Test Report

ELECTROMAGNETIC COMPATIBILITY TEST REPORT

Tests performed at:

dB Technology (Cambridge) Ltd
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On

Sepura Limited

BlueTooth antenna gain measurement testing on STP8X

Document History

Version	Date	Affected page(s)	Description of modifications	Revised by	Approved by
00	28/03/2024		Initial release		

Test Report

Product:	BlueTooth antenna gain measurement testing on STP8X
Company:	Sepura Limited
Representative:	James Conde
Address:	9000 Cambridge Research Park Beach Drive Waterbeach Cambridgeshire CB25 9TL
Start Date:	*13th March 2024*
End Date:	*13th March 2024*
Report Written By:	Stephen Browning
Report Authorised By:	Derek Barlow *Date: 28th March 2024*
Signature:	 Derek Barlow Digitally signed by Derek Barlow DN: C=UK, O=dB Technology, CN=Derek Barlow, E=derekb@dbtechnology.co.uk Reason: I am approving this document Location: dB Tech Cambridge Date: 2024-03-28 14:35:33 Foxit Reader Version: 9.6.0
Position:	Managing Director

This section intentionally left blank, by dB Technology, for additional signatories (if required - e.g. 'responsible party')

Additional signatory:

Test Report

Table of Contents

1 Introduction

This document describes testing performed by dB Technology (Cambridge) Ltd.

Section 2 of this document contain information that has been supplied by /agreed with the customer commissioning this set of work (typically the representative named at the start of this report). Any inaccuracies are the responsibility of the customer and may have a bearing on the validity of this report.

2 General Information

2.1 Product Name and Contact Details

Product:	BlueTooth antenna gain measurement testing on STP8X
Company:	Sepura Limited
Representative:	James Conde
Address:	9000 Cambridge Research Park Beach Drive Waterbeach Cambridgeshire CB25 9TL

2.2 Product Description

This report covers testing of the antenna of a BlueTooth module for use within STP8X family radios.

2.3 Details of EUT

EUT Item	Manufacturer	Model	Description	Serial No.
1	Sepura Limited	STP8X038	ATEX Portable TETRA terminal	1PR0005W59Q
2	Sepura Limited	STP8X038	ATEX Portable TETRA terminal	1PR0005080B
	Hardware/PCB versions PLX-19016M10		Software versions N/A	

3 Test Results

The following pages give details of methods and results of the tests.

3.1 Radiated Emissions - Polar Plots

3.1.1 Method

The radiation pattern was established as follows. The EUT was placed on a table at the centre of the turntable of a CISPR16 semi9-anechoic chamber and faced a receiving antenna at a 3m distance. The receiving antenna was connected to an RF receiver. The receiver was tuned to the appropriate frequency. The receiver mode was set to peak detection with a 120kHz bandwidth.

The turntable was set to 0° position. The height of the receiving antenna was adjusted to produce a maximum level on the RF receiver. This level was recorded. The EUT was then rotated clockwise by an angle of 10°. The receiver reading was recorded (without adjusting the height of the receiving antenna). This process was repeated at 10° steps until the EUT returned to the starting position (facing the receive antenna). Receiver readings were converted to equivalent antenna gain measurements. The resulting polar plots are shown in the results sections

3.1.2 Converting raw receiver readings to equivalent antenna gain

Measurements were made with the same set up as described above but with the EUT replaced by a calibrated reference antenna (double ridged guide) connected to a signal generator. The reference antenna was positioned at the centre of the turntable at the same height as the antenna on the EUT.

The level of the signal generator (*Sig_Gen_Ref*) at the reference input was measured using a power meter. The gain of the reference Antenna (*Antenna_Gain_Ref*) was taken from a calibration report.

The height of the receiving antenna was adjusted over the range 1m to 4m until a maximum reading was recorded on the RF receiver (*Receiver_Level_Ref*).

3.1.3 Derivation of Correction Factors

Measurement of reference antenna:

$$Receiver\_Level\_Ref + CFa = Sig\_Gen\_Ref + Antenna\_Gain\_Ref$$

Measurement of EUT:

$$Receiver\_Level\_EUT + CFa = Sig\_Gen\_EUT + Antenna\_Gain\_EUT$$

Correction CFa is common to both equations (related to site, receiver, receiver cable, distance etc)

so:

$$Antenna\_Gain\_EUT = Receiver\_Level\_EUT + CFb$$

$$where\ CFb = Sig\_Gen\_Ref - Sig\_Gen\_EUT + Antenna\_Gain\_Ref - Receiver\_Level\_Ref$$

Normally the value of the output level of the EUT is provided by the manufacturer, however a signal generator was used as the signal source and the output level at the end of the cable connected to the EUT was recorded.

3.1.4 Correction Factors

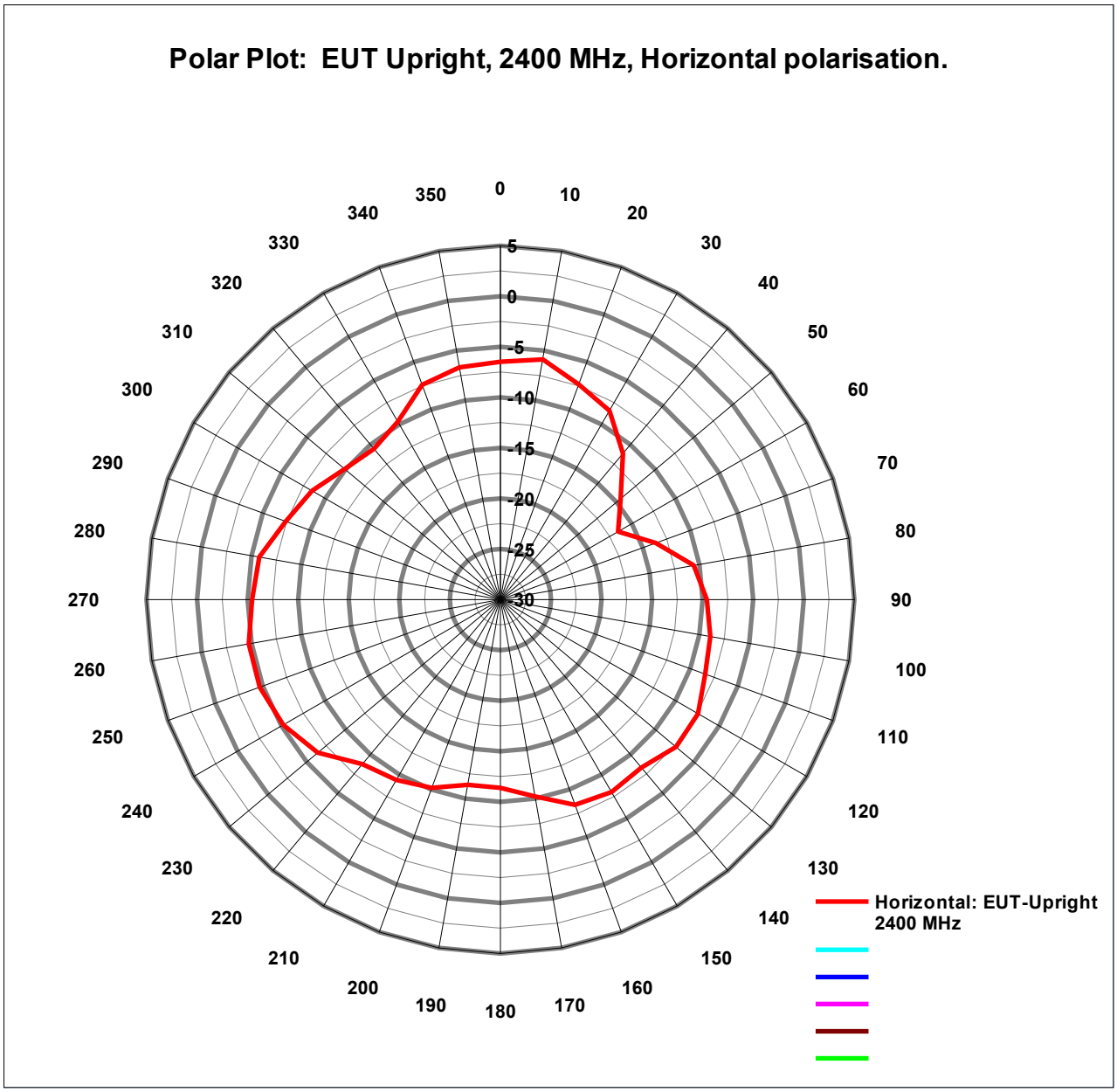
Radiated Emissions Results (Substitution Method - with Reference Antenna)											#Ref00
Date: 13/03/2024	*Test Engineer: Stephen Browning*										
Notes	**Freq. MHz**	**Fact Set**	**Ref Ant Gain (A23) dBi**	**Dist-ance (m)**	**Ant. *Pol.***	**Sig Gen Level to EUT Ant dBm**	**Sig Gen Level Ref Ant dBm**	**Rec'vr Level Ref Ant dBuV**		**Gain CF dB**	
	2400	1	9.6	3	v	-23.1	-22.2	52.8		**-42.3**	
	2400	1	9.6	3	h	-23.1	-22.2	53.3		**-42.8**	
	2442	1	9.7	3	v	-23.3	-22.3	52.3		**-41.7**	
	2442	1	9.7	3	h	-23.3	-22.3	52.8		**-42.1**	
	2485	1	9.8	3	v	-23.4	-22.4	51.9		**-41.1**	
	2485	1	9.8	3	h	-23.4	-22.4	52.6		**-41.8**	
Notes:											
	Sig gen level to EUT antenna does not take into account the half dB loss in the short wire provided between the BlueTooth Antenna and the SMA connector.										

3.1.5 Test Equipment

Test Equipment				
Ref:	**Description:**	**S/N:**	**Cal. Date**	**Cal Interval (Months)**
A23	EMCO 3115 DR Guide (1-18GHz)	9507-4525	07/01/2022	36
PM2	Marconi 6960B RF Power Meter	236963/014	27/11/2023	12
PS3	Marconi 6920 RF Power Sensor (-70dBm/-20dBm) 10MHz to 20GHz	890	08/11/2023	12
R13	Anritsu MS2830A	6201180830	19/01/2024	12
A40	ETS-Lindgen 3115 DRG	00218793	21/10/2021	36
ANECH2	Semi-anechoic chamber 2	002	Not Req.	_
SG9	HP 8648C 9kHz-3.2GHz Signal Generator	3847A05254	27/11/2023	12
Correction Factors				
CF1:A23_dBi_22A.txt				

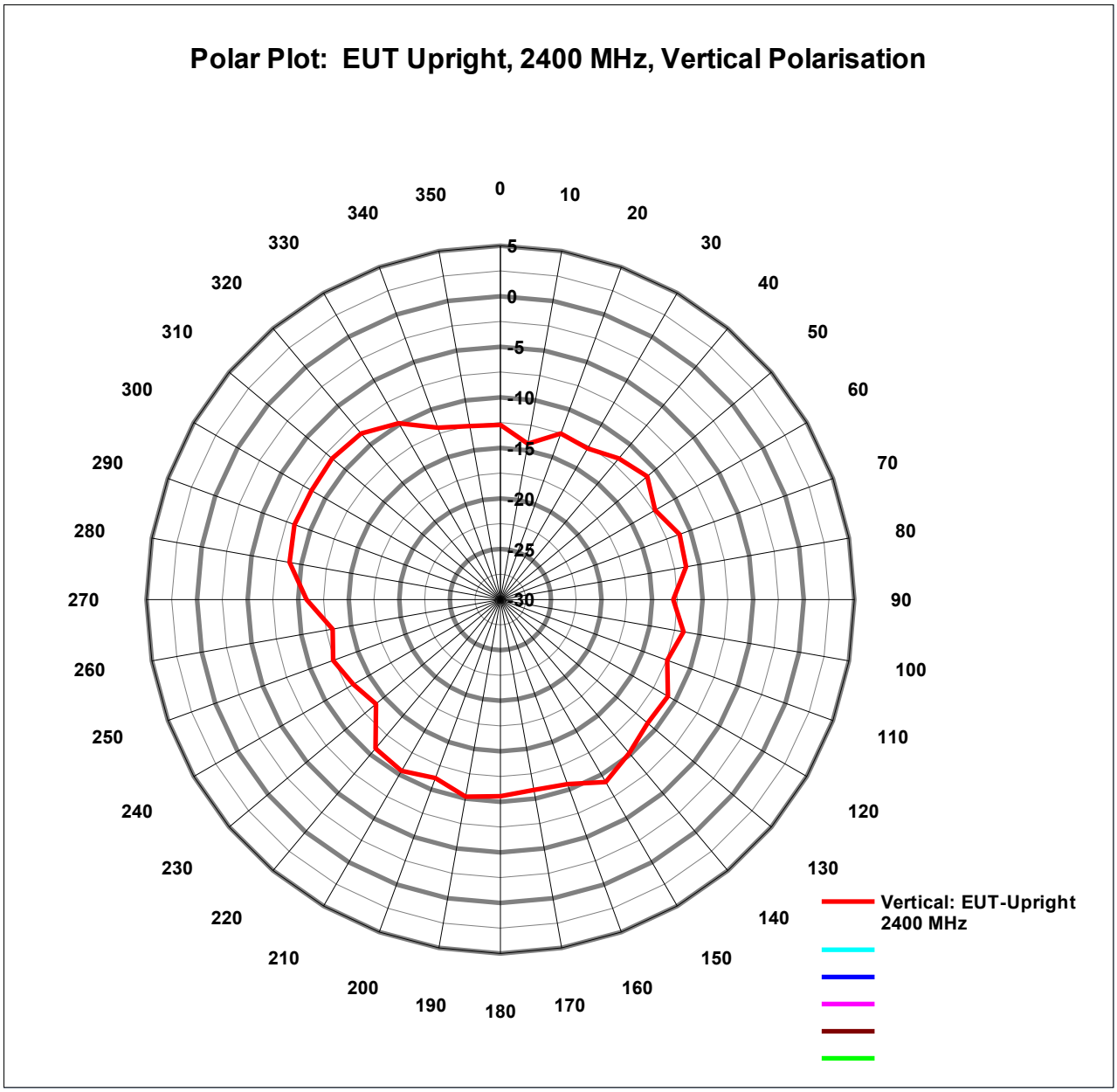
3.2 Polar Plots

The following pages contain plots of antenna gain. The gain figures are in dBi



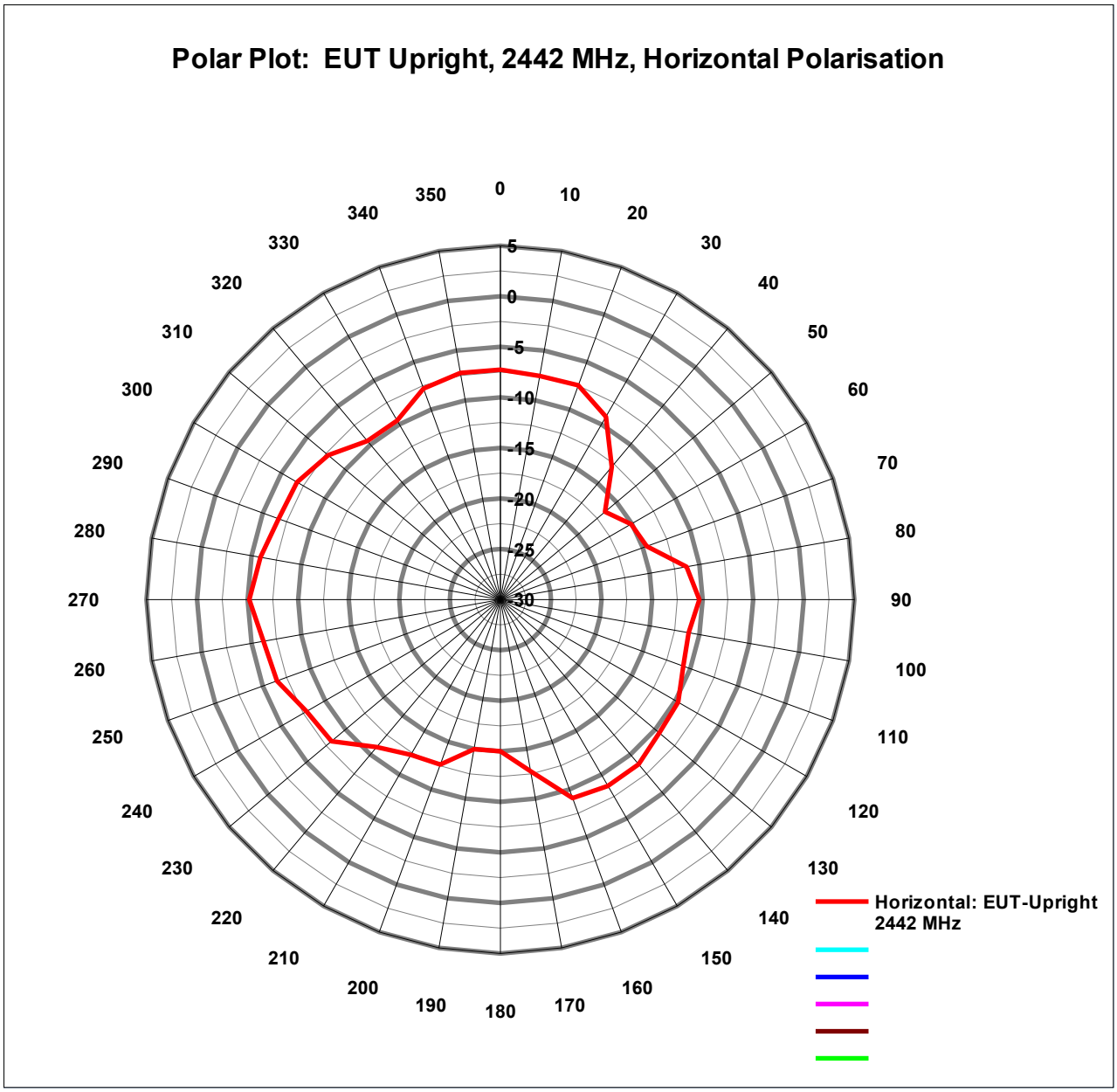
	MAX	MIN	AVG
Horizontal: EUT-Upright	-4.7	-16.5	-8.1

3.2.1 Horizontal Polarisation with EUT Upright at 2400 MHz: Gain in dBi



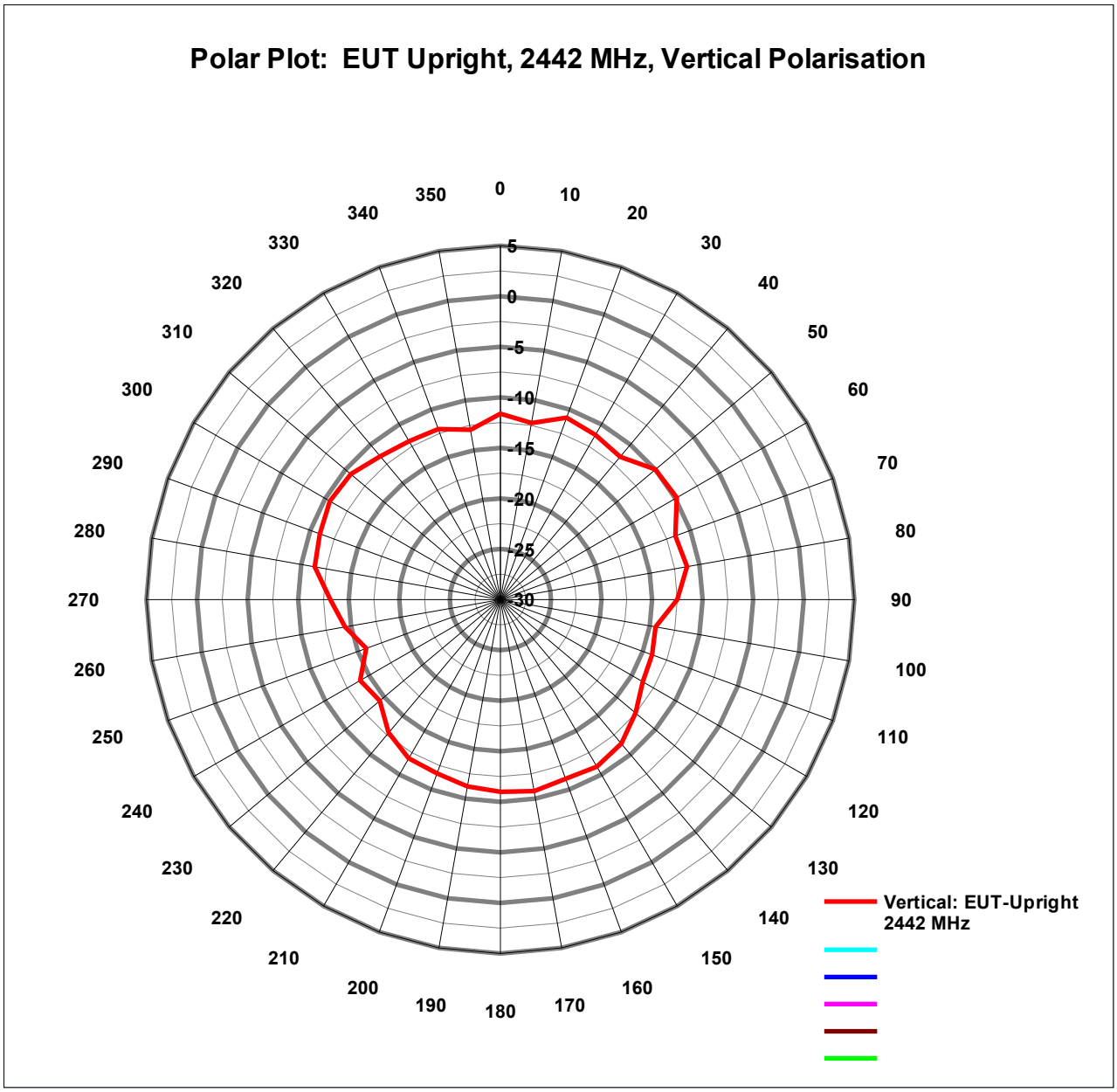
	MAX	MIN	AVG
Vertical: EUT-Upright	-8.3	-14.4	-10.9

3.2.2 Vertical Polarisation with EUT Upright at 2400 MHz: Gain in dBi



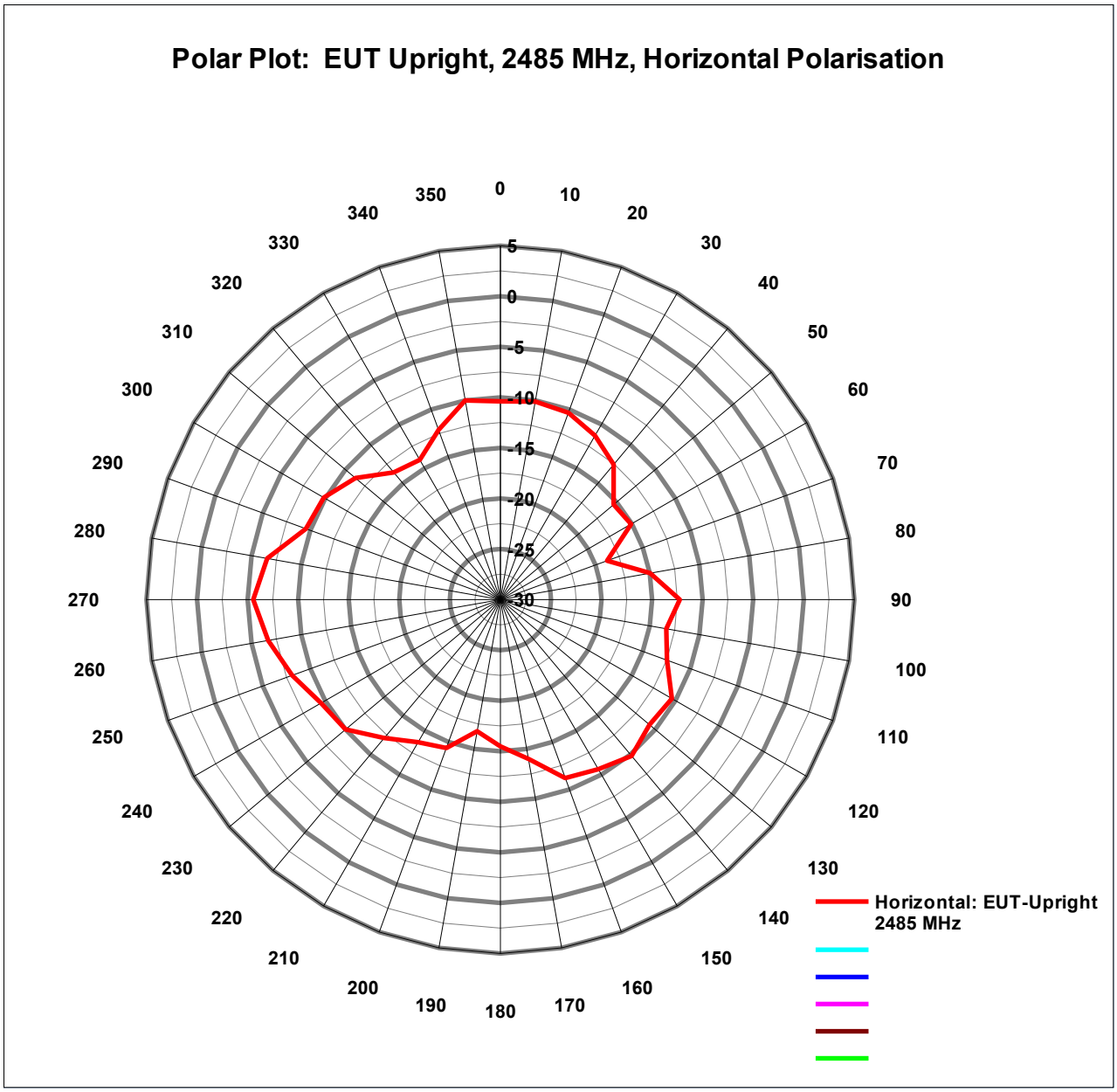
	MAX	MIN	AVG
Horizontal: EUT-Upright	-5.2	-16.5	-9.0

3.2.3 Horizontal Polarisation with EUT Upright at 2442 MHz: Gain in dBi



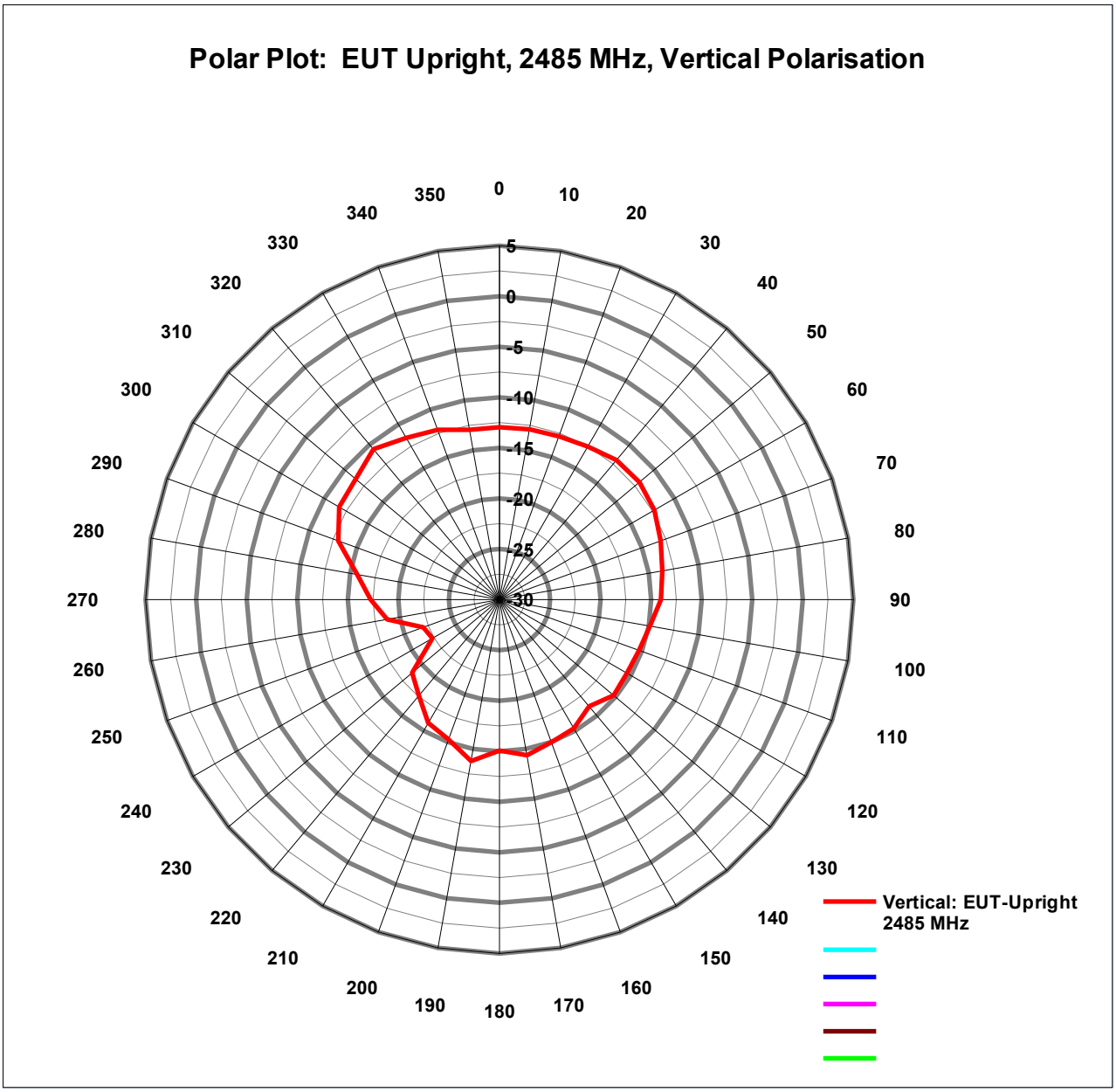
	MAX	MIN	AVG
Vertical: EUT-Upright	-9.8	-15.9	-11.9

3.2.4 Vertical Polarisation with EUT Upright at 2442 MHz: Gain in dBi



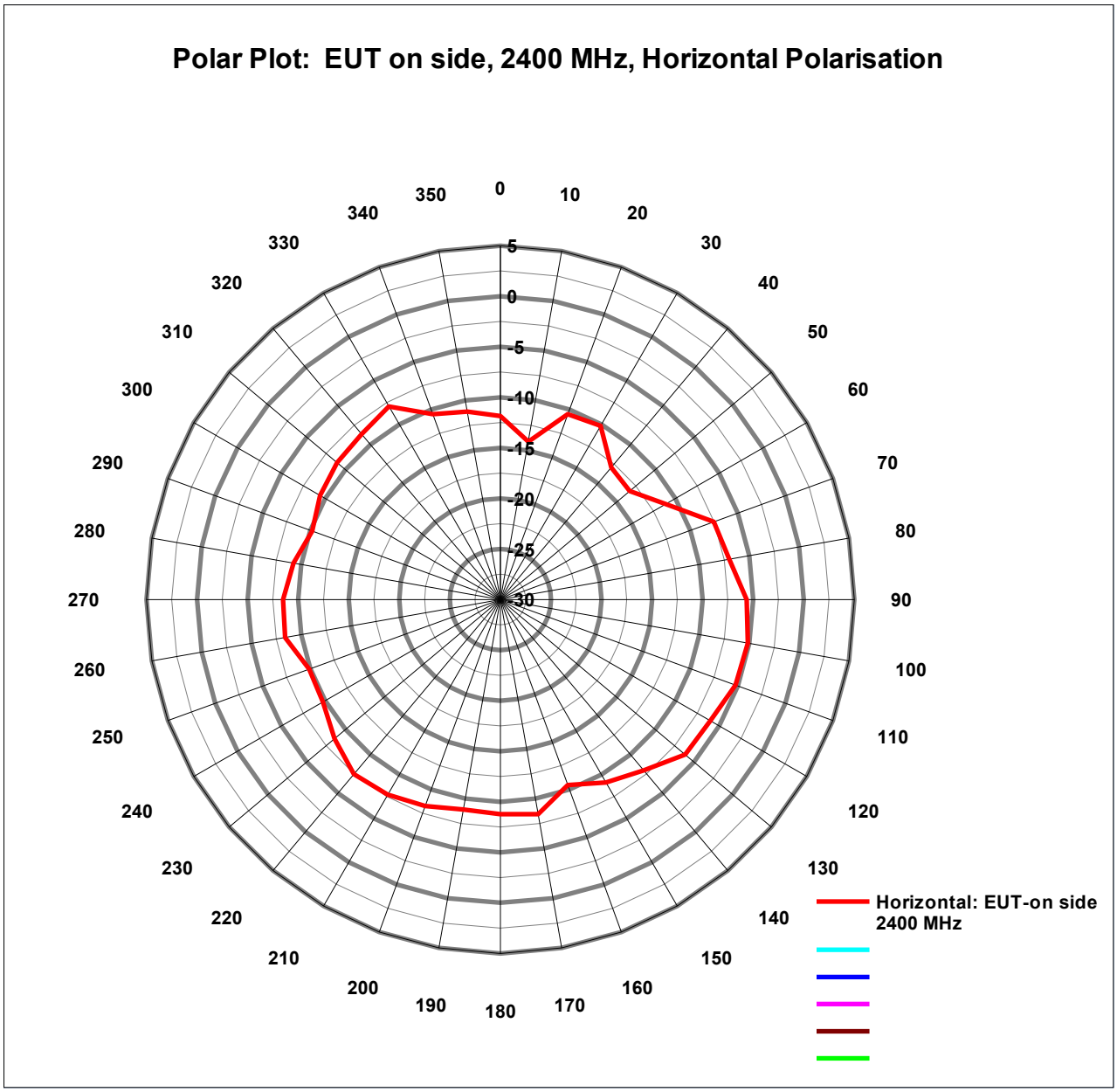
	MAX	MIN	AVG
Horizontal: EUT-Upright	-5.6	-18.8	-10.8

3.2.5 Horizontal Polarisation with EUT Upright at 2485 MHz: Gain in dBi



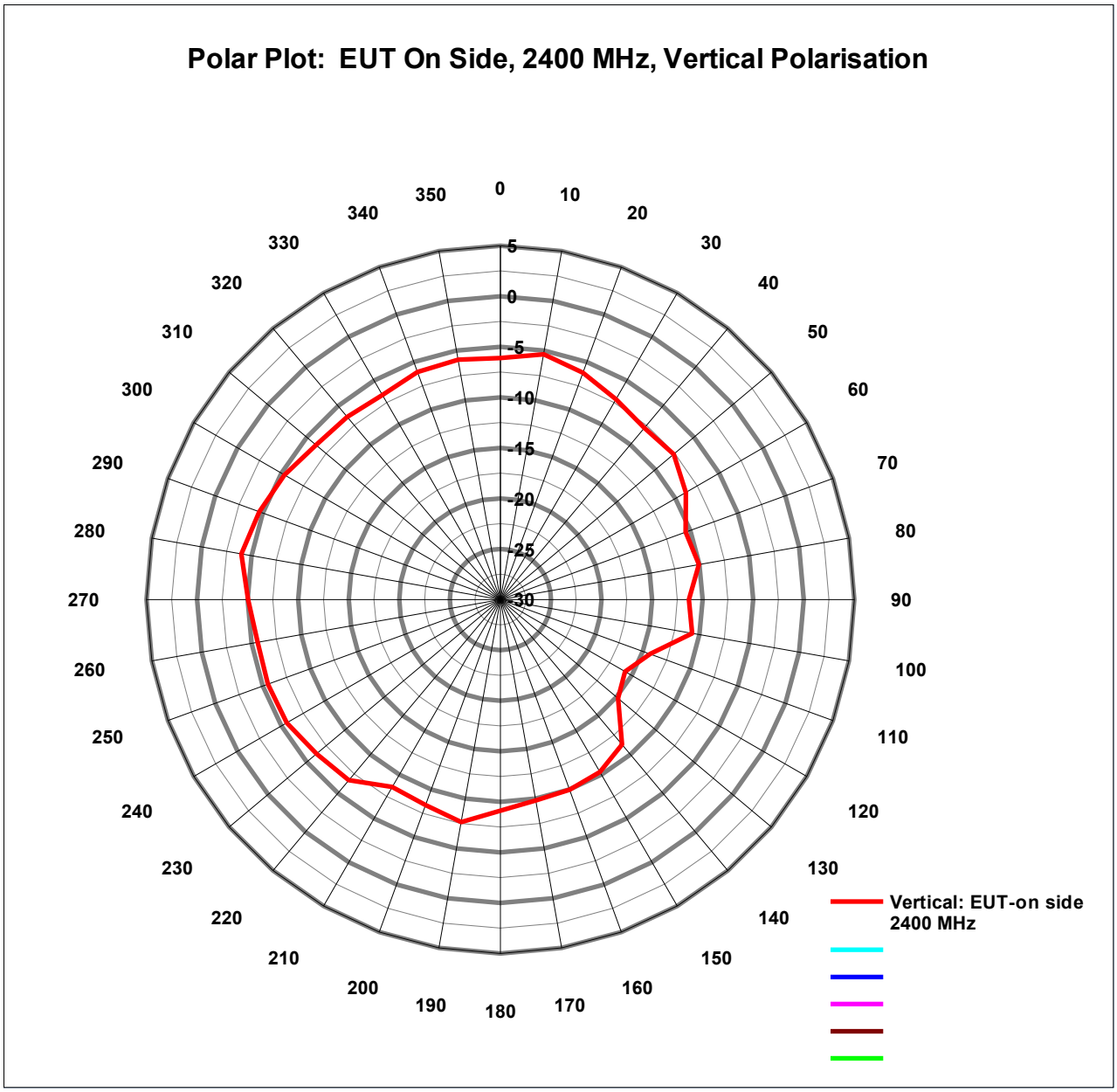
	MAX	MIN	AVG
Vertical: EUT-Upright	-10.6	-22.3	-13.9

3.2.6 Vertical Polarisation with EUT Upright at 2485 MHz: Gain in dBi



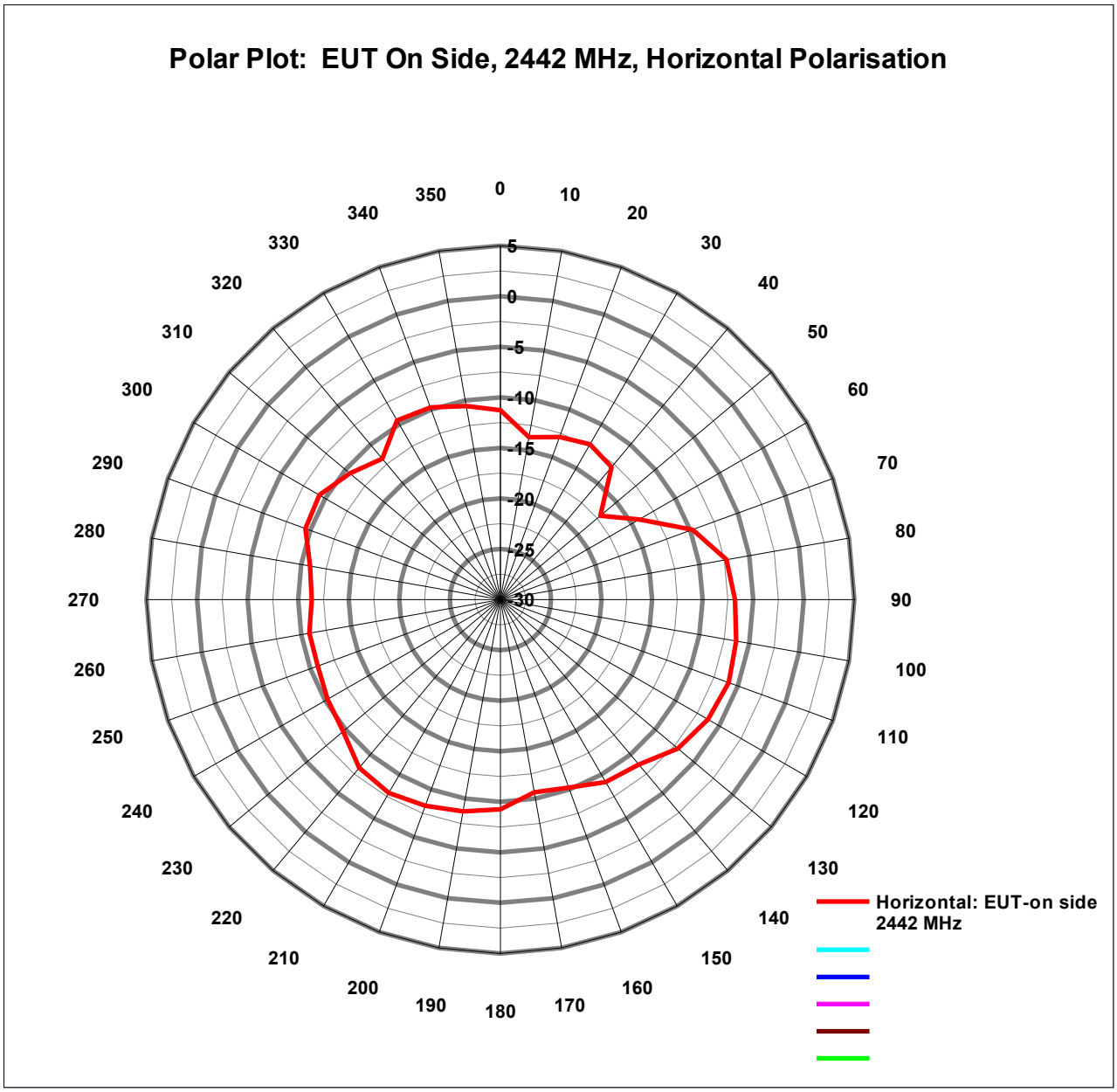
	MAX	MIN	AVG
Horizontal: EUT-on side	-5.2	-14.1	-8.5

3.2.7 Horizontal Polarisation with EUT on side at 2400 MHz: Gain in dBi



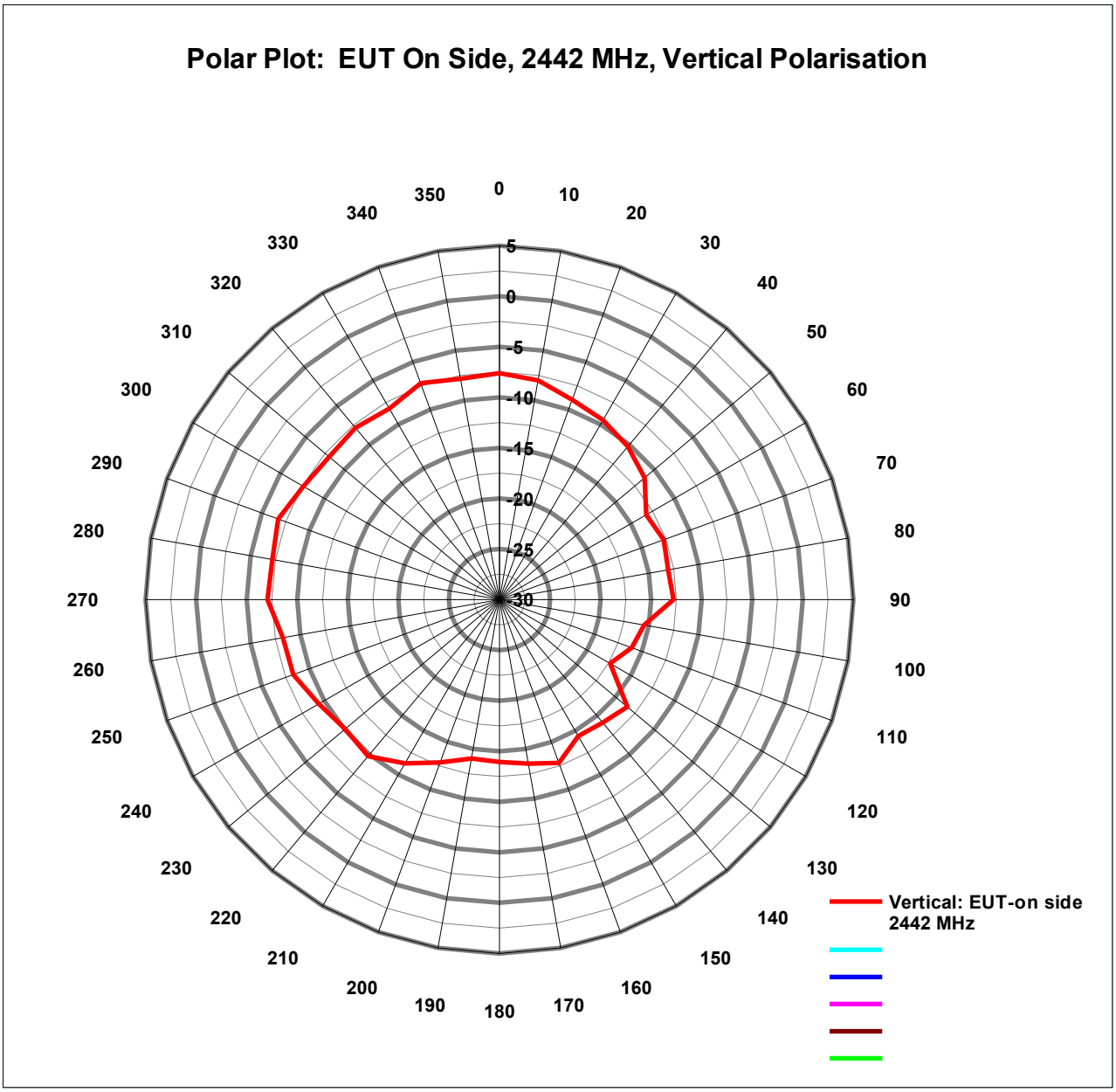
	MAX	MIN	AVG
Vertical: EUT-on side 2	-4.0	-15.8	-7.3

3.2.8 Vertical Polarisation with EUT on side at 2400 MHz: Gain in dBi



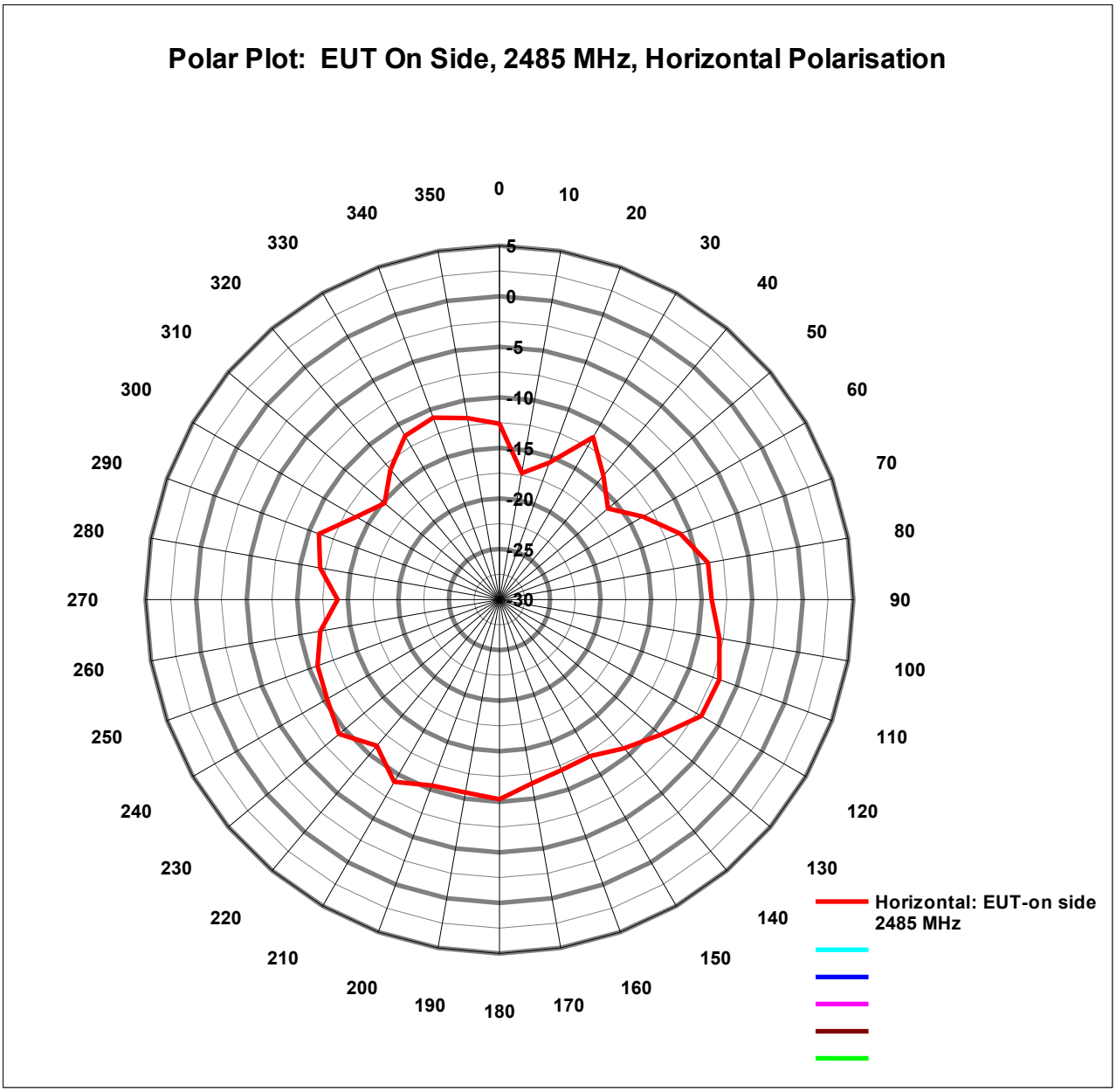
	MAX	MIN	AVG
Horizontal: EUT-on side	-6.0	-17.1	-9.4

3.2.9 Horizontal Polarisation with EUT on side at 2442 MHz: Gain in dBi



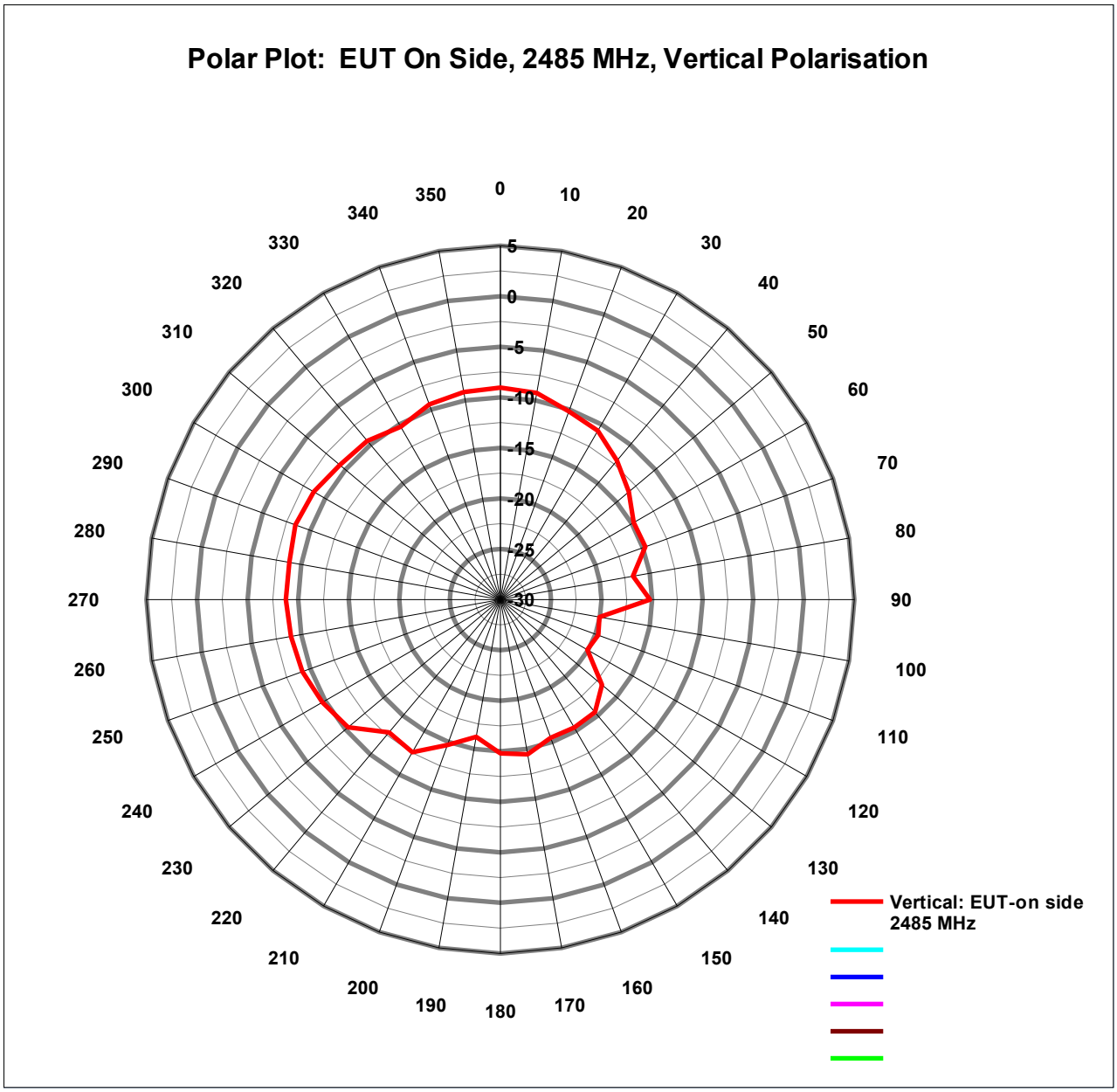
	MAX	MIN	AVG
Vertical: EUT-on side 2	-6.7	-17.4	-9.9

3.2.10 Vertical Polarisation with EUT on side at 2442 MHz: Gain in dBi



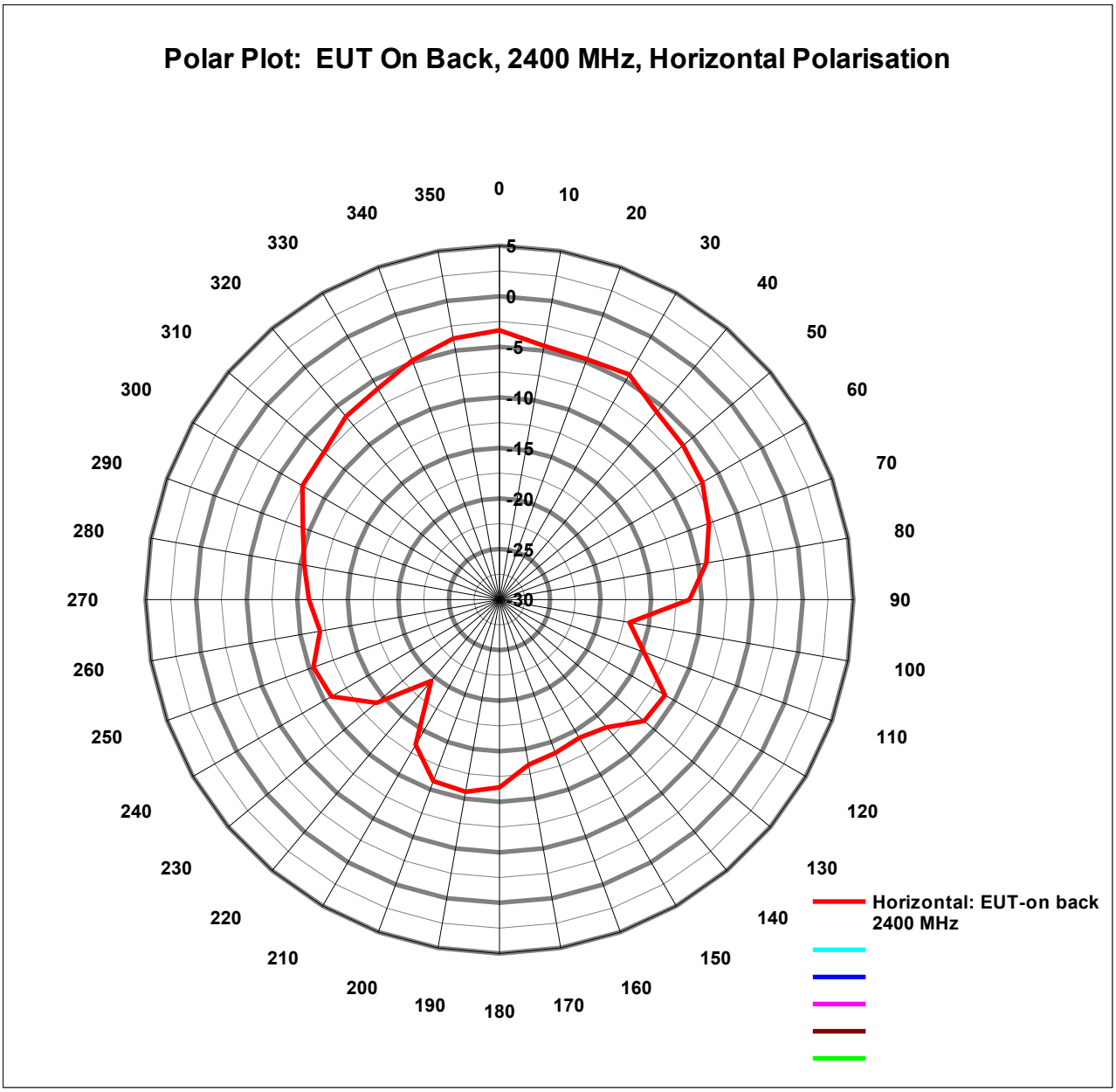
	MAX	MIN	AVG
Horizontal: EUT-on side	-6.9	-17.3	-10.9

3.2.11 Horizontal Polarisation with EUT on side at 2485 MHz: Gain in dBi



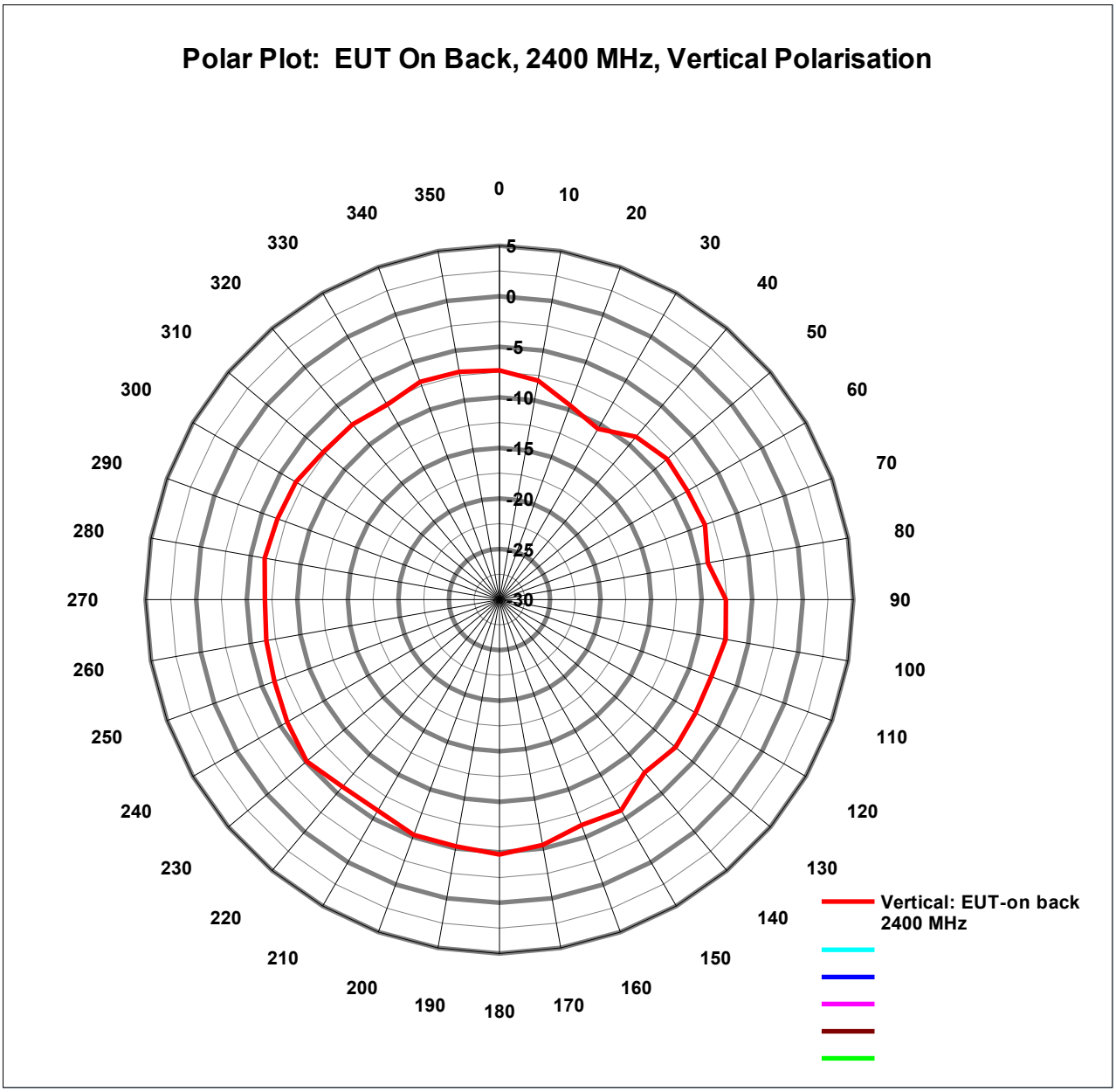
	MAX	MIN	AVG
Vertical: EUT-on side 2	-8.4	-20.1	-11.5

3.2.12 Vertical Polarisation with EUT on side at 2485 MHz: Gain in dBi



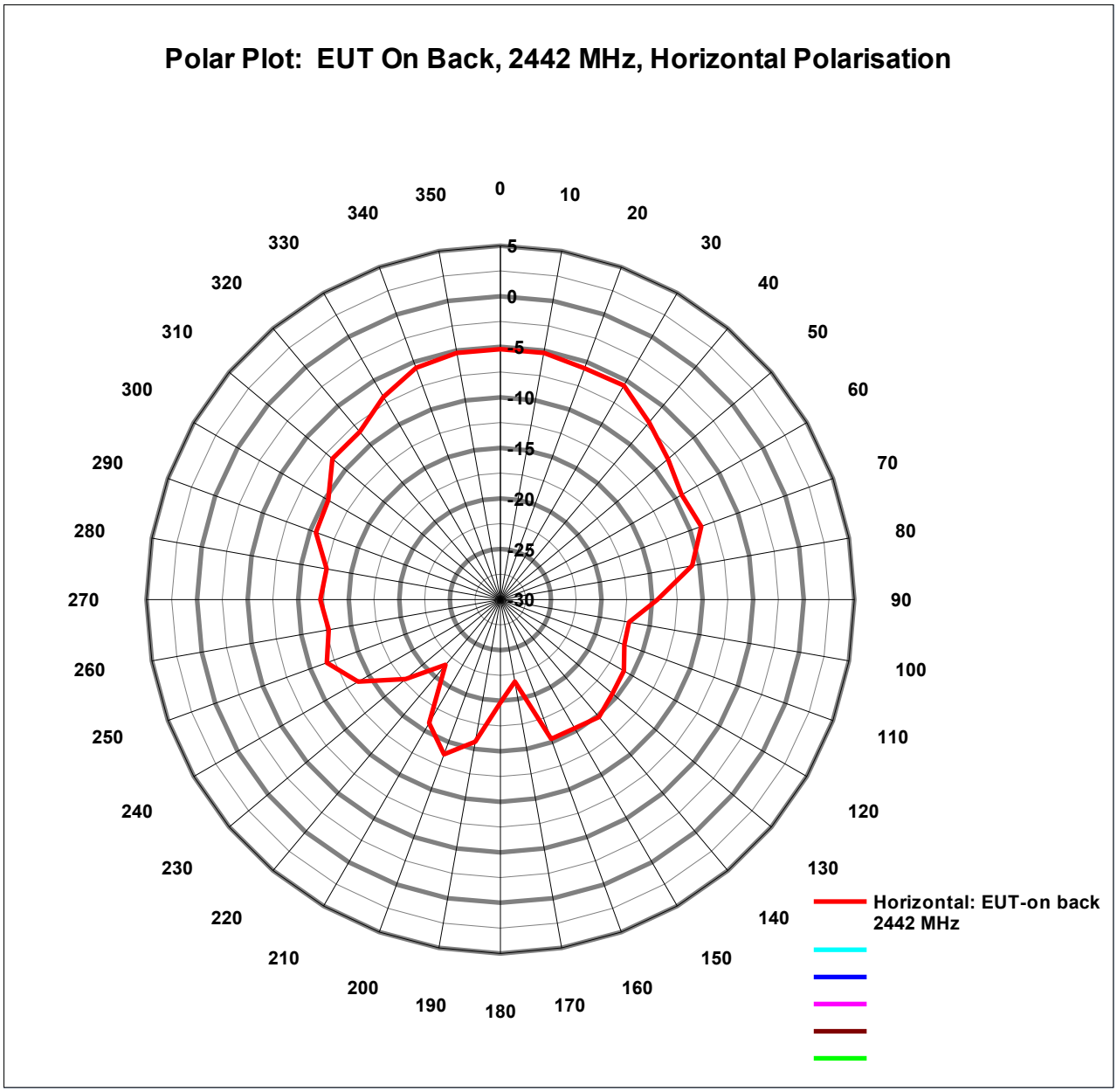
	MAX	MIN	AVG
Horizontal: EUT-on bac	-3.4	-19.5	-8.2

3.2.13 Horizontal Polarisation with EUT on back at 2400 MHz: Gain in dBi



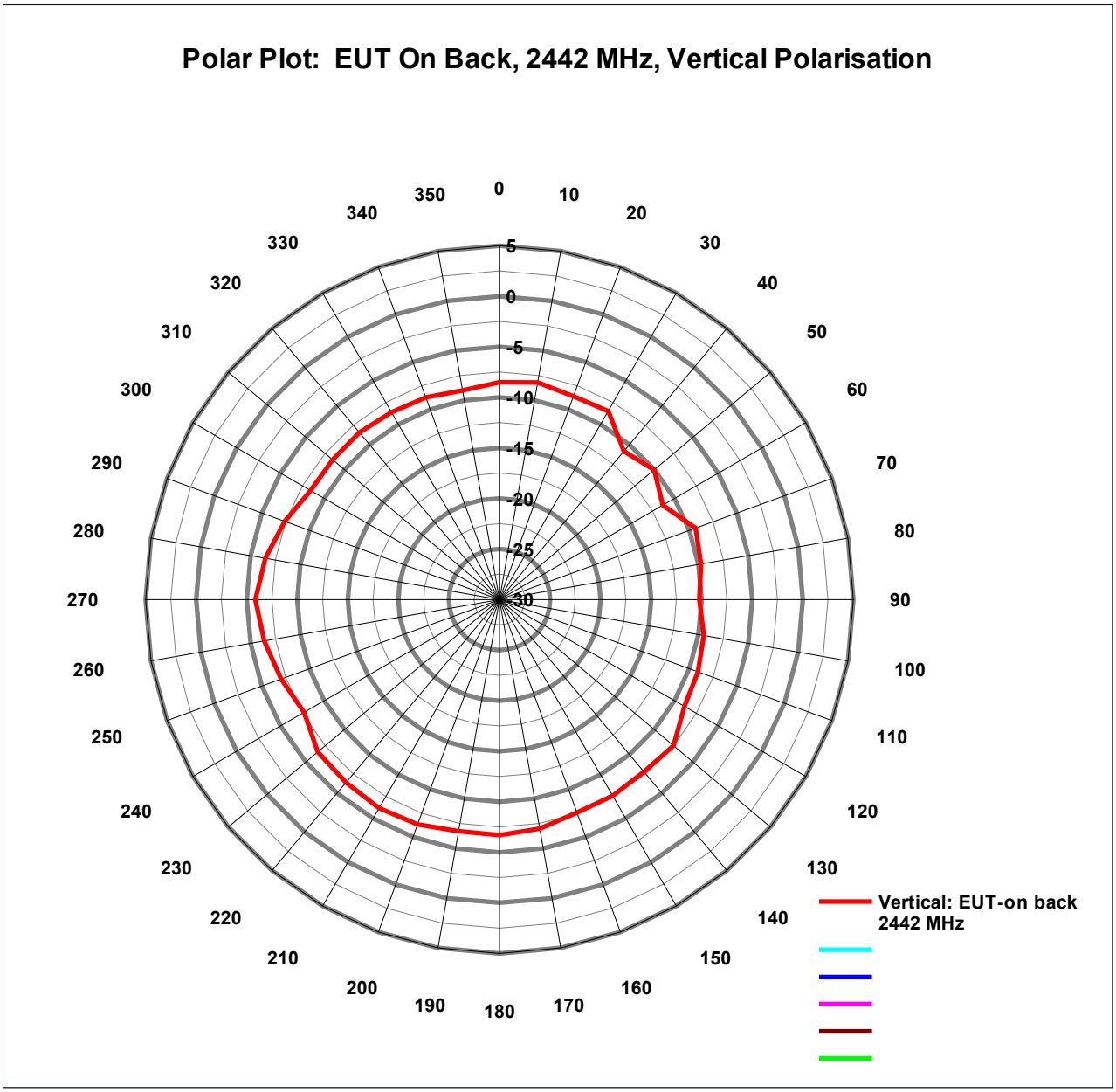
	MAX	MIN	AVG
Vertical: EUT-on back	-4.8	-10.5	-6.9

3.2.14 Vertical Polarisation with EUT on back at 2400 MHz: Gain in dBi



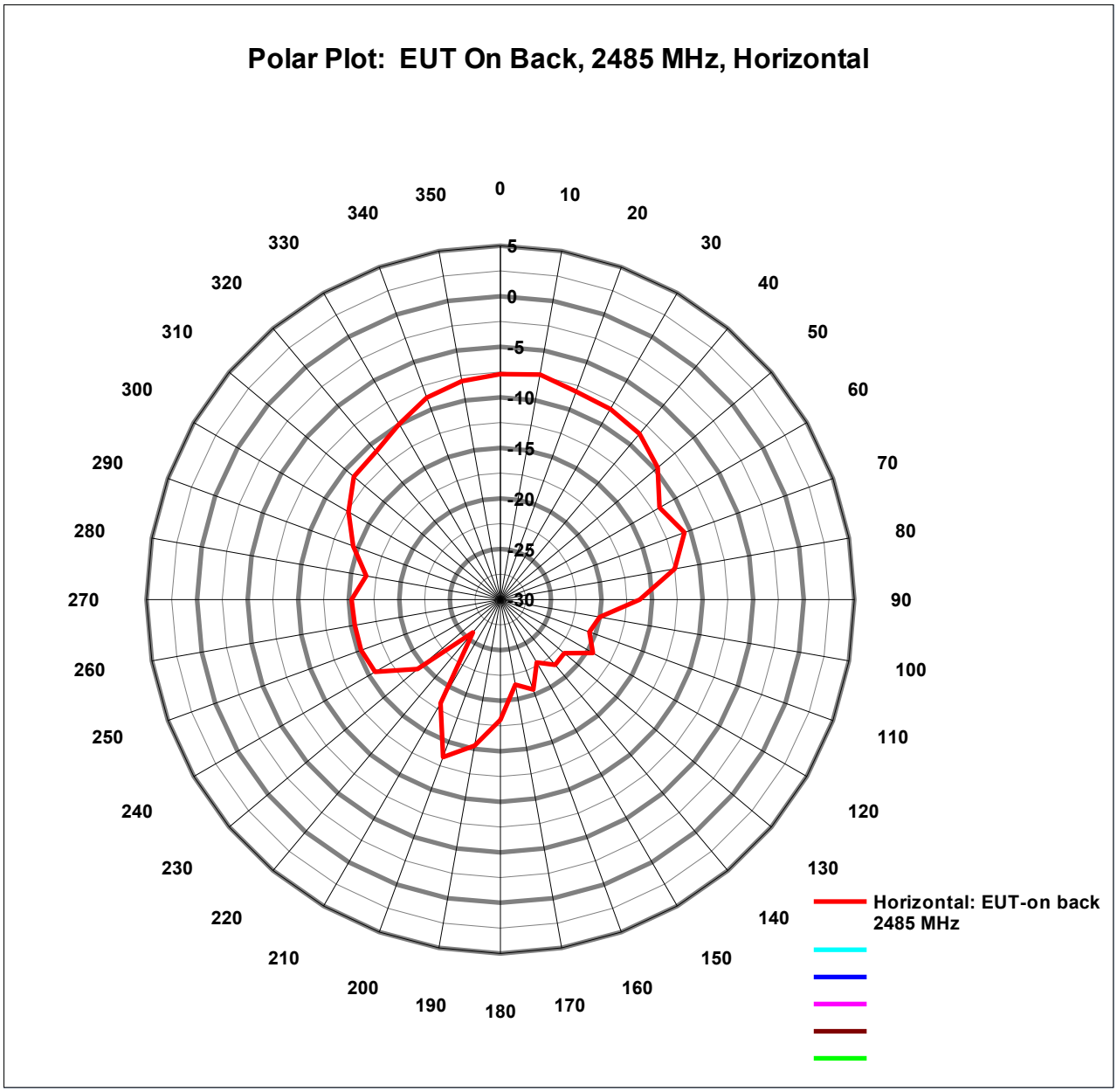
	MAX	MIN	AVG
Horizontal: EUT-on bac	-5.2	-21.7	-9.9

3.2.15 Horizontal Polarisation with EUT on back at 2442 MHz: Gain in dBi



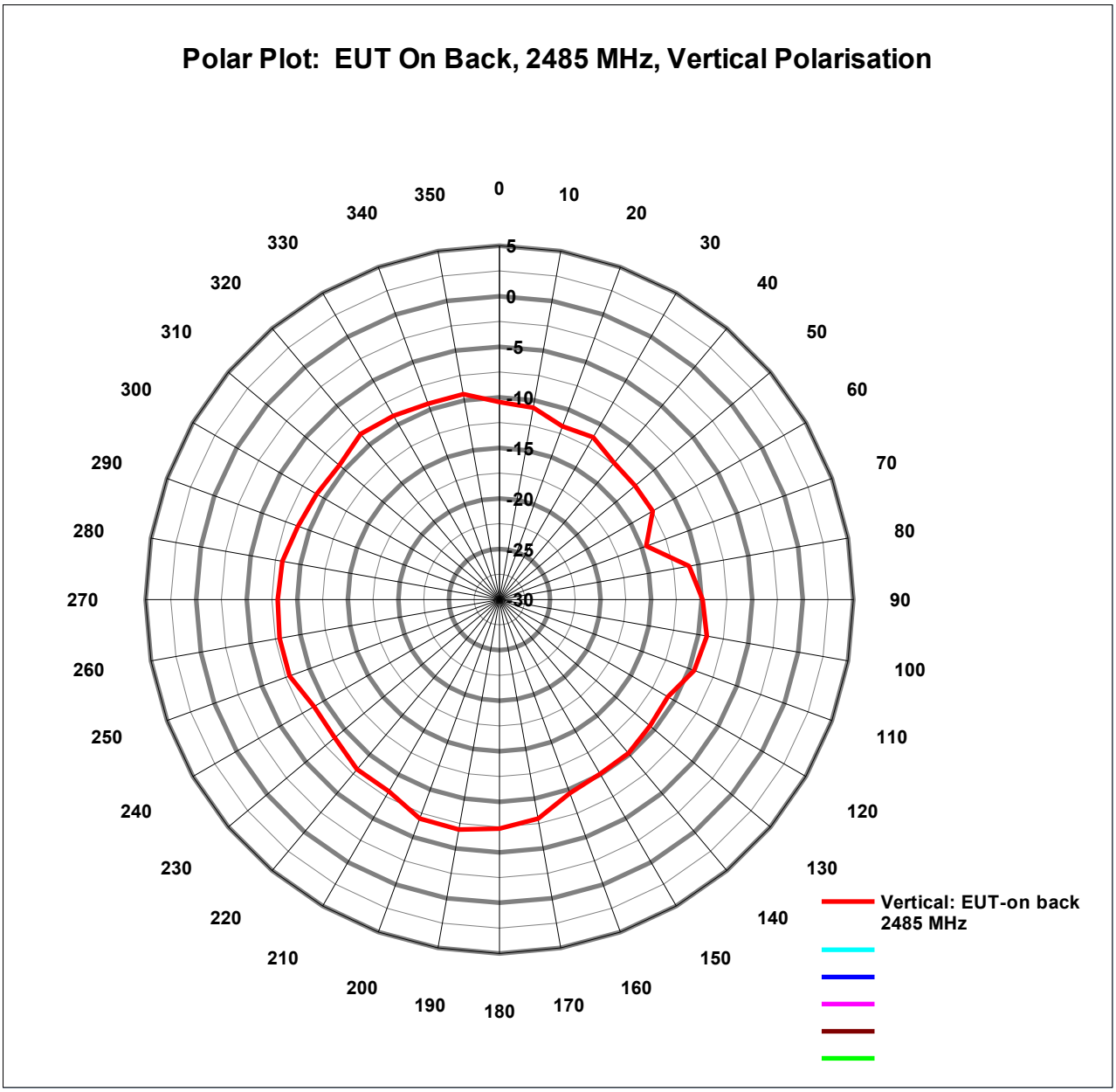
	MAX	MIN	AVG
Vertical: EUT-on back	-5.9	-11.3	-7.9

3.2.16 Vertical Polarisation with EUT on back at 2442 MHz: Gain in dBi



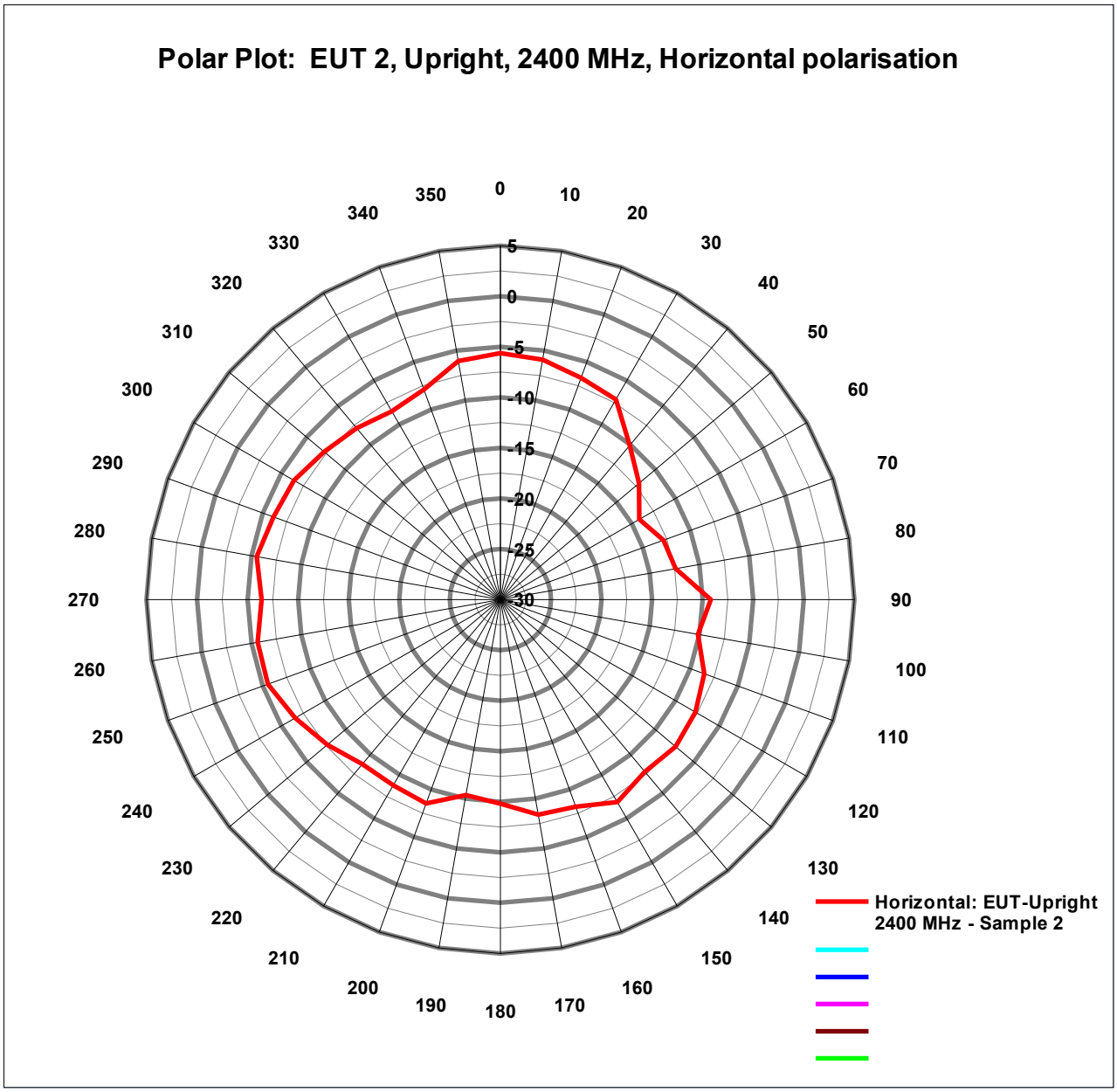
	MAX	MIN	AVG
Horizontal: EUT-on bac	-7.4	-25.8	-12.3

3.2.17 Horizontal Polarisation with EUT on back at 2485 MHz: Gain in dBi



	MAX	MIN	AVG
Vertical: EUT-on back	-6.9	-14.5	-9.3

3.2.18 Vertical Polarisation with EUT on back at 2485 MHz: Gain in dBi



	MAX	MIN	AVG
Horizontal: EUT-Upright	-5.5	-14.1	-7.7

3.2.19 Horizontal Polarisation with alternative EUT upright at 2400 MHz: Gain in dBi