



Raven Manufacturing Limited

Document Number: 143

Title: HNS 98cm FCC Ku Data Submission
Radiation Patterns and Gains

A report prepared in support of FCC certification

Issue: G

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Revision History

Date	Issue	Updated by	Changes
07/06/06	A	GJC	Initial Draft
12/06/06	B	GJC	Changed antenna size and mask limits in Introduction
4/07/06	C	GJC	All plots updated to the latest test data for the re-tested antenna
6/07/06	D	GJC	Typographic errors and plot axis labels updated
28/09/07	E	GJC	All Plots updated to the latest test data for the re-tested antenna
2/10/07	F	GJC	Mask limit lines changed from 1.7 to 1.25 degrees
4/10/07	G	GJC	Transition effects removed from gain plots. Formal issue to customer.

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1. Introduction

This report details the Transmit and Receive radiation patterns and gain performance of the Raven Ku-band 98cm antenna. The data is presented in accordance with FCC regulation 25.209 with the Co-polar mask starting at ± 1.25 degrees and cross polar mask starting at ± 1.80 degrees. The measurements were carried out on a proven test range at ERA's Far Field Antenna Test Range at Leatherhead, Surrey using a production reflector antenna and a production Feed arrangement including feed cap.

1.1. Antenna Configuration

The antenna comprised a 98cm elliptical reflector (Dim $\sim 970\text{mm} \times 900\text{mm}$) with a Ku-band feed horn. Measurements are referenced to the waveguide transition at the feed.

1.2. Frequency List

The antenna system had both Co and Cross polar radiation components taken in the azimuth and elevation planes for both vertical (V) and horizontal (H) polarisations at 14.00, 14.25 and 14.5GHz for the transmit band. The pattern set is repeated at 11.70, 11.95 and 12.20GHz for the receive band. Each pattern is presented on a separate sheet and is plotted along with the applicable FCC mask.

2. Pattern Set

The pattern sets for both transmit and receive bands are detailed in the subsequent sections.

2.1. Transmit Patterns

The transmit pattern set is as follows:

14.00GHz	Copolar	+/-10 degrees	Horizontal	Azimuth cut
14.25GHz	Copolar	+/-10 degrees	Horizontal	Azimuth cut
14.50GHz	Copolar	+/-10 degrees	Horizontal	Azimuth cut
14.00GHz	Copolar	+/-180 degrees	Horizontal	Azimuth cut
14.25GHz	Copolar	+/-180 degrees	Horizontal	Azimuth cut
14.50GHz	Copolar	+/-180 degrees	Horizontal	Azimuth cut
14.00GHz	Copolar	0 to +30 degrees	Horizontal	Elevation cut
14.25GHz	Copolar	0 to +30 degrees	Horizontal	Elevation cut
14.50GHz	Copolar	0 to +30 degrees	Horizontal	Elevation cut
14.00GHz	Xpolar	+/-10 degrees	Horizontal	Azimuth cut

14.25GHz	Xpolar	+/-10 degrees	Horizontal	Azimuth cut
14.50GHz	Xpolar	+/-10 degrees	Horizontal	Azimuth cut
14.00GHz	Xpolar	+/-10 degrees	Horizontal	Elevation cut
14.25GHz	Xpolar	+/-10 degrees	Horizontal	Elevation cut
14.50GHz	Xpolar	+/-10 degrees	Horizontal	Elevation cut
14.00GHz	Copolar	+/-10 degrees	Vertical	Azimuth cut
14.25GHz	Copolar	+/-10 degrees	Vertical	Azimuth cut
14.50GHz	Copolar	+/-10 degrees	Vertical	Azimuth cut
14.00GHz	Copolar	+/-180 degrees	Vertical	Azimuth cut
14.25GHz	Copolar	+/-180 degrees	Vertical	Azimuth cut
14.50GHz	Copolar	+/-180 degrees	Vertical	Azimuth cut
14.00GHz	Copolar	0 to +30 degrees	Vertical	Elevation cut
14.25GHz	Copolar	0 to +30 degrees	Vertical	Elevation cut
14.50GHz	Copolar	0 to +30 degrees	Vertical	Elevation cut
14.00GHz	Xpolar	+/-10 degrees	Vertical	Azimuth cut
14.25GHz	Xpolar	+/-10 degrees	Vertical	Azimuth cut
14.50GHz	Xpolar	+/-10 degrees	Vertical	Azimuth cut
14.00GHz	Xpolar	+/-10 degrees	Vertical	Elevation cut
14.25GHz	Xpolar	+/-10 degrees	Vertical	Elevation cut
14.50GHz	Xpolar	+/-10 degrees	Vertical	Elevation cut

2.2. Receive Patterns

The receive pattern set is as follows:

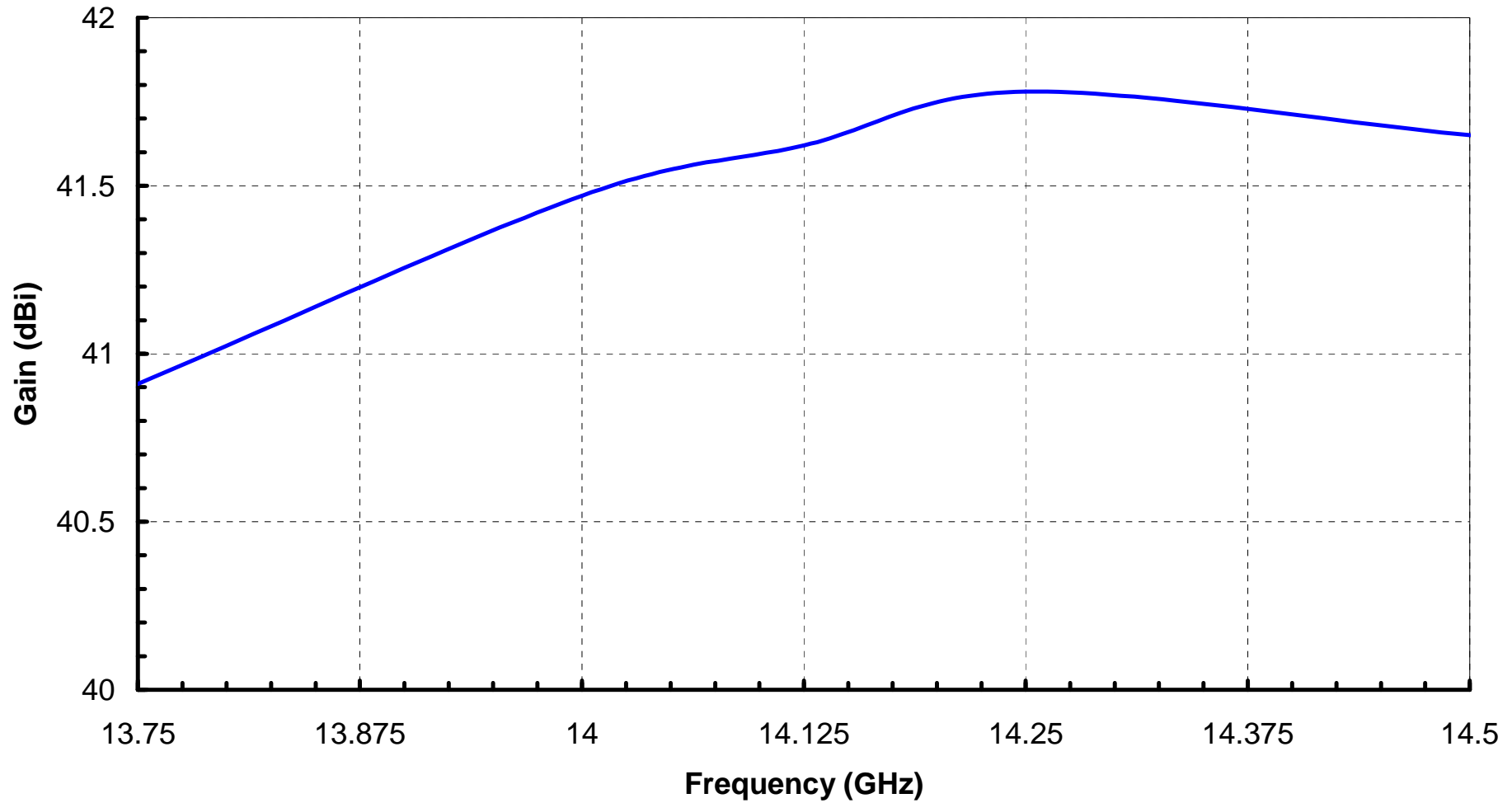
11.70GHz	Copolar	+/-10 degrees	Horizontal	Azimuth cut
11.95GHz	Copolar	+/-10 degrees	Horizontal	Azimuth cut
12.20GHz	Copolar	+/-10 degrees	Horizontal	Azimuth cut
11.70GHz	Copolar	+/-180 degrees	Horizontal	Azimuth cut
11.95GHz	Copolar	+/-180 degrees	Horizontal	Azimuth cut
12.20GHz	Copolar	+/-180 degrees	Horizontal	Azimuth cut
11.70GHz	Copolar	0 to +30 degrees	Horizontal	Elevation cut

11.95GHz	Copolar	0 to +30 degrees	Horizontal	Elevation cut
12.20GHz	Copolar	0 to +30 degrees	Horizontal	Elevation cut
11.70GHz	Xpolar	+/-10 degrees	Horizontal	Azimuth cut
11.95GHz	Xpolar	+/-10 degrees	Horizontal	Azimuth cut
12.20GHz	Xpolar	+/-10 degrees	Horizontal	Azimuth cut
11.70GHz	Xpolar	+/-10 degrees	Horizontal	Elevation cut
11.95GHz	Xpolar	+/-10 degrees	Horizontal	Elevation cut
12.20GHz	Xpolar	+/-10 degrees	Horizontal	Elevation cut
11.70GHz	Copolar	+/-10 degrees	Vertical	Azimuth cut
11.95GHz	Copolar	+/-10 degrees	Vertical	Azimuth cut
12.20GHz	Copolar	+/-10 degrees	Vertical	Azimuth cut
11.70GHz	Copolar	+/-180 degrees	Vertical	Azimuth cut
11.95GHz	Copolar	+/-180 degrees	Vertical	Azimuth cut
12.20GHz	Copolar	+/-180 degrees	Vertical	Azimuth cut
11.70GHz	Copolar	0 to +30 degrees	Vertical	Elevation cut
11.95GHz	Copolar	0 to +30 degrees	Vertical	Elevation cut
12.20GHz	Copolar	0 to +30 degrees	Vertical	Elevation cut
11.70GHz	Xpolar	+/-10 degrees	Vertical	Azimuth cut
11.95GHz	Xpolar	+/-10 degrees	Vertical	Azimuth cut
12.20GHz	Xpolar	+/-10 degrees	Vertical	Azimuth cut
11.70GHz	Xpolar	+/-10 degrees	Vertical	Elevation cut
11.95GHz	Xpolar	+/-10 degrees	Vertical	Elevation cut
12.20GHz	Xpolar	+/-10 degrees	Vertical	Elevation cut

3. Results

The following section contains the measured test data.

Tx G98cm HH Azimuth



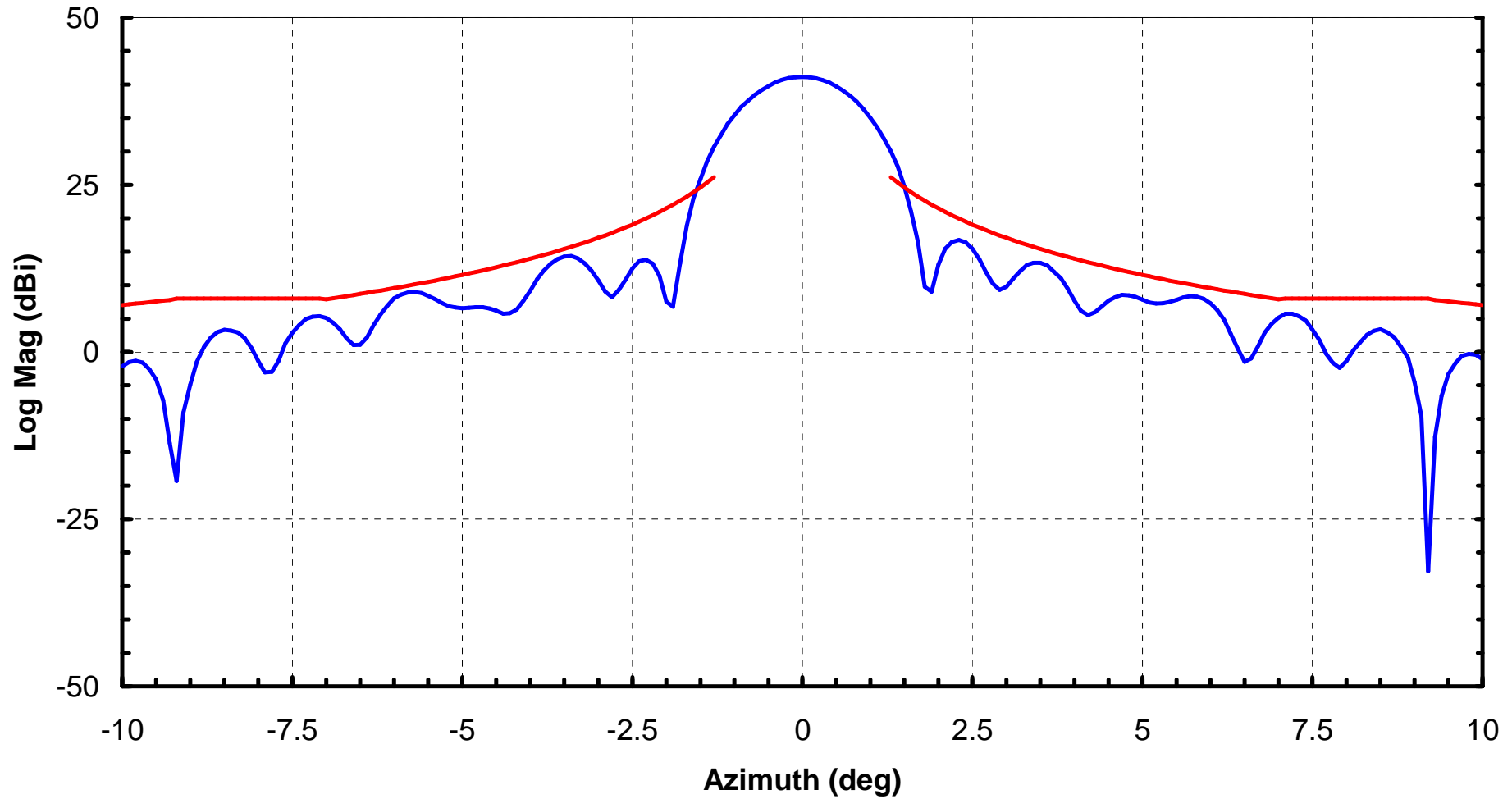
Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

7

Horizontal Co-Polar
Gain Sweep

Tx G98cm HH Azimuth

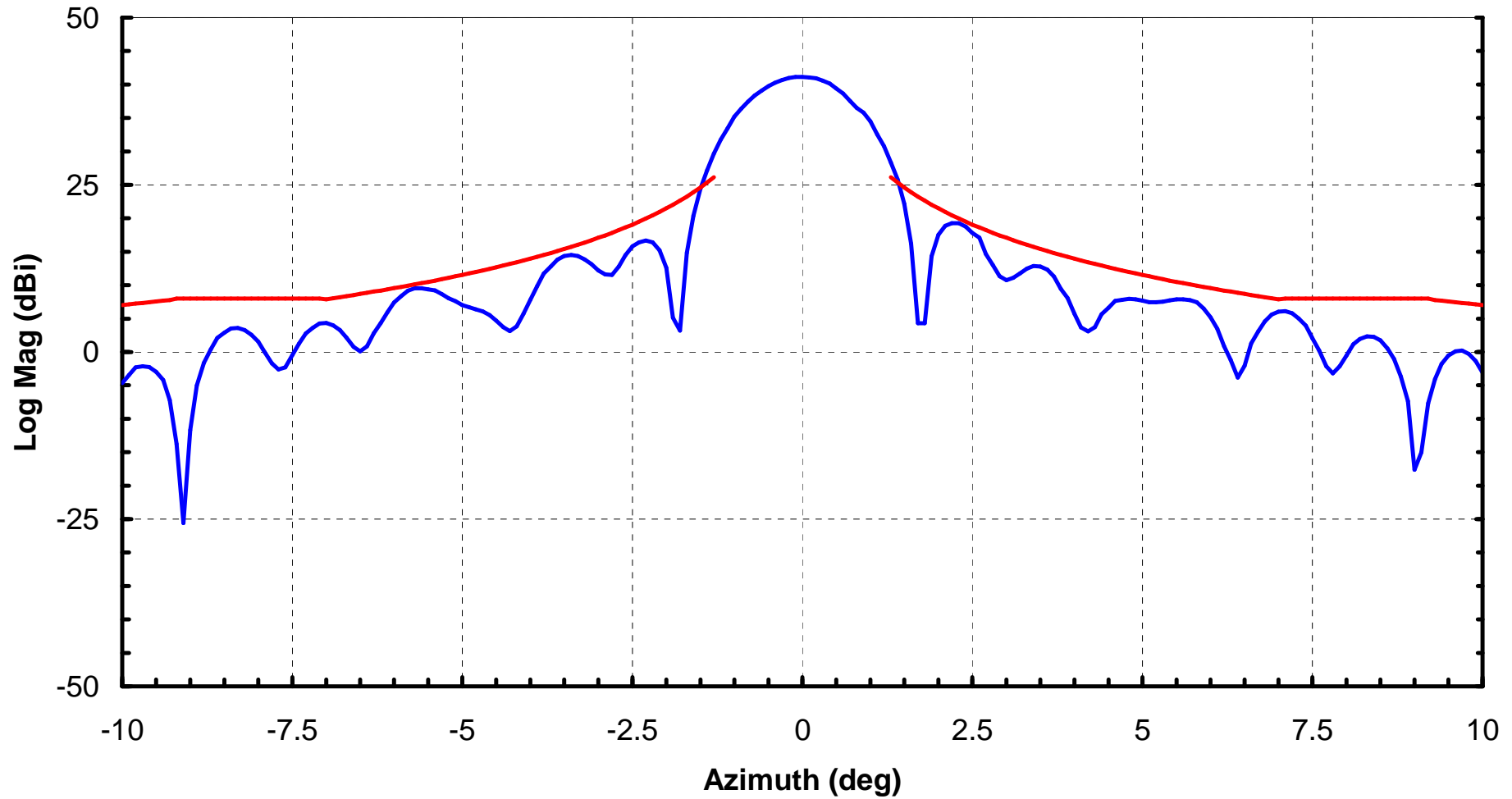


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed
8

Horizontal Co-Polar Azimuth
14.00GHz

Tx G98cm HH Azimuth



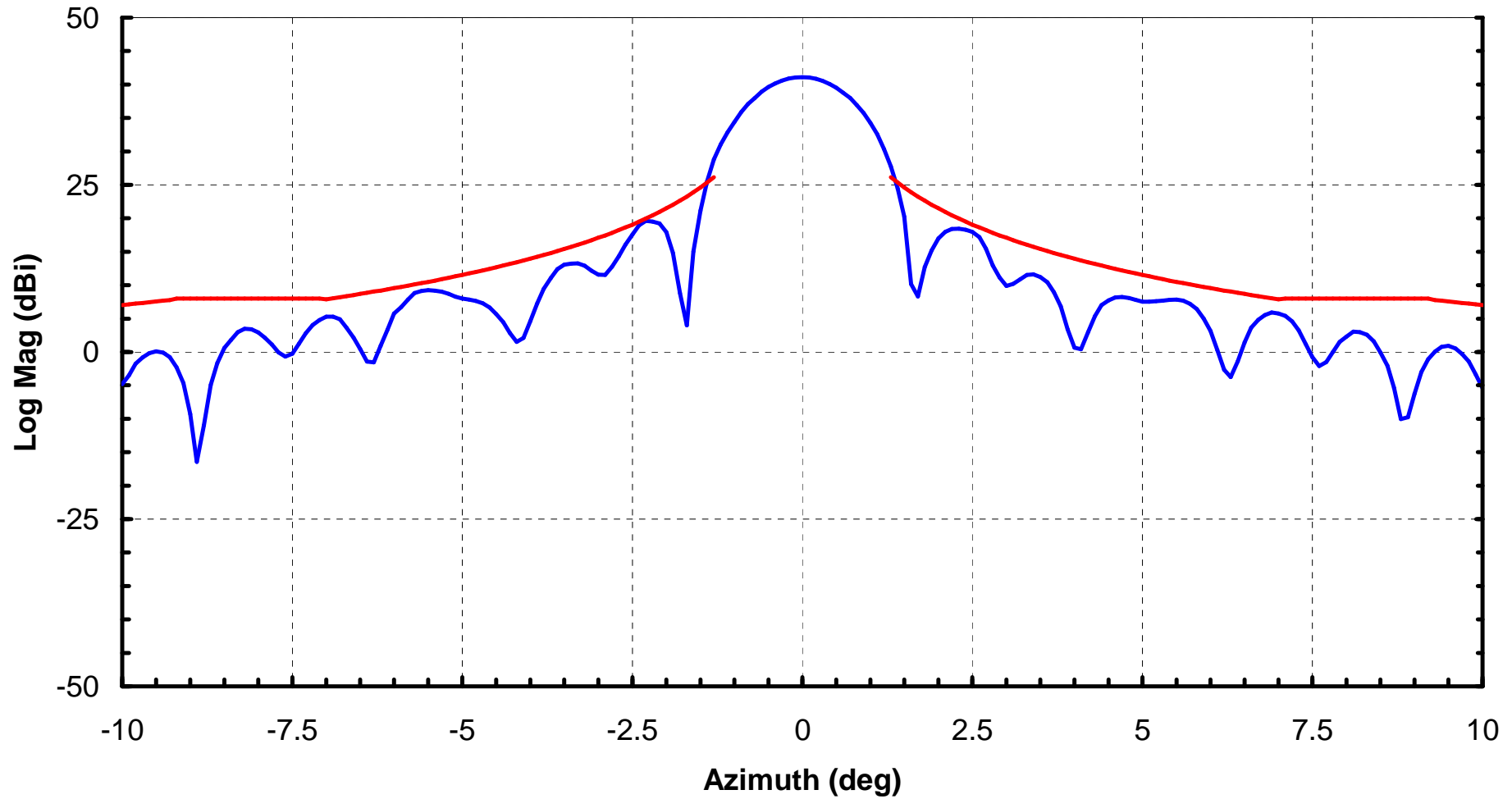
Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

9

Horizontal Co-Polar Azimuth
14.25GHz

Tx G98cm HH Azimuth



Test Data: 26th Sept 2007
ERA Leatherhead, UK.

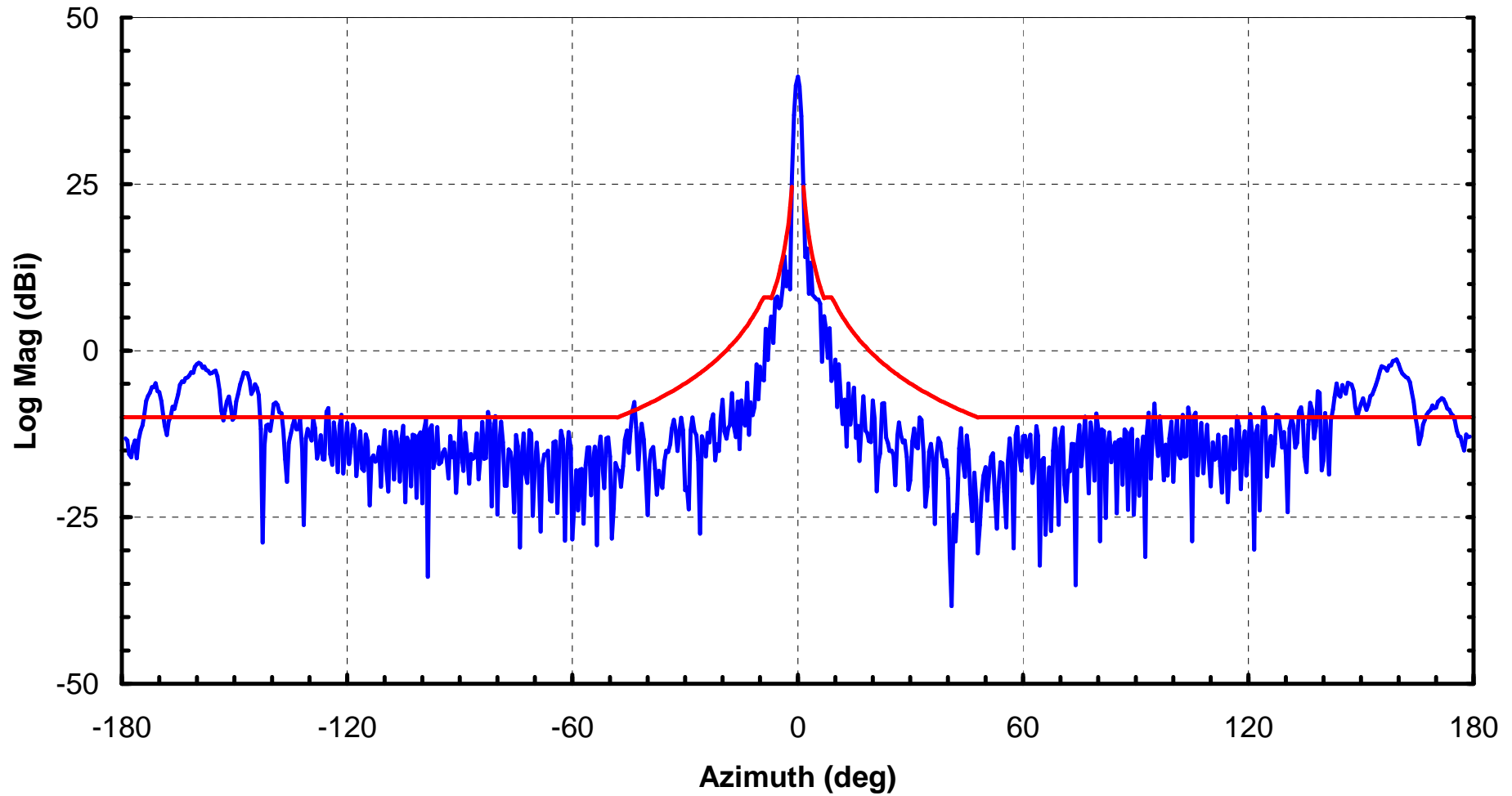
HNS 98cm Antenna with Mode Cancelling Feed

Horizontal Co-Polar Azimuth

10

14.5GHz

Tx G98cm HH Azimuth

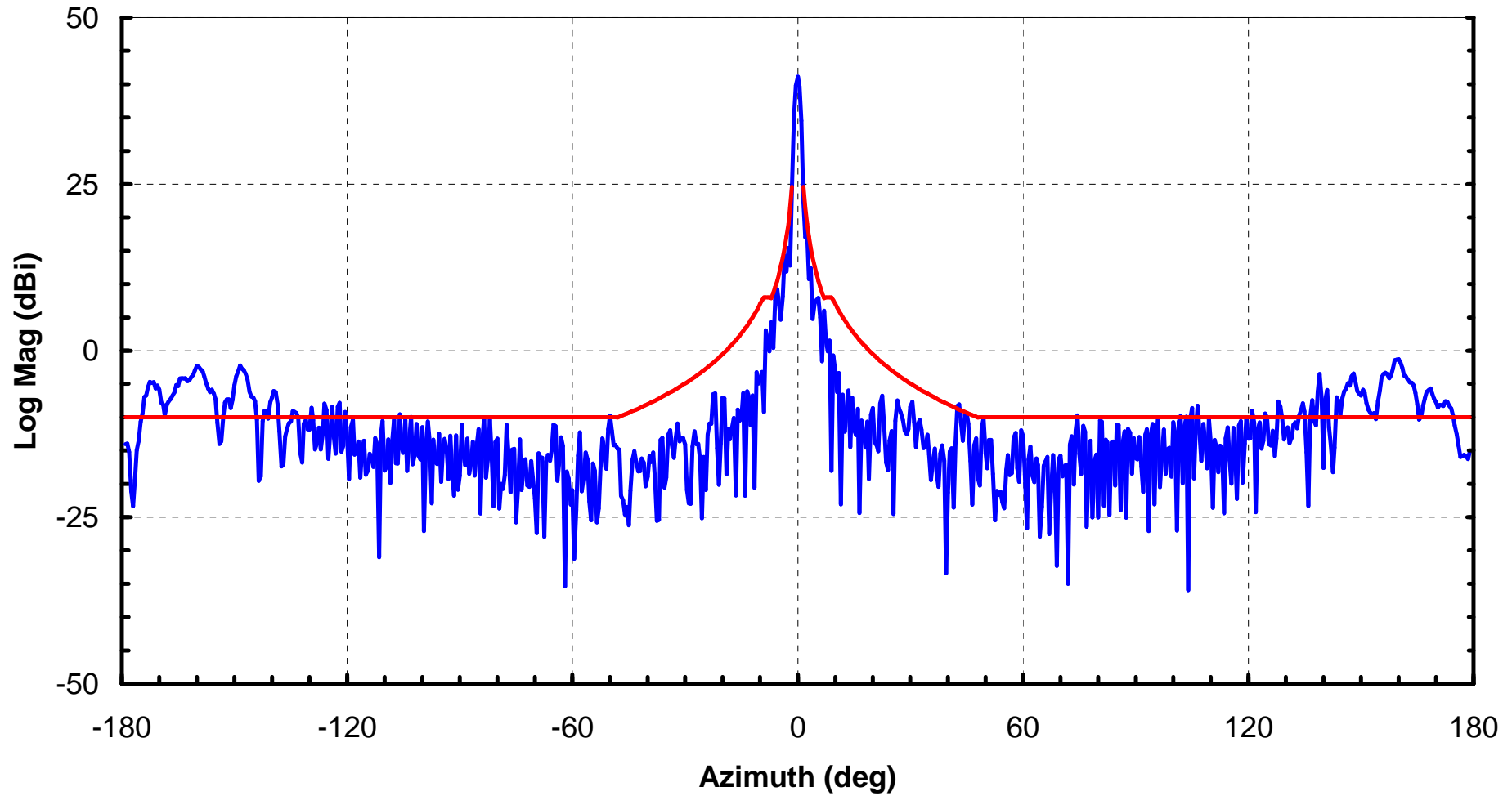


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

Horizontal Co-Polar Azimuth

Tx G98cm HH Azimuth

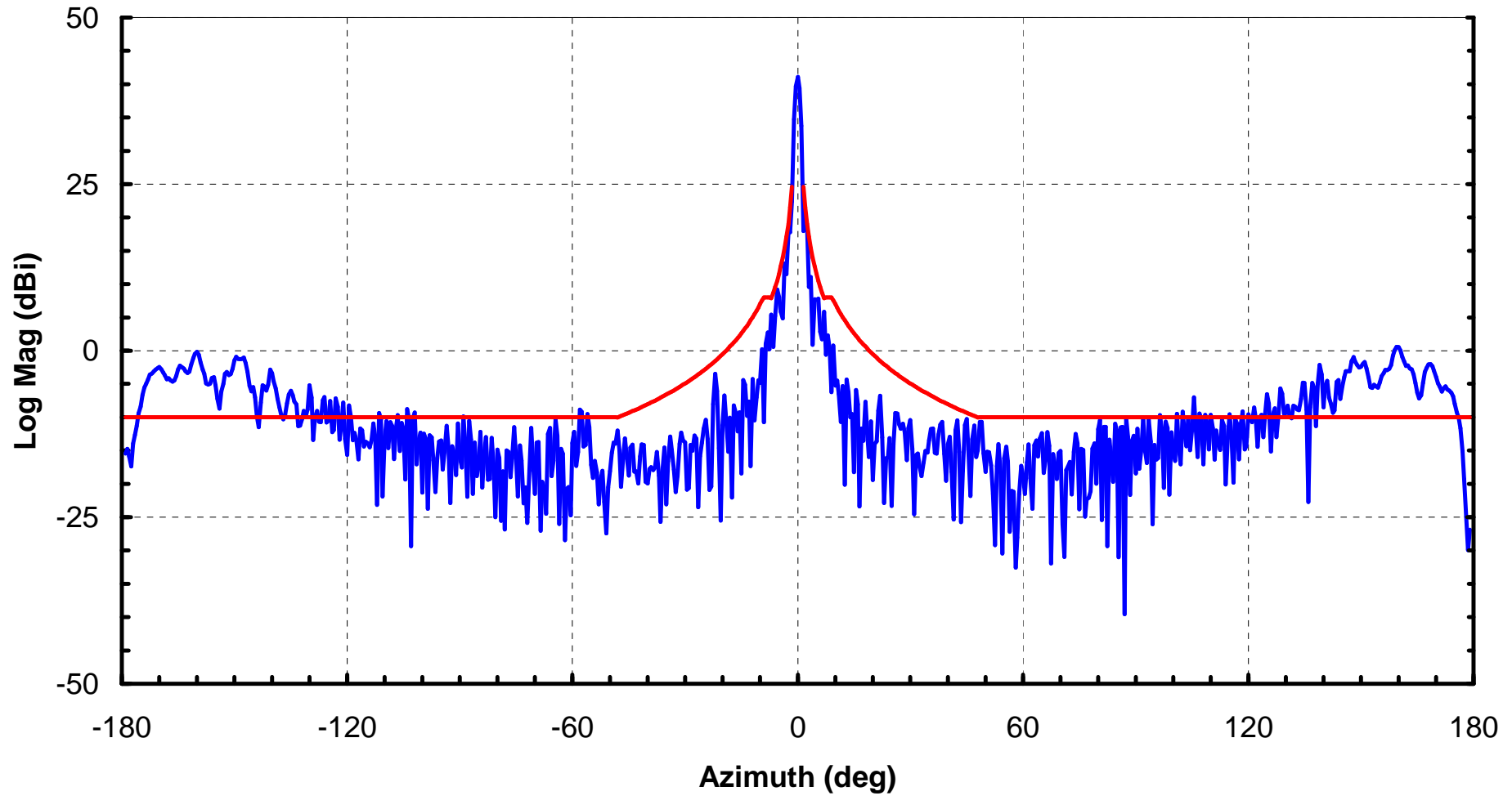


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed
12

Horizontal Co-Polar Azimuth
14.25GHz

Tx G98cm HH Azimuth

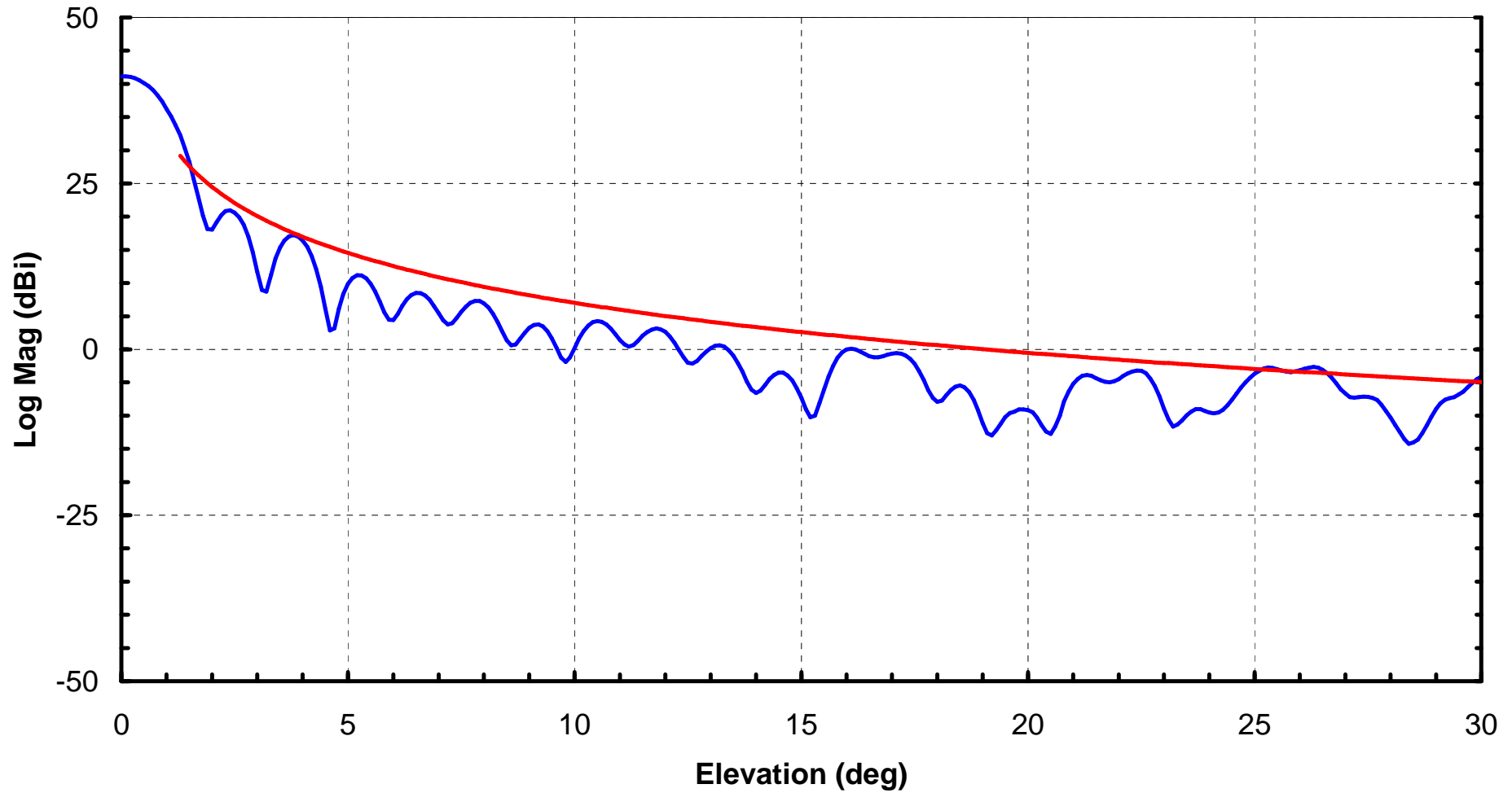


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

Horizontal Co-Polar Azimuth

Tx G98cm HH Elevation



Test Data: 26th Sept 2007
ERA Leatherhead, UK.

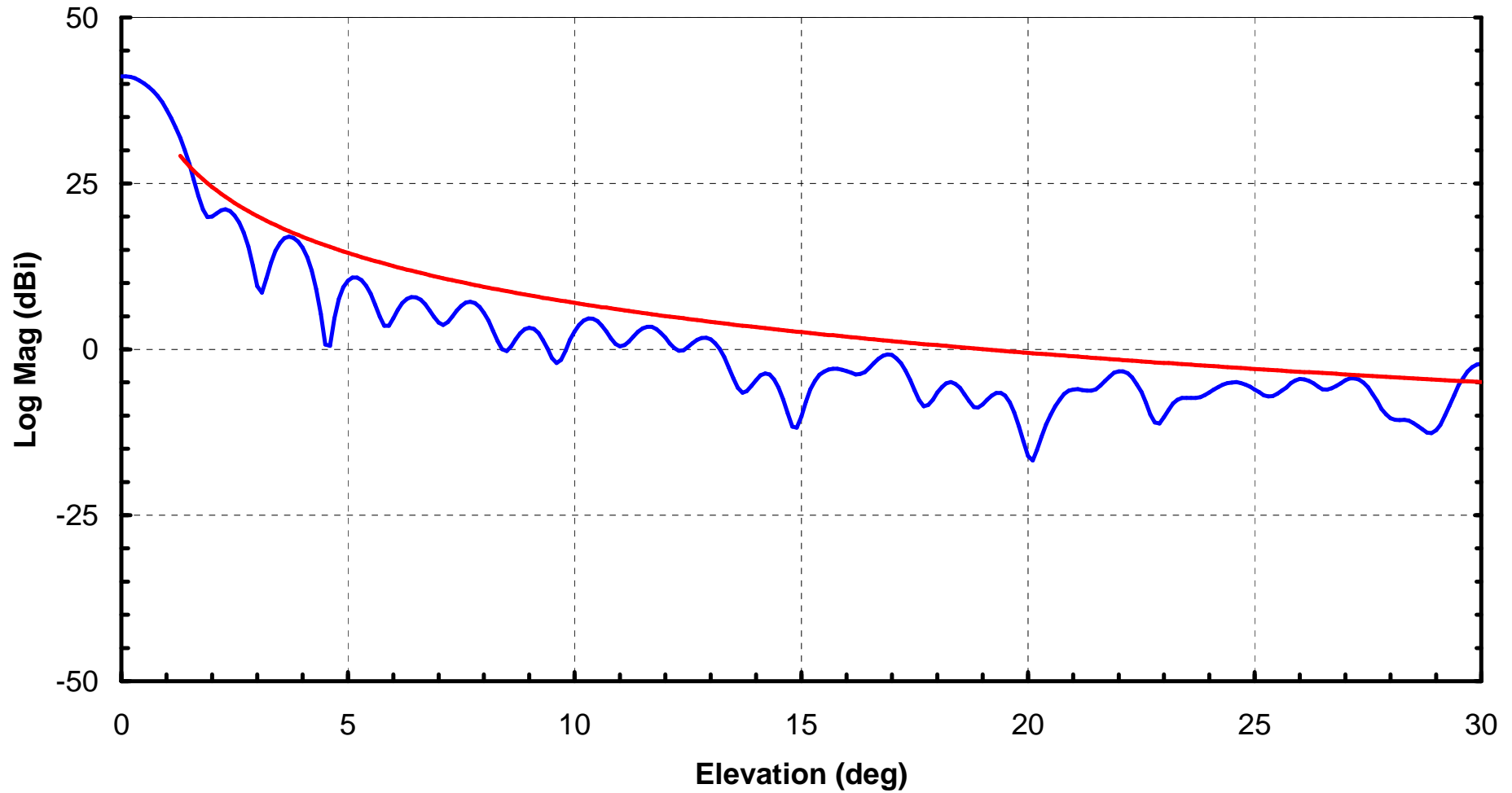
HNS 98cm Antenna with Mode Cancelling Feed

Horizontal Co-Polar Elevation

14

14.00GHz

Tx G98cm HH Elevation

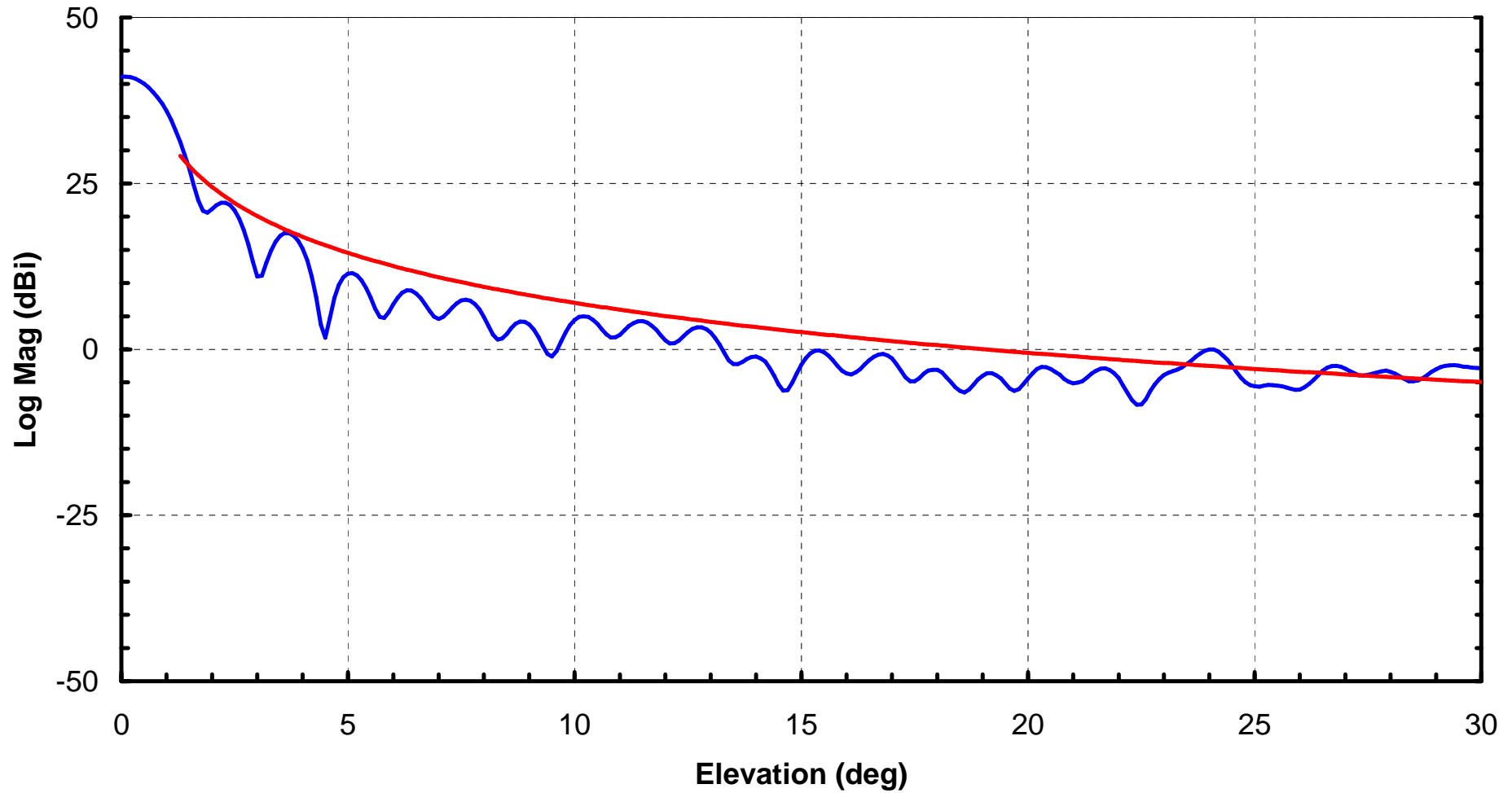


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed
15

Horizontal Co-Polar Elevation
14.25GHz

Tx G98cm HH Elevation



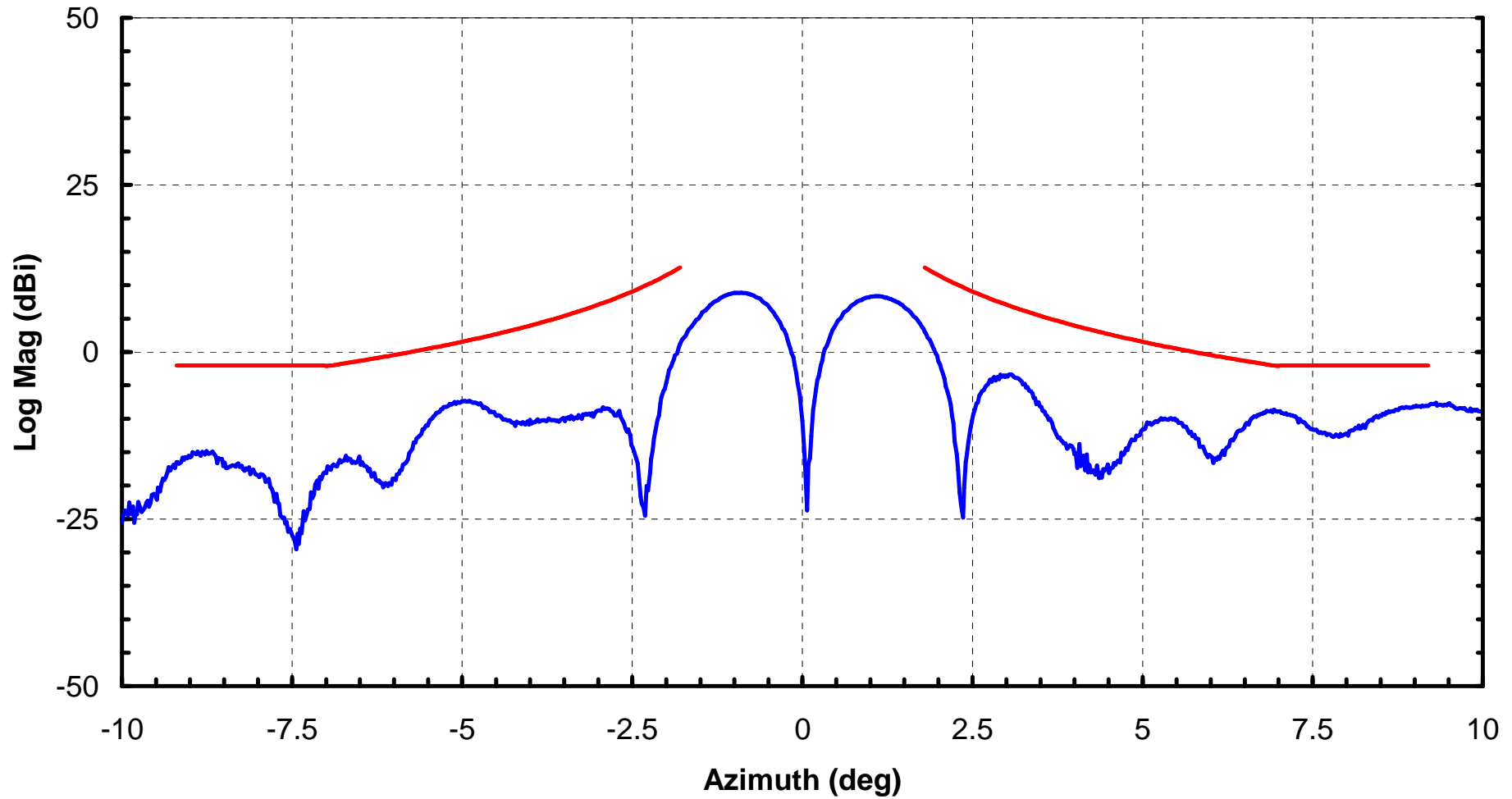
Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

16

Horizontal Co-Polar Elevation
14.5GHz

Tx G98cm HV Azimuth

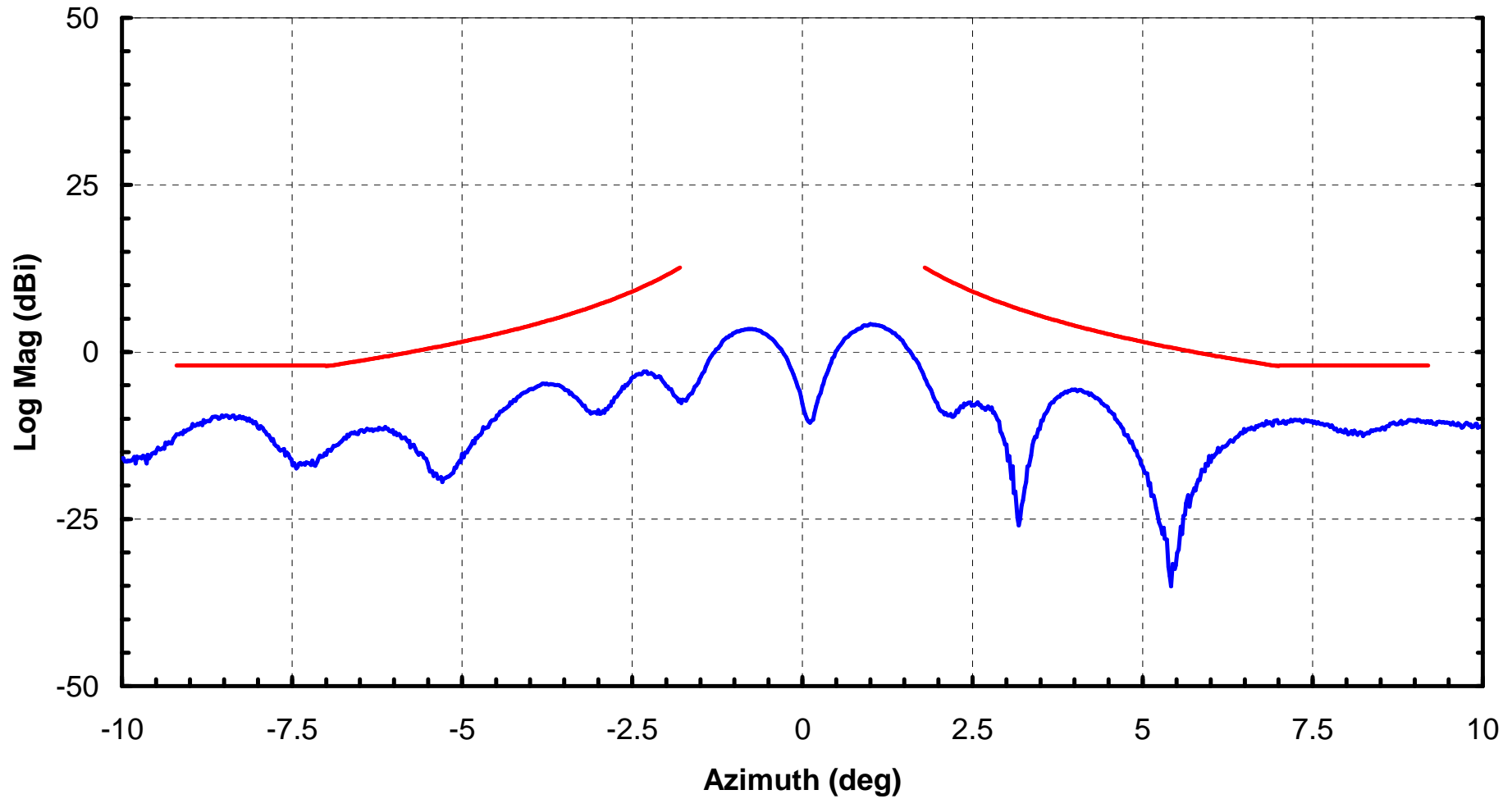


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

Horizontal Cross-Polar Azimuth

Tx G98cm HV Azimuth



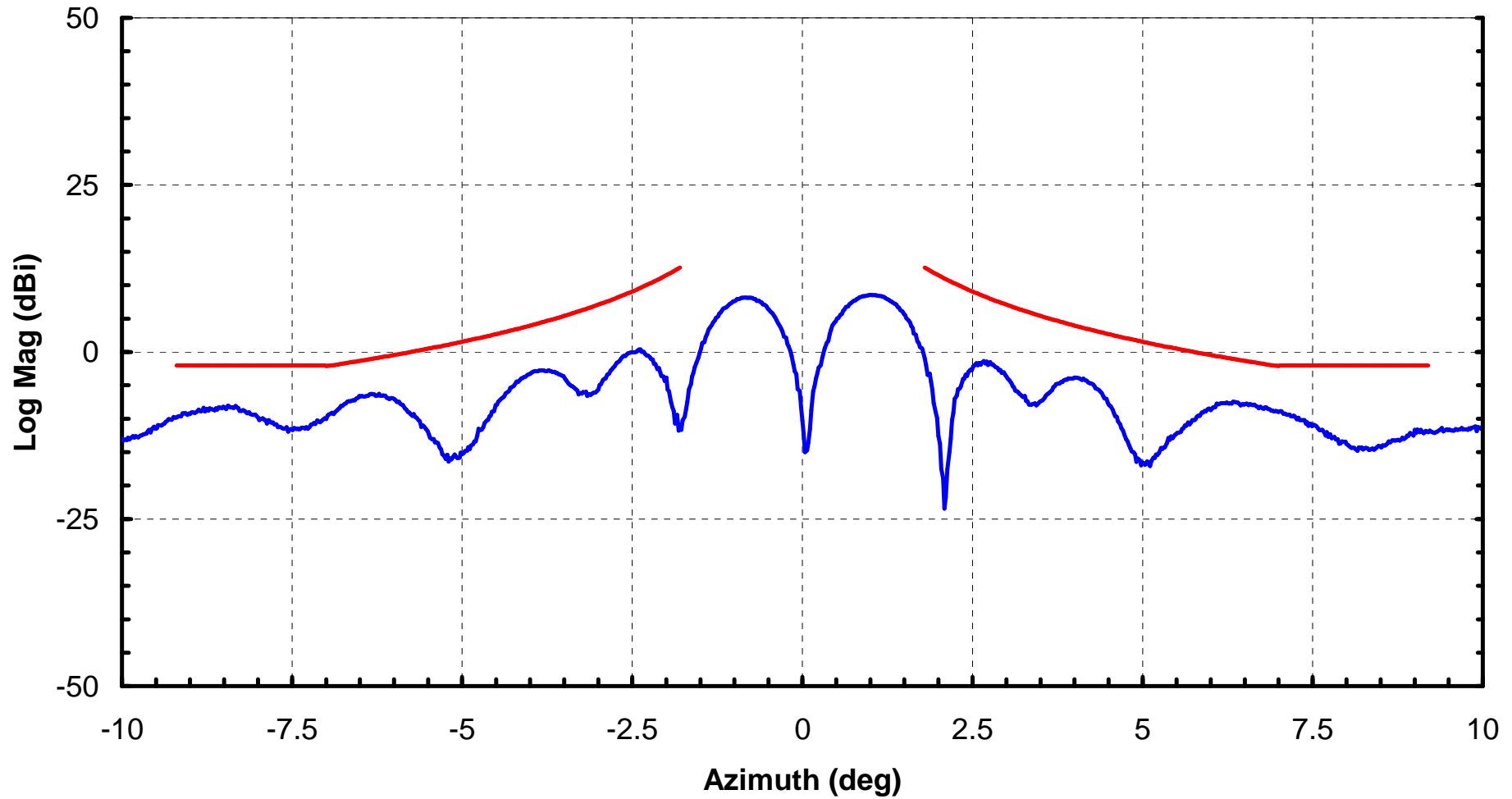
Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

18

Horizontal Cross-Polar Azimuth
14.25GHz

Tx G98cm HV Azimuth

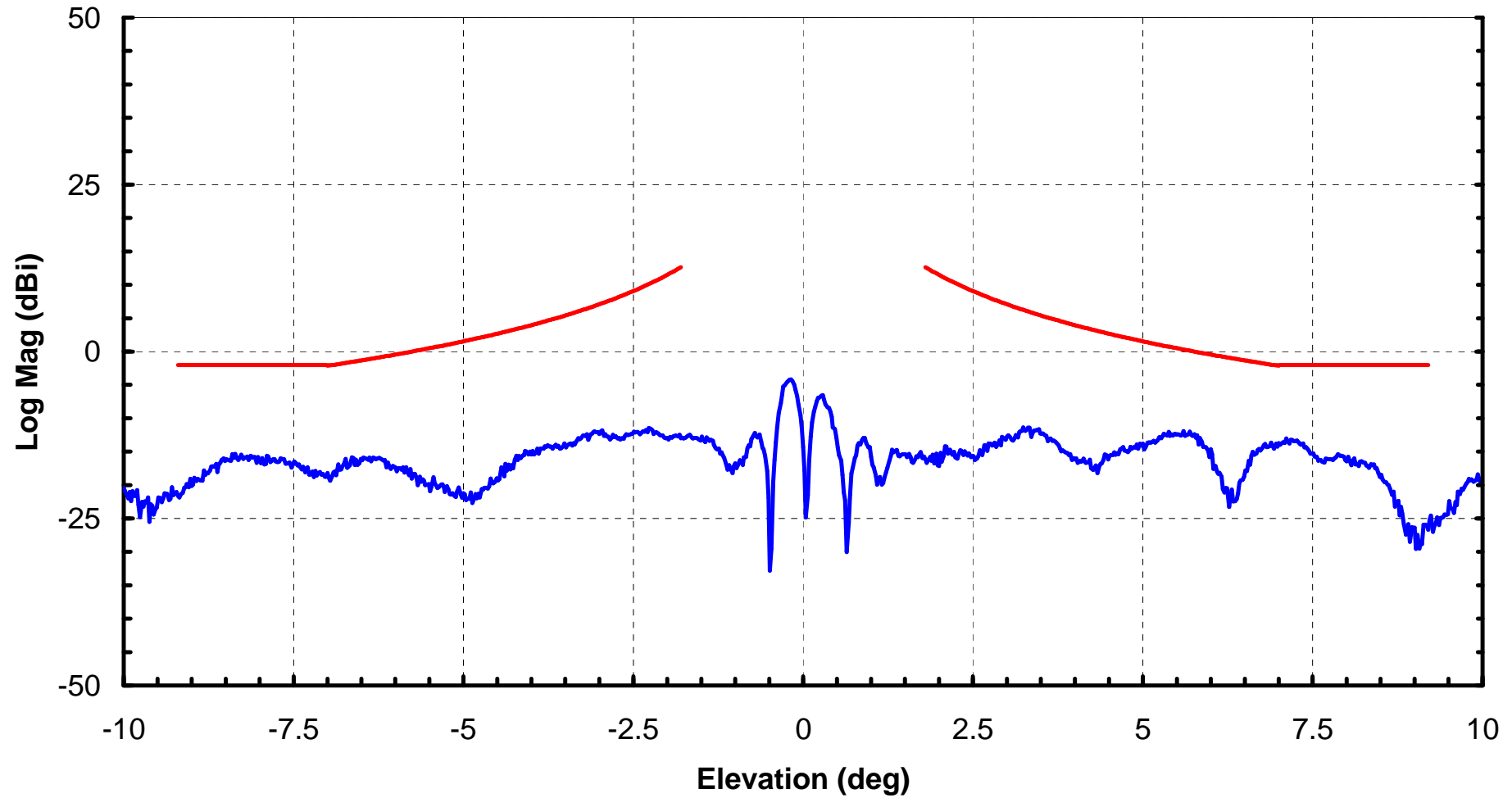


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

Horizontal Cross-Polar Azimuth

Tx G98cm HV Elevation

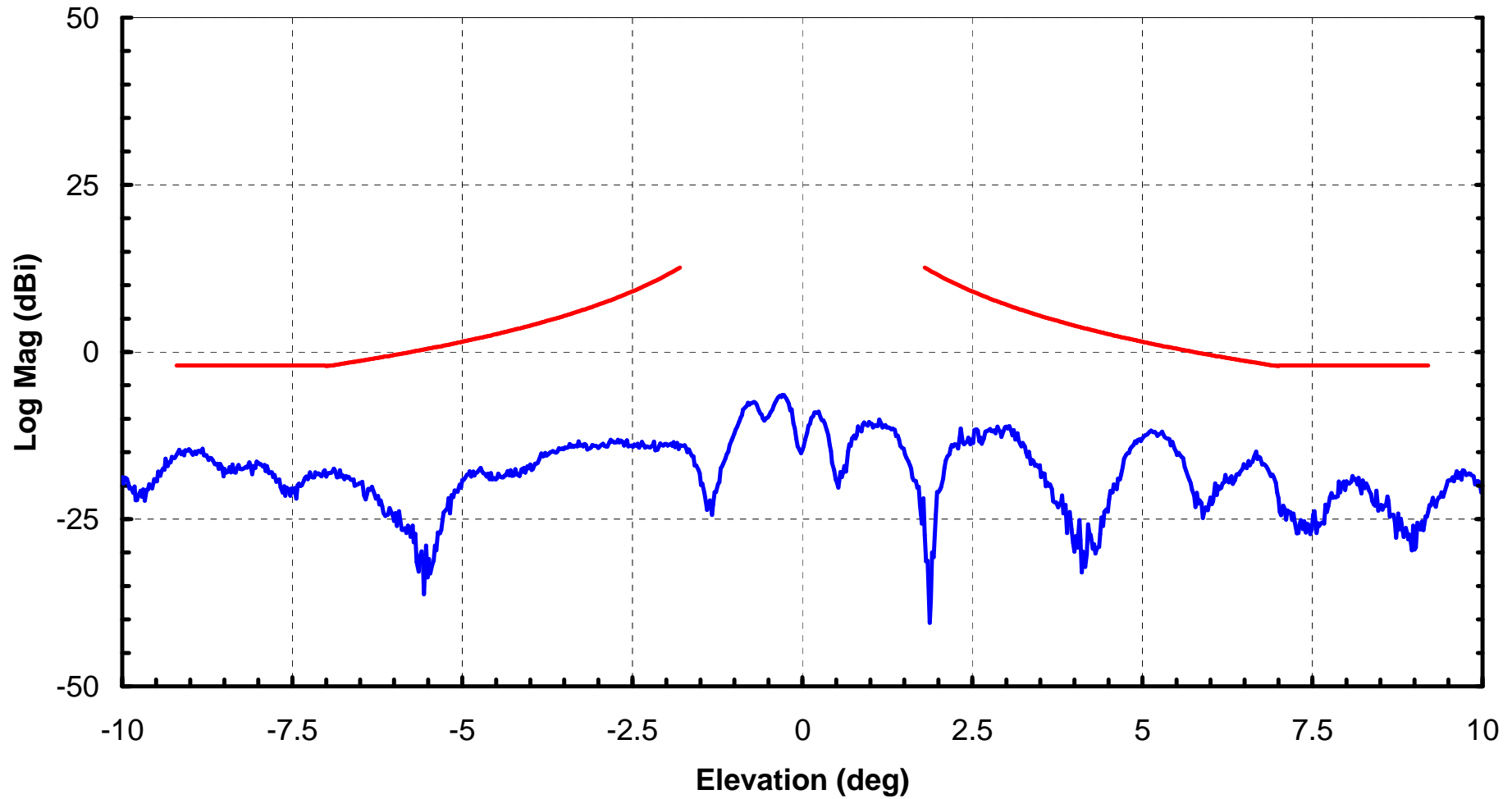


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed
20

Horizontal Cross-Polar Elevation
14.00GHz

Tx G98cm HV Elevation



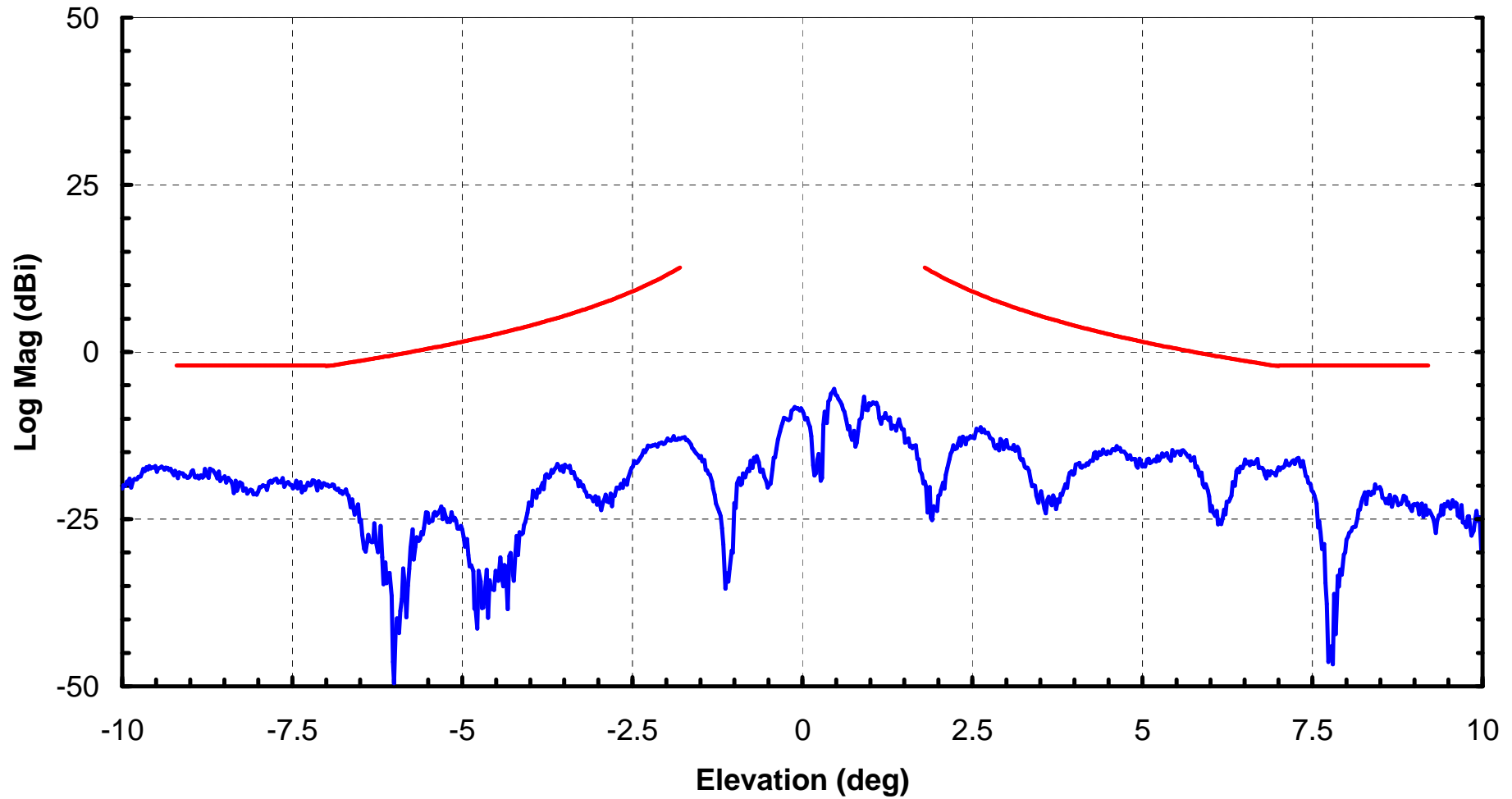
Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

21

Horizontal Cross-Polar Elevation
14.25GHz

Tx G98cm HV Elevation

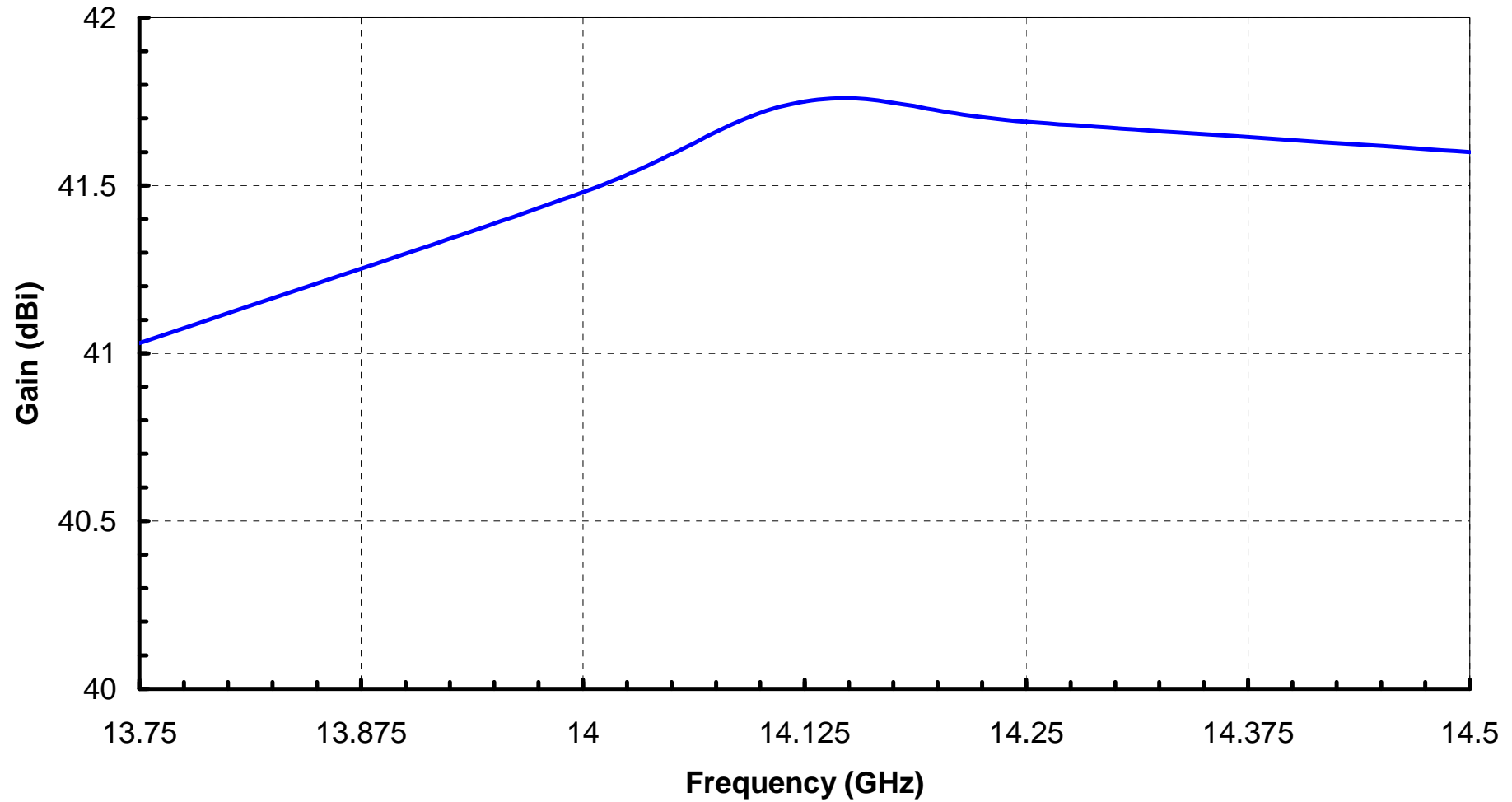


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed
22

Horizontal Cross-Polar Elevation
14.5GHz

Tx G98cm VV Azimuth

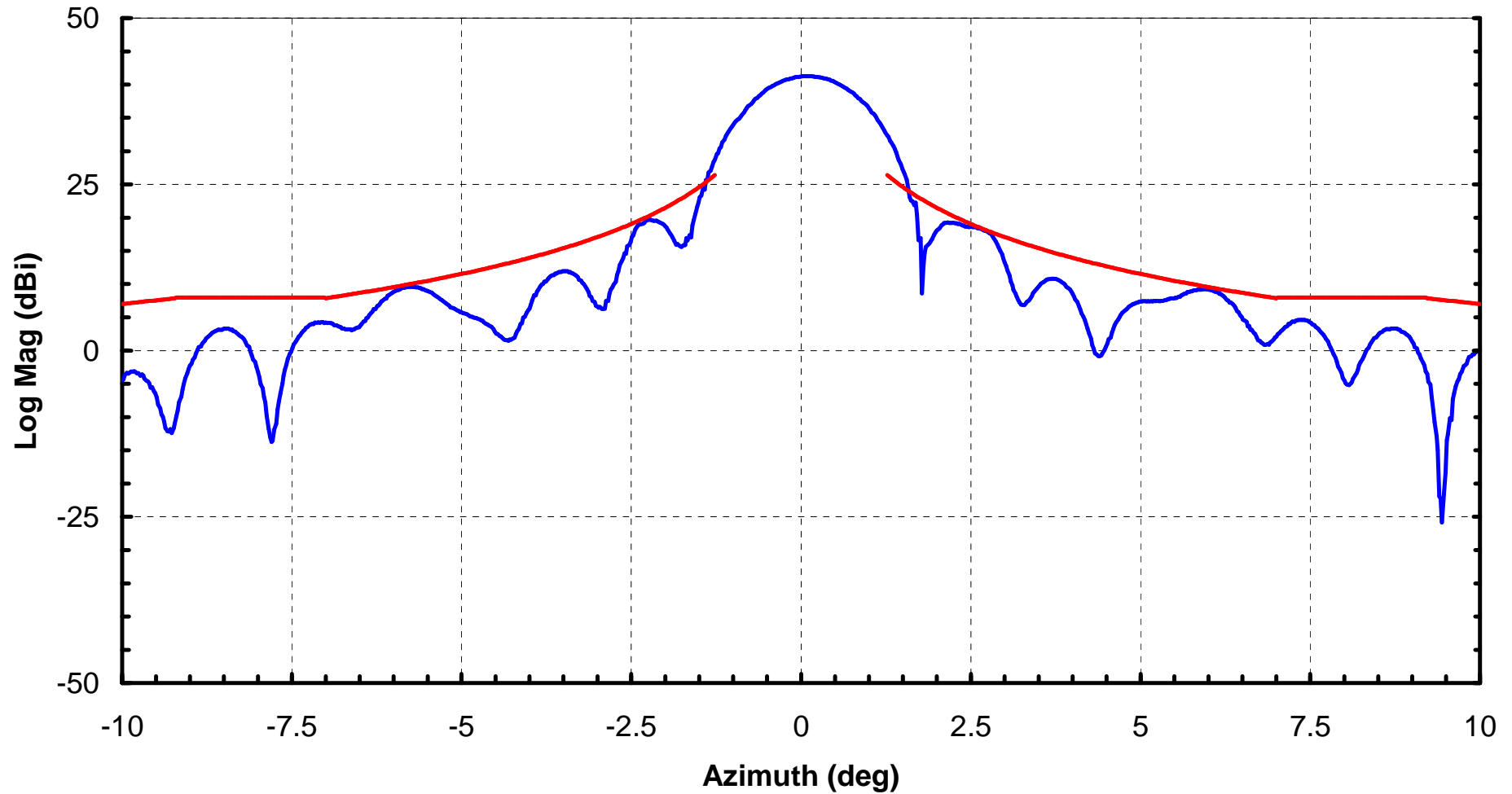


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed
23

Vertical Co-Polar
Gain Sweep

Tx G98cm VV Azimuth



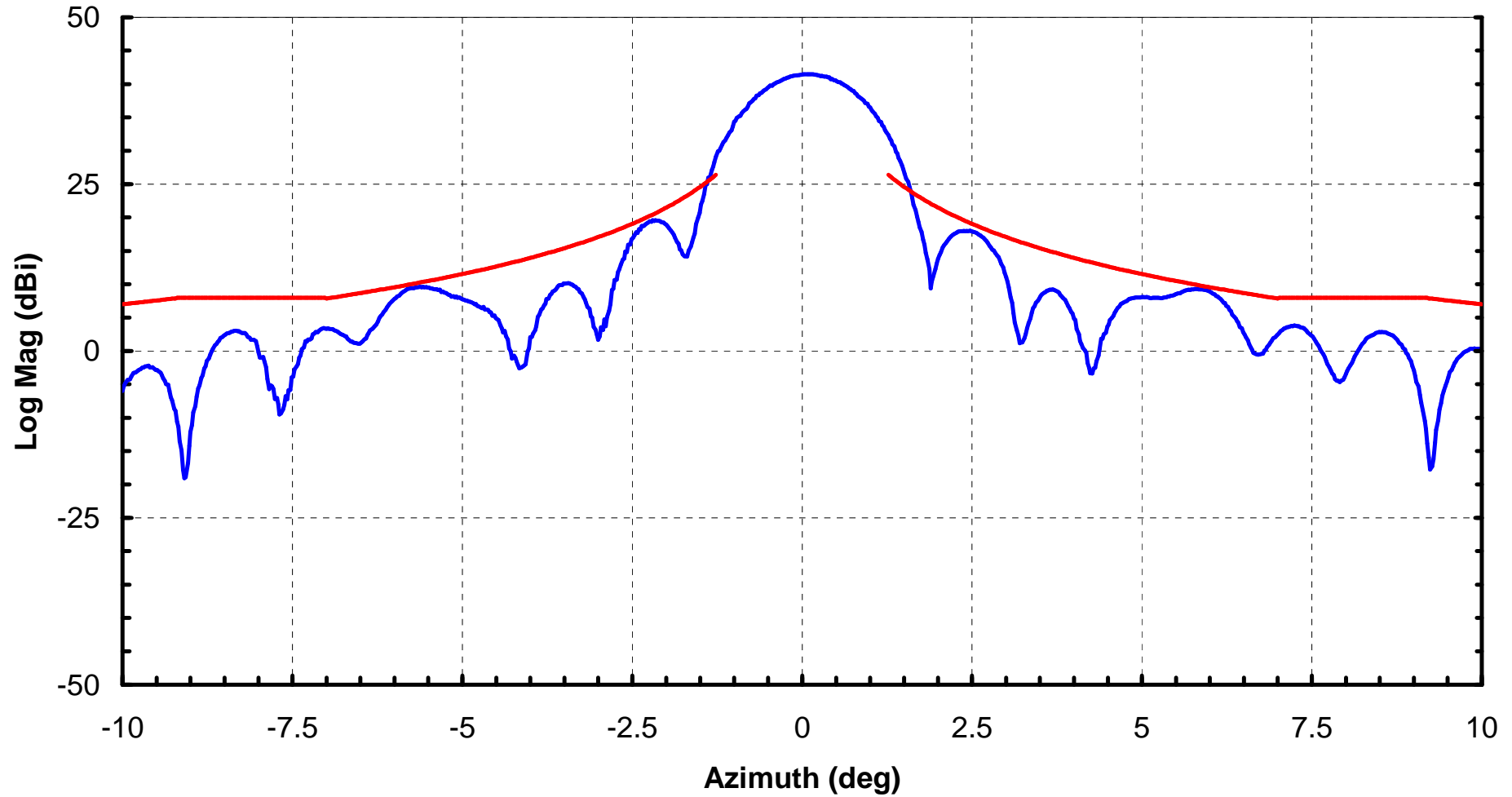
Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

24

Vertical Co-Polar Azimuth
14.00GHz

Tx G98cm VV Azimuth

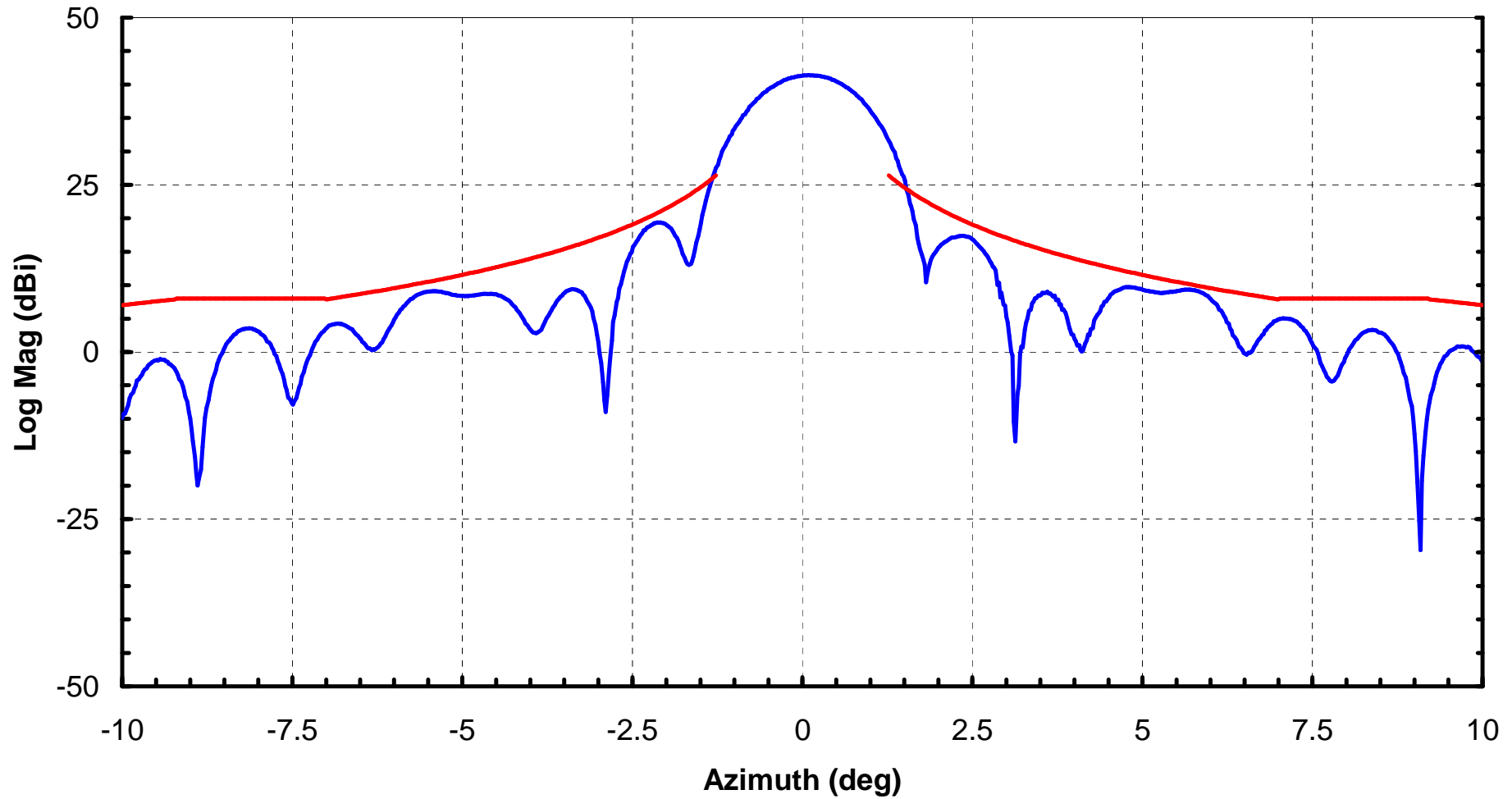


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed
25

Vertical Co-Polar Azimuth
14.25GHz

Tx G98cm VV Azimuth

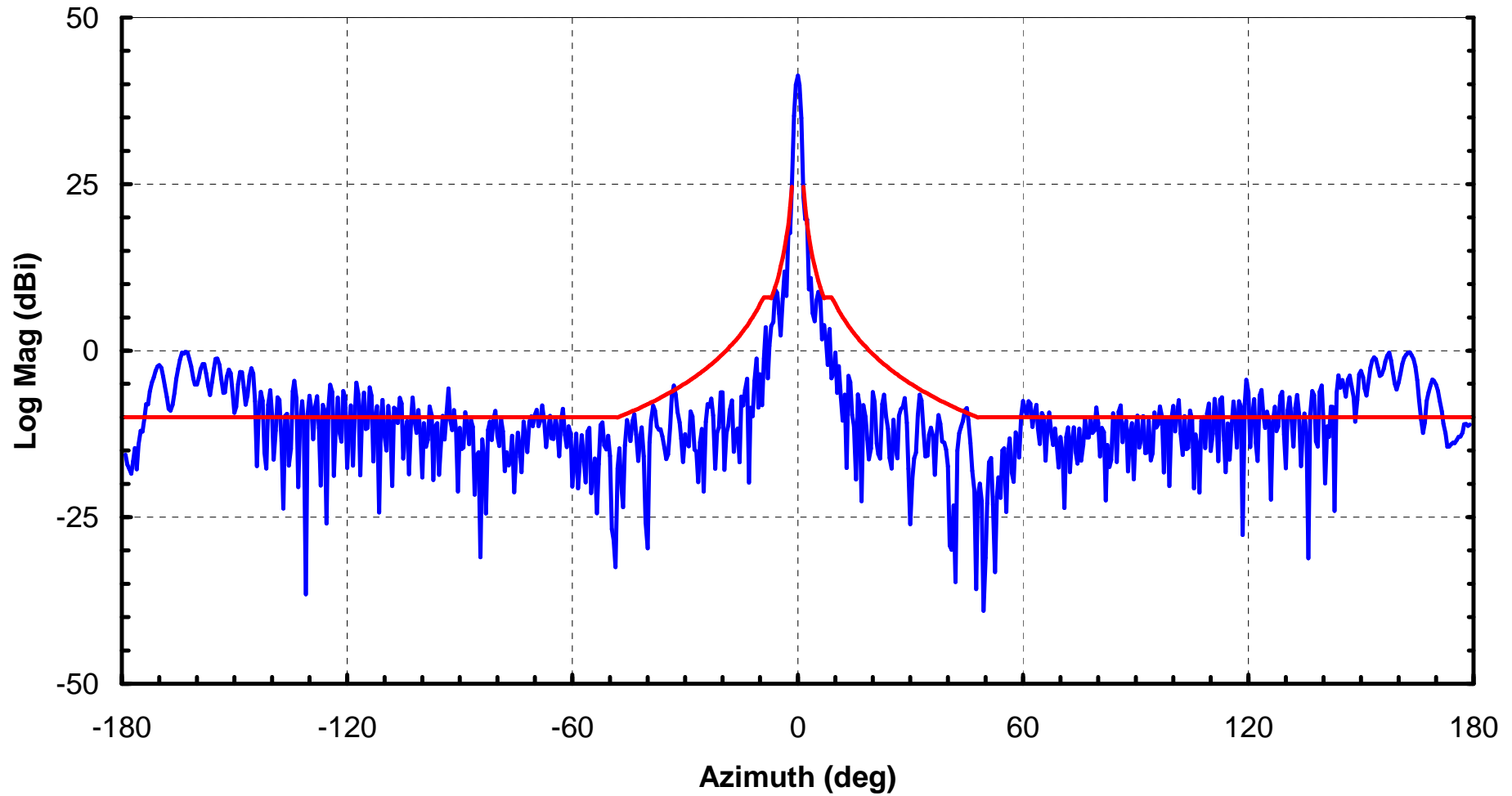


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed
26

Vertical Co-Polar Azimuth
14.5GHz

Tx G98cm VV Azimuth

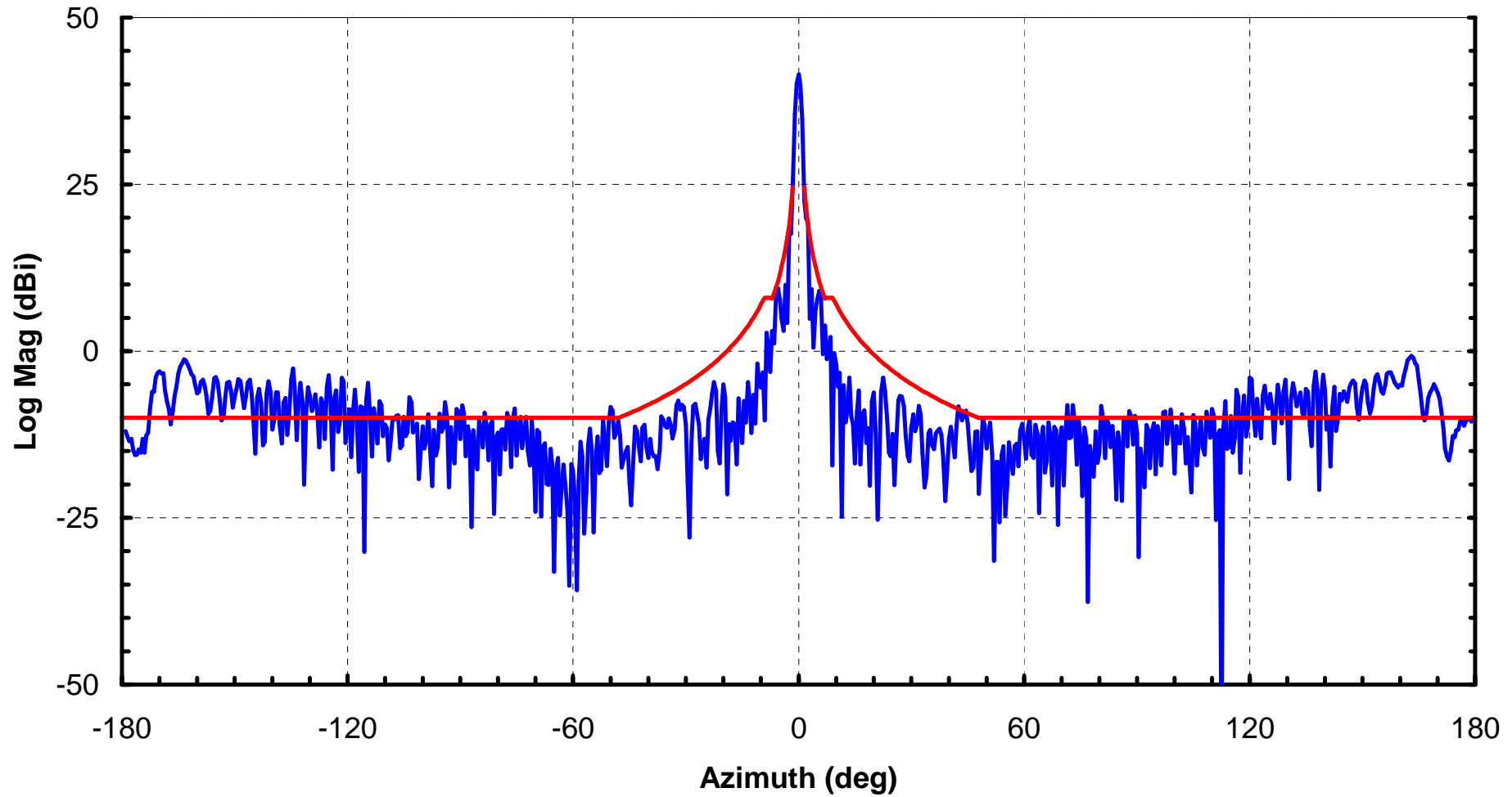


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed
27

Vertical Co-Polar Azimuth
14.00GHz

Tx G98cm VV Azimuth

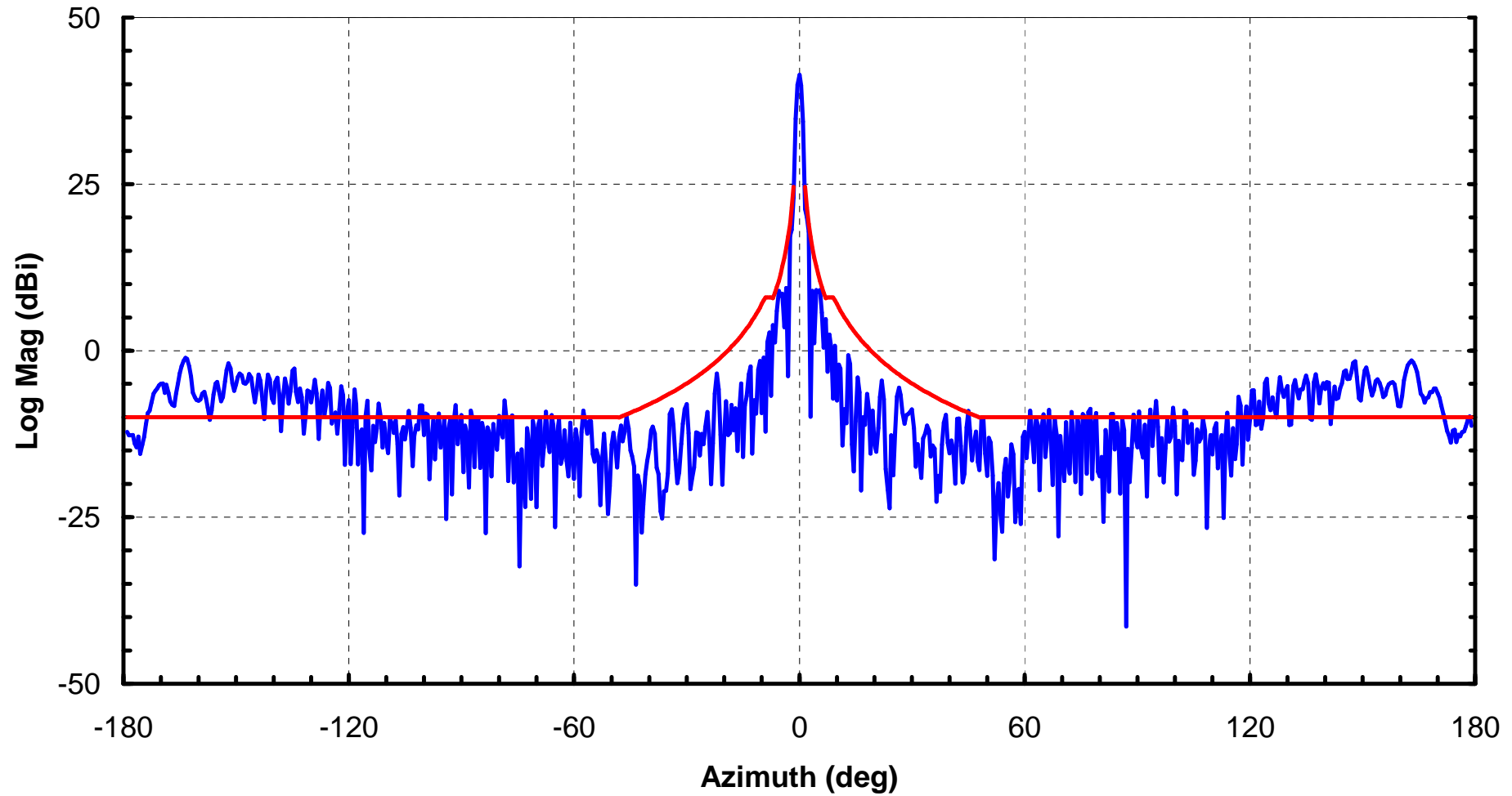


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed
28

Vertical Co-Polar Azimuth
14.25GHz

Tx G98cm VV Azimuth

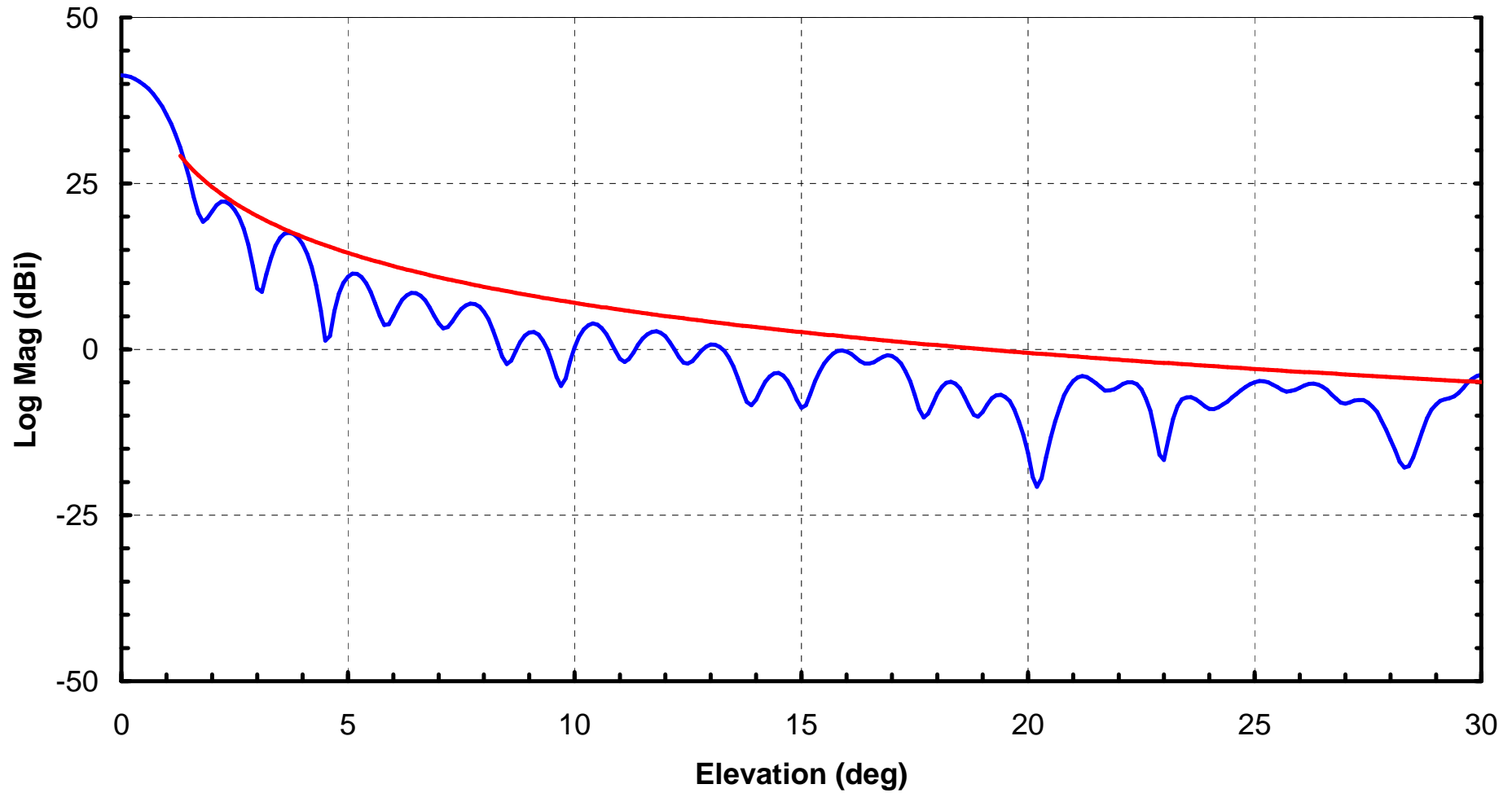


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed
29

Vertical Co-Polar Azimuth
14.5GHz

Tx G98cm VV Elevation

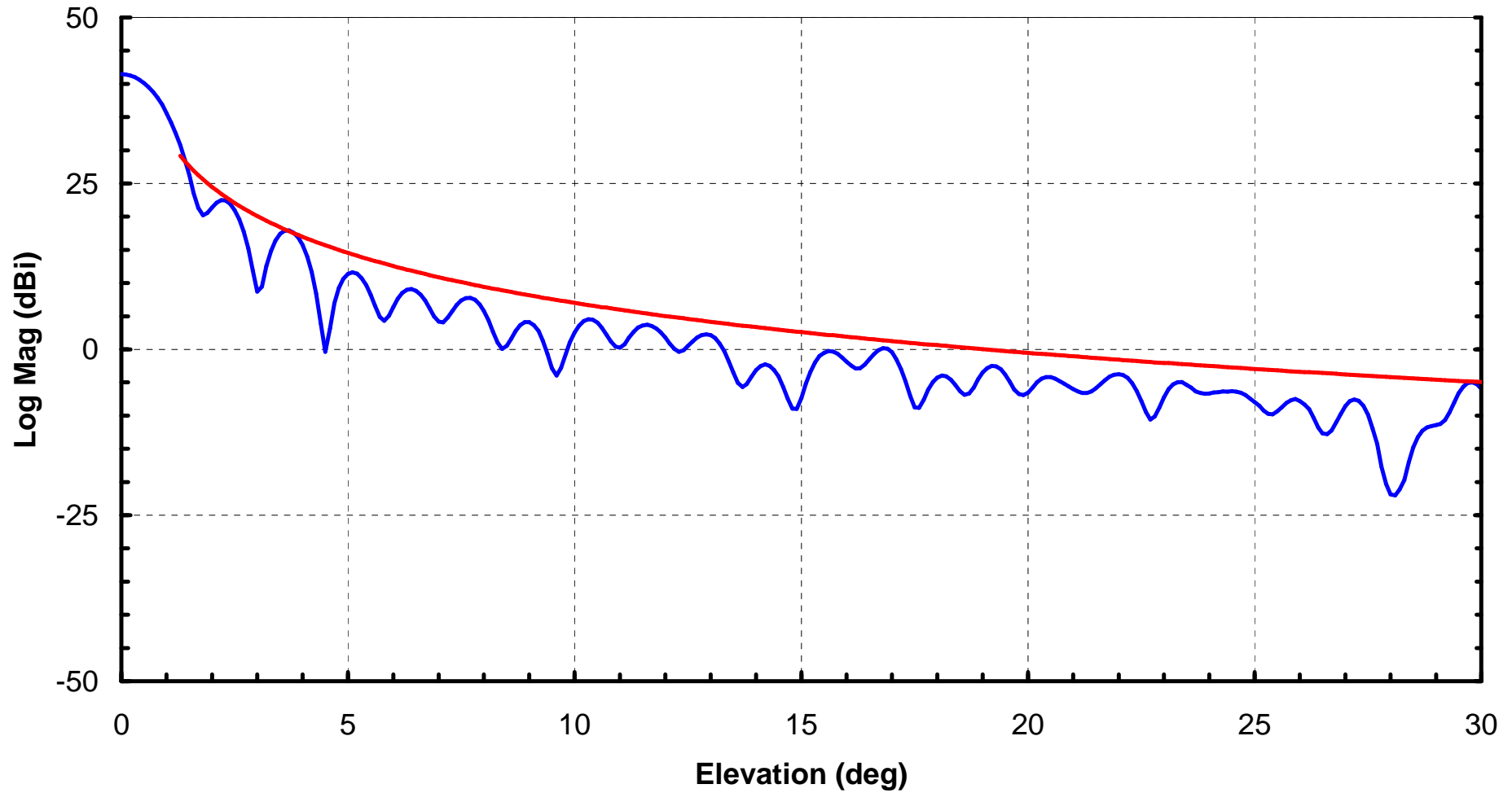


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed
30

Vertical Co-Polar Elevation
14.00GHz

Tx G98cm VV Elevation

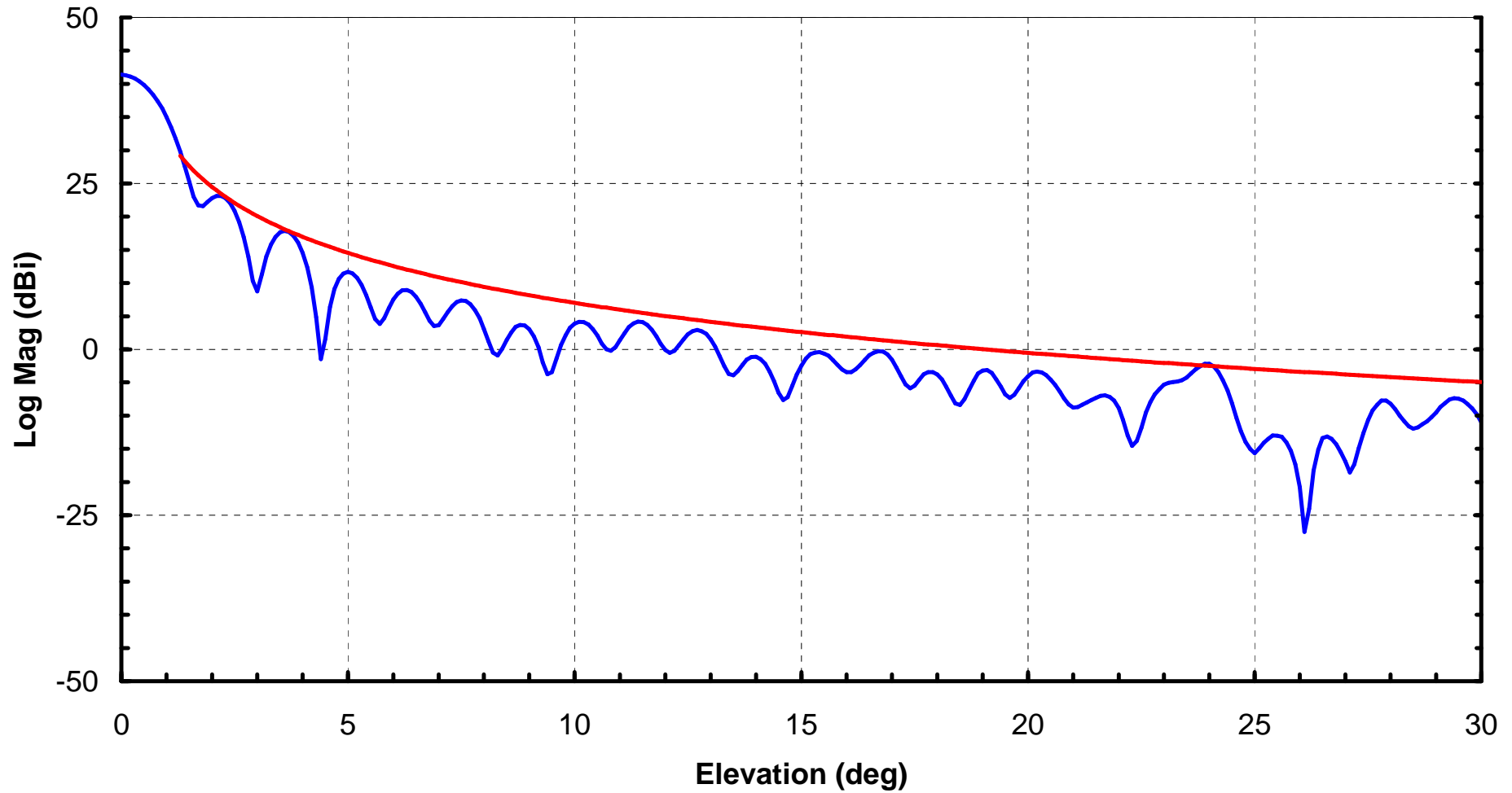


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

Vertical Co-Polar Elevation
14.25GHz

Tx G98cm VV Elevation



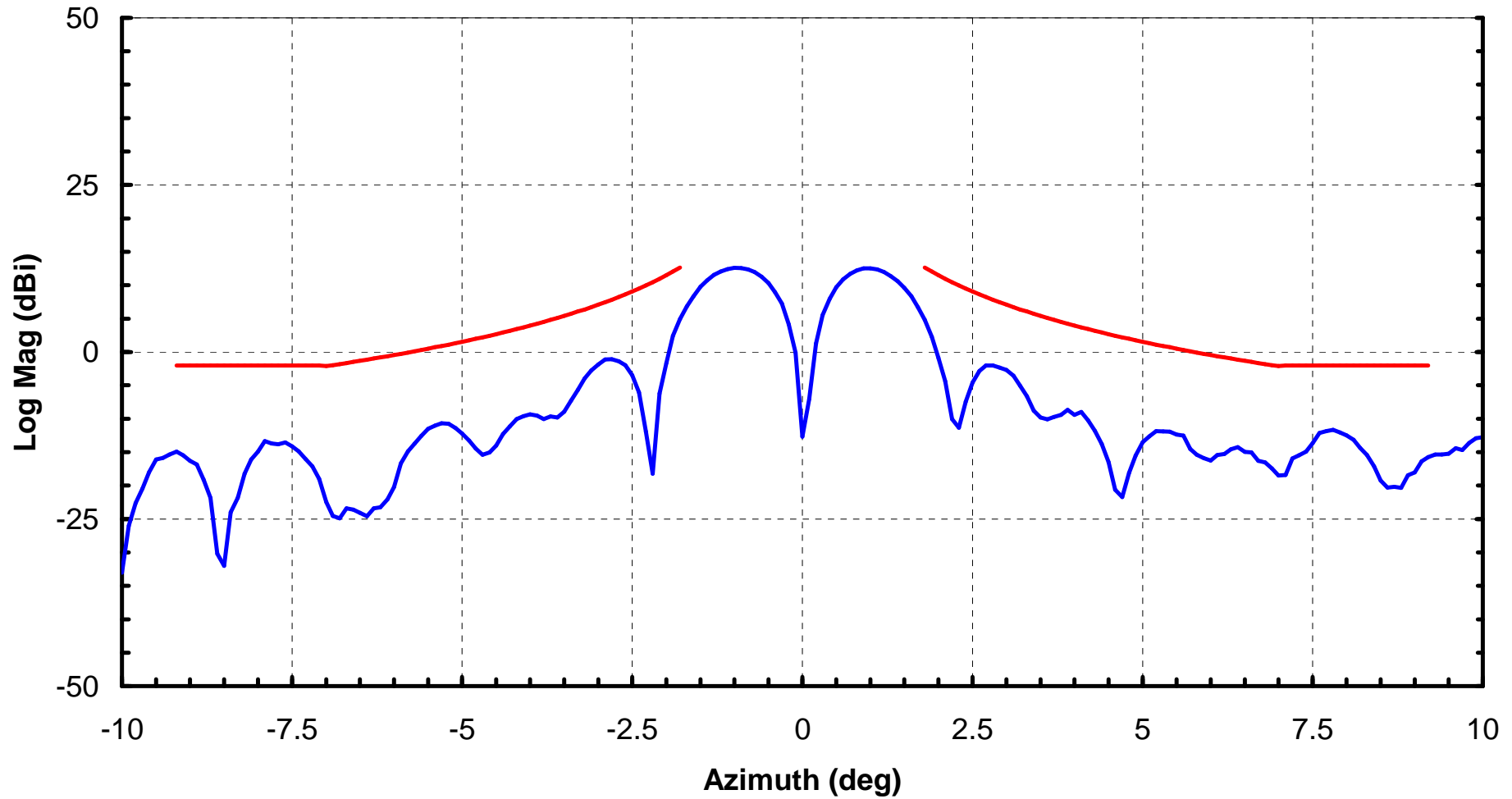
Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

32

Vertical Co-Polar Elevation
14.5GHz

Tx G98cm VH Azimuth



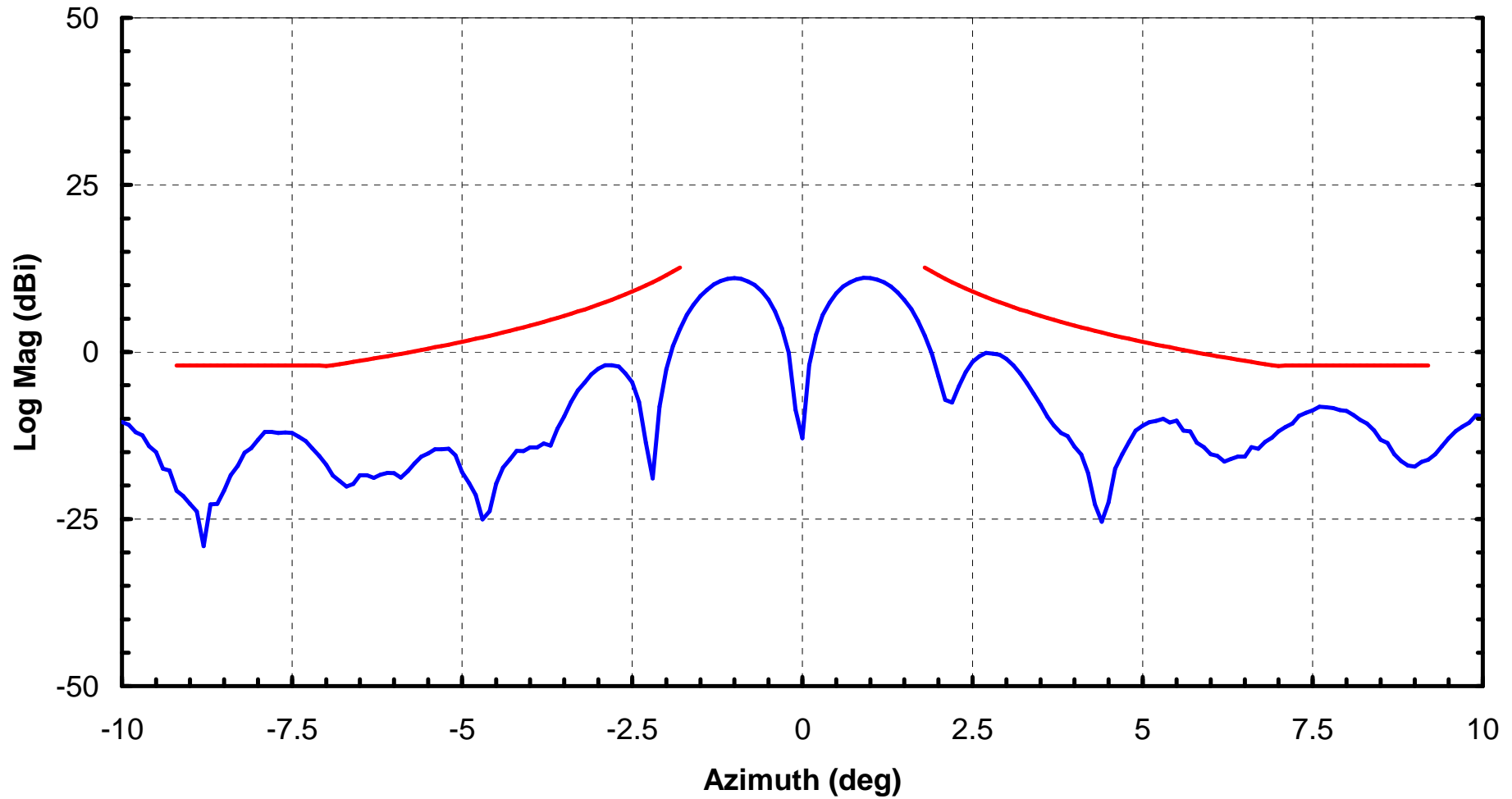
Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

33

Vertical Cross-Polar Azimuth
14.00GHz

Tx G98cm VH Azimuth

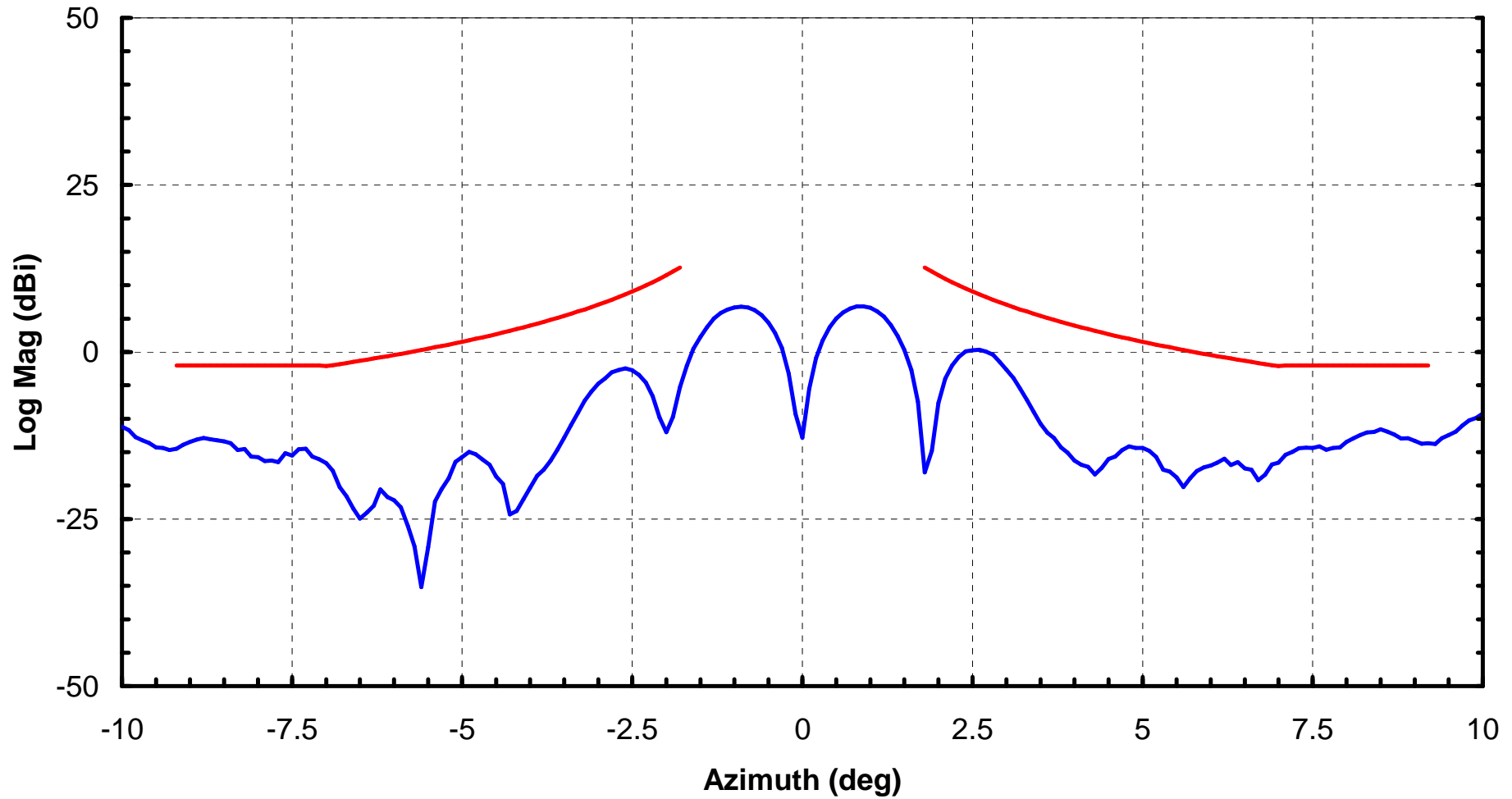


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

Vertical Cross-Polar Azimuth

Tx G98cm VH Azimuth

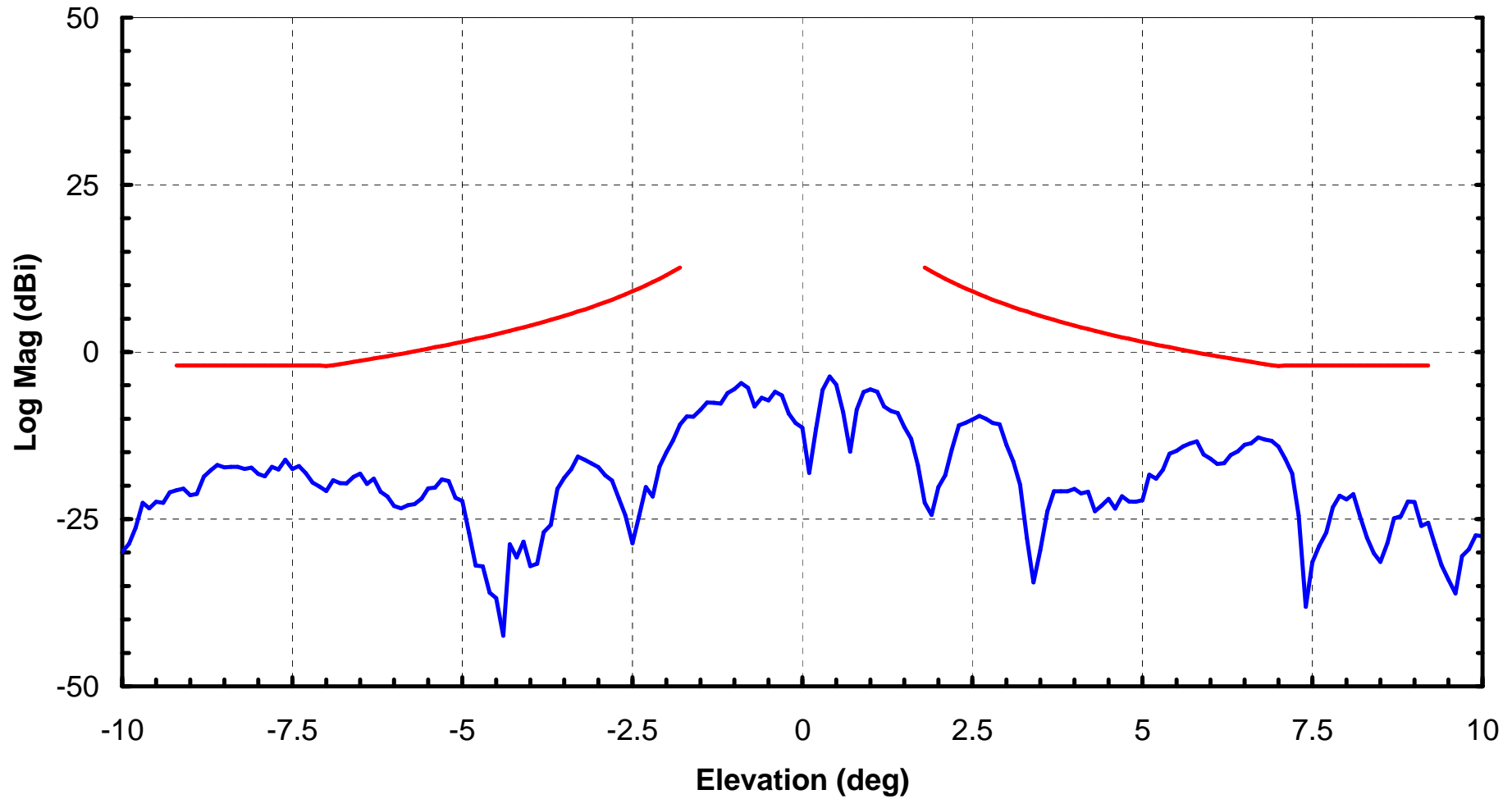


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed
35

Vertical Cross-Polar Azimuth
14.5GHz

Tx G98cm VH Elevation



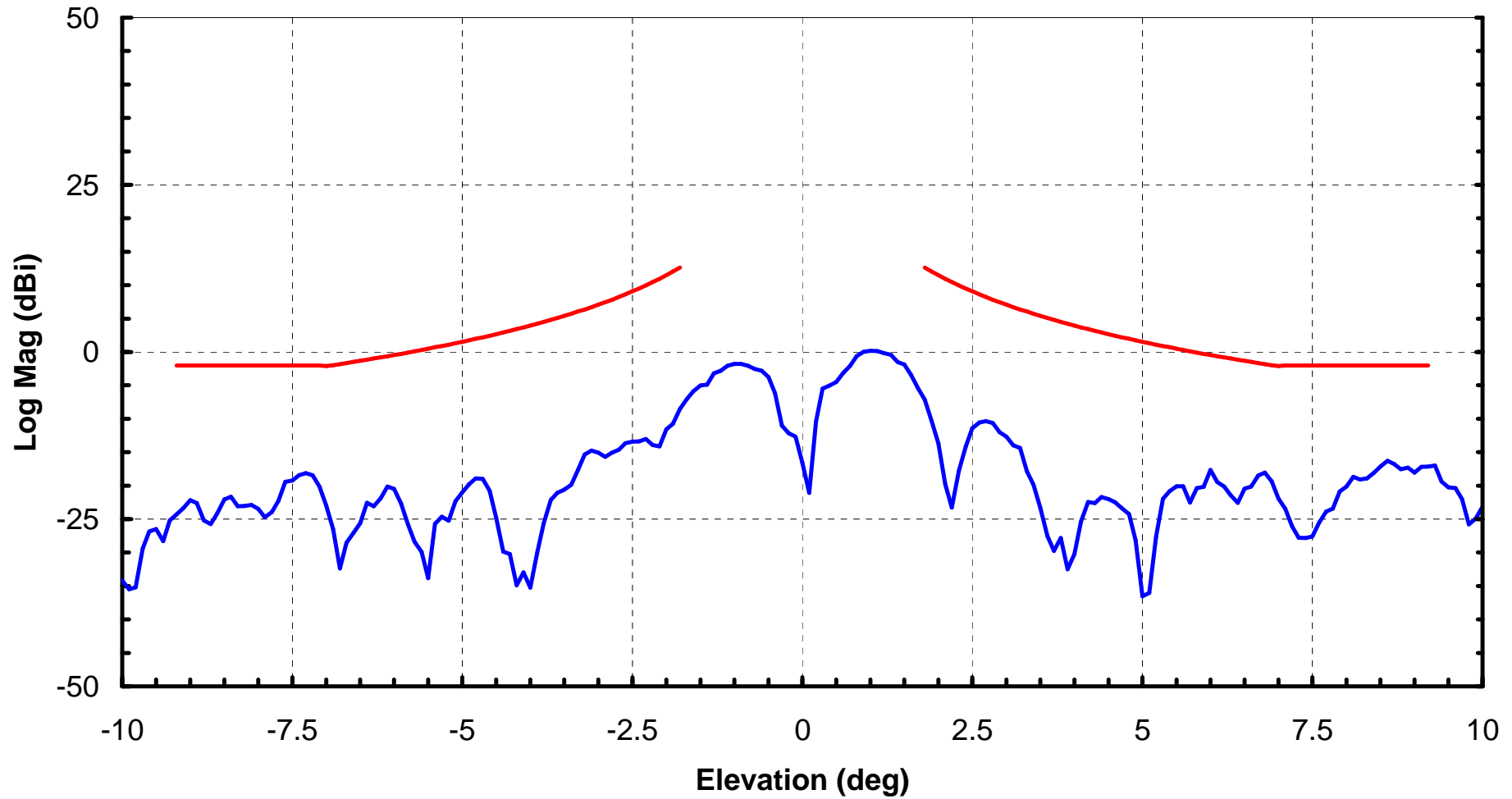
Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

36

Vertical Cross-Polar Elevation
14.00GHz

Tx G98cm VH Elevation



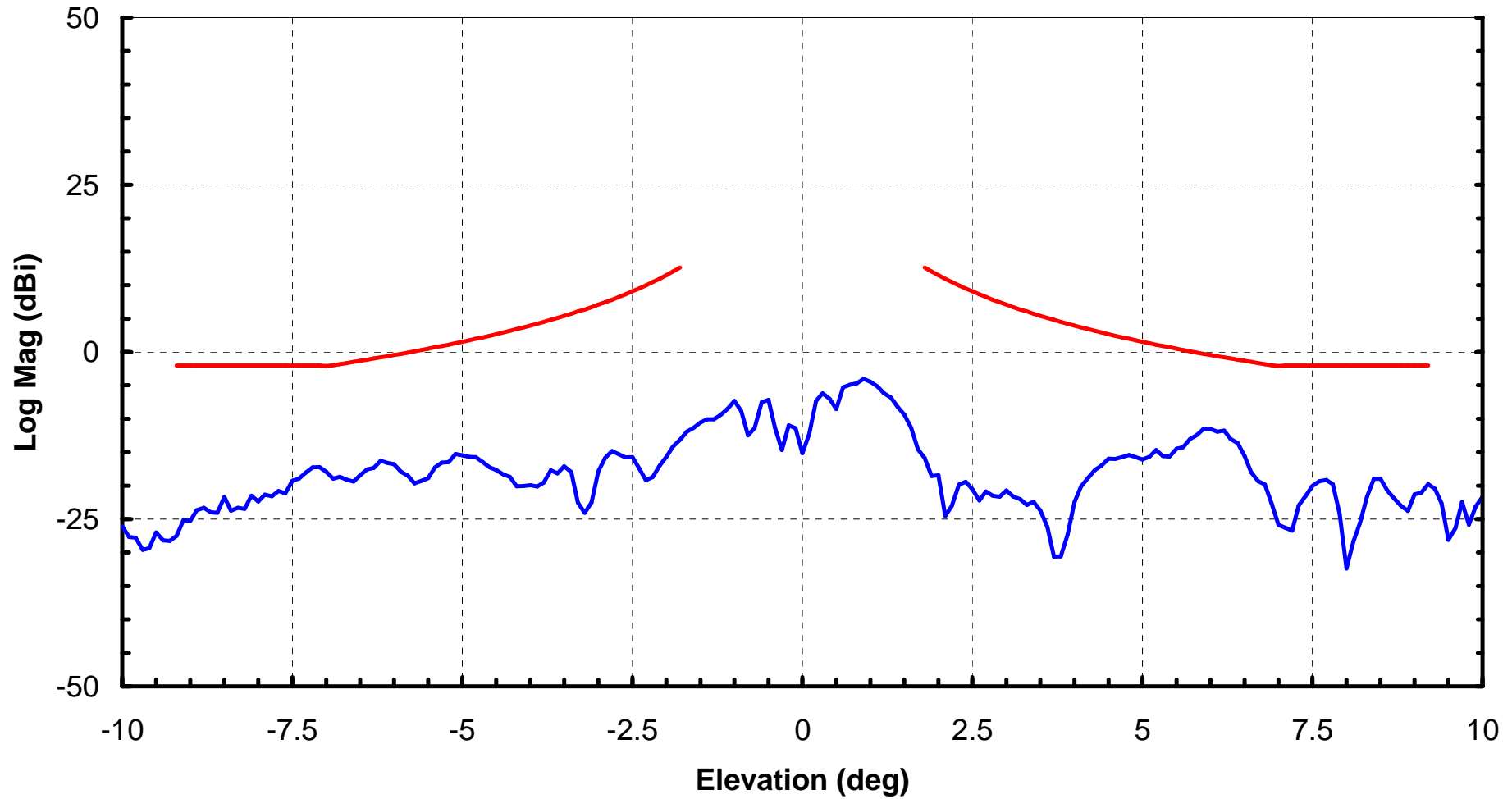
Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

37

Vertical Cross-Polar Elevation
14.25GHz

Tx G98cm VH Elevation



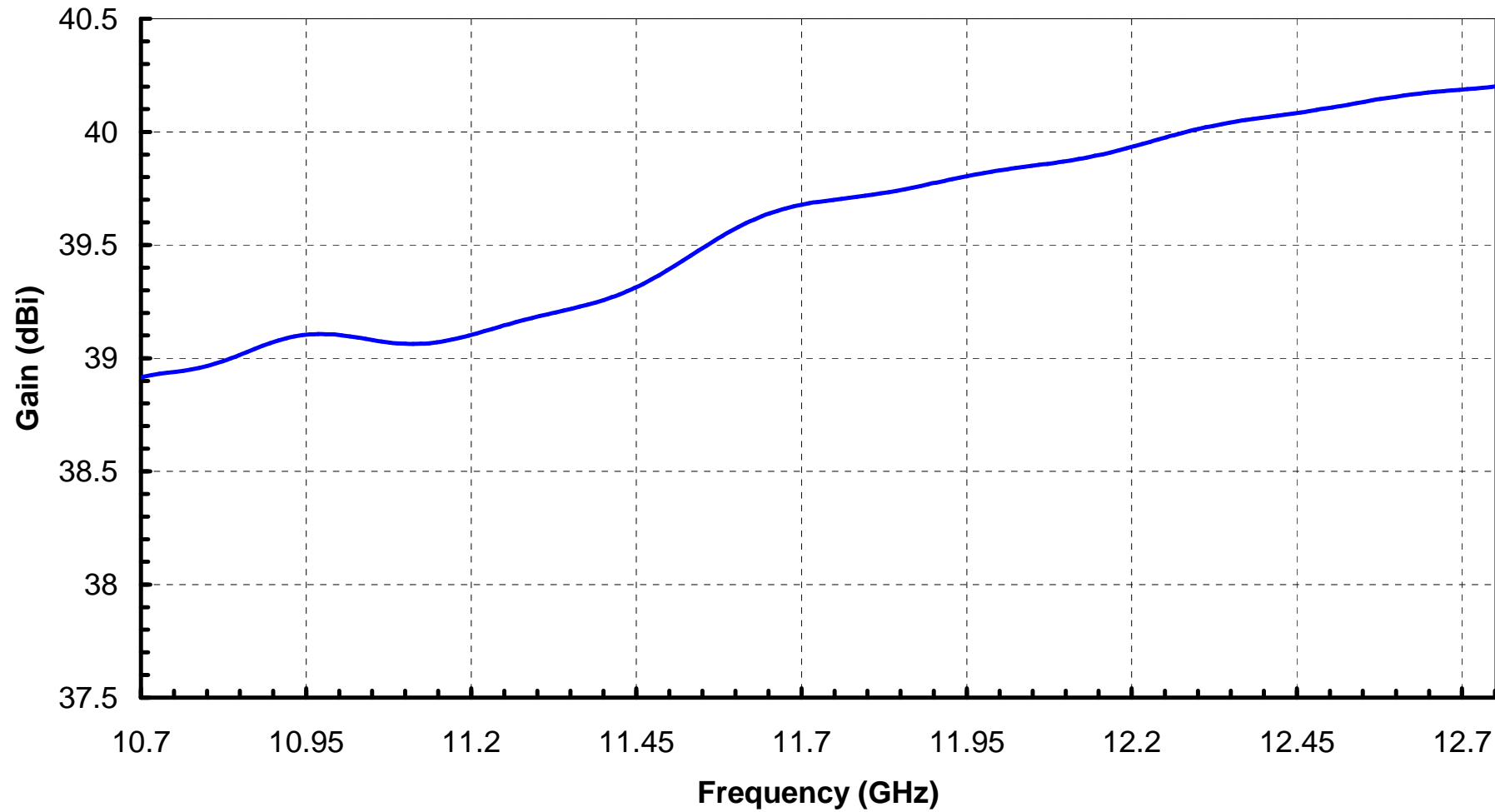
Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

38

Vertical Cross-Polar Elevation
14.5GHz

Rx G98cm HH Azimuth

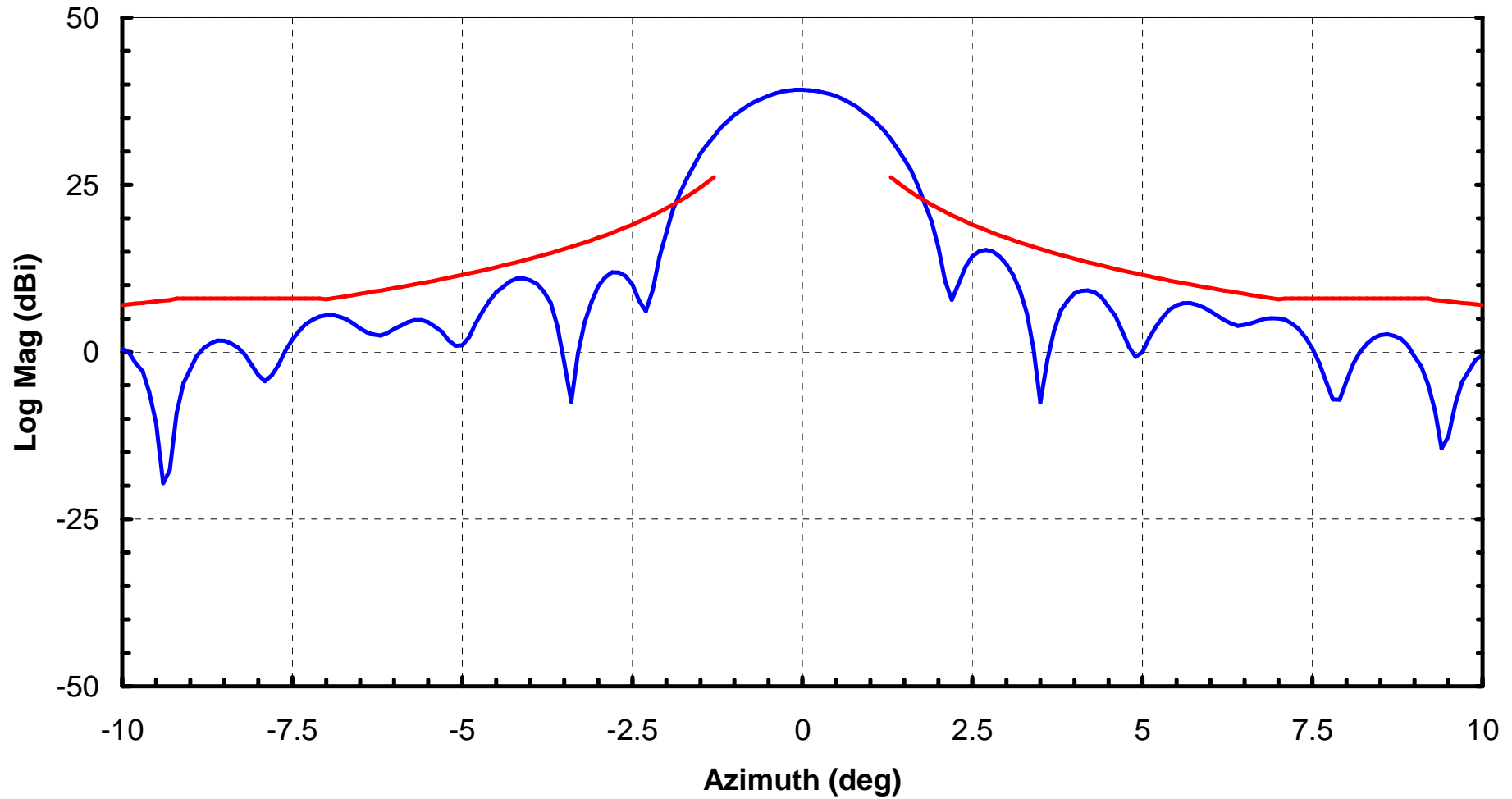


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

Horizontal Co-Polar
Gain Sweep

Rx G98cm HH Azimuth



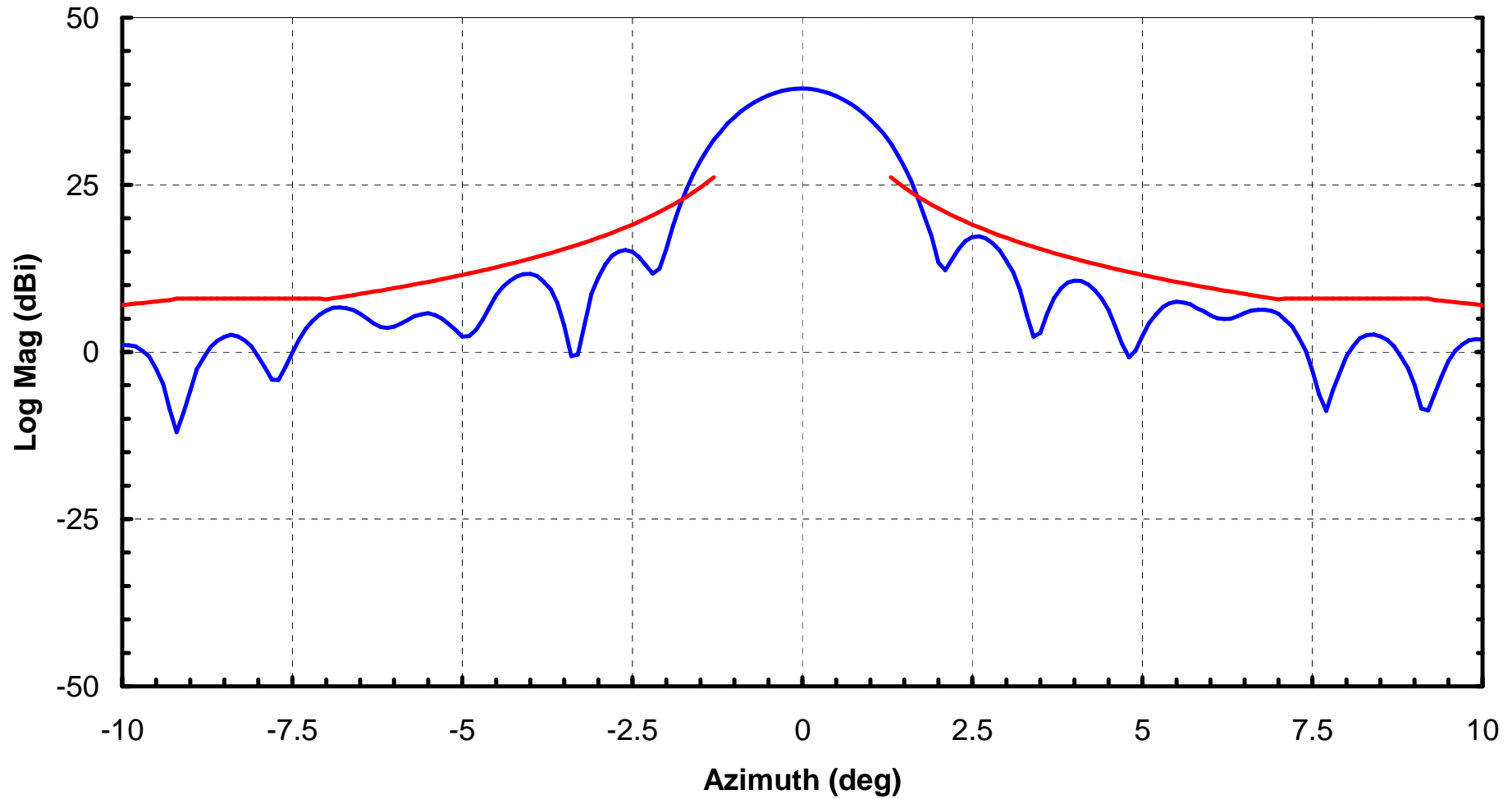
Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

40

Horizontal Co-Polar Azimuth
11.70GHz

Rx G98cm HH Azimuth



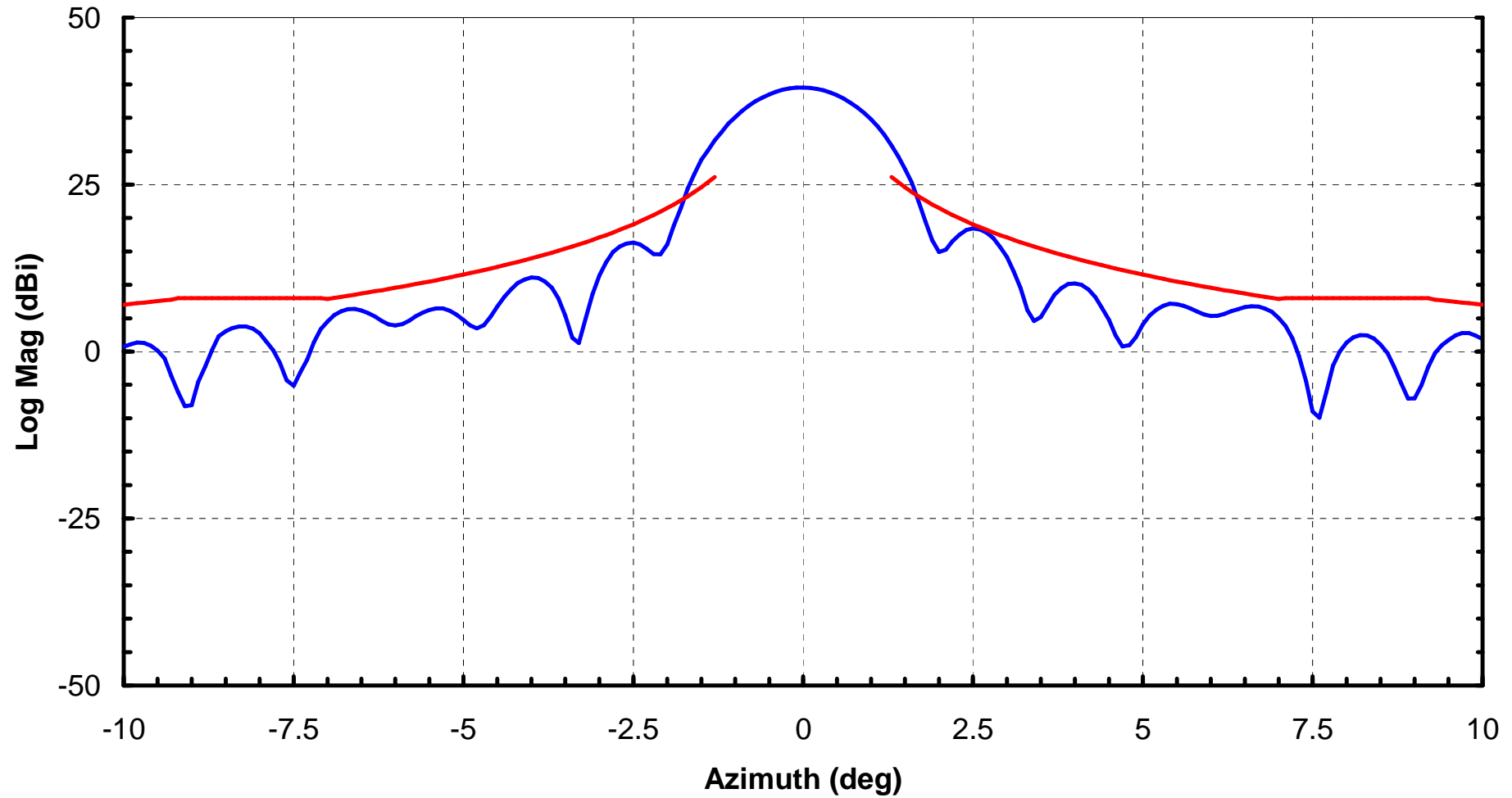
Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

41

Horizontal Co-Polar Azimuth
11.95GHz

Rx G98cm HH Azimuth



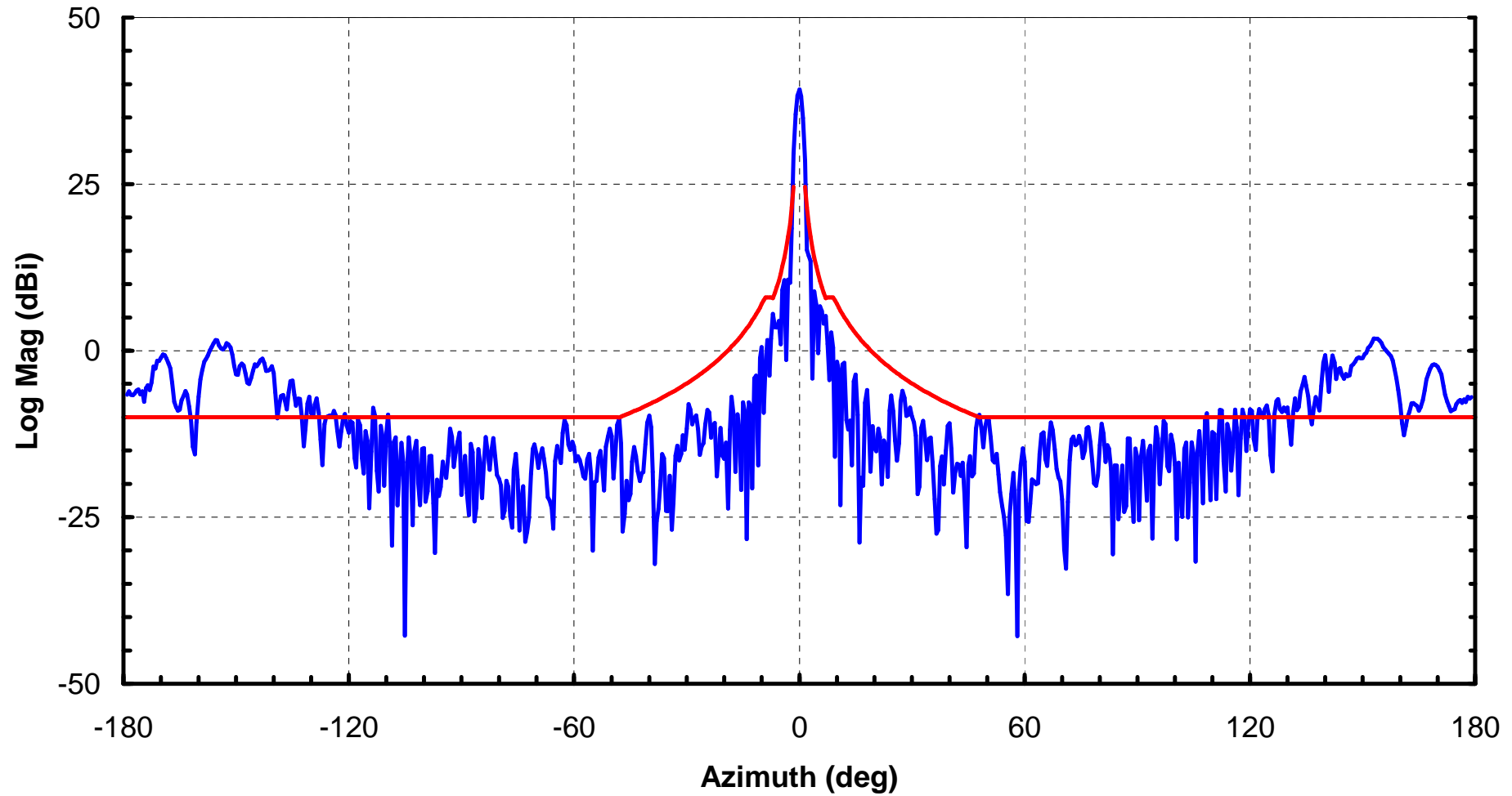
Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

42

Horizontal Co-Polar Azimuth
12.20GHz

Rx G98cm HH Azimuth



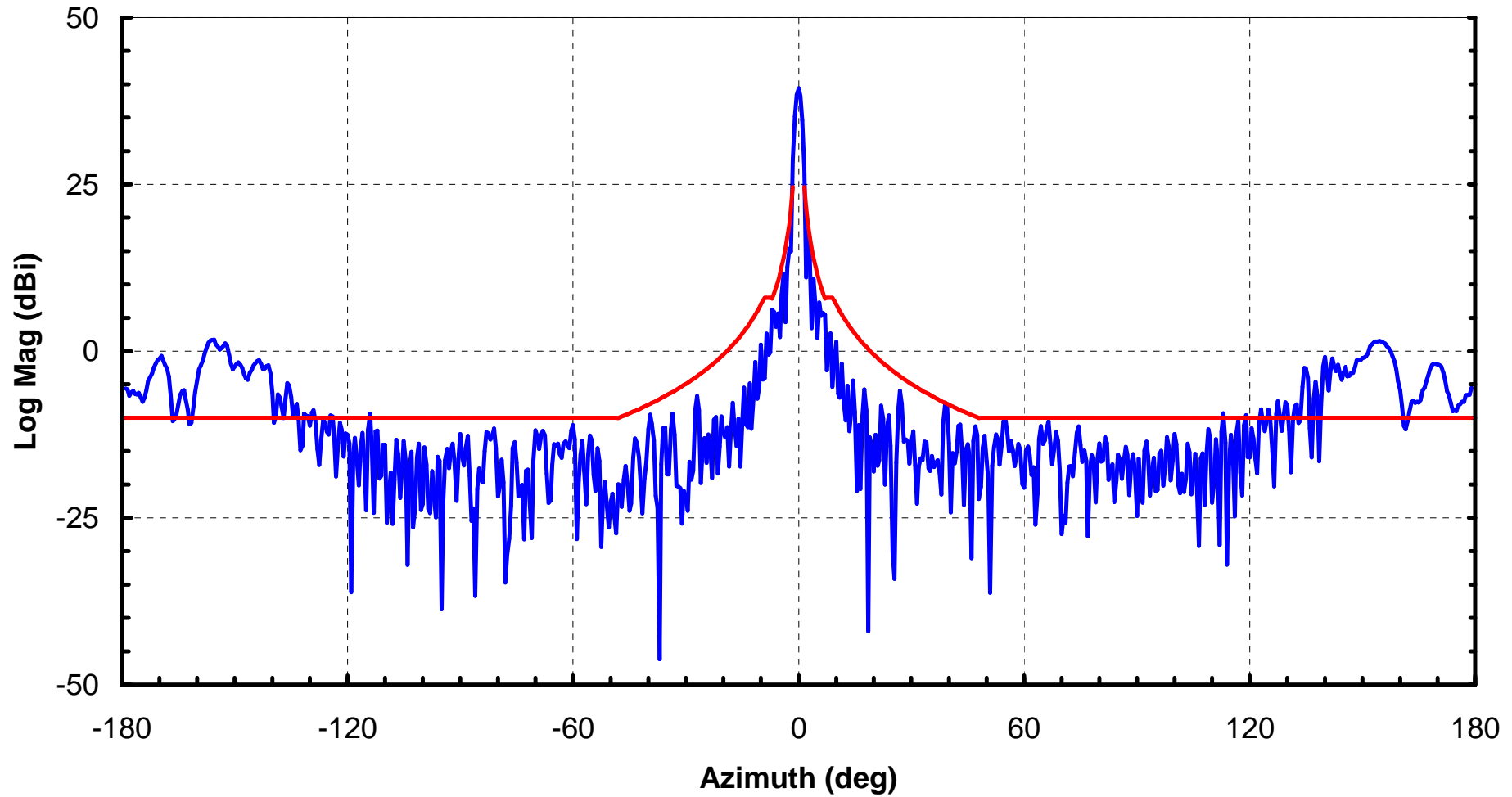
Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

43

Horizontal Co-Polar Azimuth
11.70GHz

Rx G98cm HH Azimuth

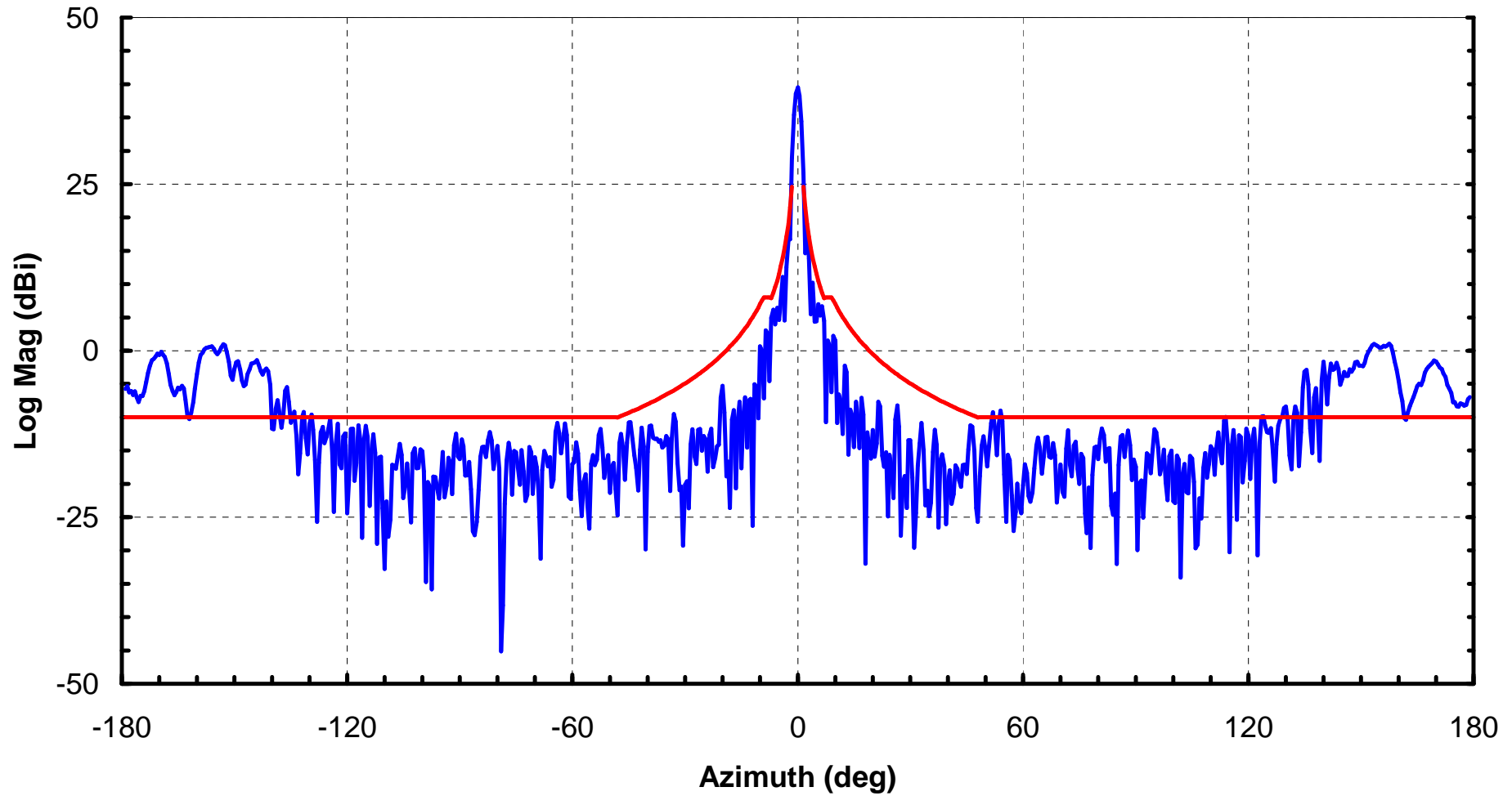


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

Horizontal Co-Polar Azimuth

Rx G98cm HH Azimuth

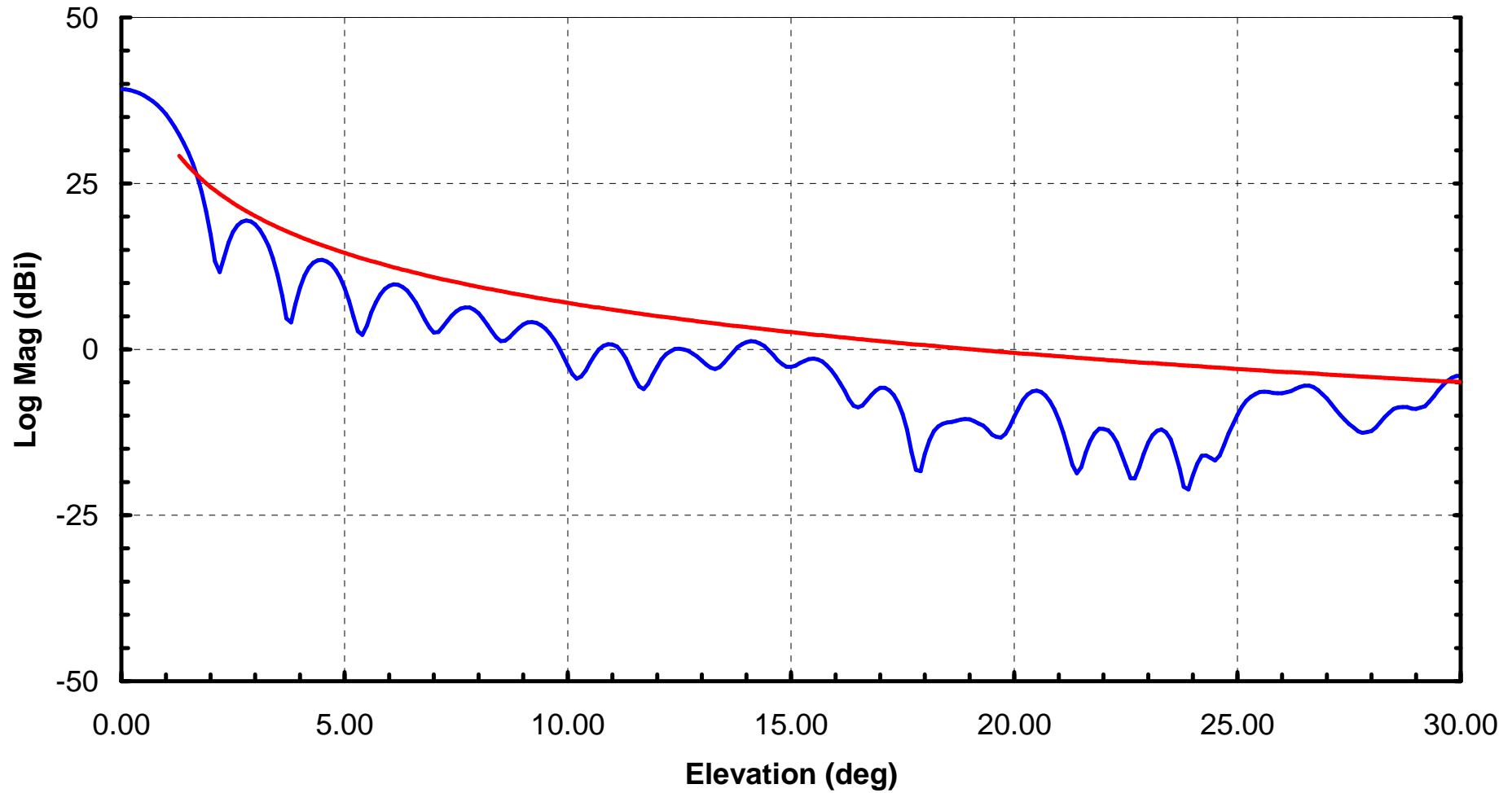


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed
45

Horizontal Co-Polar Azimuth
12.20GHz

Rx G98cm HH Elevation



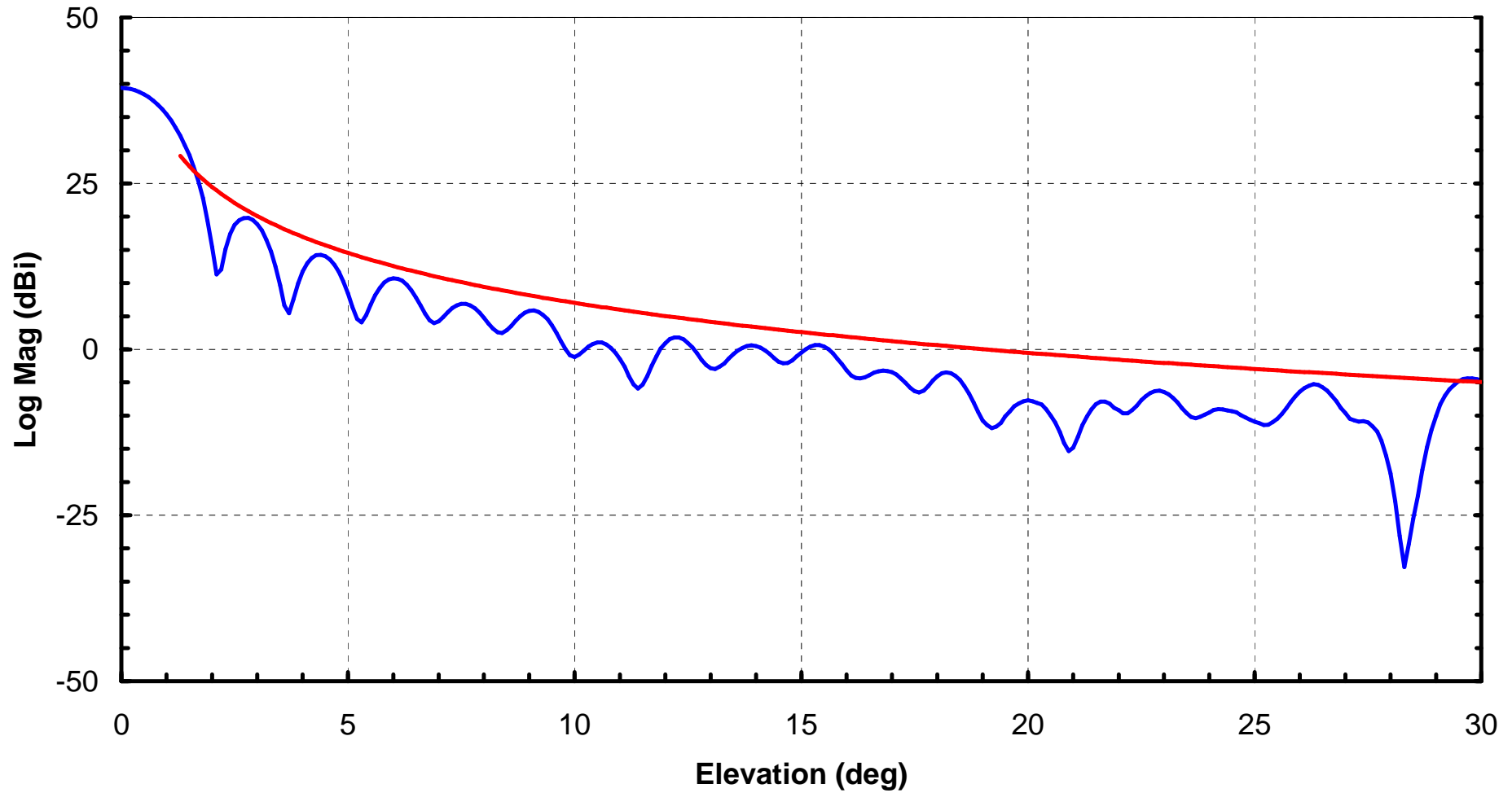
Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

46

Horizontal Co-Polar Elevation
11.70GHz

Rx G98cm HH Elevation



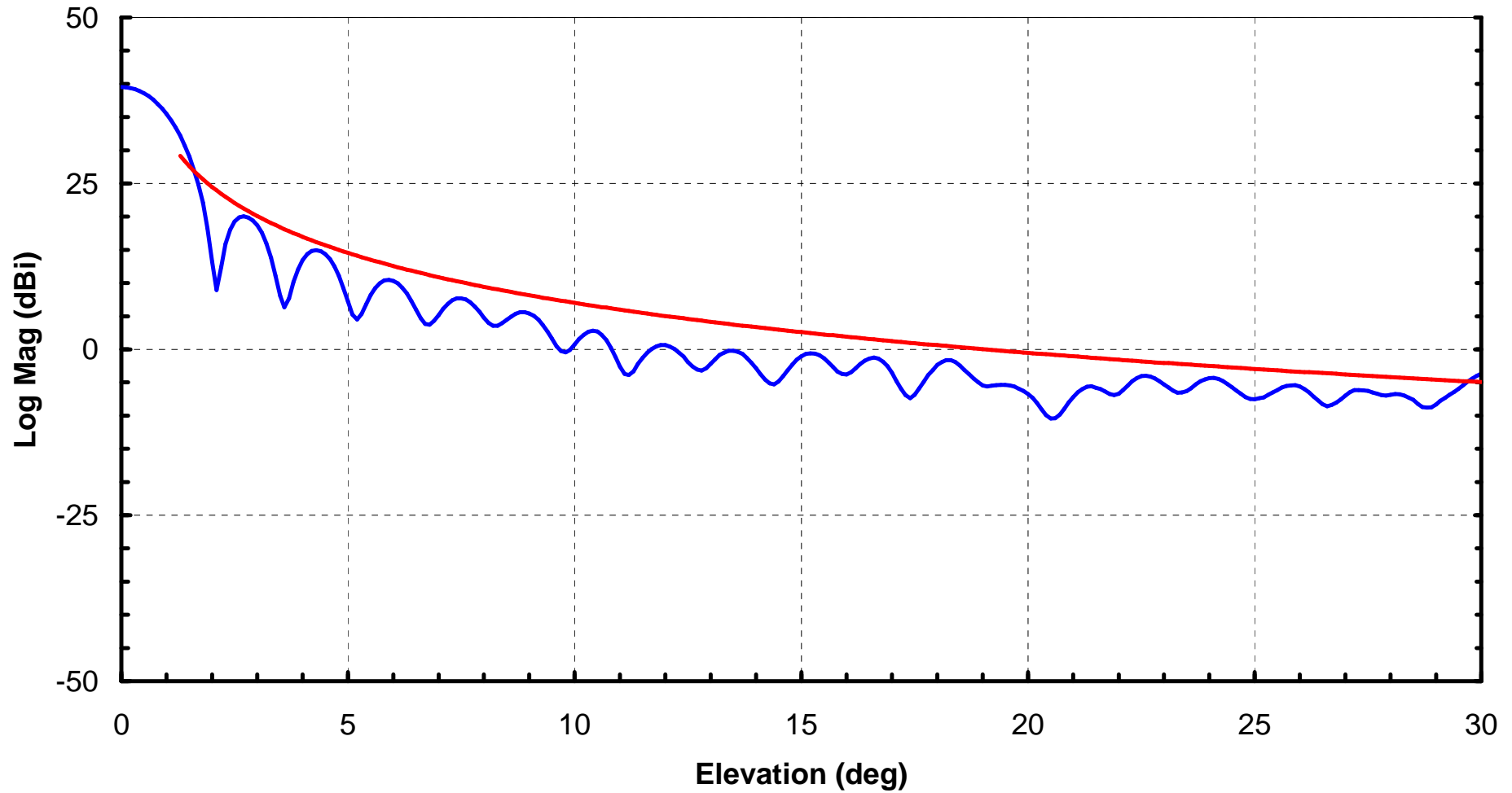
Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

47

Horizontal Co-Polar Elevation
11.95GHz

Rx G98cm HH Elevation



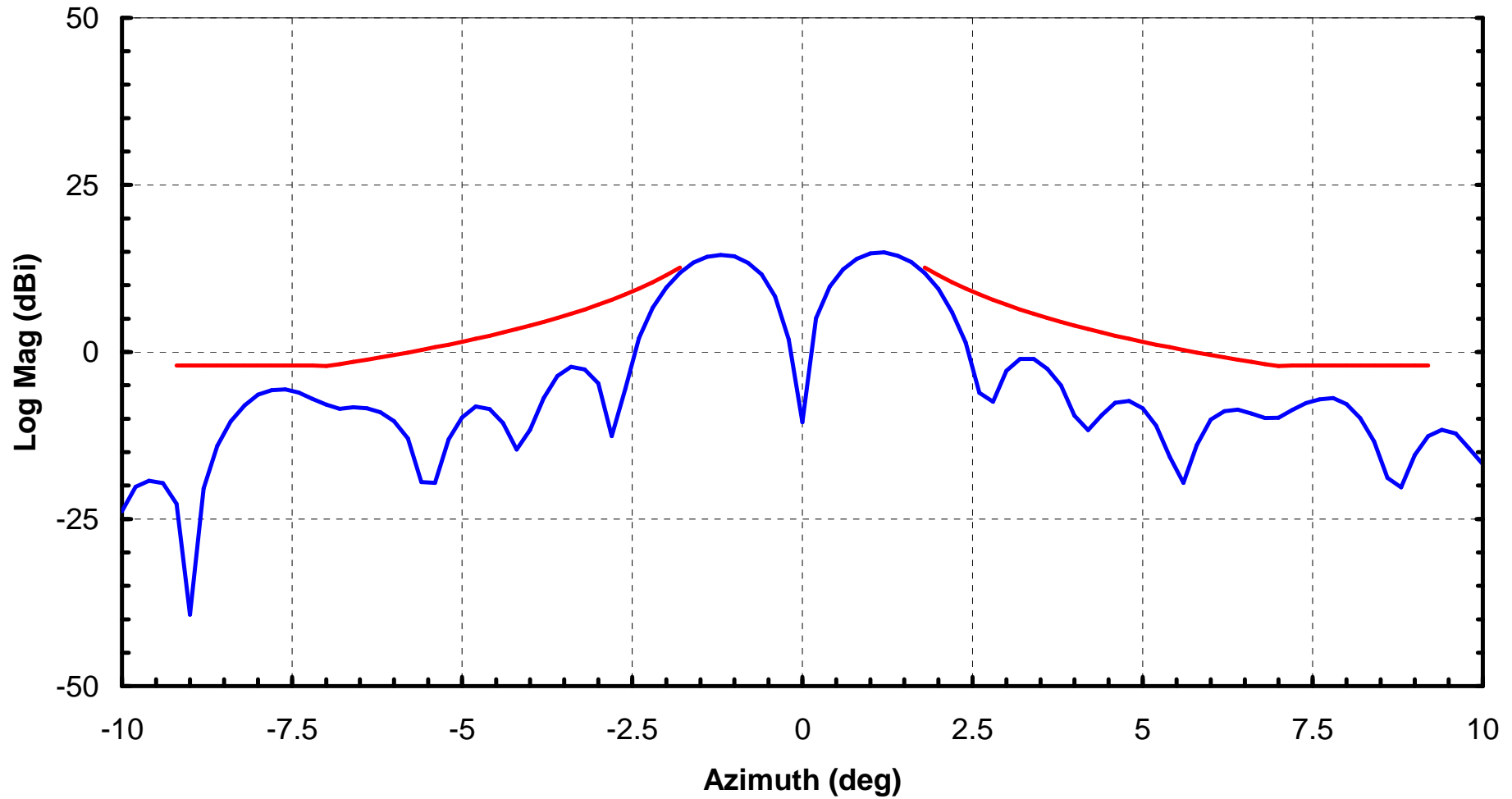
Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

48

Horizontal Co-Polar Elevation
12.20GHz

Rx G98cm HV Azimuth

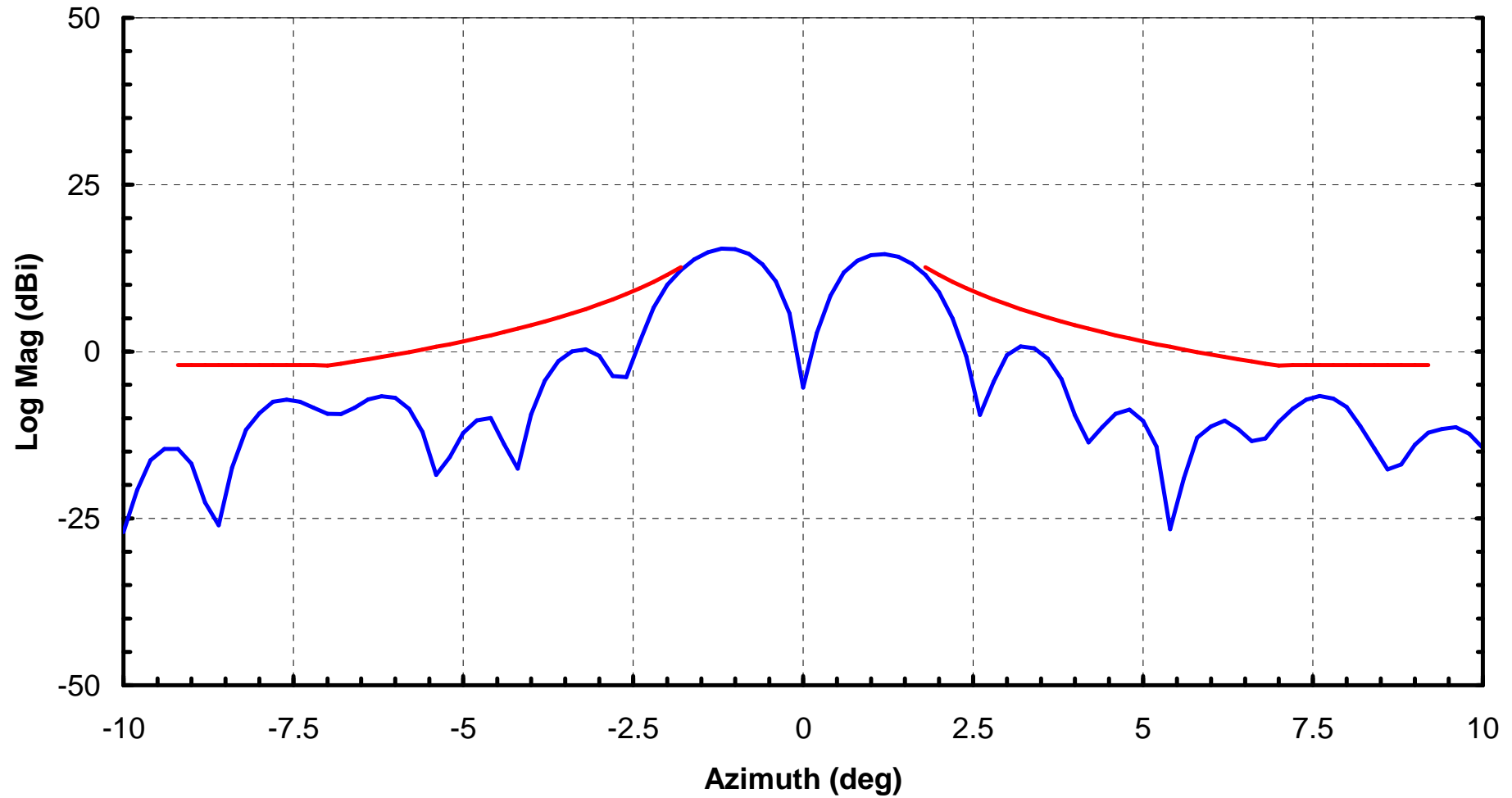


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

Horizontal Cross-Polar Azimuth
11.70GHz

Rx G98cm HV Azimuth

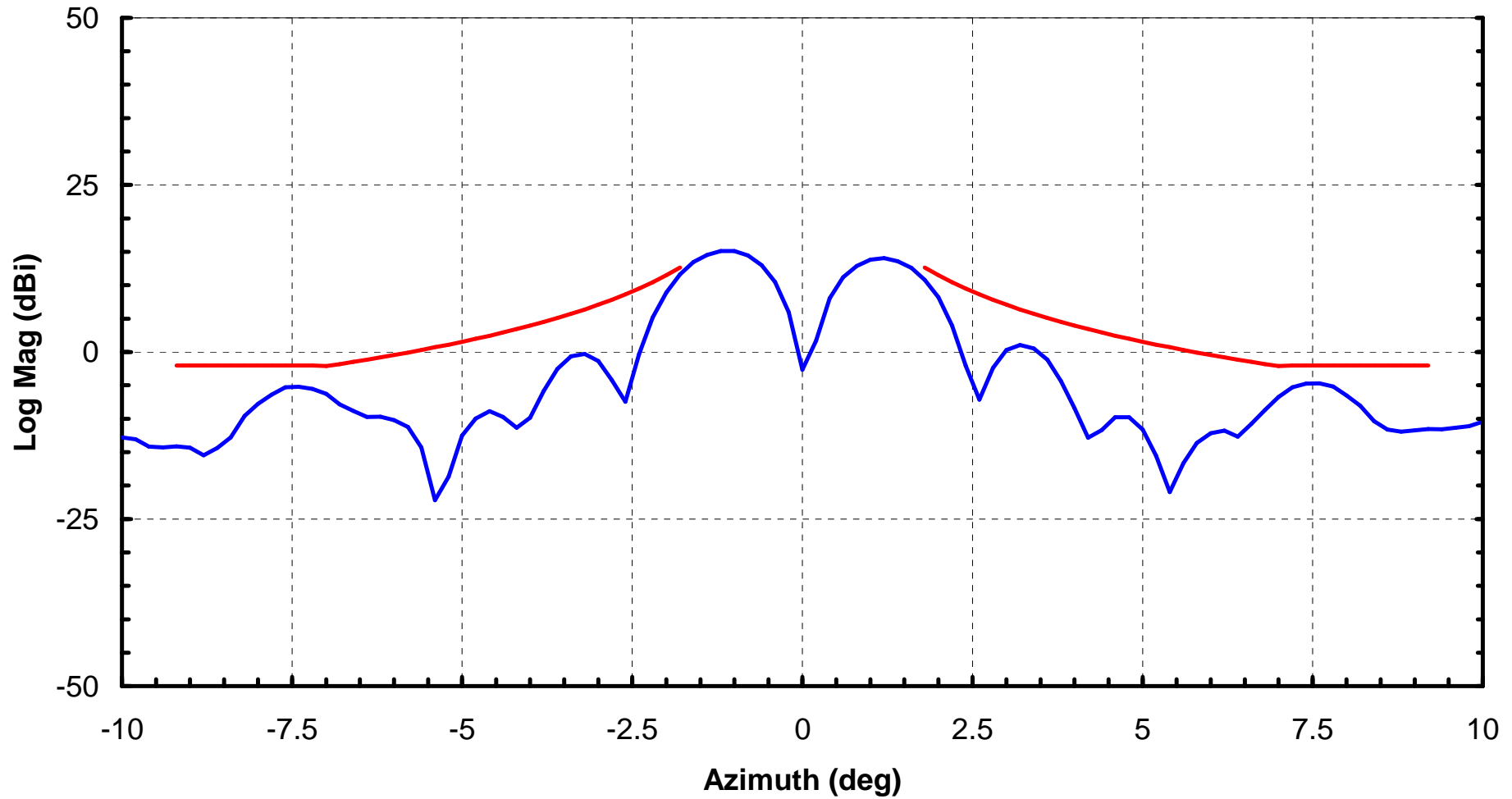


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed
50

Horizontal Cross-Polar Azimuth
11.95GHz

Rx G98cm HV Azimuth



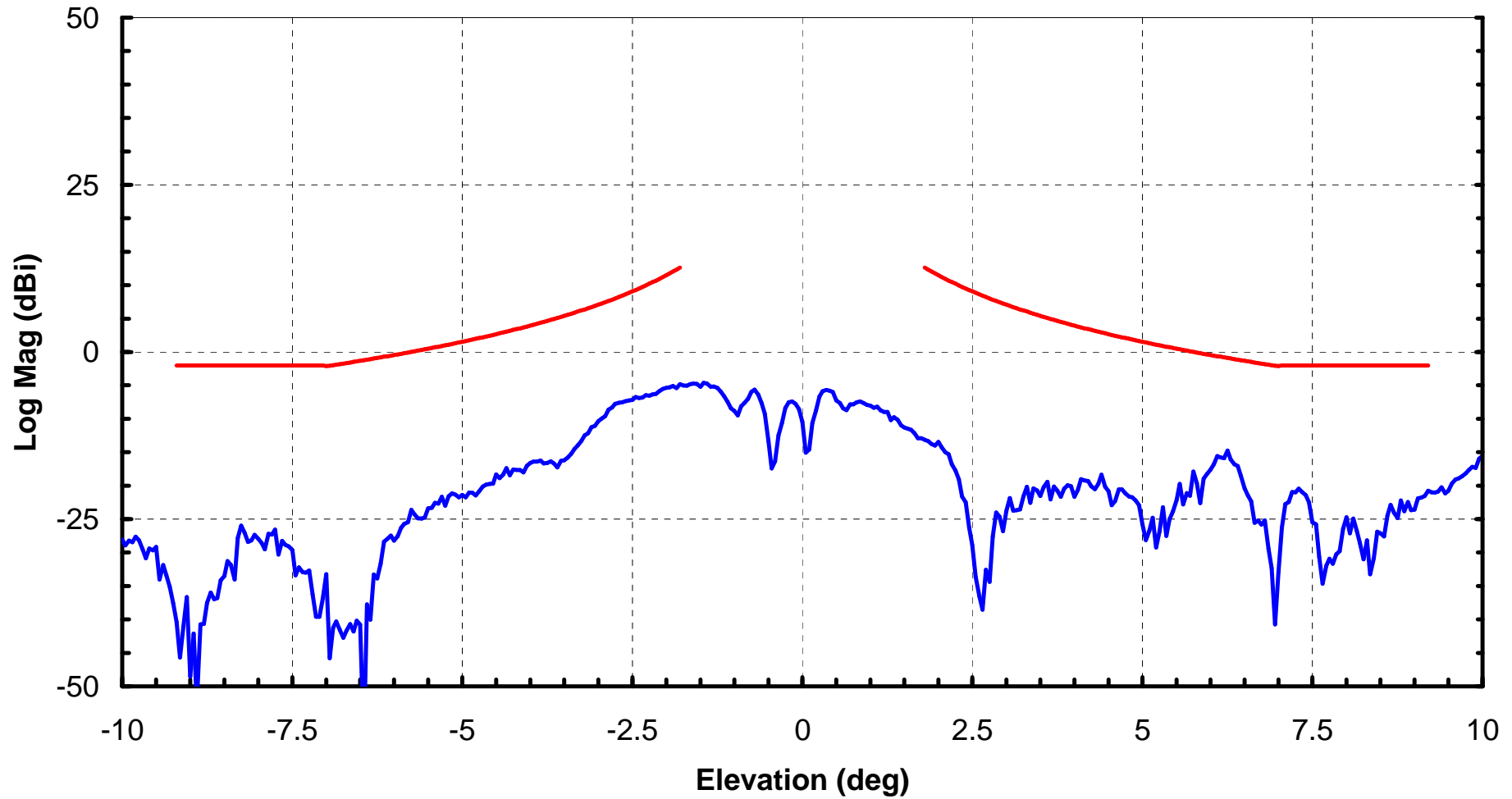
Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

51

Horizontal Cross-Polar Azimuth
12.20GHz

Rx G98cm HV Elevation

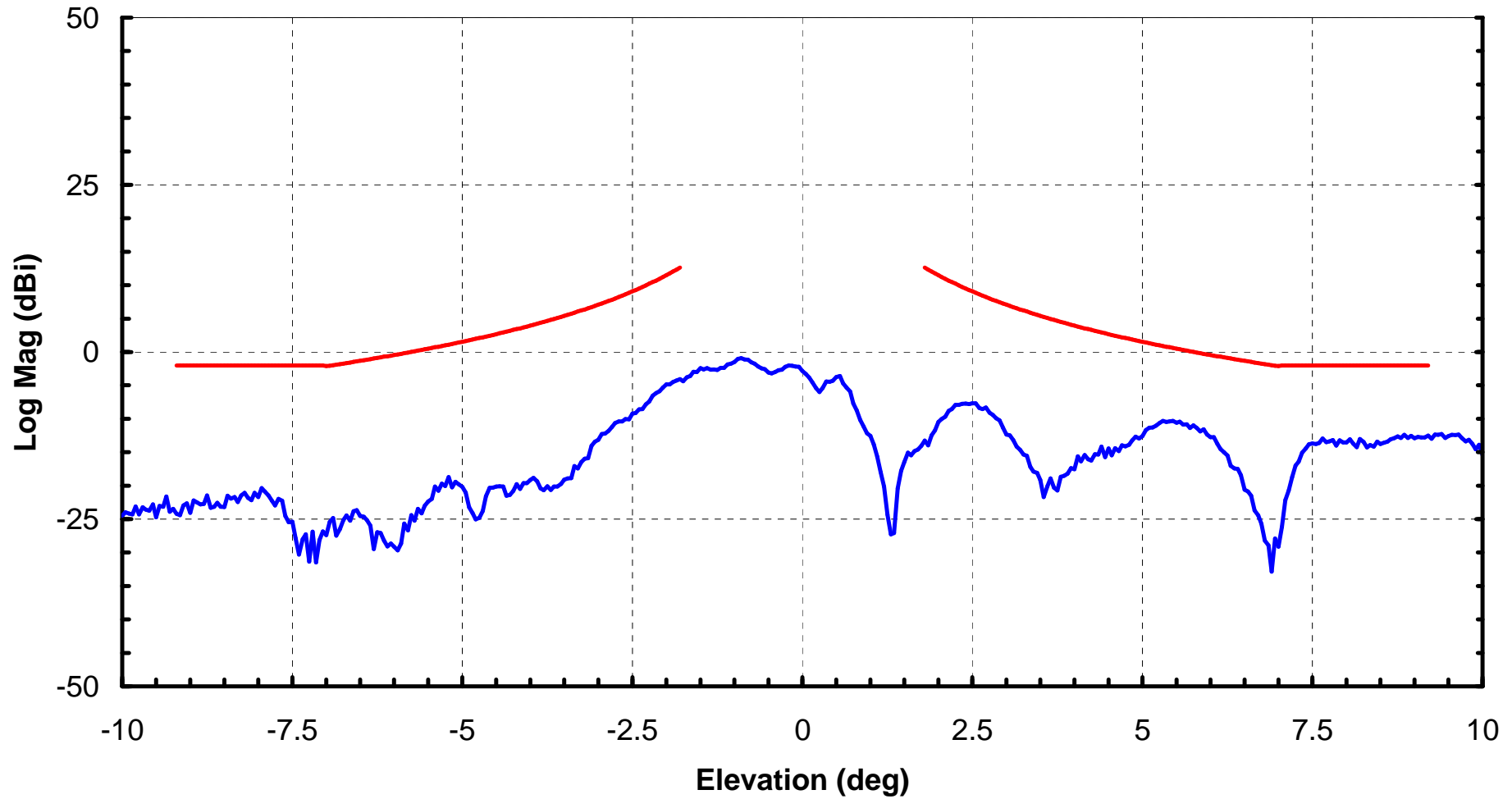


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed
52

Horizontal Cross-Polar Elevation
11.70GHz

Rx G98cm HV Elevation

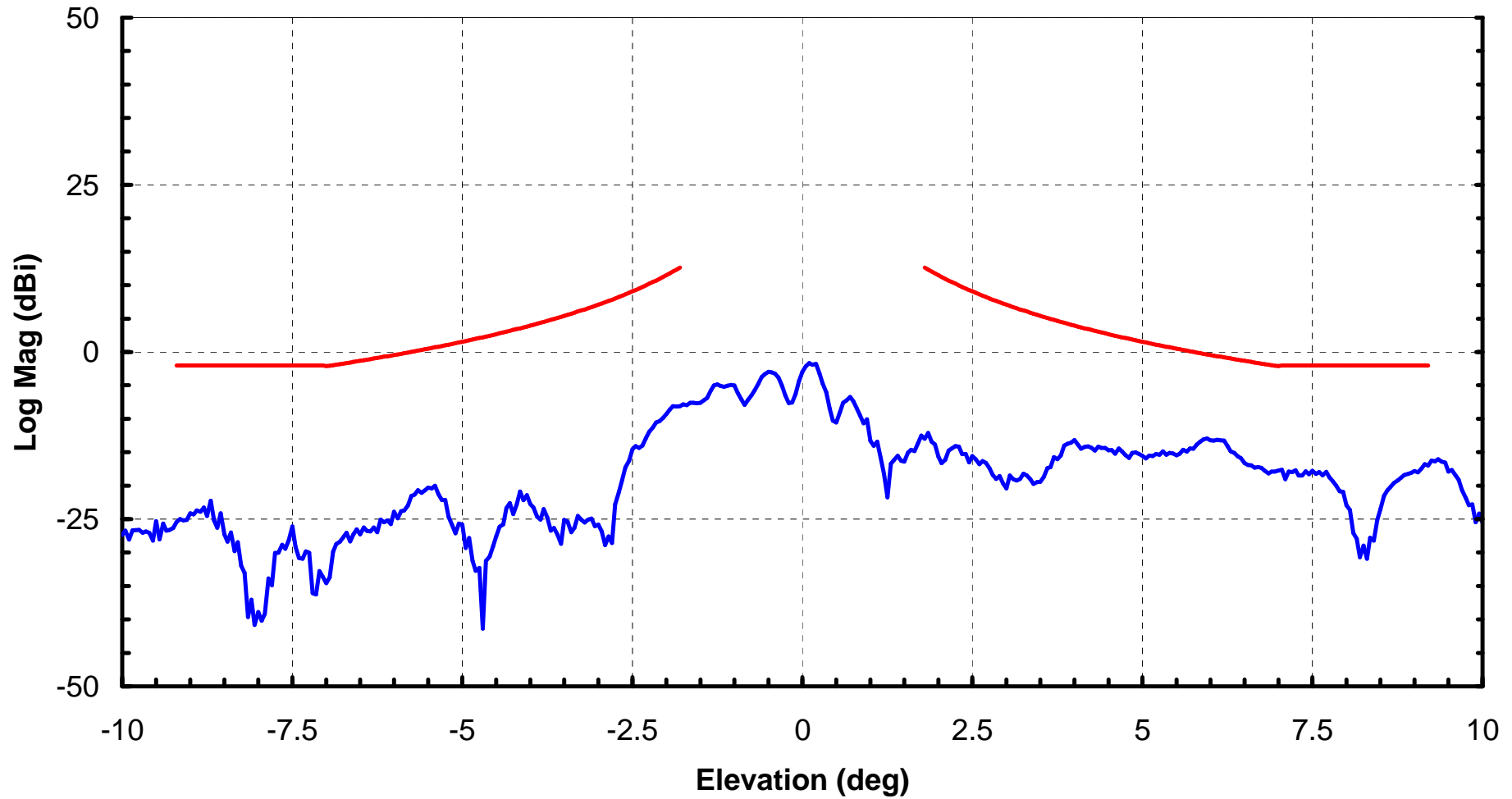


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed
53

Horizontal Cross-Polar Elevation
11.95GHz

Rx G98cm HV Elevation



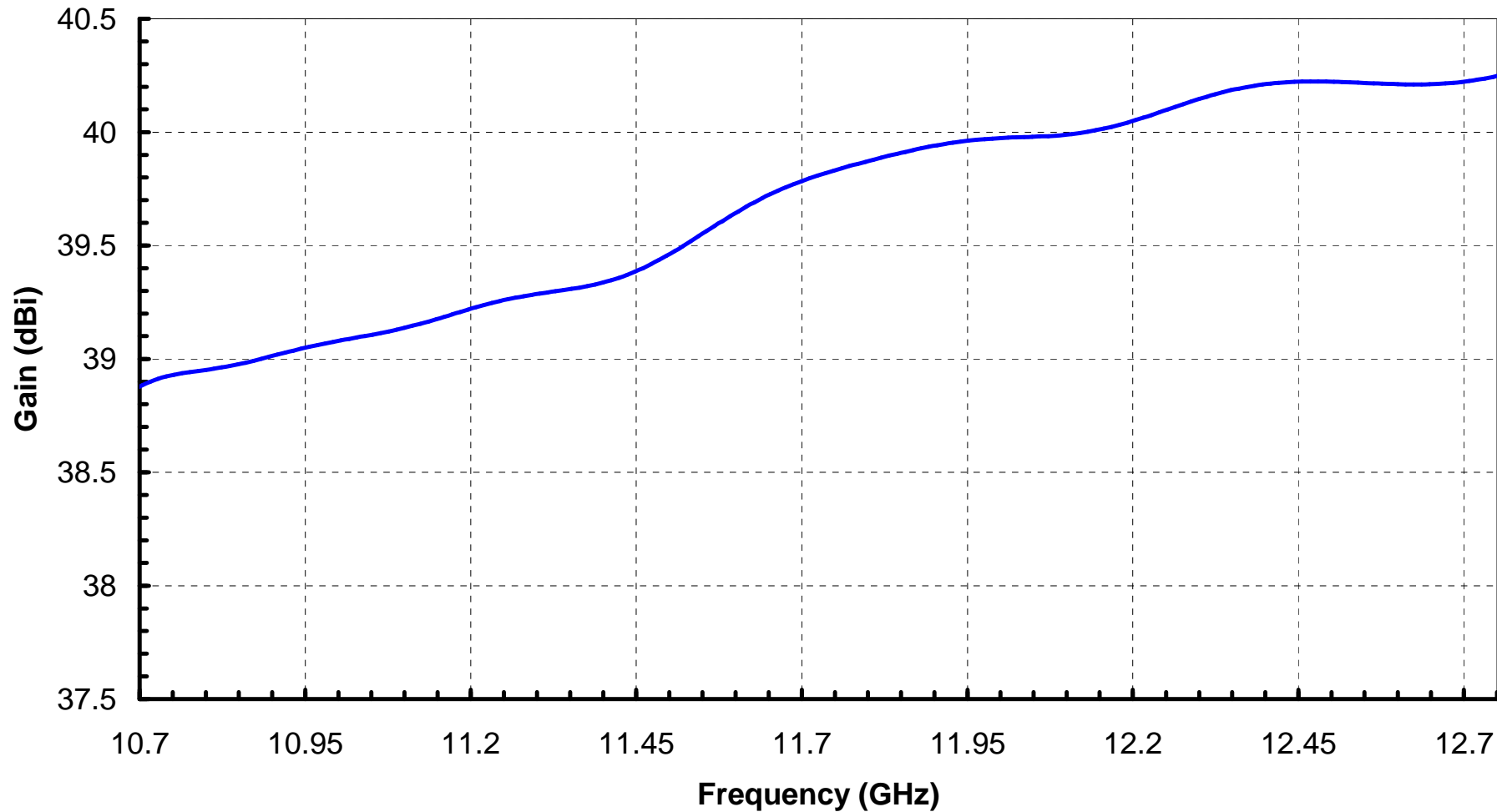
Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

54

Horizontal Cross-Polar Elevation
12.20GHz

Rx G98cm VV Azimuth

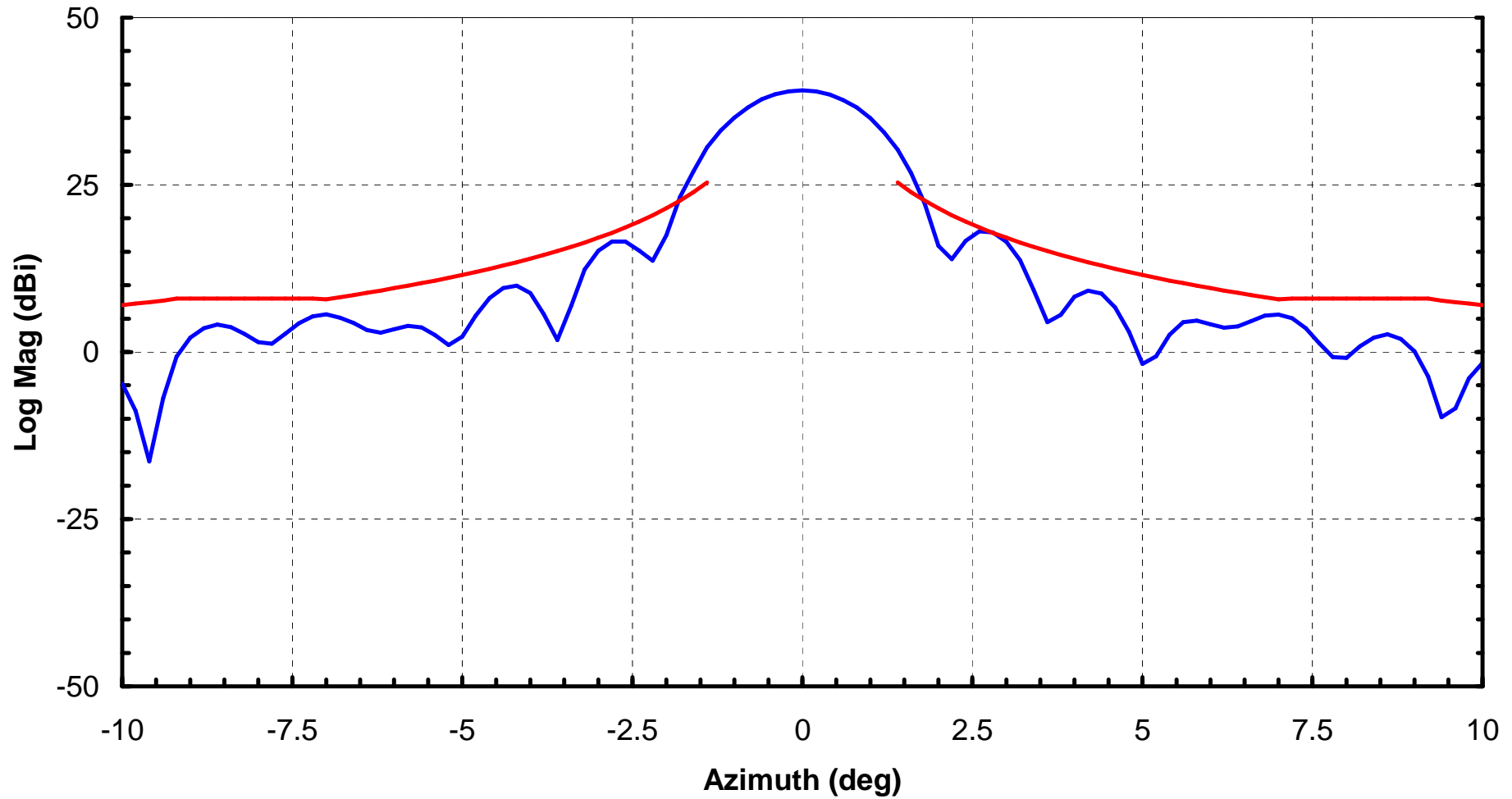


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed
55

Vertical Co-Polar
Gain Sweep

Rx G98cm VV Azimuth



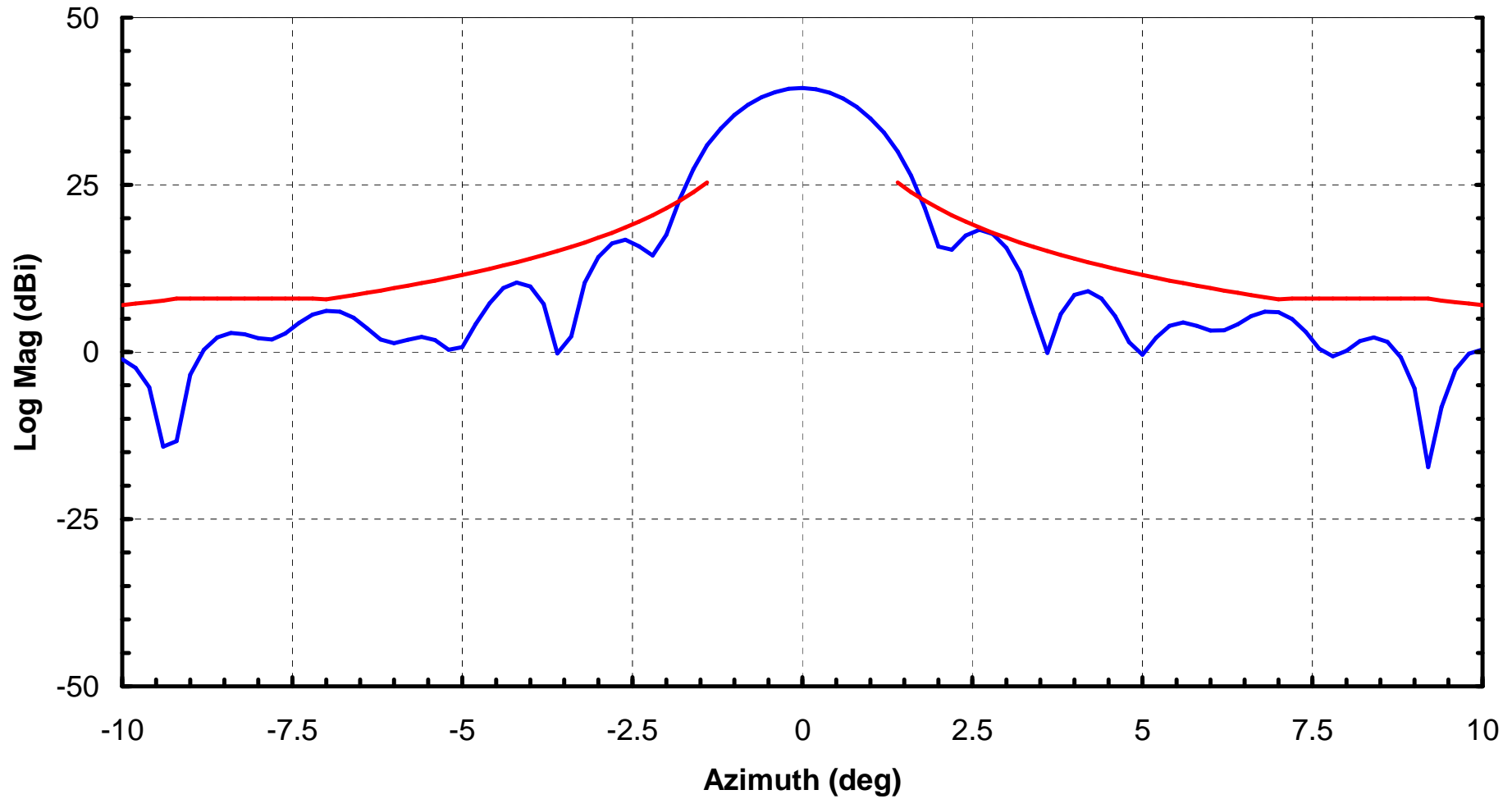
Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

56

Vertical Co-Polar Azimuth
11.70GHz

Rx G98cm VV Azimuth



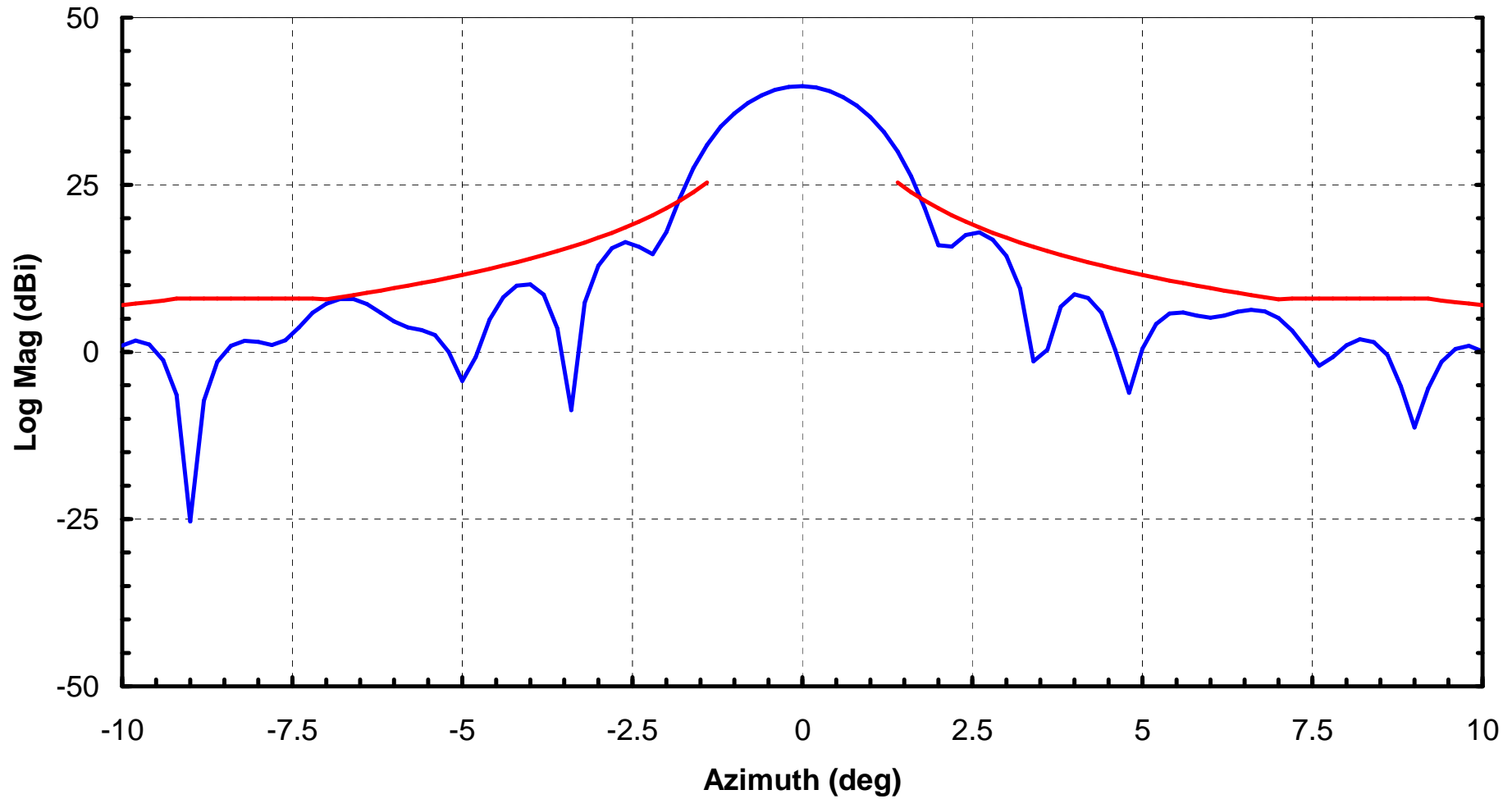
Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

57

Vertical Co-Polar Azimuth
11.95GHz

Rx G98cm VV Azimuth



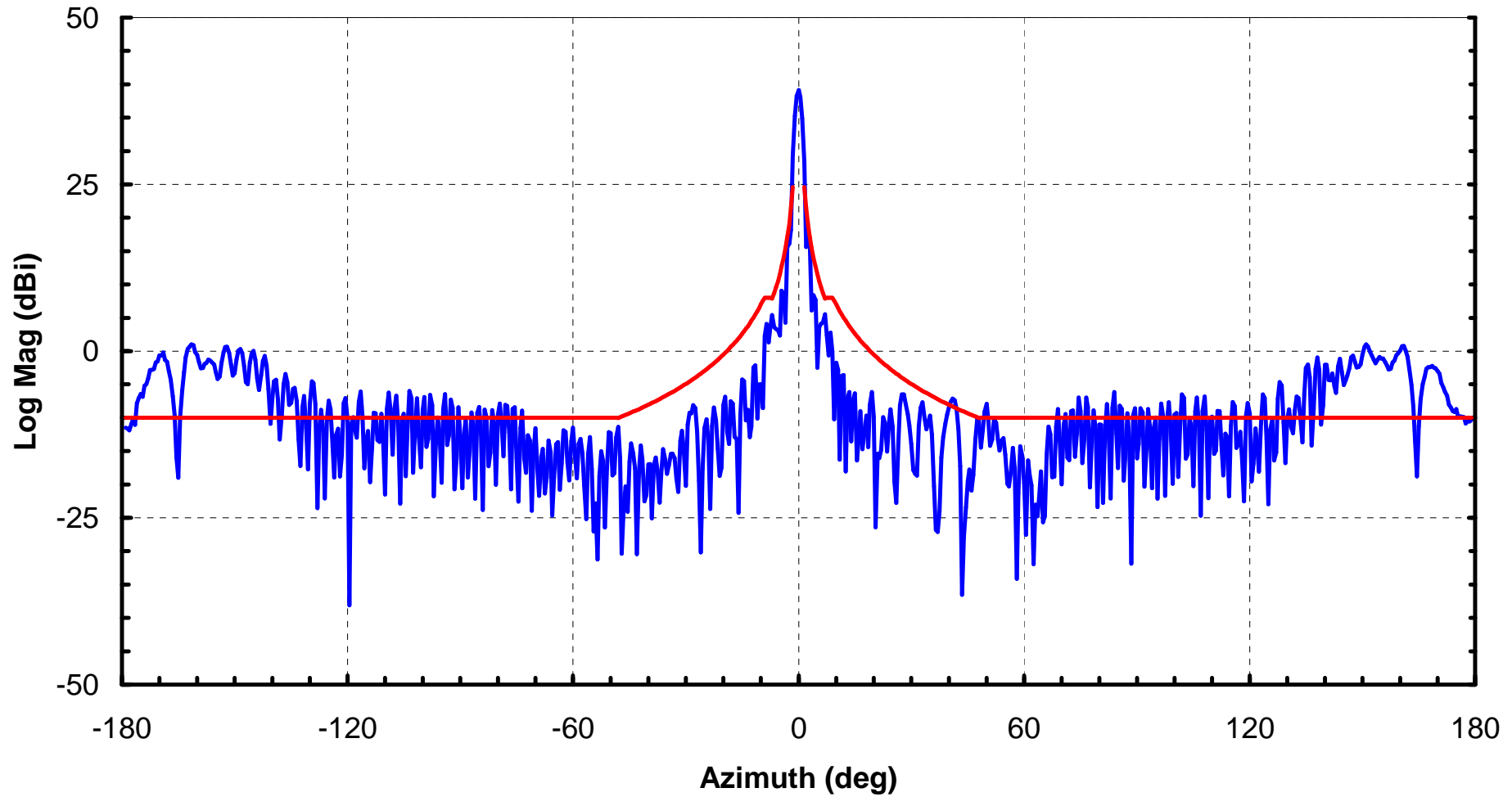
Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

58

Vertical Co-Polar Azimuth
12.20GHz

Rx G98cm VV Azimuth

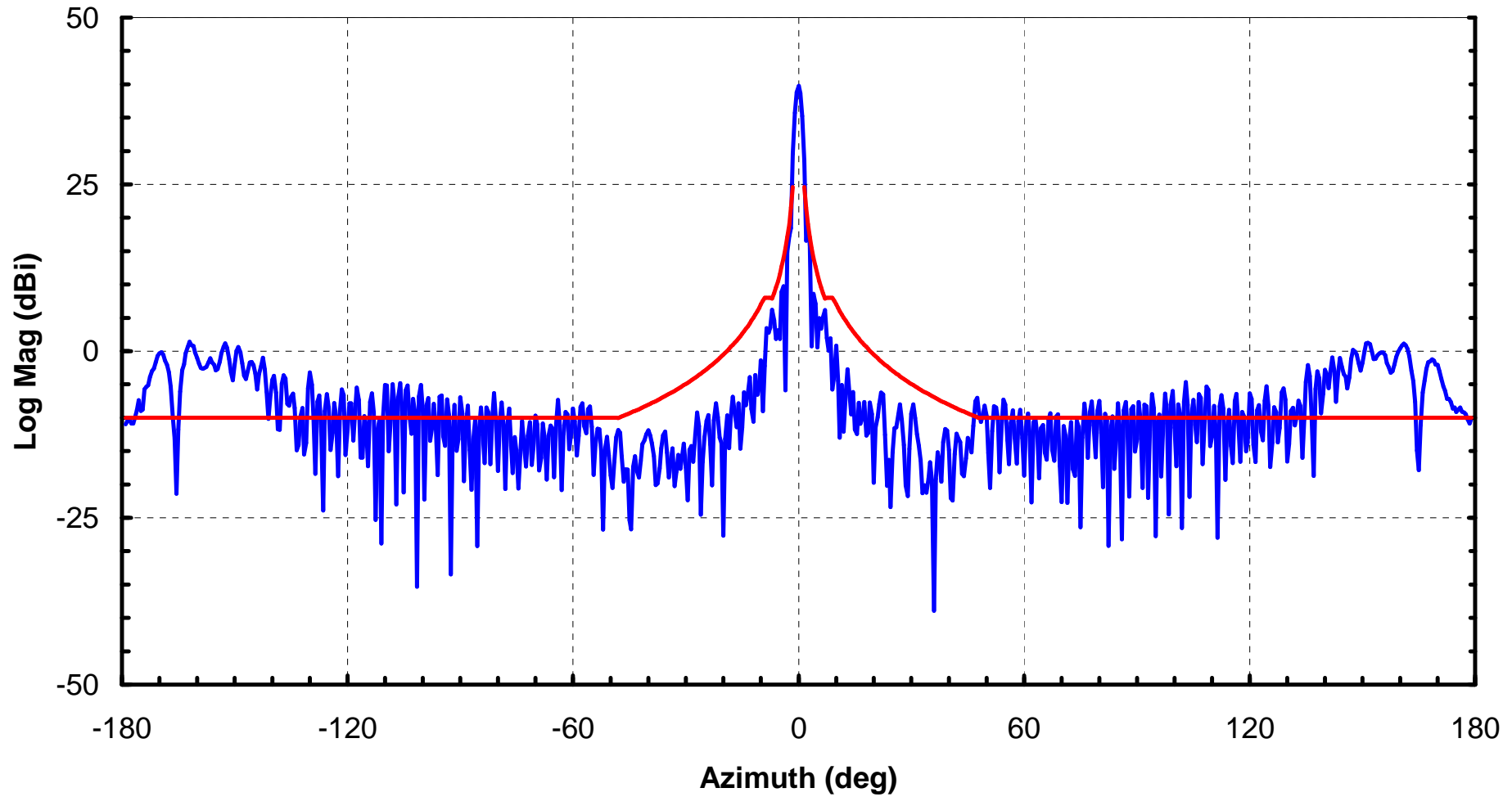


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

Vertical Co-Polar Azimuth
11.70GHz

Rx G98cm VV Azimuth

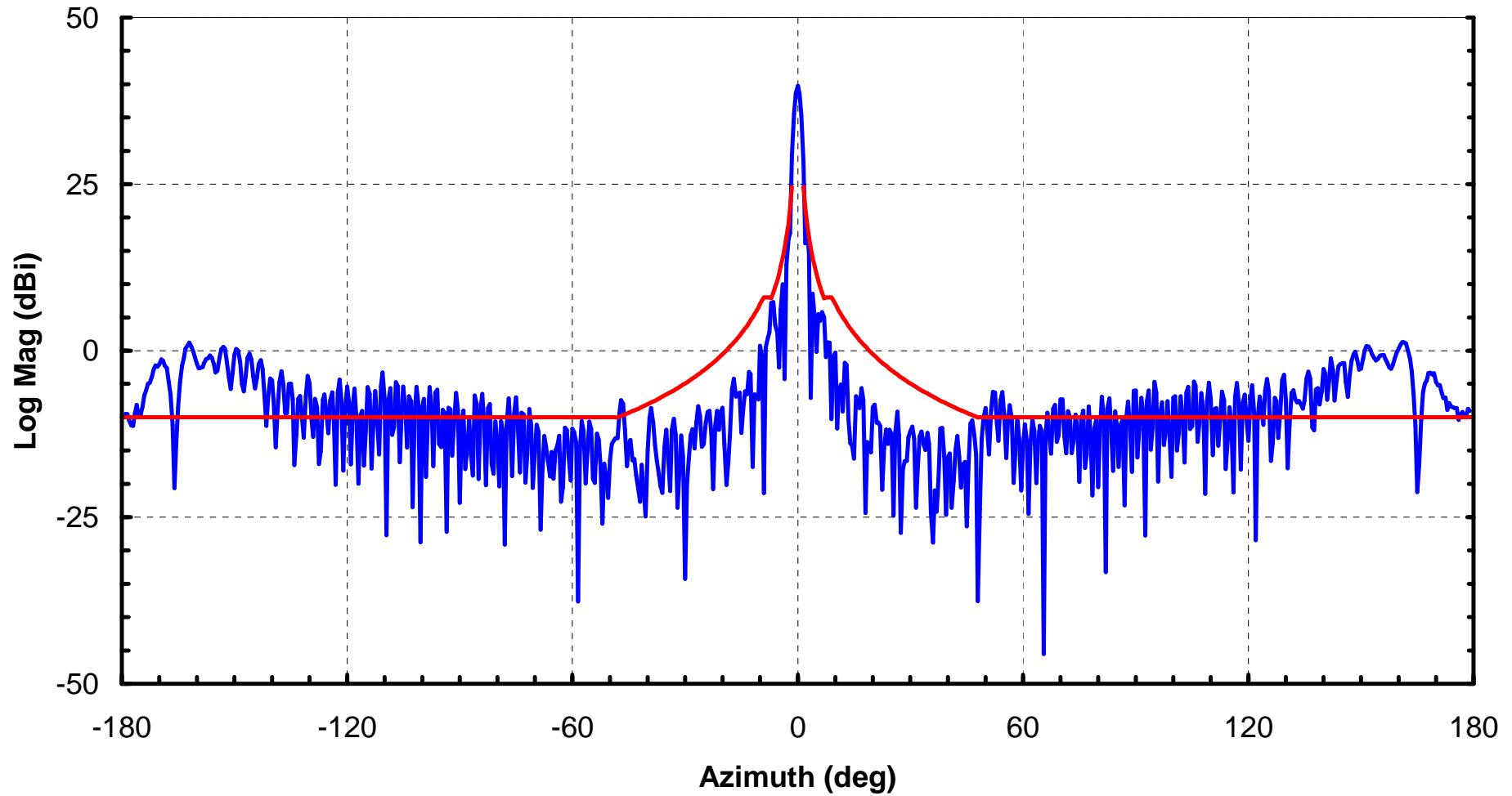


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed
60

Vertical Co-Polar Azimuth
11.95GHz

Rx G98cm VV Azimuth

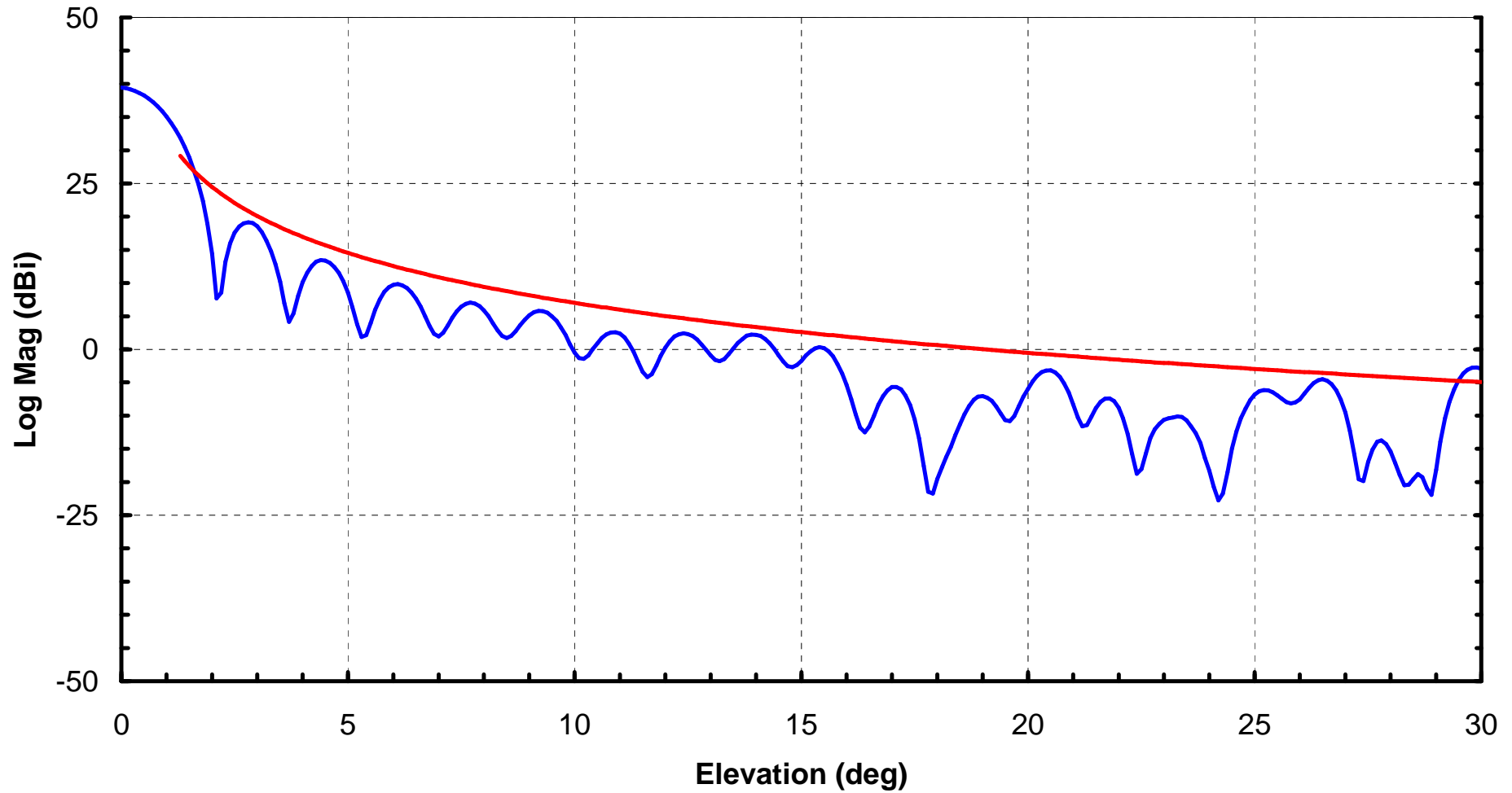


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed
61

Vertical Co-Polar Azimuth
12.20GHz

Rx G98cm VV Elevation

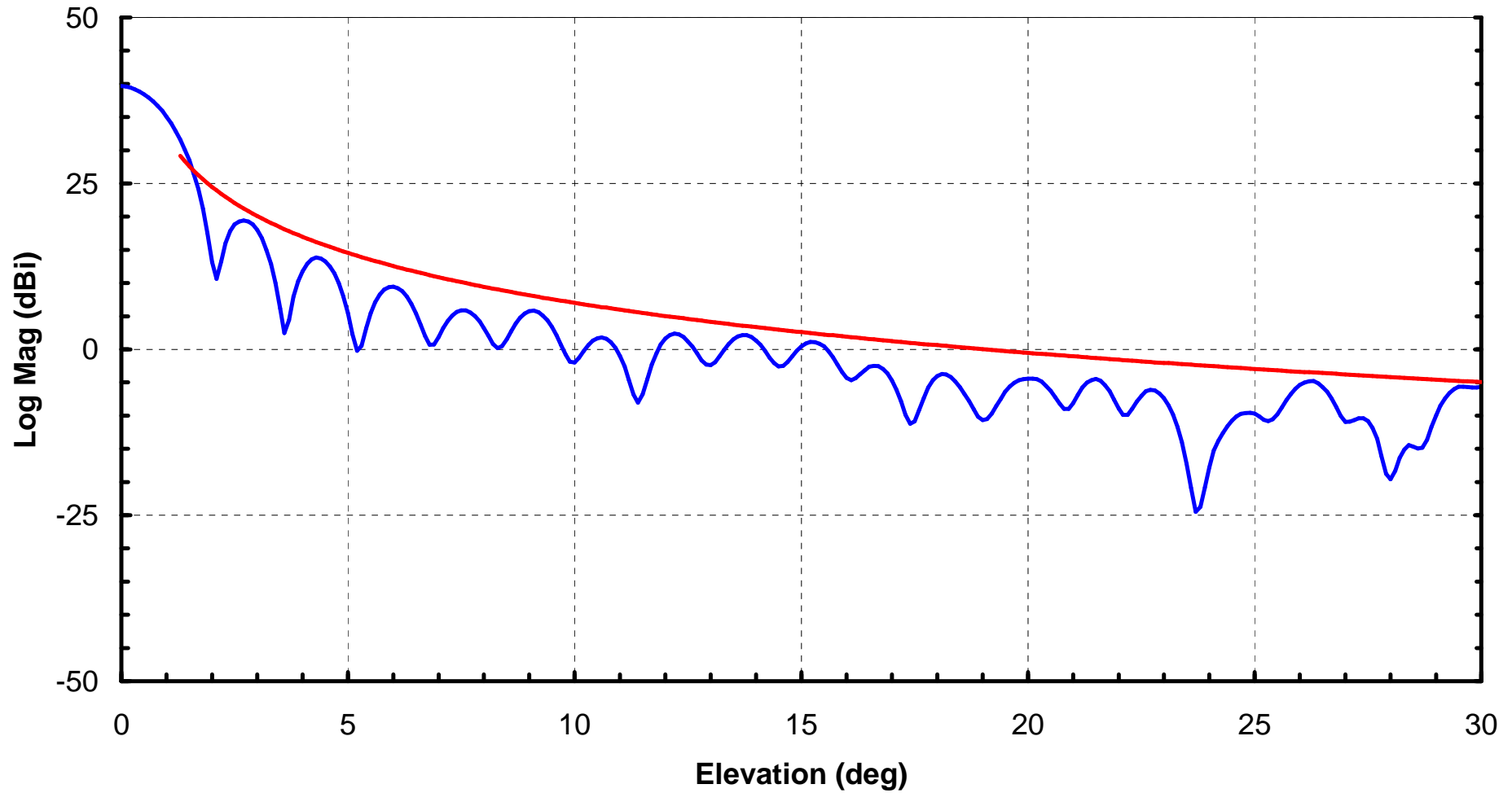


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed
62

Vertical Co-Polar Elevation
11.70GHz

Rx G98cm VV Elevation

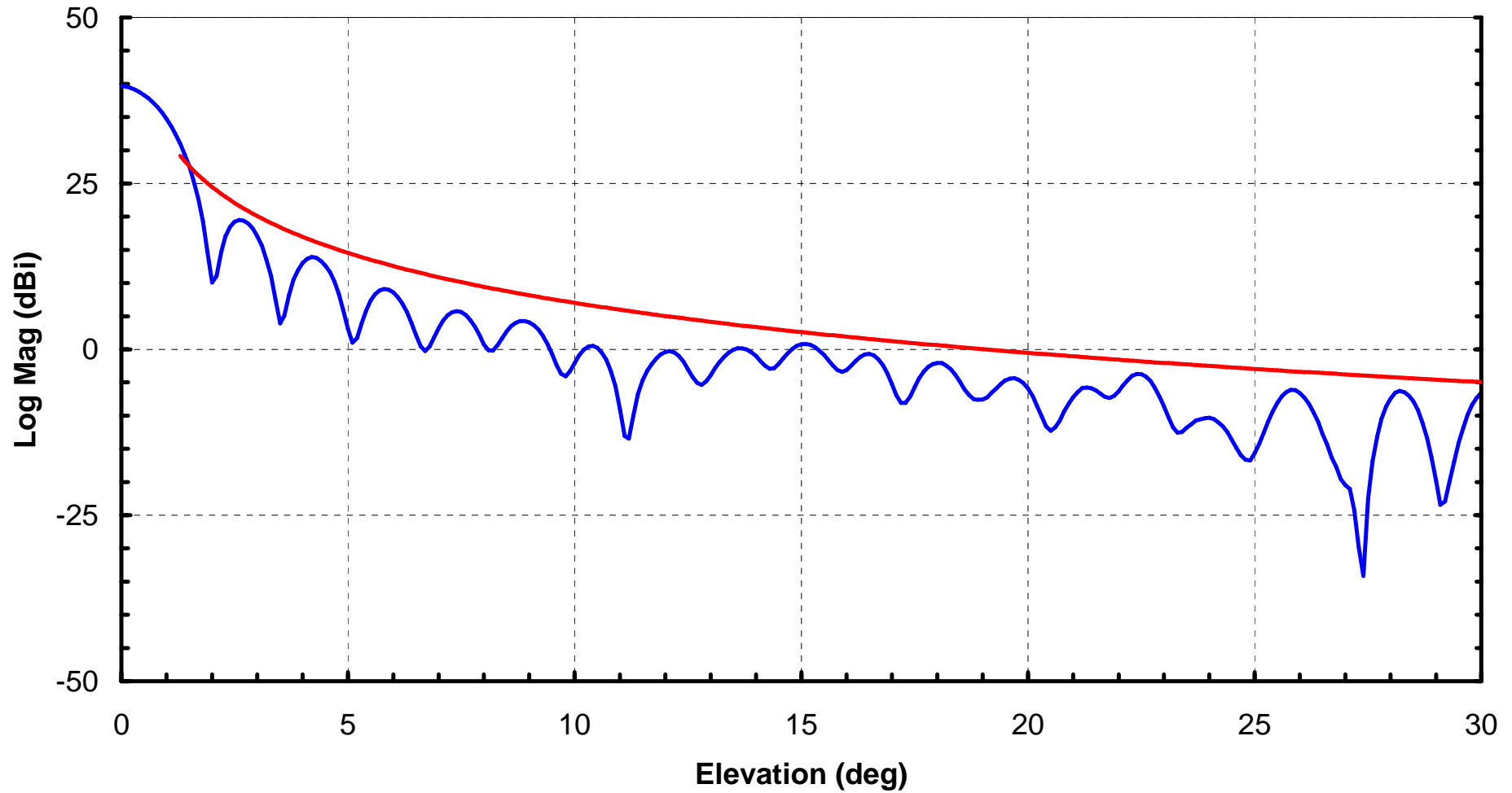


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed
63

Vertical Co-Polar Elevation
11.95GHz

Rx G98cm VV Elevation

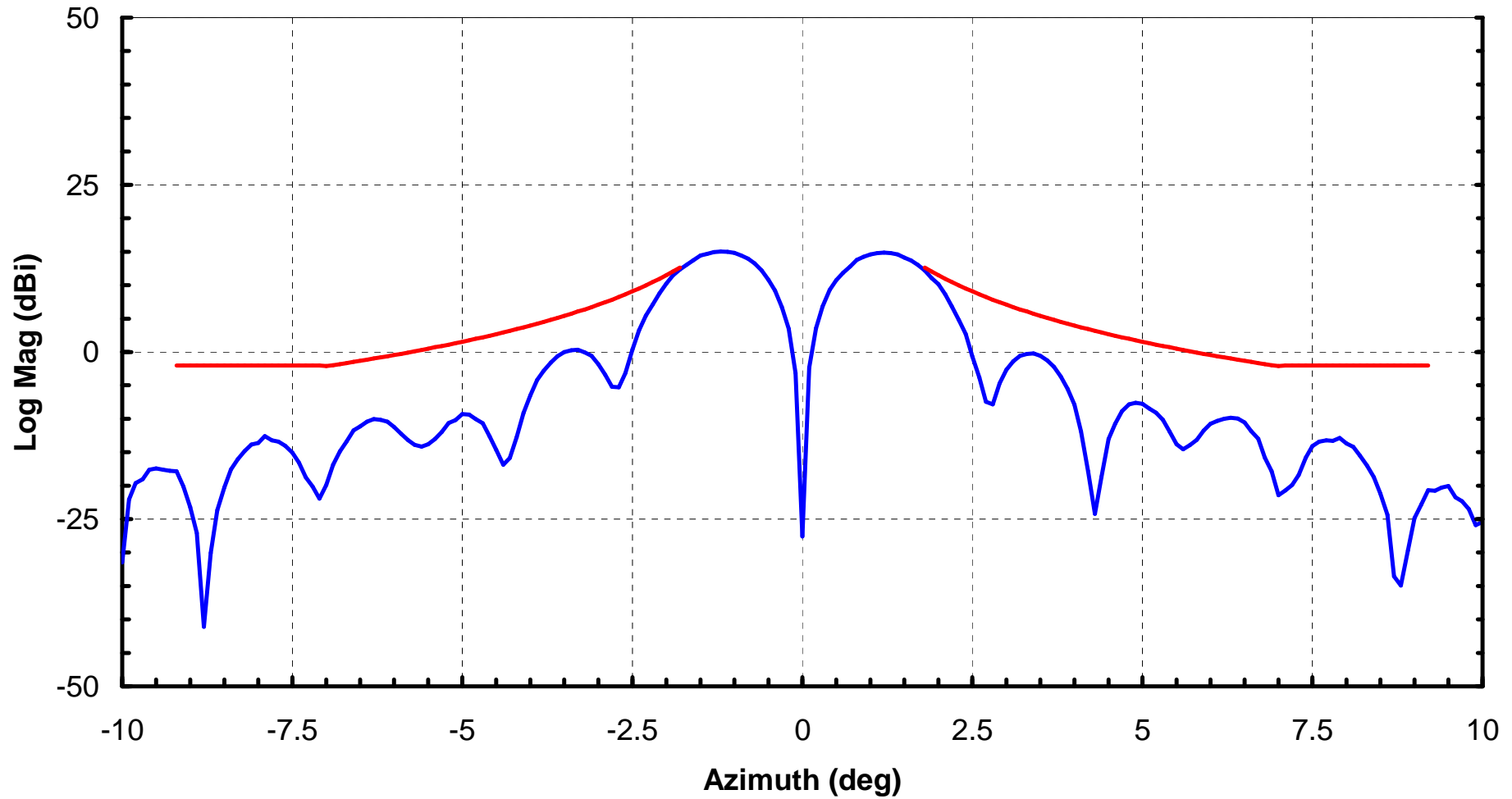


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed
64

Vertical Co-Polar Elevation
12.20GHz

Rx G98cm VH Azimuth

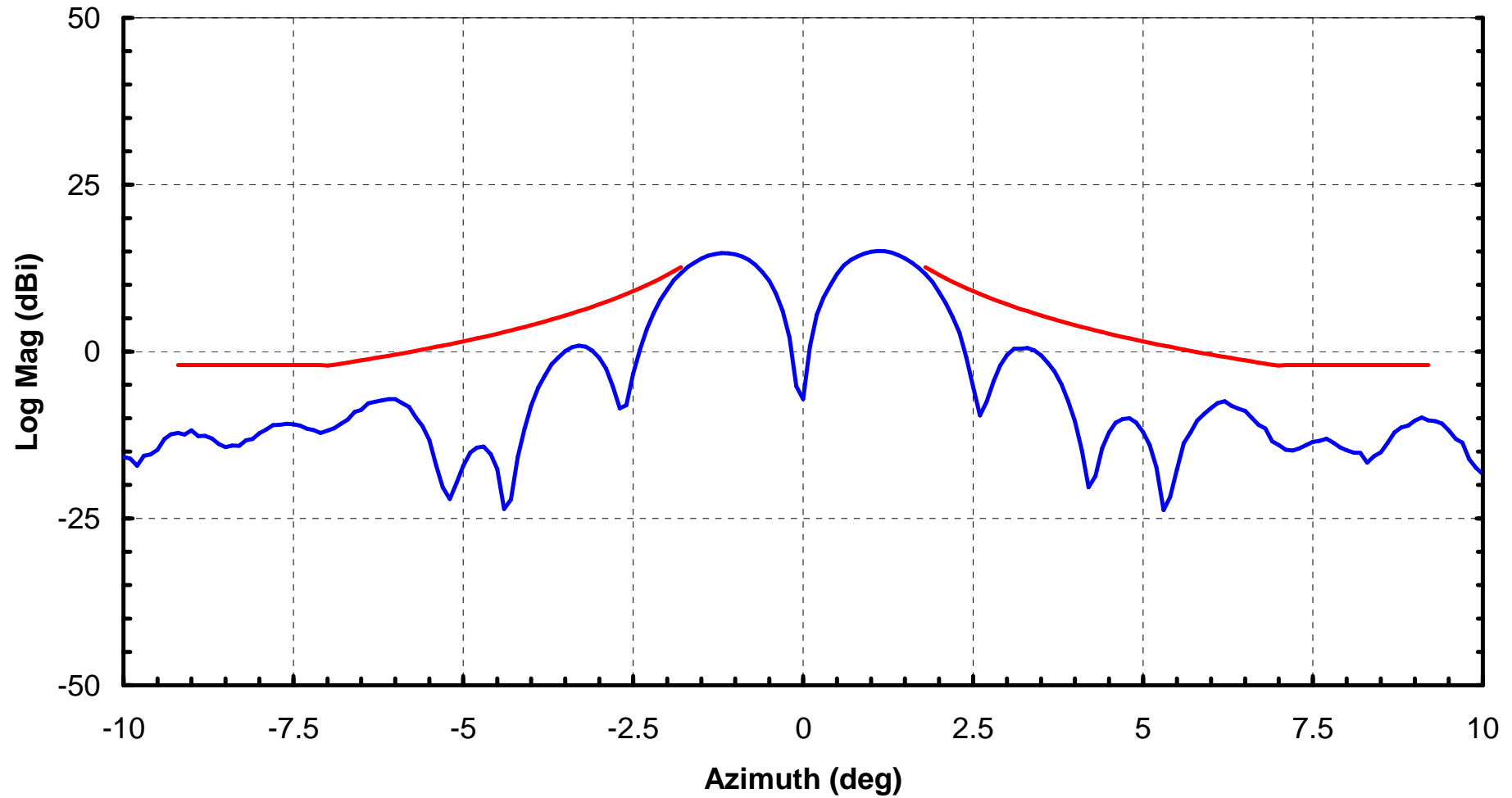


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed
65

Vertical Cross-Polar Azimuth
11.70GHz

Rx G98cm VH Azimuth

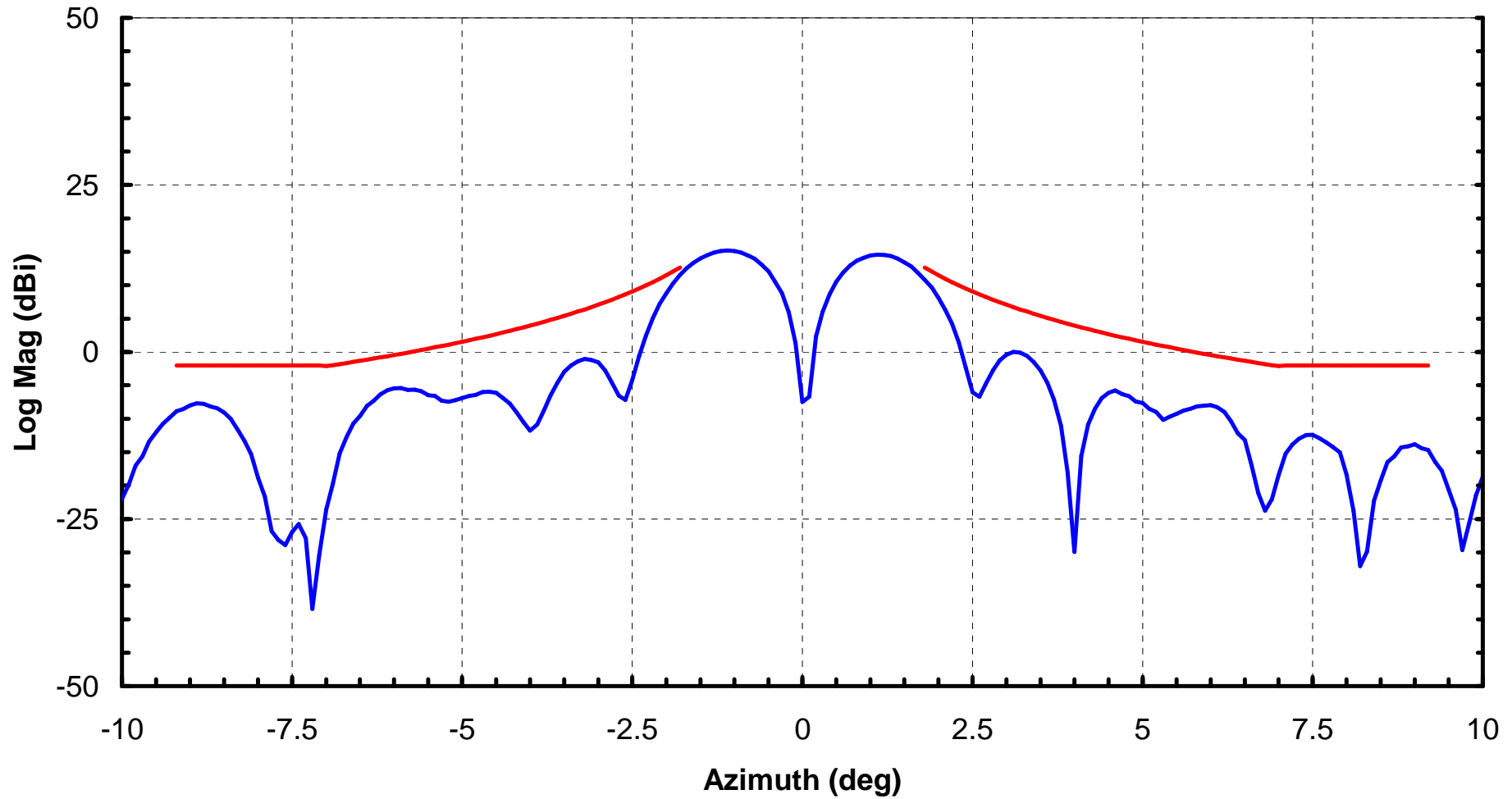


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed
66

Vertical Cross-Polar Azimuth
11.95GHz

Rx G98cm VH Azimuth



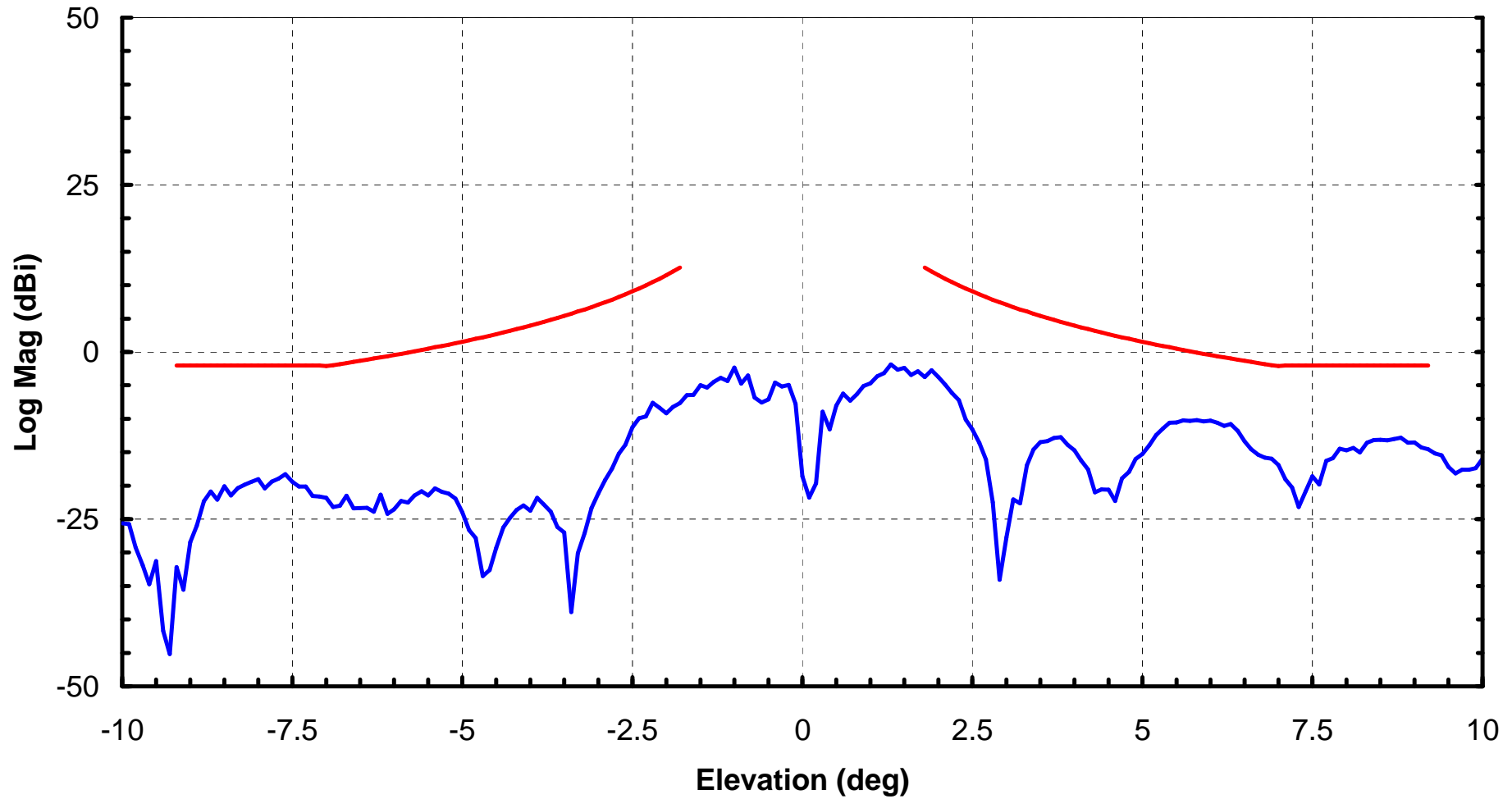
Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

67

Vertical Co-Polar Azimuth
12.20GHz

Rx G98cm VH Elevation

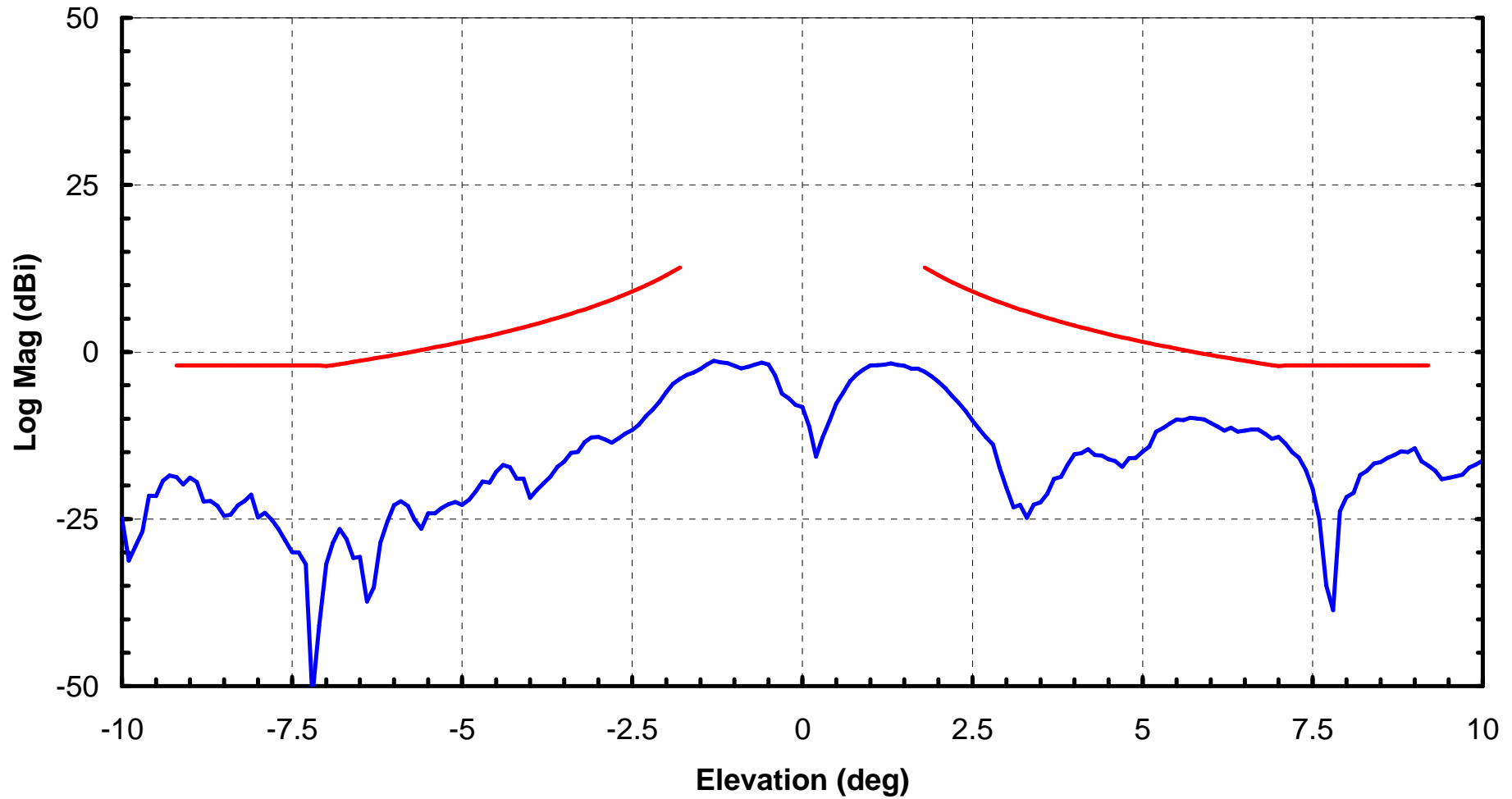


Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed
68

Vertical Cross-Polar Elevation
11.70GHz

Rx G98cm VH Elevation



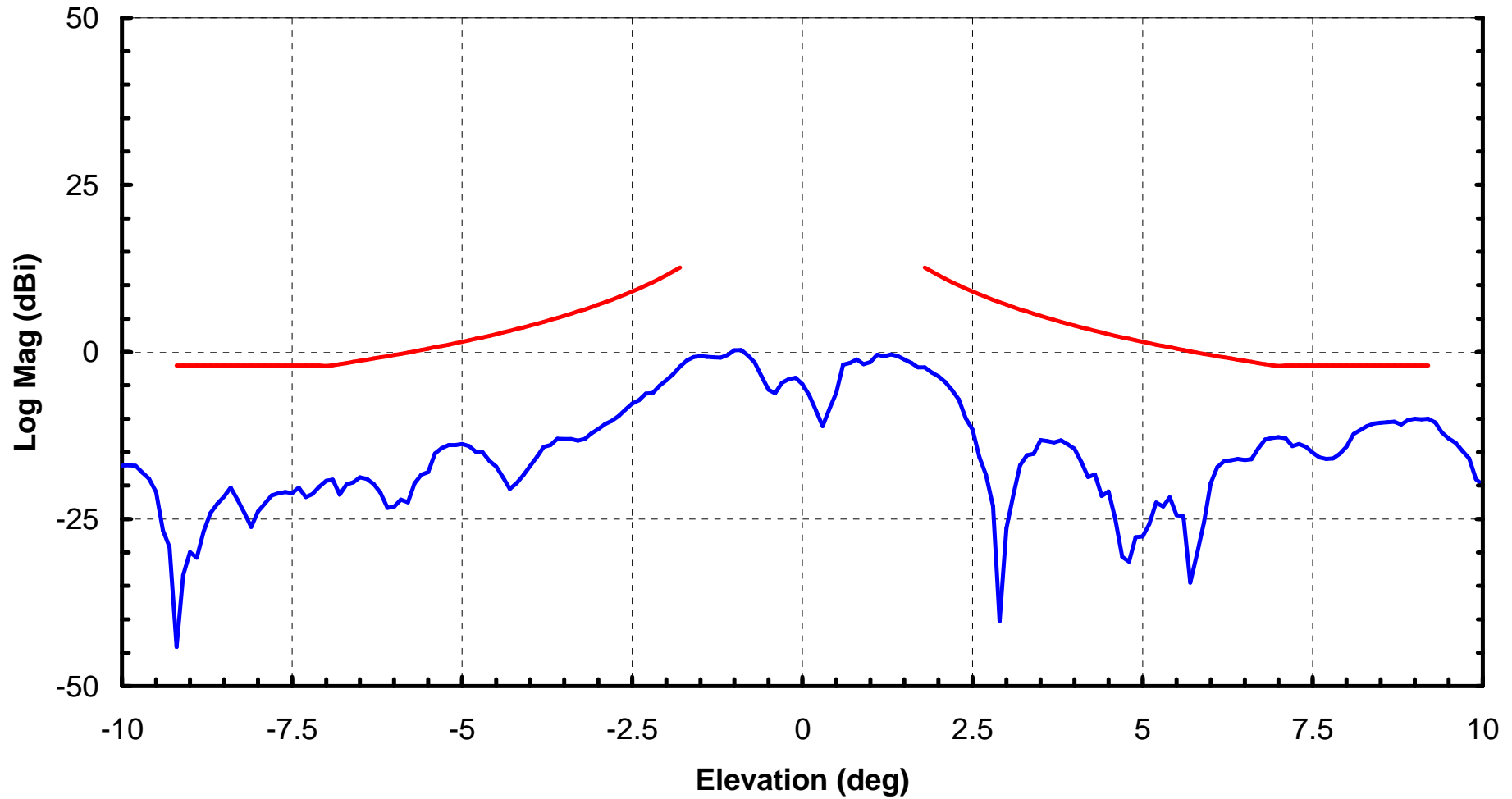
Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed

69

Vertical Cross-Polar Elevation
11.95GHz

Rx G98cm VH Elevation



Test Data: 26th Sept 2007
ERA Leatherhead, UK.

HNS 98cm Antenna with Mode Cancelling Feed
70

Vertical Cross-Polar Elevation
12.20GHz