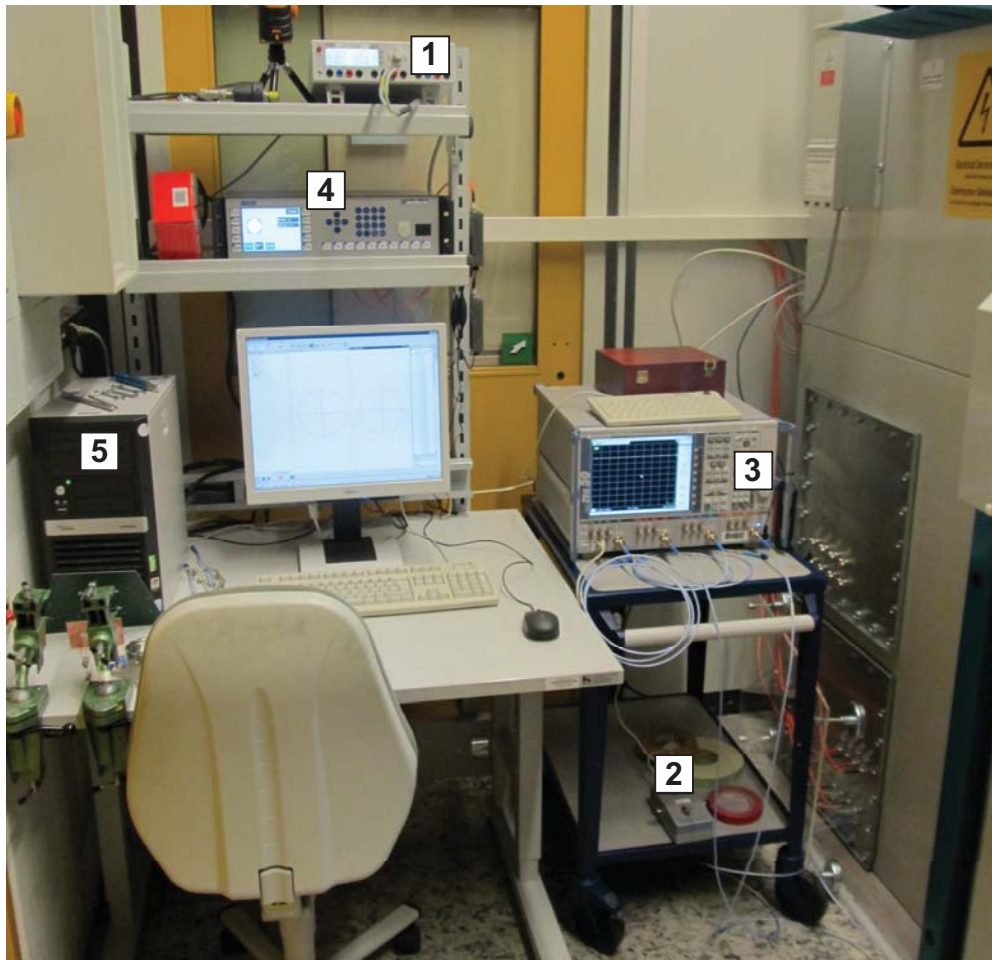
Anechoic Chamber in Munich Perlach



- 1) Door
- 2) DUT
- 3) 360° positioner
- 4) 360° turn table
- 5) Walkway absorber
- 6) Reference horn

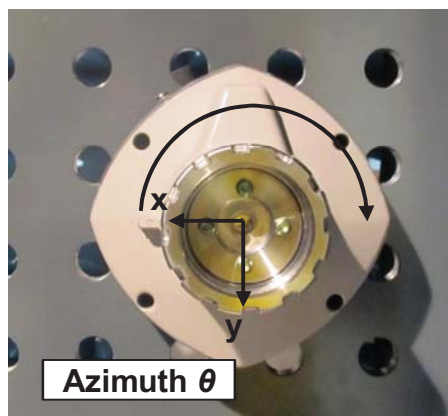
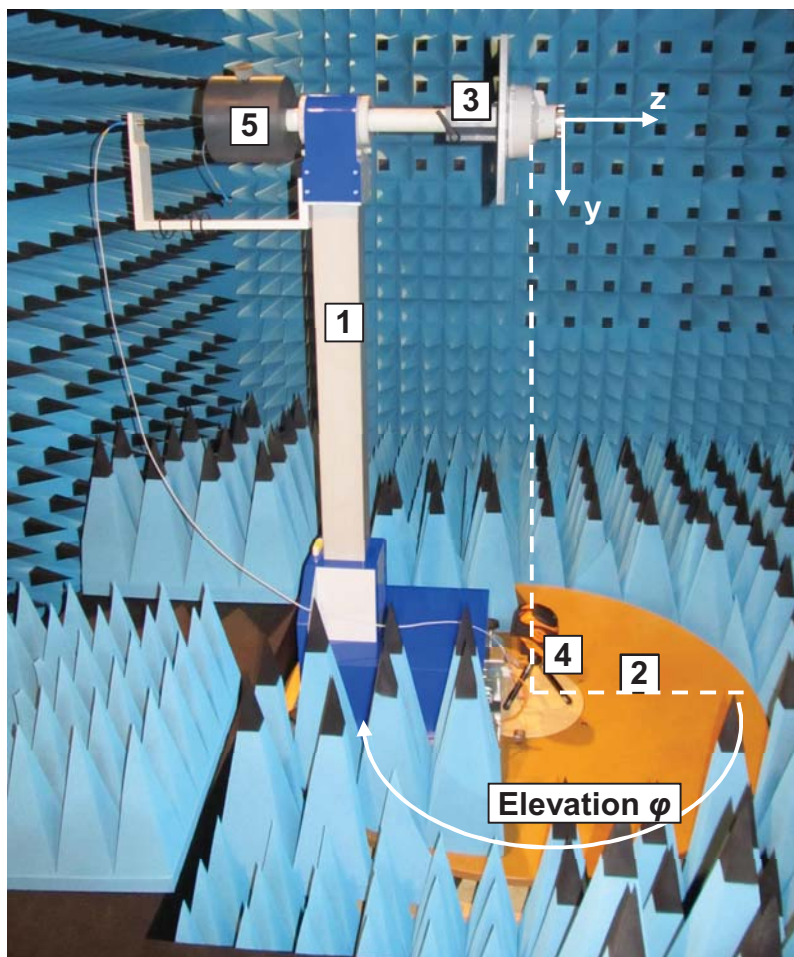


Measurement Setup

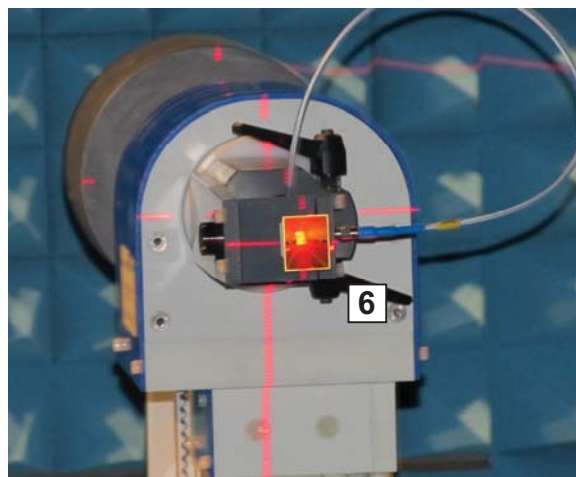


- 1) DC power supply
- 2) E-cal kit for network analyzer
- 3) Network analyzer ZVA-50
- 4) Controller unit for positioner/turn table
- 5) Computer with measurement software

Setup Alignment



- 1) 360° positioner
- 2) 360° turn table
- 3) Mounting unit for DUT/laser
- 4) Lot laser for elevation alignment
- 1) Counter weight
- 2) Cross laser for horizontal alignment



Reference Horn Antenna



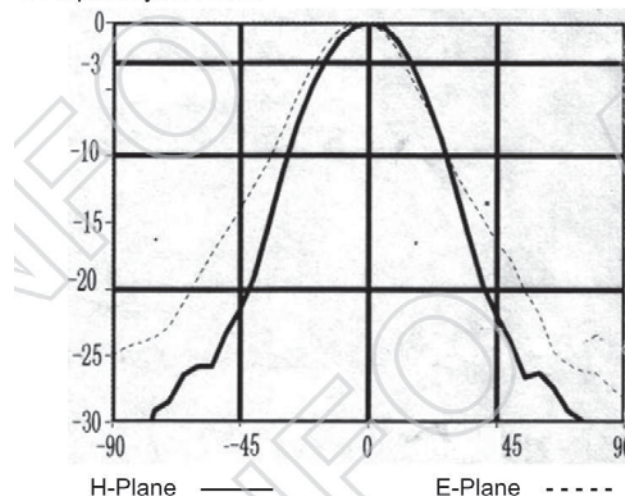
LB-180400

18 - 40GHz Broadband Horn Antenna

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Frequency Range(GHz)	18 - 40
Gain(dB)	15 Typ.
Polarization	Linear
VSWR	1.5:1 Typ.
	2:1 Max.
Connector	2.92mm (K)- Female
Power Handling(W)	20 Max. CW
Size(mm)	32x27x71
Net Weight(Kg)	0.08 Around

Frequency: 24GHz

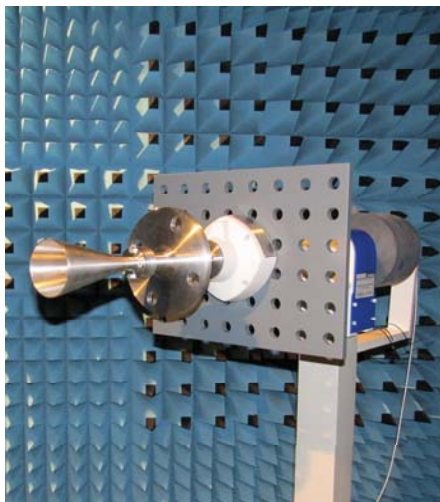


3dB Beamwidth (deg): 30.78

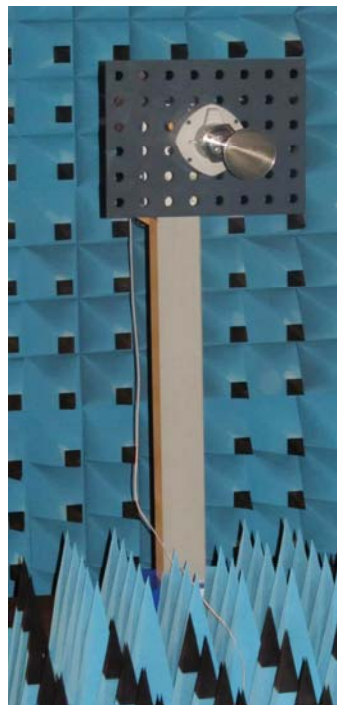
3dB Beamwidth (deg): 31.31

Antennas under test

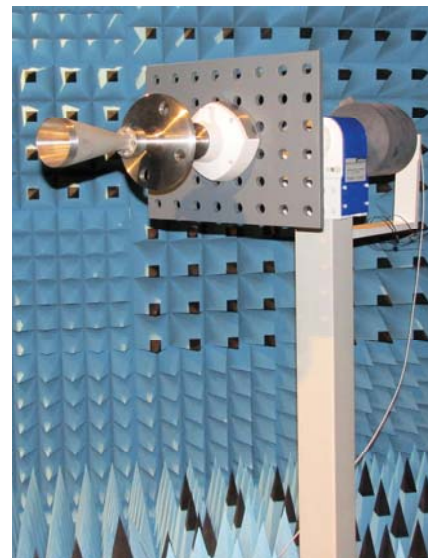
3inLR250



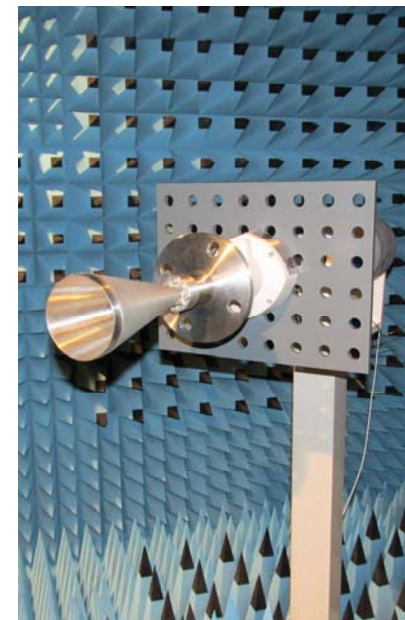
4inLR250



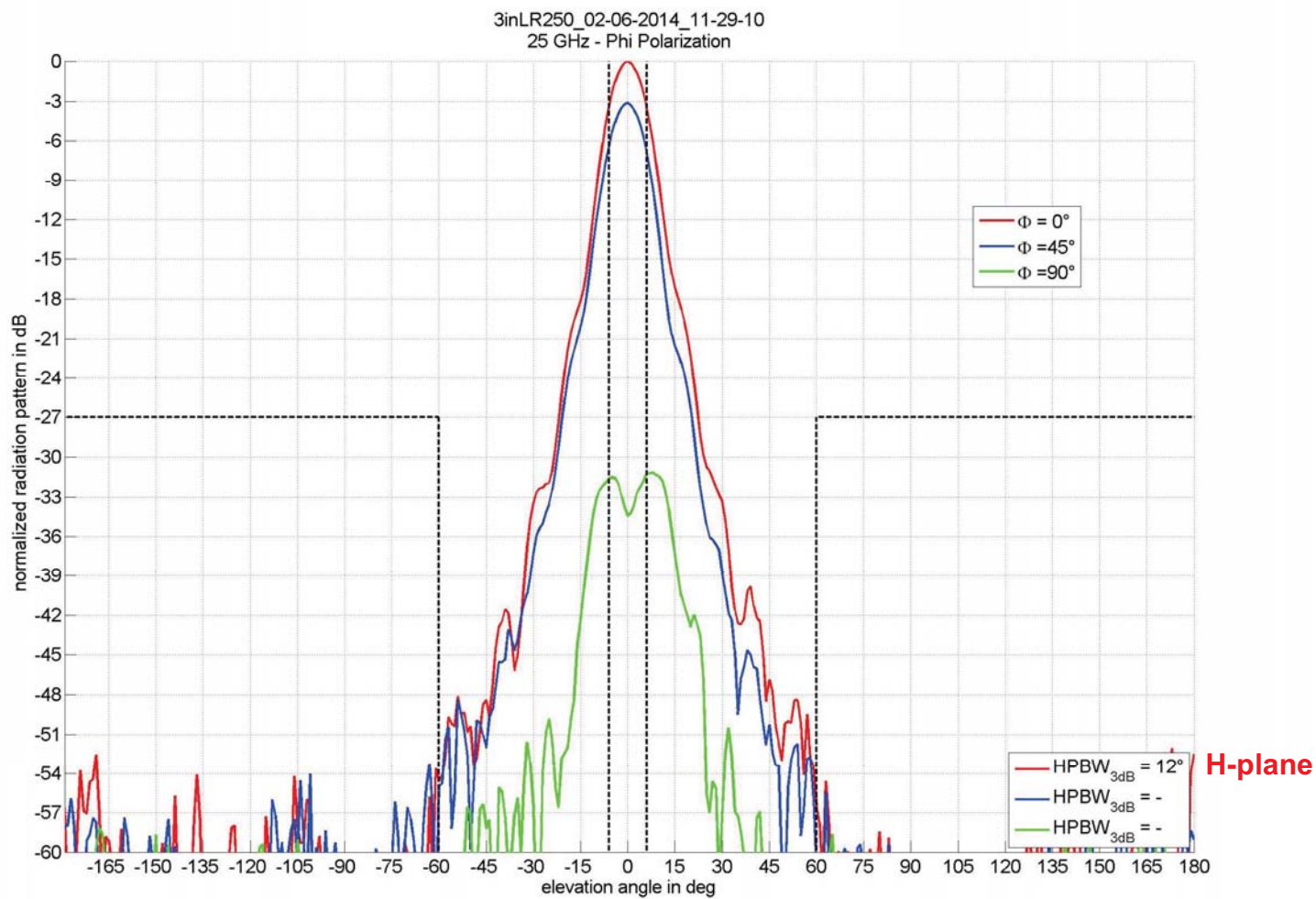
3inLR260



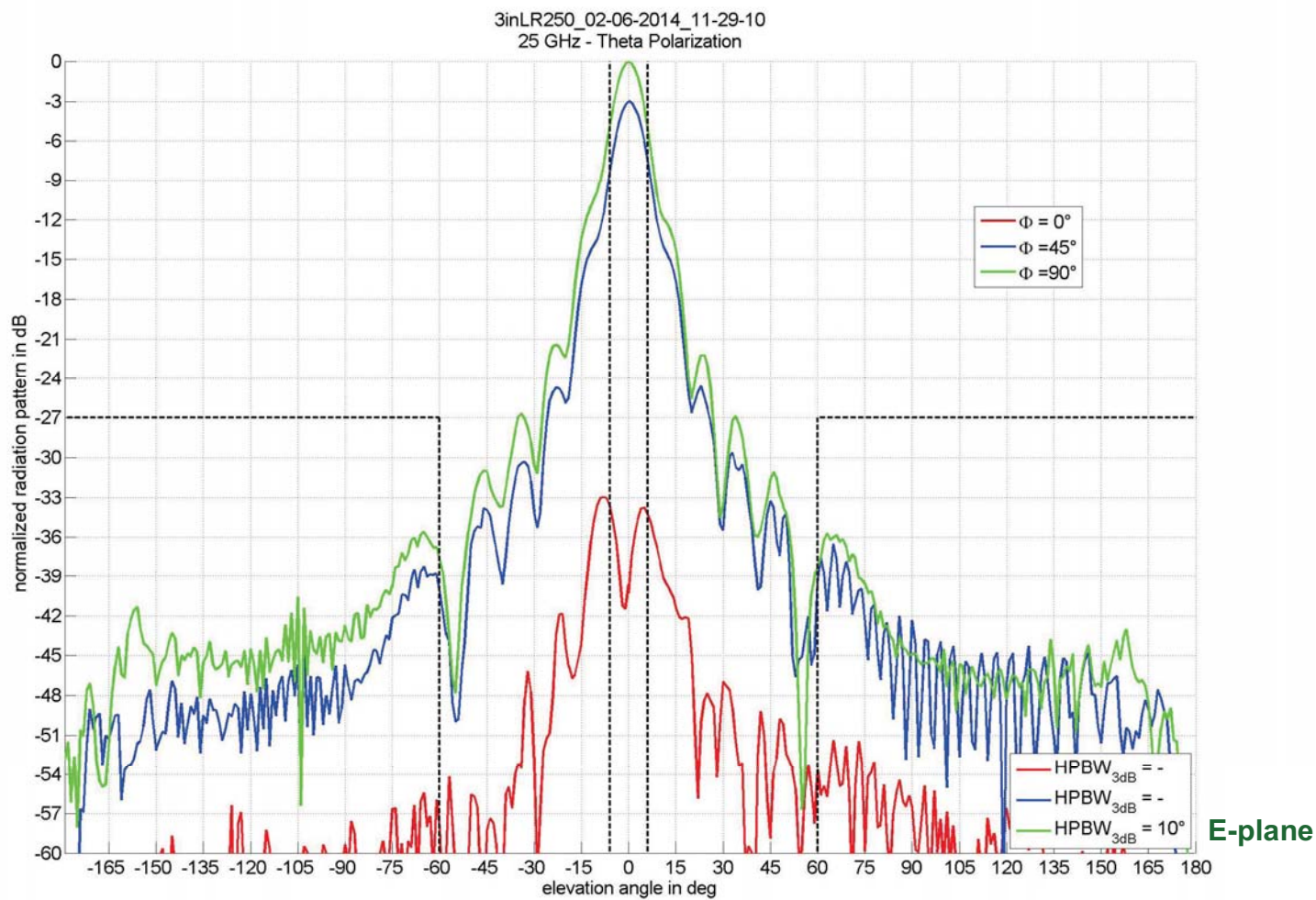
4inLR260



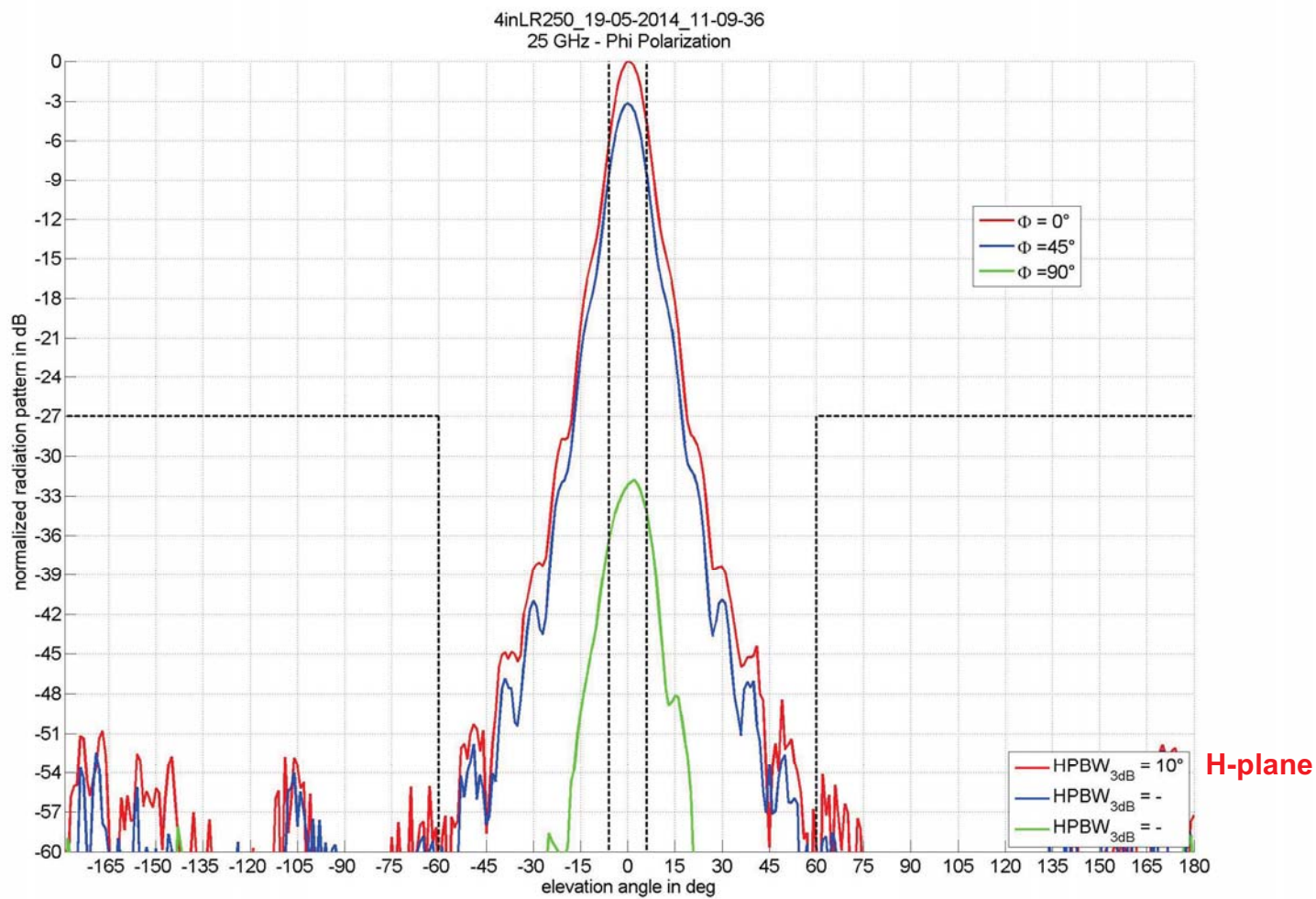
Measurement Results – 3inLR250 Horn Antenna



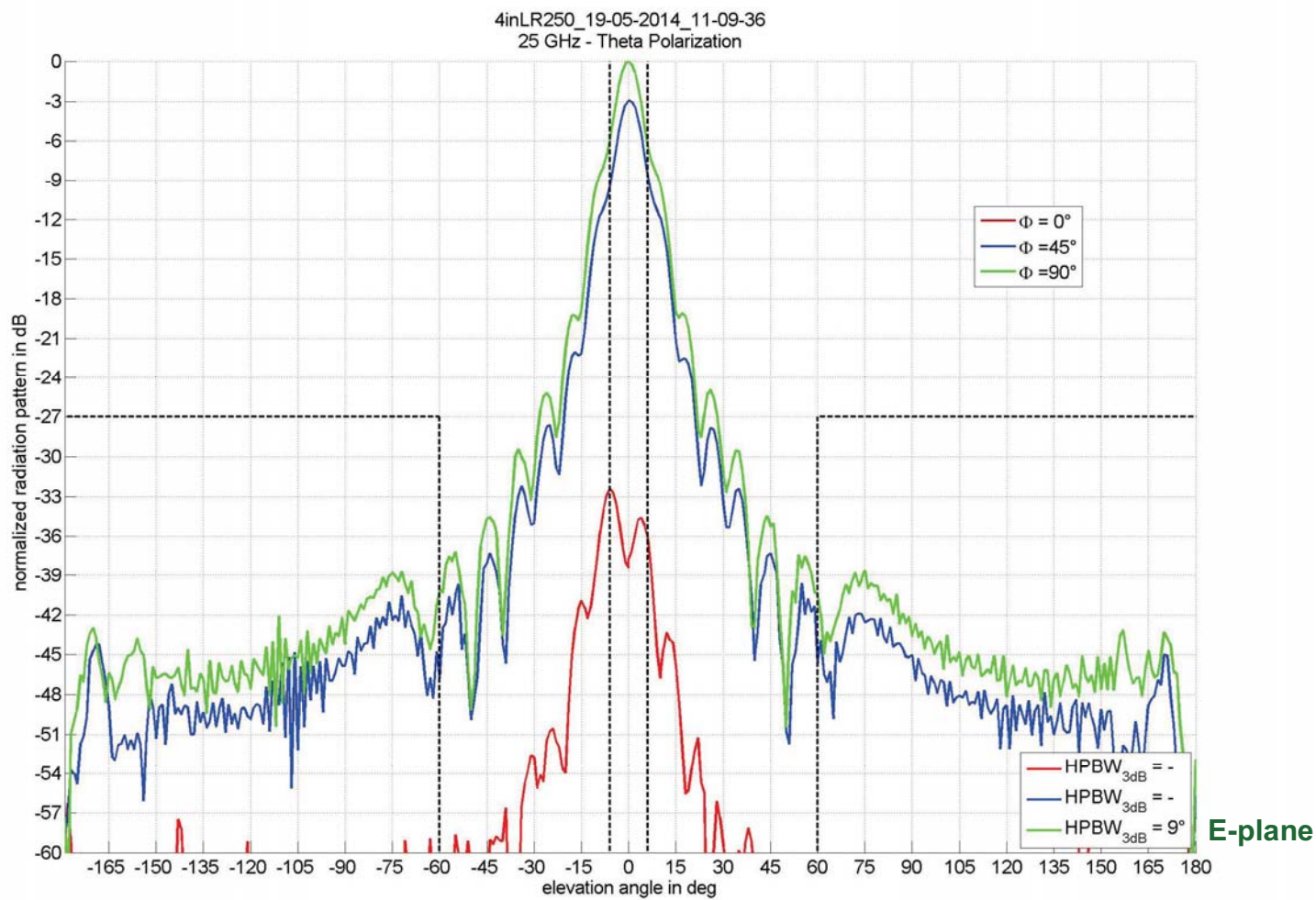
Measurement Results – 3inLR250 Horn Antenna



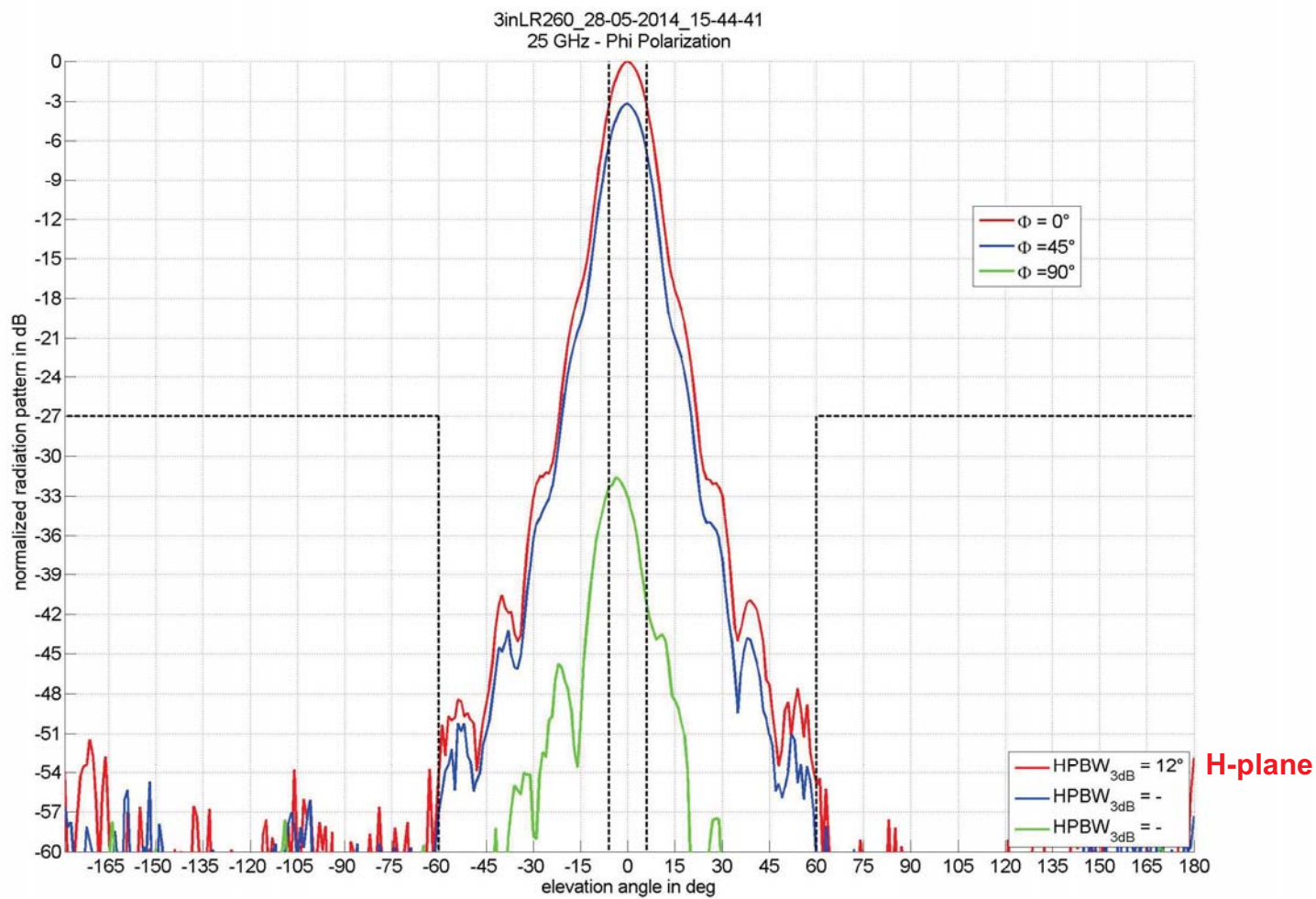
Measurement Results – 4inLR250 Horn Antenna



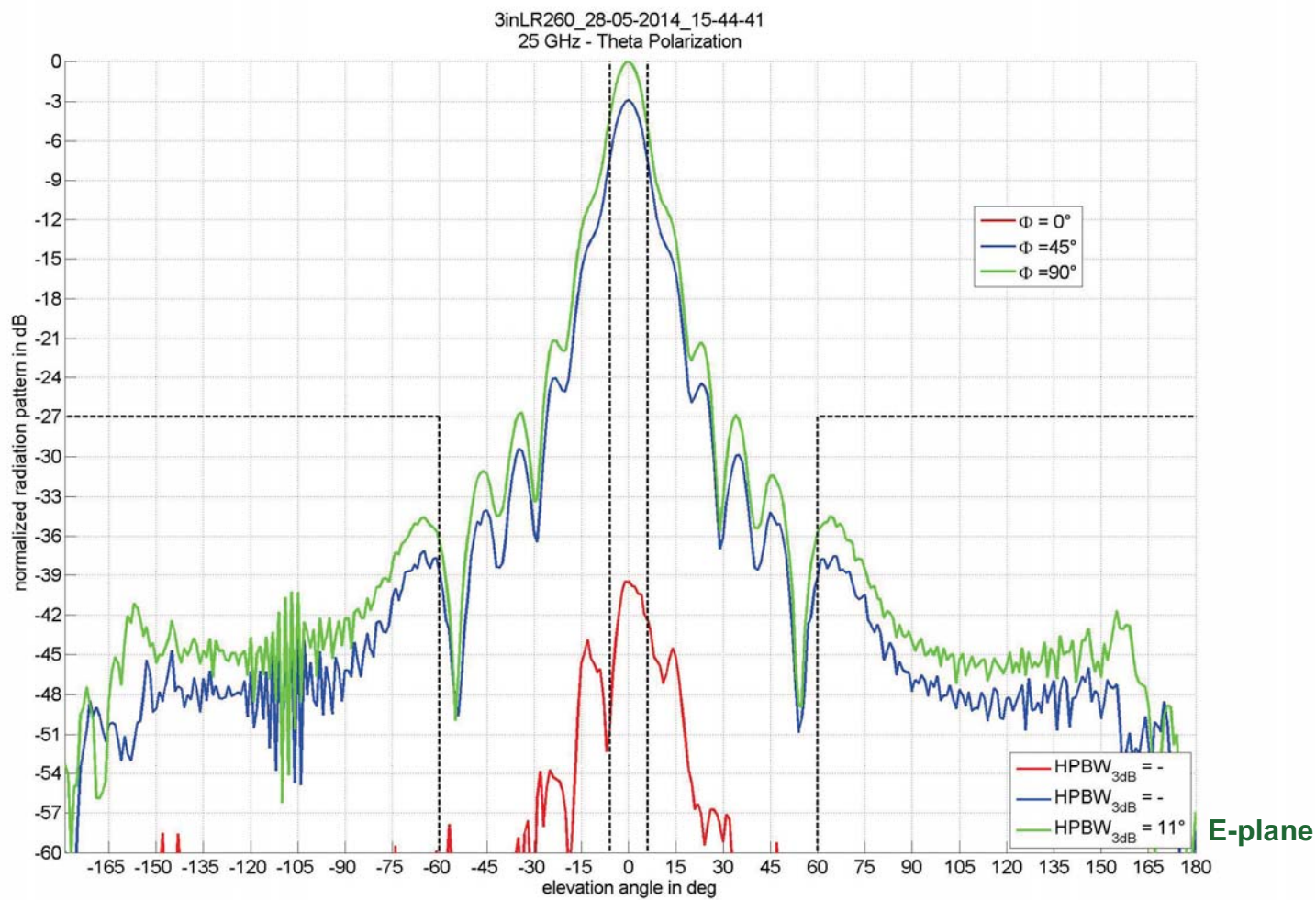
Measurement Results – 4inLR250 Horn Antenna



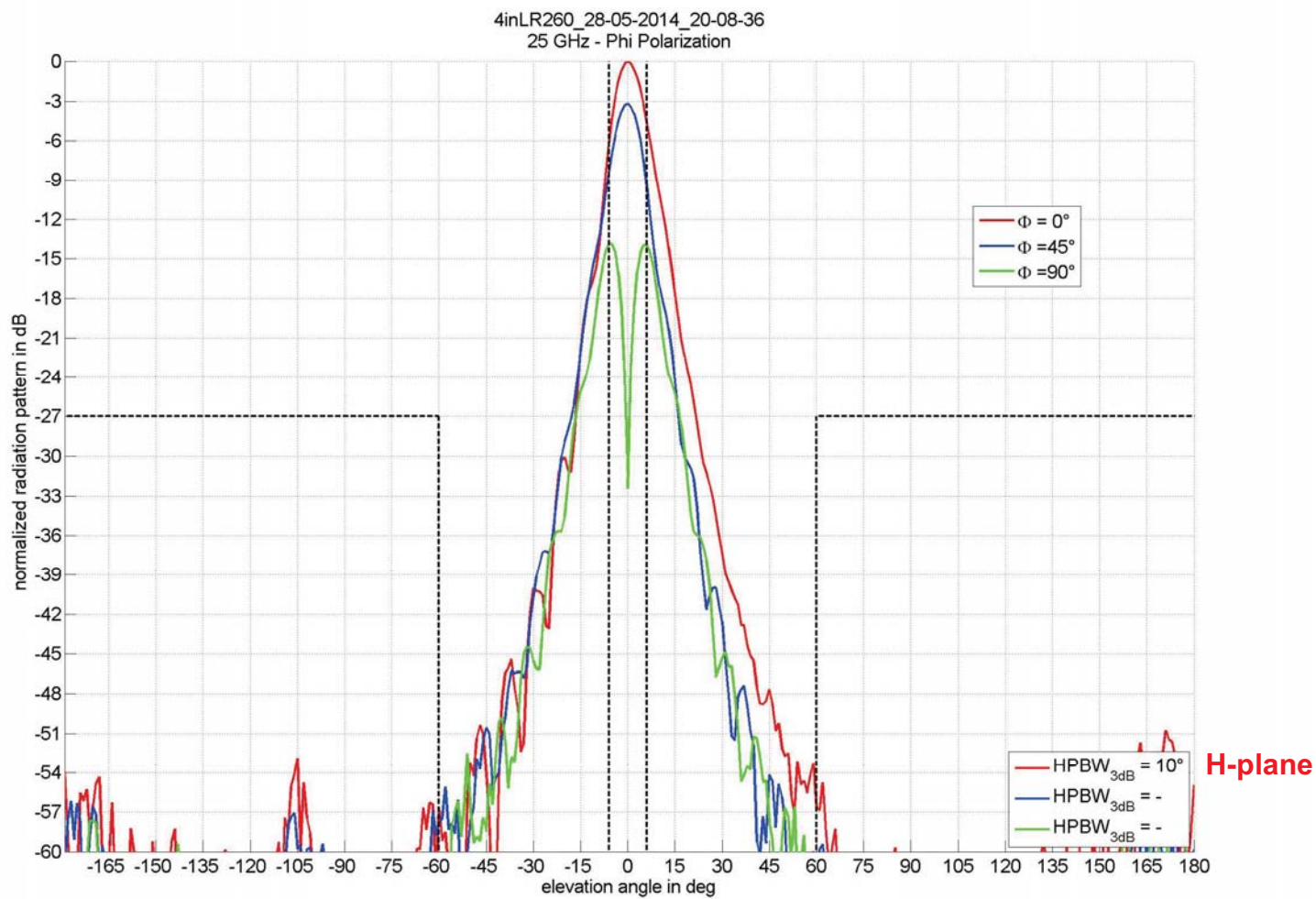
Measurement Results – 3inLR260 Horn Antenna



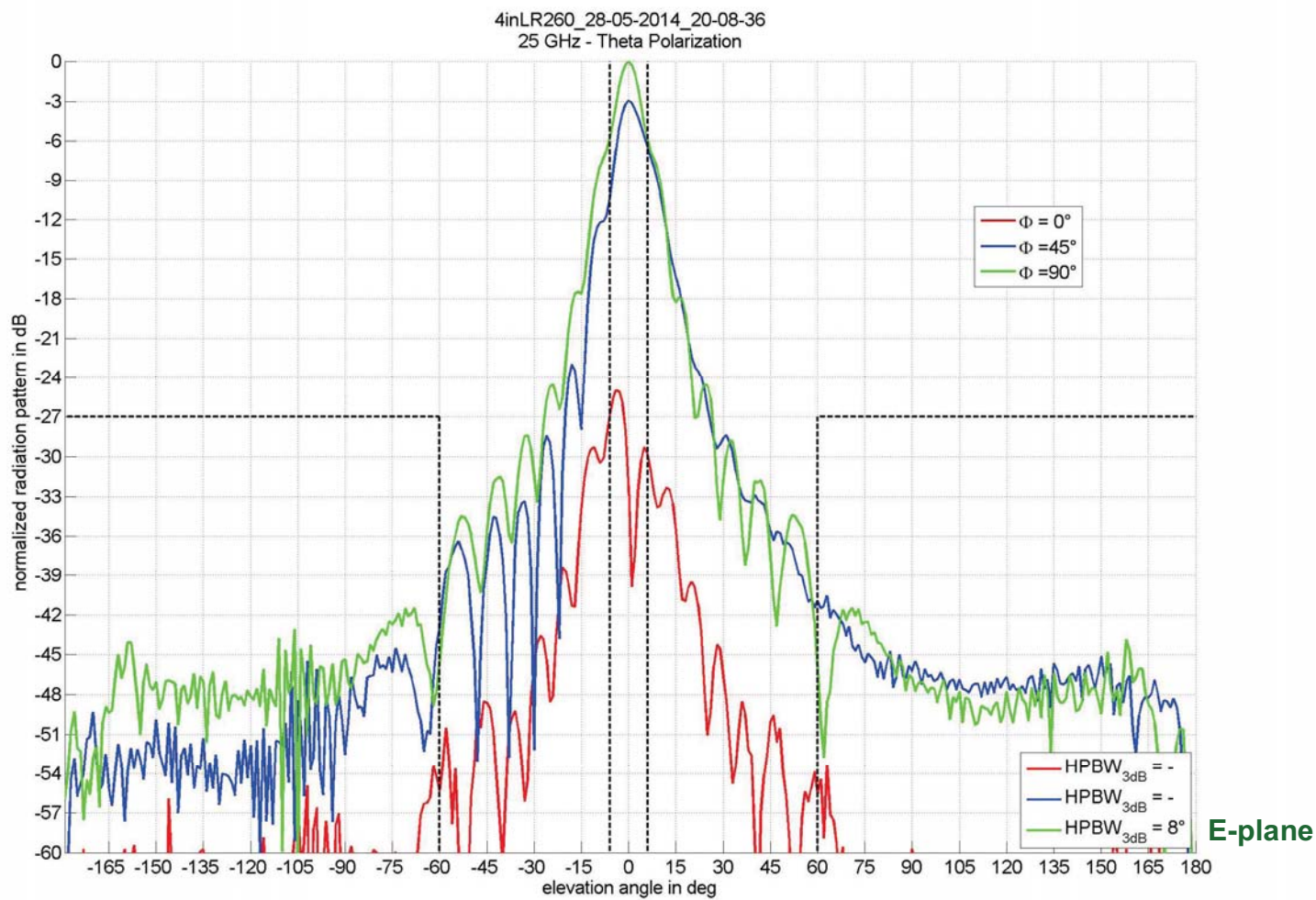
Measurement Results – 3inLR260 Horn Antenna



Measurement Results – 4inLR260 Horn Antenna



Measurement Results – 4inLR260 Horn Antenna



Summary

Antenna Type	HPBW _{3dB} < 12°	Antenna side lobe gain limit (>± 60°) relative to main beam gain < 27 dB
3inLR250	OK	OK
4inLR250	OK	OK
3inLR260	OK	OK
4inLR260	OK	OK

All values are measured at a frequency of 25.0 GHz.

Measurement distance: app. 4.5 meter.

Date of measurements: 2014-05-19, 2014-05-28, 2014-06-02

Chamber Certification Data I

Measurement of shielding attenuation according to EN 50147-1

Results

The shielding attenuation measurement at the specified measurement points (see figure 5.1 - 5.2) showed that the enclosure keeps the specified attenuation values.

3.3 Requirements

The enclosure was measured at the following frequencies:

field	frequency	expected attenuation	antenna distance
magnetic	10 kHz	≥ 80 dB	70 cm
	100 kHz	≥ 100 dB	
	1 MHz	≥ 100 dB	
electric	100 MHz	≥ 110 dB	210 cm
plane wave	2 GHz	≥ 110 dB	70 cm
	10 GHz	≥ 100 dB	
	18 GHz	≥ 100 dB	
	40 GHz	≥ 100 dB	

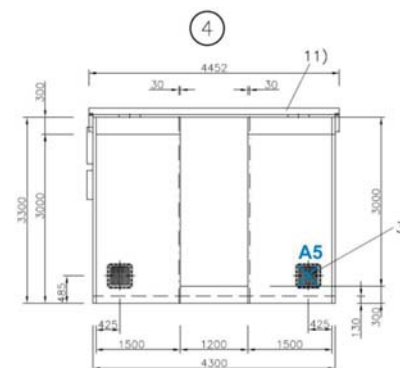


Abb. 5.2: wall view 4

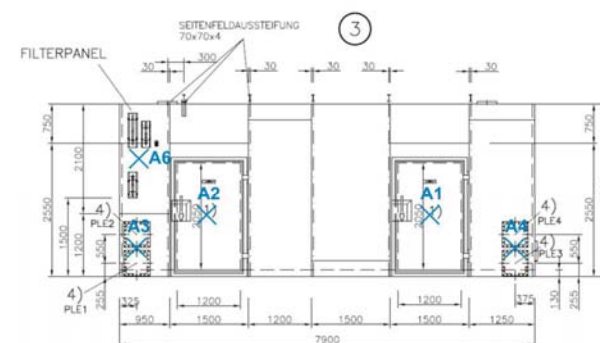


Abb. 5.1: wall view 3

Chamber Certification Data II

Reflectivity Performance (Quiet Zone)

When measured in accordance with the method "**Free-Space VSWR Field Probe Procedure for Antenna Range Evaluation**", the performance in the spherical Quiet zone (center is positioned in the middle of the chamber height and width) is specified to be as follows :

Transmission Length (TL) = 3.5 m

Frequency	QZ diameter	Antenna Gain		Guaranteed Quiet Zone Reflectivity
		Transmit Antenna	Receive Antenna	
800 MHz	0.8 m	8dBi	8dBi	-23 dB
3 GHz	0.6 m	18dBi	18dBi	-41 dB
10 GHz	0.6 m	22dBi	22dBi	-47 dB

Results

At **0.80 GHz**, the worst-case signal level was measured to be **-36 dB** while the specified (expected) reflectivity at the same frequency had been set to be better than -25 dB.

At **3.00 GHz**, the worst-case signal level was measured to be **-52.3 dB** while the specified (expected) reflectivity at the same frequency had been set to be better than -41 dB.

At **10.0 GHz**, the worst-case signal level was measured to be **-50 dB** while the specified (expected) reflectivity at the same frequency had been set to be better than -47 dB.

The measurement results show that the installed chamber possesses better reflectivity levels than the expected ones in the design phase. Hence, the results for the antenna patterns measured in this chamber will have lower uncertainty levels than the ones expected.

Calibration Expiry Date For Instruments

Instrument	Model	Manufacturer	Calibration Expiry Date
Network Analyzer	ZVA50	Rohde&Schwarz	2014-08-30
Calibration Unit	ZV-Z55	Rohde&Schwarz	2014-09-02
Power Supply	HMP2030	Hameg	-
Motor Controller Unit	NCD	Maturo GmbH	-

Measurement Error Evaluation

Instrument	Error/Specifications
VNWA ZVA-50	see: R&S®ZVA Vector Network Analyzer Specifications - Version 11.00, March 2014 http://cdn.rohde-schwarz.com/dl_downloads/dl_common_library/dl_brochures_and_datasheets/pdf_1/ZVA_dat-sw_en_5213-5680-22_v1100.pdf
Turn table TT 1.2 (positioning accuracy)	$\pm 0.5^\circ$
DUT positioner EAS (positioning accuracy)	$\pm 0.5^\circ$
REF positioner EAP(positioning accuracy)	$\pm 0.5^\circ$
Estimated misalignment (vertical)	$\pm 1^\circ$
Estimated misalignment (horizontal)	$\pm 1^\circ$