

Test report No:

NIE: 56485RAN.001

Test Report

LoRa Alliance End-Device Certification Radiated RF Performance for EU 868 MHz ISM Band Devices

Identification of item tested.....:	GPS Tracker
Trademark	FFLY4U
Model and/or type reference	FFLYTRACK MyriaPlus
Other identification of the product	Device EUI: 84:5A:81:00:38:F1:58:A3
Final HW version	V2.1
Final SW version	1755132000 v0.3
Manufacturer	Company name: FFLY4U SAS Address: 3 Avenue Didier Daurat, 31400, Toulouse, France
Test method requested, standard.....:	[1] LoRa Alliance End-Device Certification Radiated RF Performance for EU 868 MHz ISM Band Devices
Approved by (name / position & signature)	Miguel Lacave Antennas Lab Manager
Date of issue	2018-04-09
Report template No.....:	FDT08_20

Instrumentation used.....:

1. Anechoic chamber ETS LINDGREN AMS-8500 (SN: 3954)
2. Positioning system controller ETS LINDGREN EMCENTER 2090 (SN: 00078508)
3. RF switch unit mainframe Agilent 3499A (SN: MY42003363)
4. OTA measurement software ETS LINDGREN EMQuest v1.10 (SN: 1095)
5. Spectrum analyzer Rohde & Schwarz FSU (SN: 200143)
6. LoRa Gateway Semtech IOT868TKLM1 HAL v3.2.0
7. Step attenuator Vaunix Technology Corporation Lab BrickDigital Attenuator (SN: 9826)
8. RF Circulator Channel Microwave Corporation, Model BUL330
9. RF Isolator Channel Microwave Corporation, Model AUL330
10. Temperature and Humidity probe, model HUMIDIPROBE (SN: ZNR30/064)

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Competences and guarantees

DEKRA Testing and Certification S.A.U. is a testing laboratory competent to carry out the tests described in this report.

In order to assure the traceability to other national and international laboratories, DEKRA has a calibration and maintenance program for its measurement equipment.

DEKRA guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at DEKRA at the time of performance of the test.

DEKRA is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.

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General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of DEKRA.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA and the Accreditation Bodies.

Uncertainty

Uncertainty (factor $k=2$) was calculated according to the following documents:

1. 3GPP TS 34.114: "User Equipment (UE) / Mobile Station (MS) Over The Air (OTA) antenna performance; Conformance testing", 12.2.0 (2016-10-05).
2. FAN17_00 - OTA SISO - AMS-8500 Uncertainty data sheet.

Usage of samples

Samples undergoing test have been selected by the client.

Sample M/01 is composed of the following elements:

Control N°	Description	Model	Device EUI	Date of reception
56104/007	GPS Tracker	FFLYTRACK MyriaPlus	84:5A:81:00:38:F1:58:A3	2018-04-02

1. Sample M/01 has undergone the test(s) specified in subclause “Test method requested”.

Test sample description

The test sample is a GPS industrial asset tracker.

Identification of the client

Company name: FFLY4U SAS

Postal Address: 3 Avenue Didier Daurat, 31400, Toulouse, France

Contact Person: Nghia Phan

Telephone: +33561248091

e-mail: nph@ffly4u.com

Testing period

The performed test started on 2018-04-03 and finished on 2018-04-04.

The tests have been performed at DEKRA Testing and Certification, S.A.U.

Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

Temperature	Min. = 23.30 °C Max. = 25.94 °C
Relative humidity	Min. = 33.73 % Max. = 44.04 %

Remarks and comments

None.

Testing verdicts

Not applicable	N/A
Pass	P
Fail	F
Measured	M
Not measured	N/M

Transmitter Performance:

LoRa Alliance End-Device Certification Radiated RF Performance for EU 868 MHz ISM Band Devices, PARAGRAPH	VERDICT				
	N/A	P	F	M	N/M
2 : End-device transmitter performance				X	

Receiver Performance:

LoRa Alliance End-Device Certification Radiated RF Performance for EU 868 MHz ISM Band Devices, PARAGRAPH	VERDICT				
	N/A	P	F	M	N/M
3 : End-device receiver performance				X	

Appendix A – Test results

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1. TEST CONDITIONS

1.1 Power supply

The device was power supplied by its own 3.6 V internal battery.

1.2 Test frequencies and output power

In all required operating bands the measurements for Total Radiated Power (TRP) measurements are to be performed on lowest, default and highest channels and Total Isotropic Sensitivity (TIS) measurements are to be performed on default and highest channels defined by the standard [1].

The output power of the EUT was set to maximum for all tests.

1.3 Antenna orientation and setup requirements

The EUT is rotated along two different spherical axes with a segmentation of 10 degrees: theta (θ) and phi (Φ). The relationship between the 3D Cartesian coordinate system (X, Y, Z) and the theta and phi axes is illustrated in the following figure. This coordinate system should be used as reference in all 3D radiation pattern graphs in section 4 as well as test setup photographs in Appendix B.

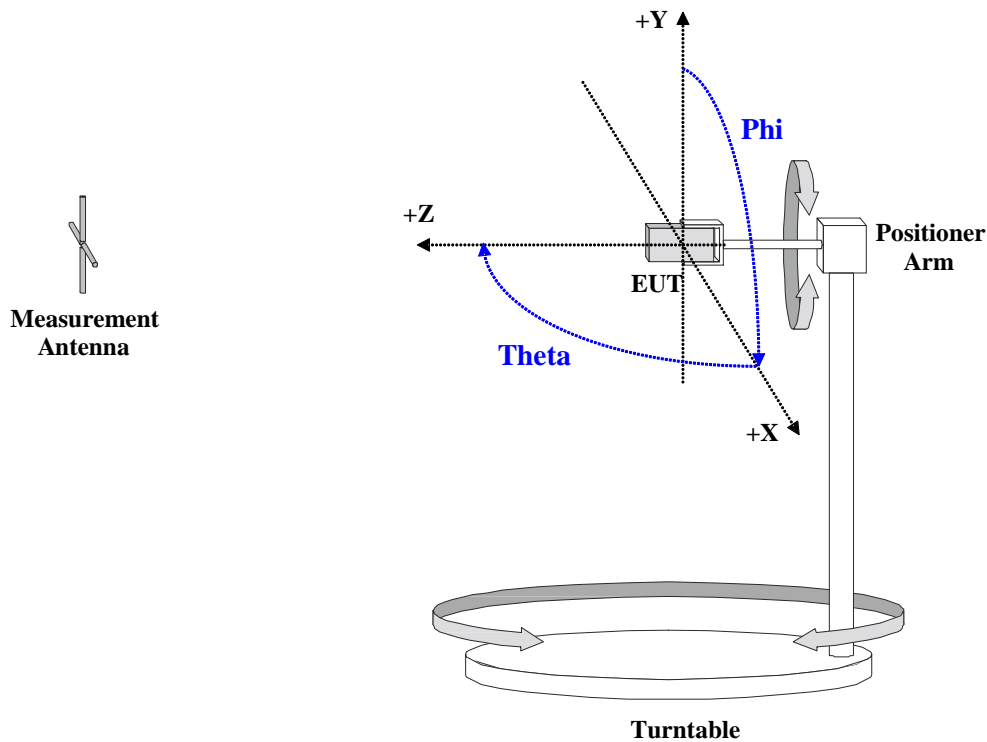


Fig. 1. Coordinate system.

Theta is the spherical axis that rotates along the Cartesian Y axis while Phi is the spherical axis that rotates along the Cartesian Z axis. The initial measurement position (Theta = 0° and Phi = 0°) is illustrated in each of the test setup photographs in Appendix B. The EUT has only one mechanical configuration each and it was tested in the “Free-space” configuration, whereby EUT has been placed directly on a support. The following figures illustrate the connection diagrams of the test system for end-device transmitter and receiver performance tests.

End-device transmitter performance

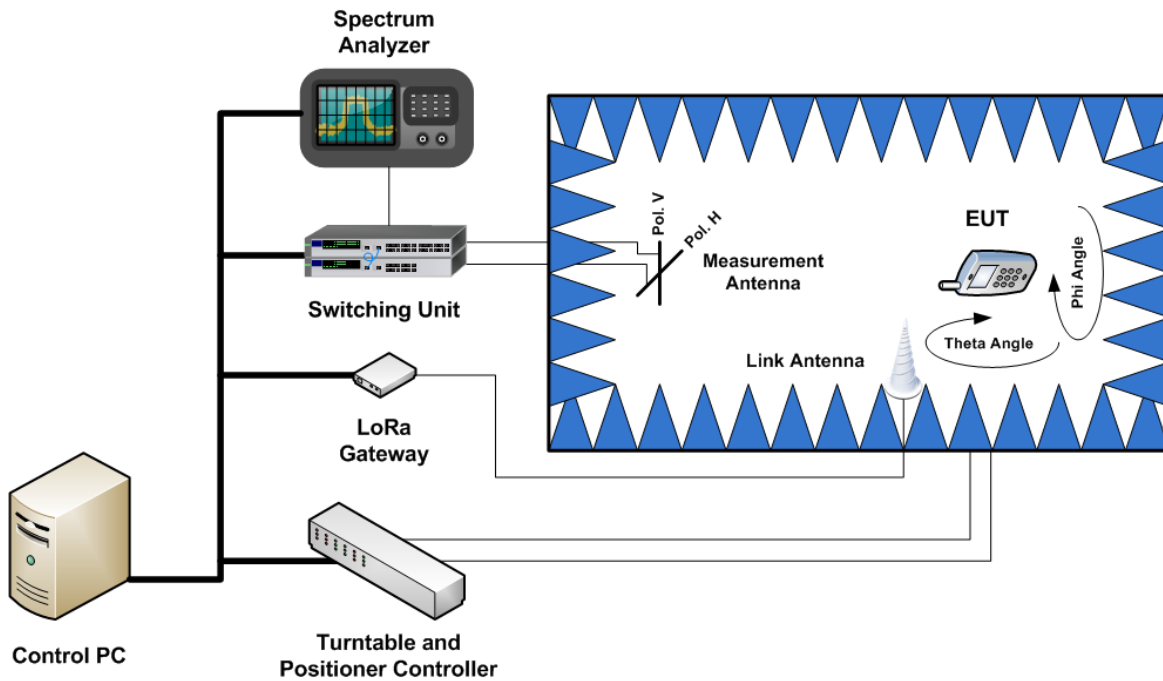


Fig. 2. Transmitter performance test connection diagram.

End-device receiver performance

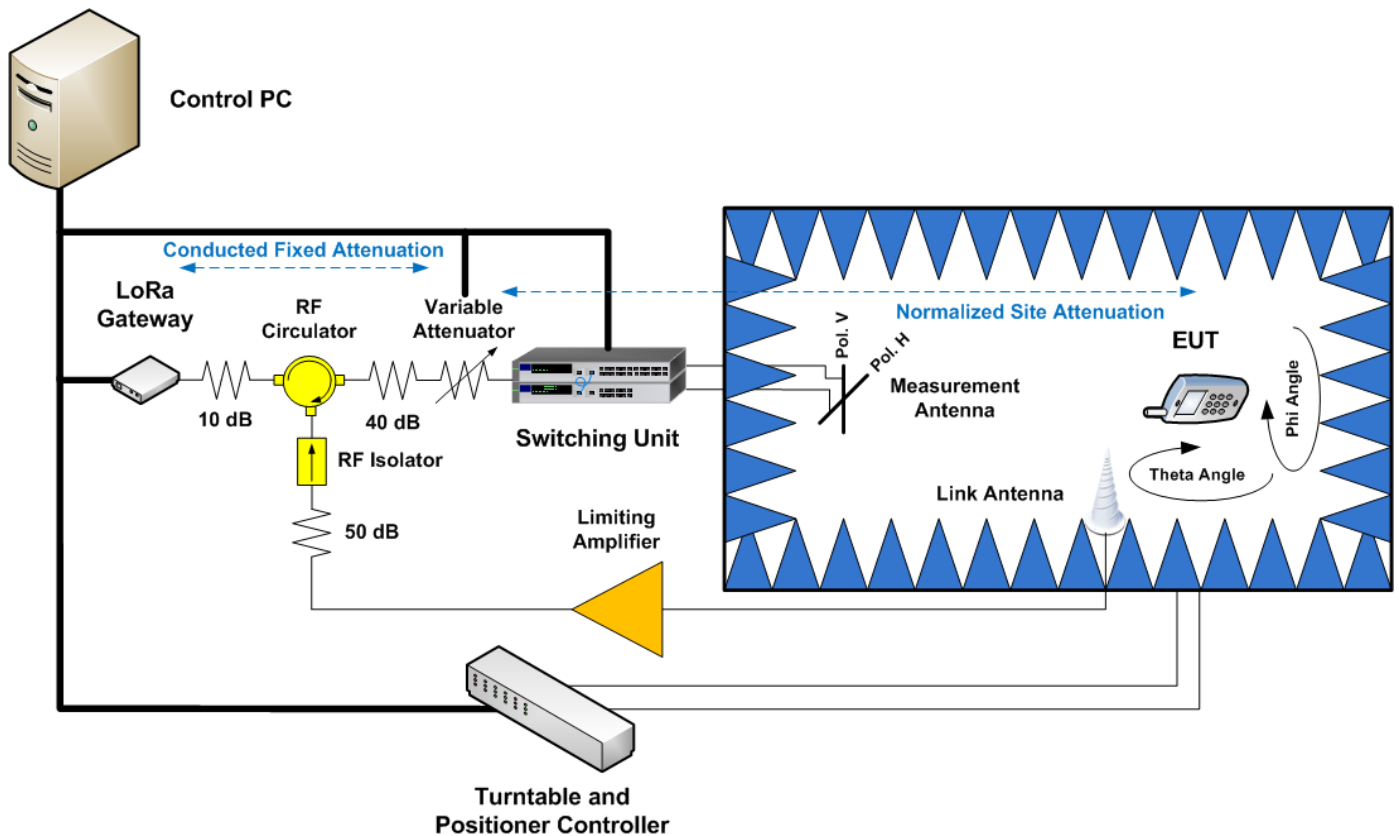


Fig. 3. Receiver performance test connection diagram.

2. TEST RESULTS

Transmitter Performance

Frequency (MHz)	TRP FS (dBm)	Maximum EIRP				
		Horizontal EIRP FS (dBm)	Vertical EIRP FS (dBm)	Total EIRP FS (dBm)	Theta (°)	Phi (°)
863.1	14.30	16.27	-3.66	16.31	90	180
868.3	14.02	15.96	-3.37	16.00	90	180
869.525	14.04	15.98	-2.94	16.03	90	180

Receiver Performance

Frequency (MHz)		868.3		869.525	
Spreading Factor		SF12 (DR0)	SF7 (DR5)	SF12 (DR0)	SF7 (DR5)
TIS FS (dBm)		-133.91	-119.03	-133.67	-120.07
Measured EIS	EIS FS (dBm)	-136.10	-121.21	-135.85	-122.25
	PER (%)	5.00	6.67	6.67	8.33
	Polarization	Theta	Theta	Theta	Theta
	Theta (°)	90	90	90	90
	Phi (°)	180	180	180	180
GW Tx Power (dBm)		12.60	12.97	13.30	13.40
Forward path attenuation (dB)		-148.70	-134.19	-149.15	-135.65
Normalized Site Attenuation (NSA) (dB) ¹		-47.77	-47.77	-47.77	-47.77
Conducted fixed attenuation (dB) ¹		-49.87	-49.87	-49.89	-49.89
Actual RF step-attenuator attenuation (dB) ¹		-51.06	-36.54	-51.49	-37.99
RF Path attenuation step size (dB)		0.50	0.50	0.50	0.50

FS = Free Space

¹ See Figure 3

3. EXPANDED MEASUREMENT UNCERTAINTIES

The expanded measurement uncertainties are listed below for the different tests. These uncertainties refer to a coverage factor of 2, corresponding to 95% confidence level.

Test	Test Configuration	Expanded Uncertainty (k=2, 95 % confidence level) [dB]	
		Value (dB)	LoRa Alliance End-Device Certification Radiated RF Performance for EU 868 MHz ISM Band Devices Uncertainty Limit (dB)
TRP	FREE SPACE	0.96	3.0
TIS	FREE SPACE	1.36	3.5

4. RF TEST RESULT ON 2D

4.1 EIRP Pattern 863.1 MHz – Free Space

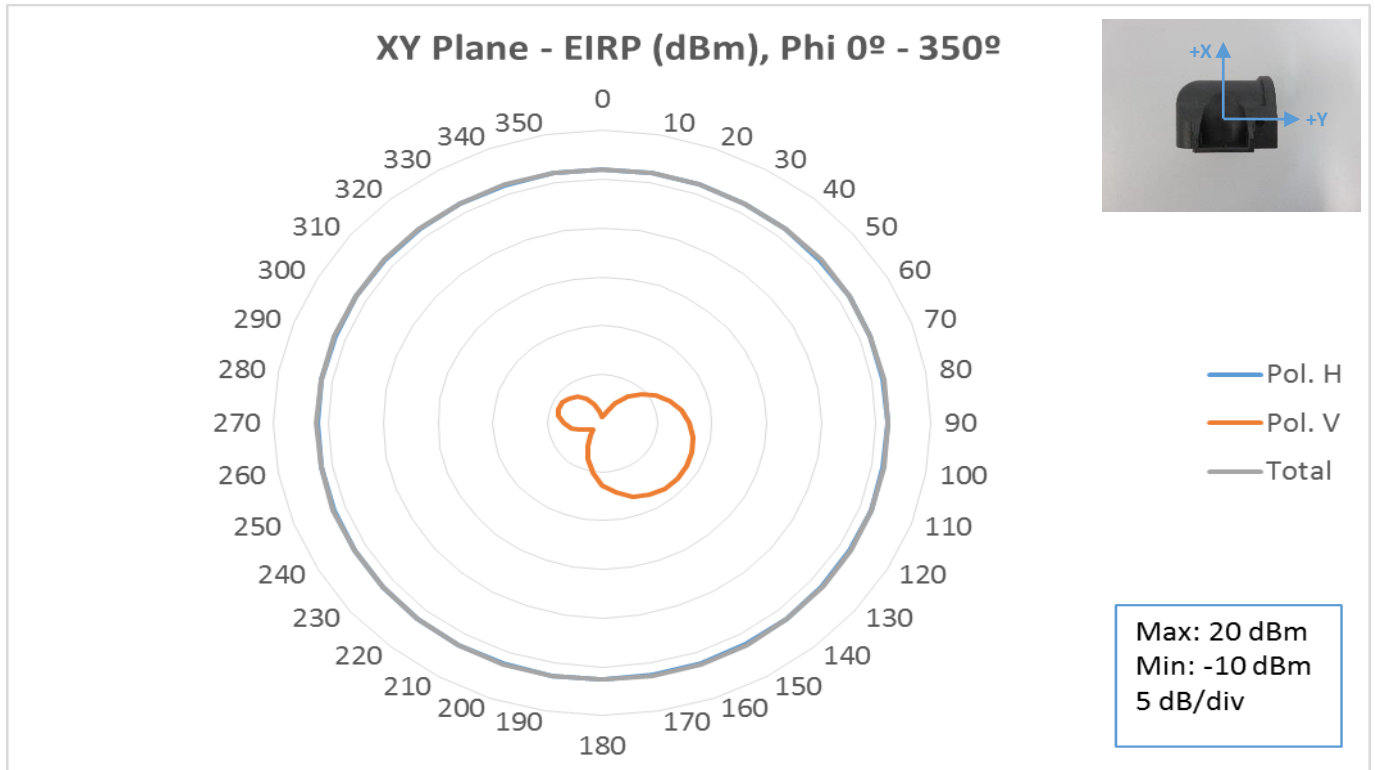


Fig. 4. XY Plane EIRP, Free Space, 863.1 MHz.

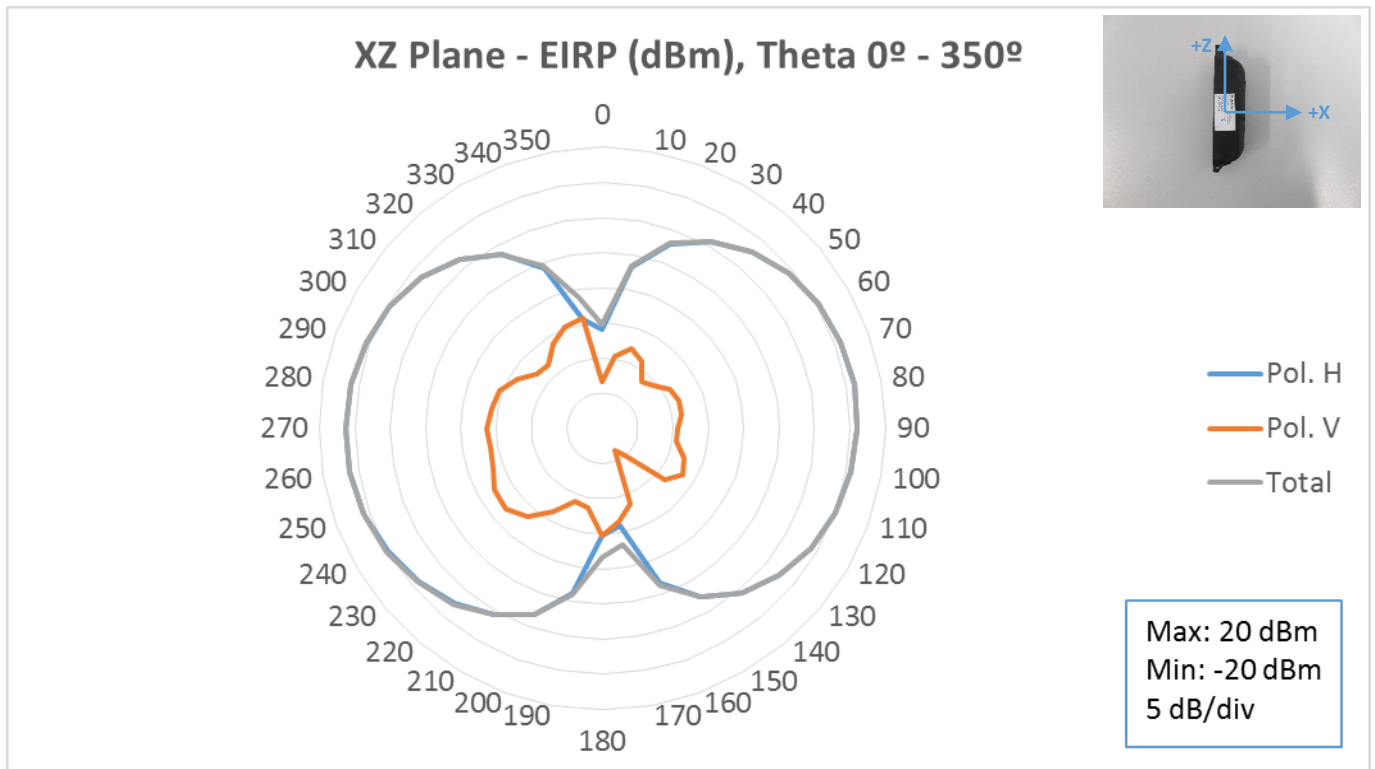


Fig. 5. XZ Plane EIRP, Free Space, 863.1 MHz.

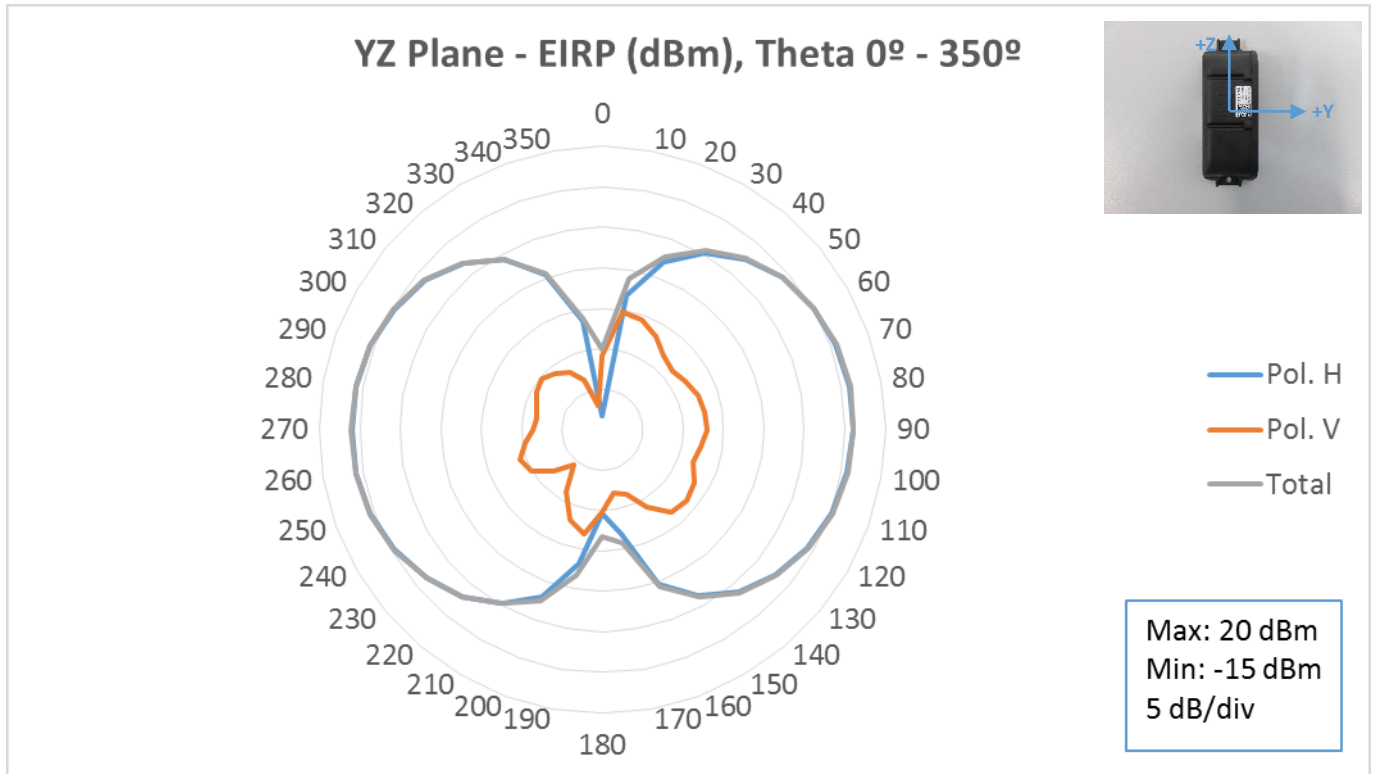


Fig. 6. YZ Plane EIRP, Free Space, 863.1 MHz.

4.2 EIRP Pattern 868.3 MHz – Free Space

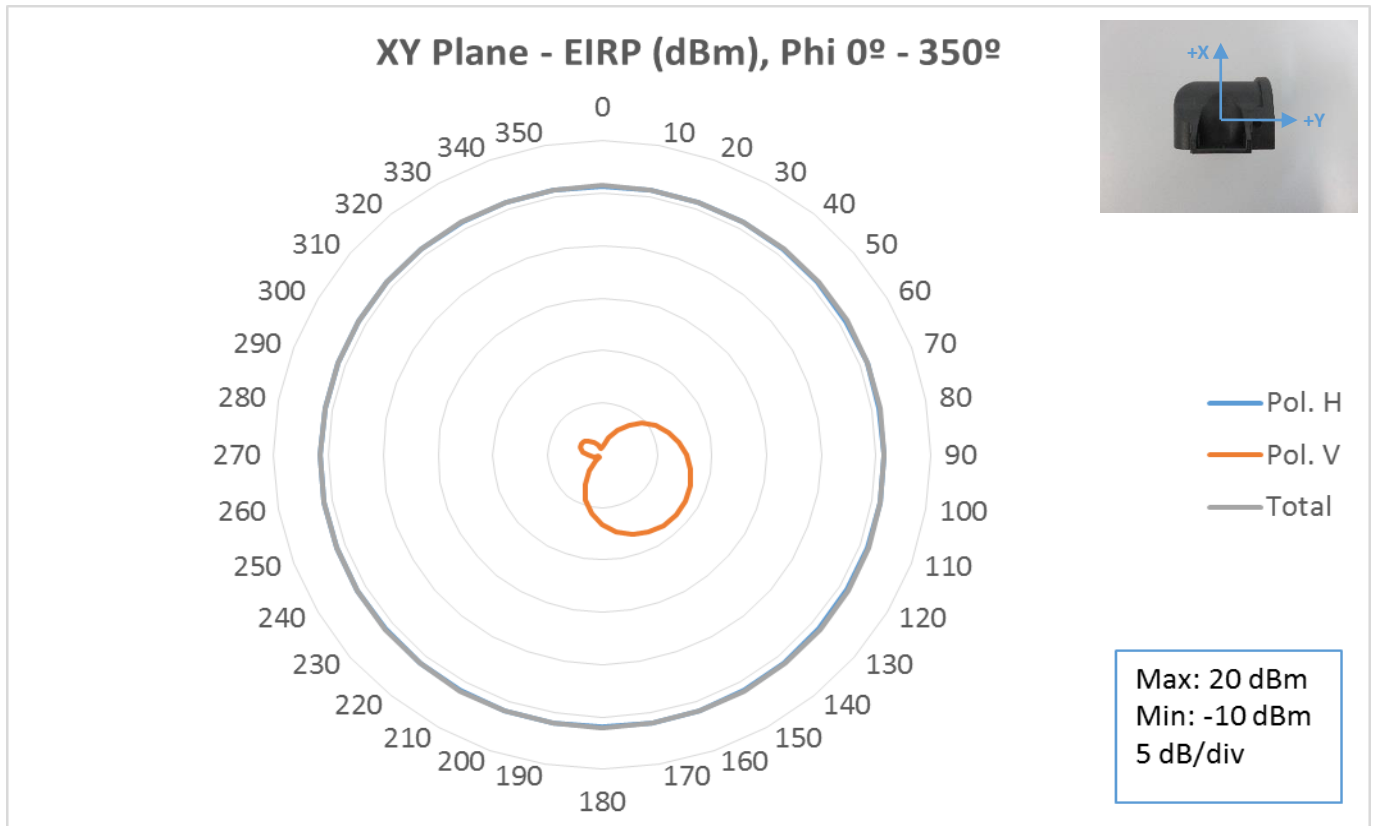


Fig. 7. XY Plane EIRP, Free Space, 868.3 MHz.

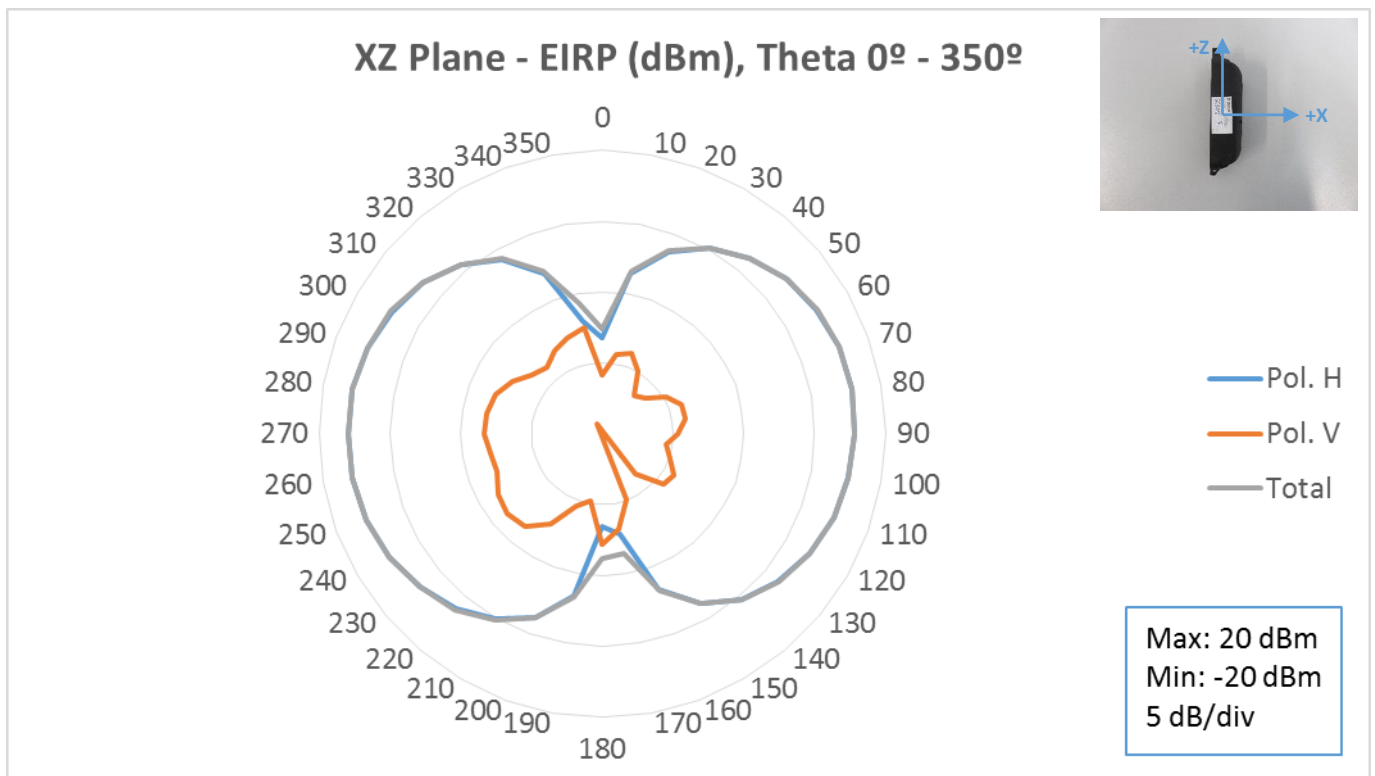


Fig. 8. XZ Plane EIRP, Free Space, 868.3 MHz.

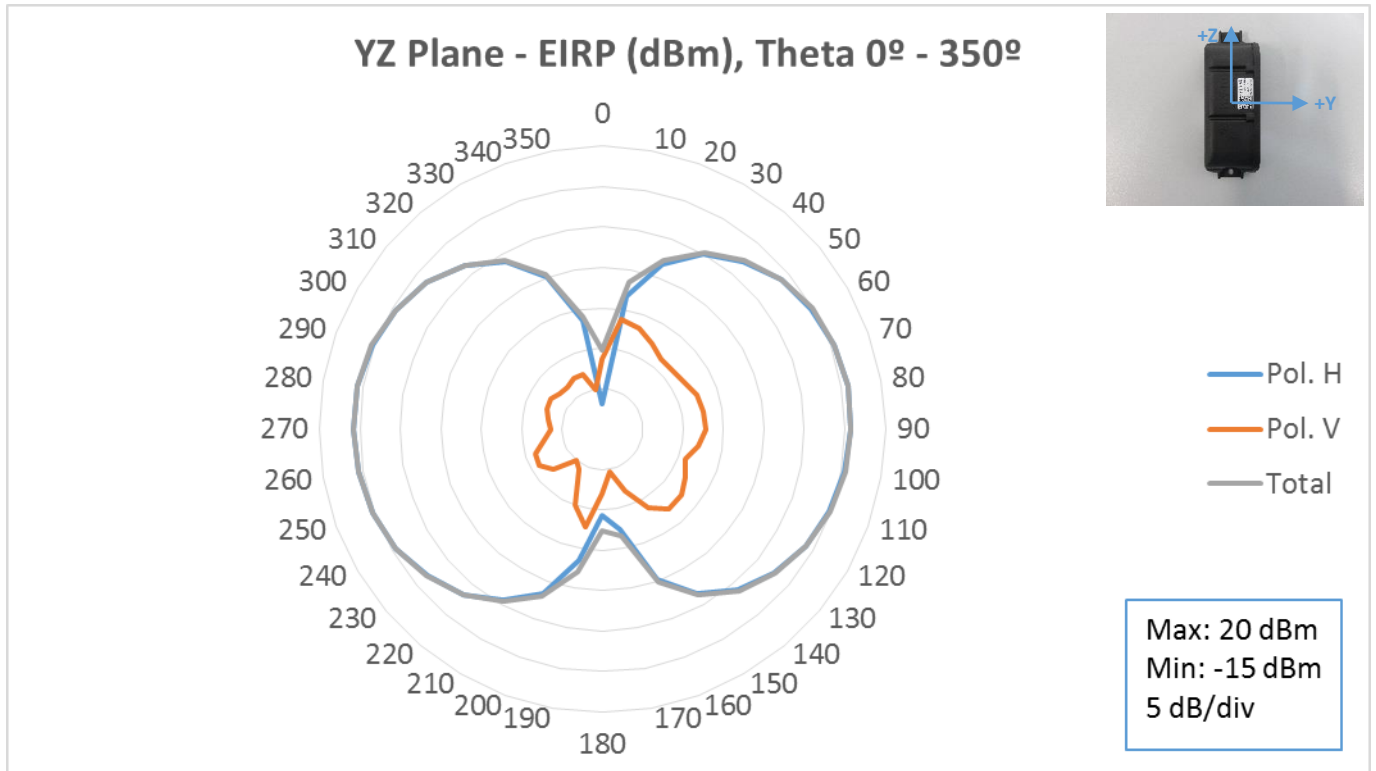


Fig. 9. YZ Plane EIRP, Free Space, 868.3 MHz.

4.3 EIRP Pattern 869.525 MHz – Free Space

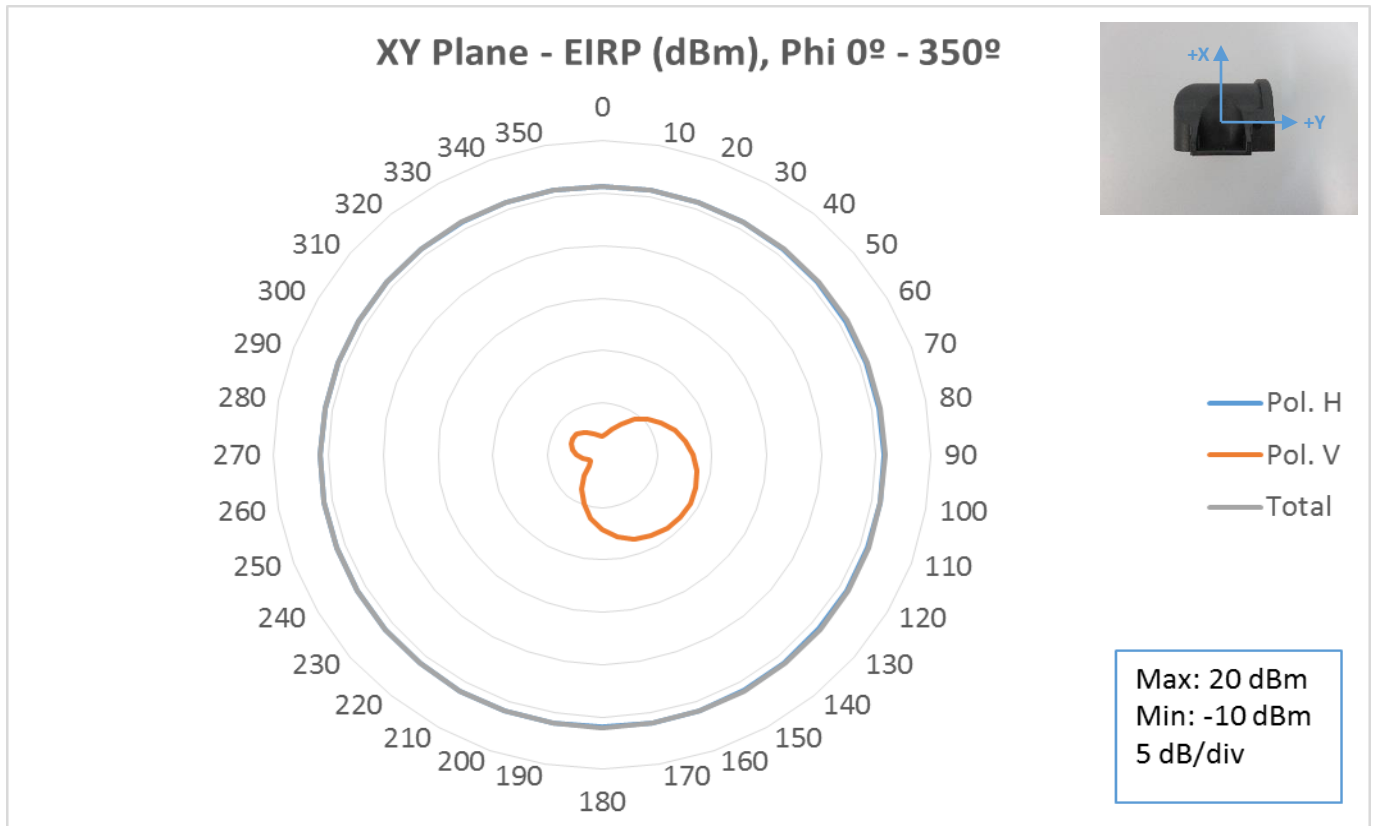


Fig. 10. XY Plane EIRP, Free Space, 869.525 MHz.

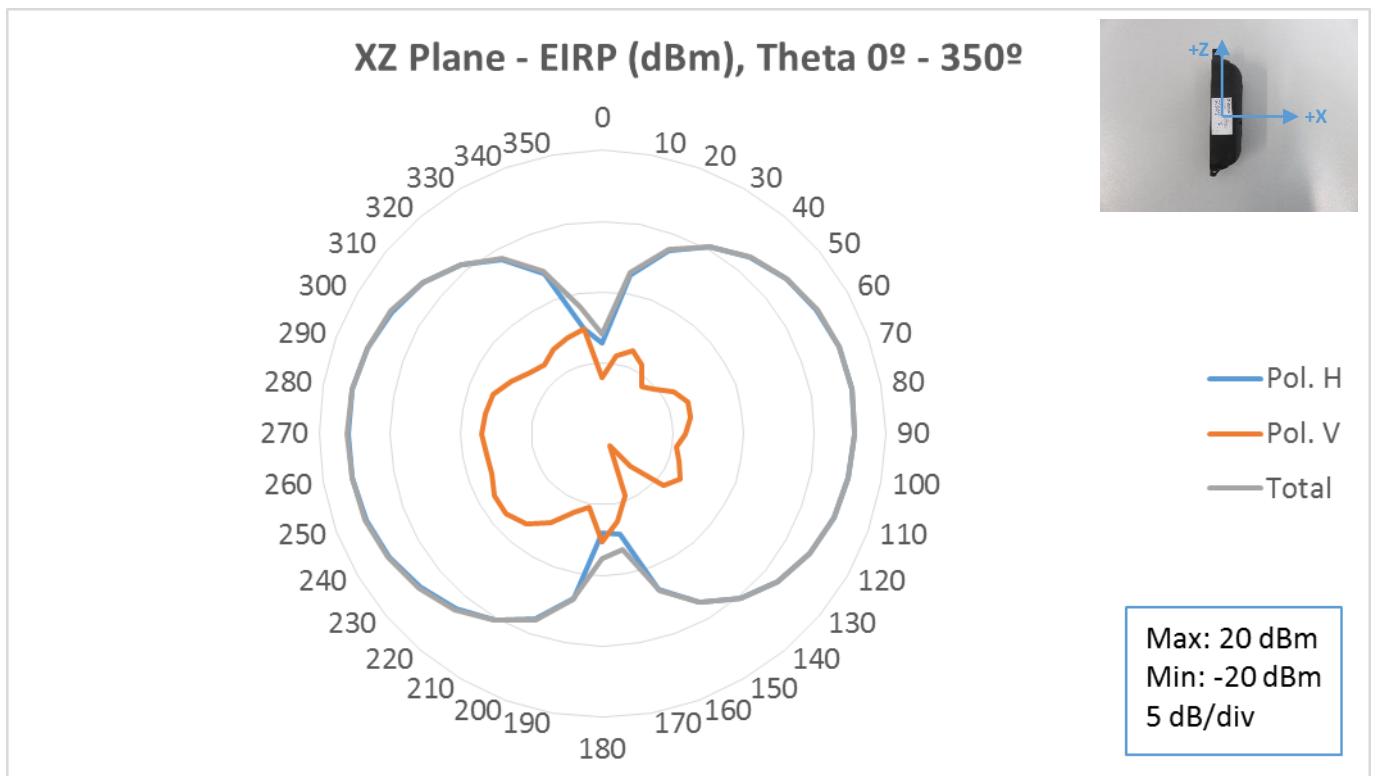


Fig. 11. XZ Plane EIRP, Free Space, 869.525 MHz.

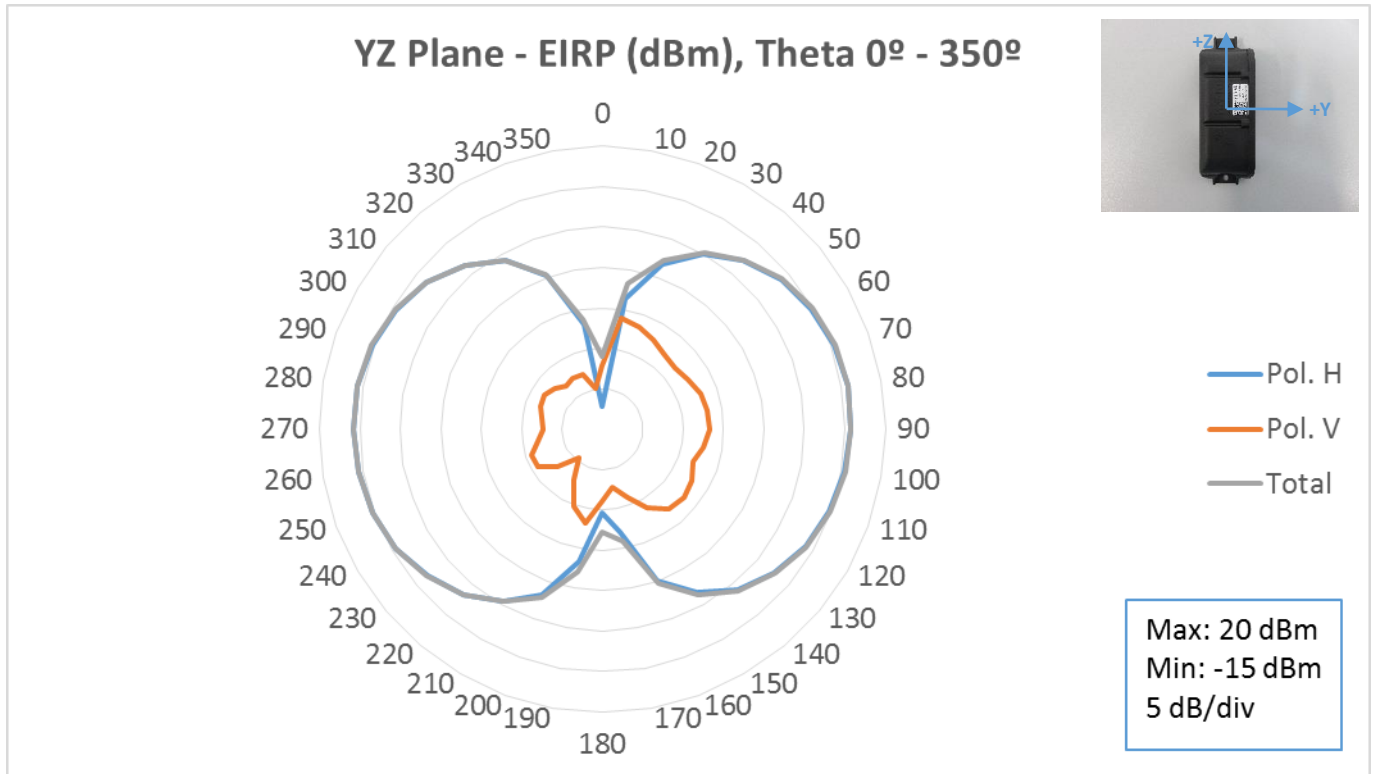


Fig. 12. YZ Plane EIRP, Free Space, 869.525 MHz.

5. RF TEST RESULT ON 3D

5.1 TRP 863.1 MHz – Free Space

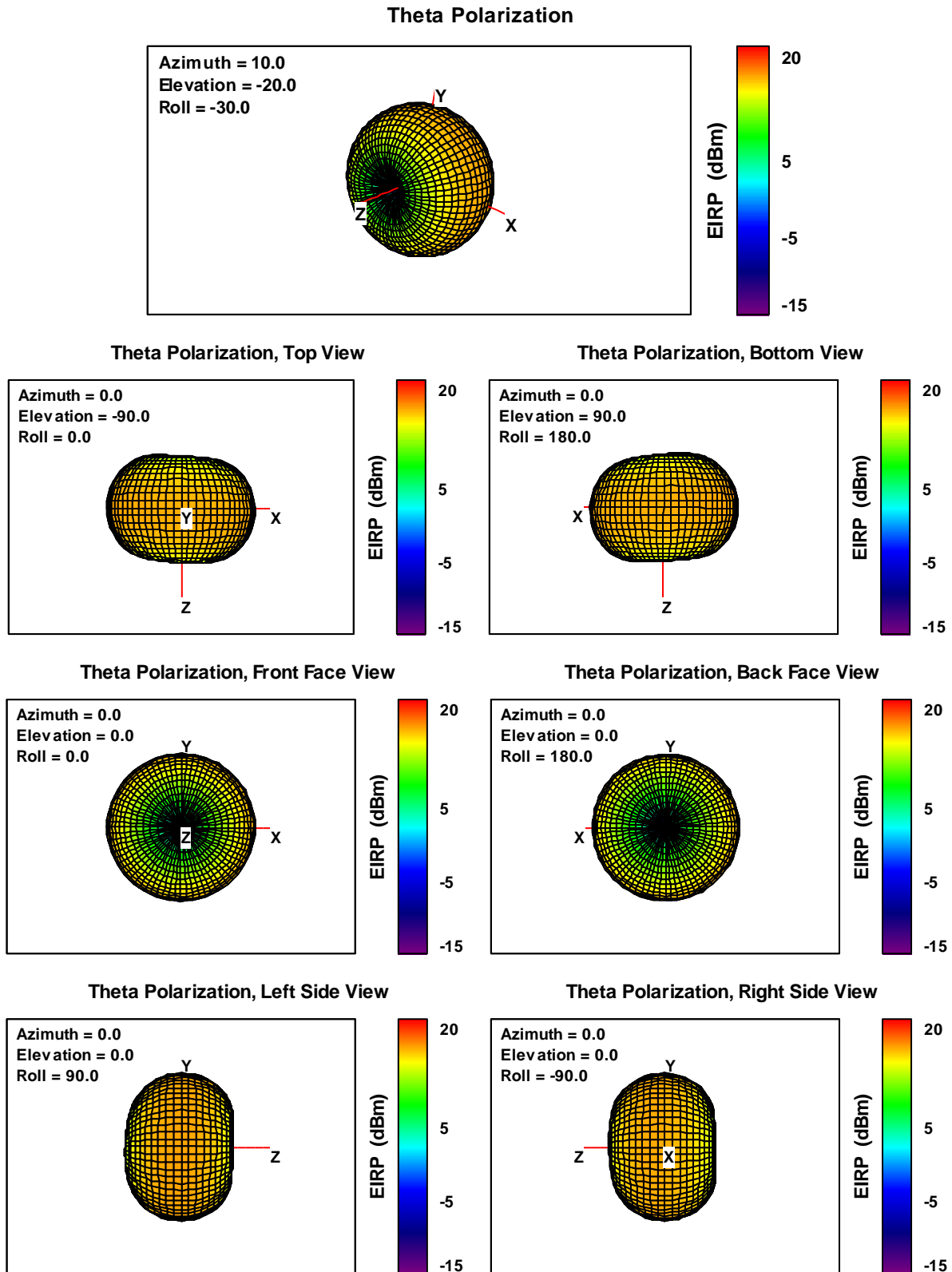
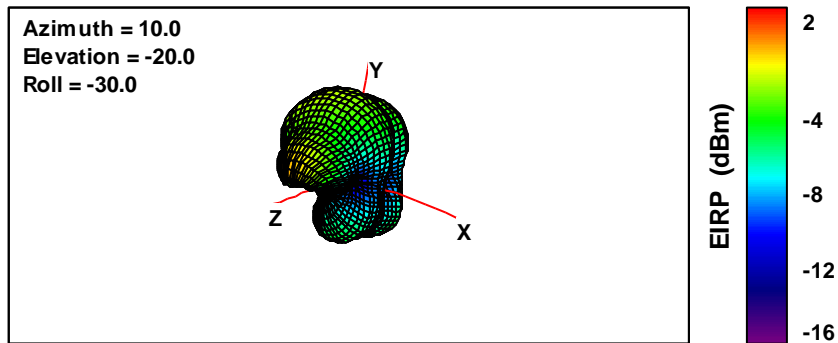
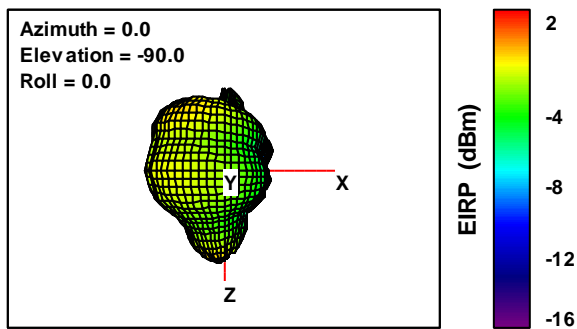


Fig. 13. Theta Polarization (Horizontal) EIRP, Free Space, 863.1 MHz.

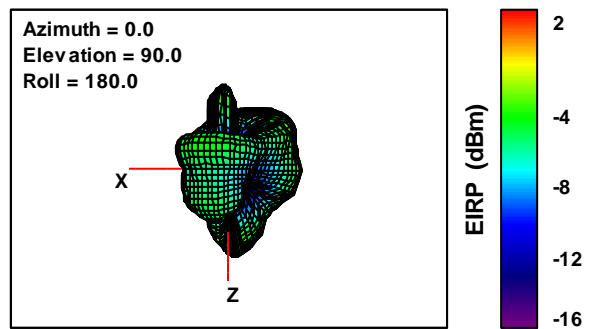
Phi Polarization



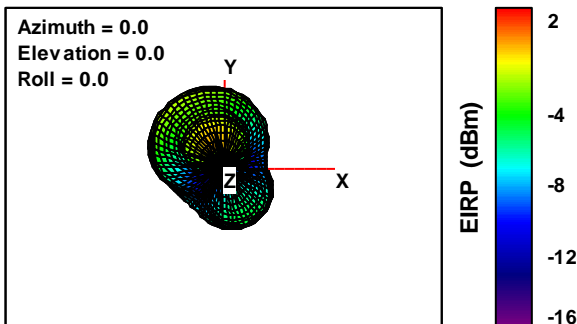
Phi Polarization, Top View



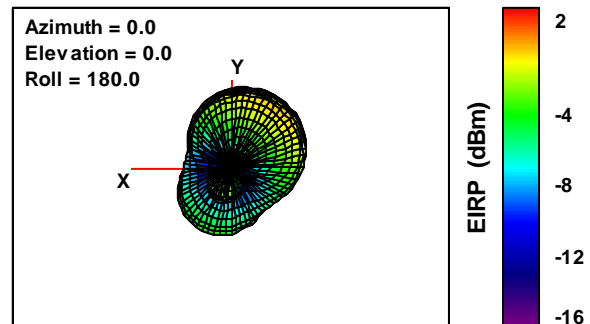
Phi Polarization, Bottom View



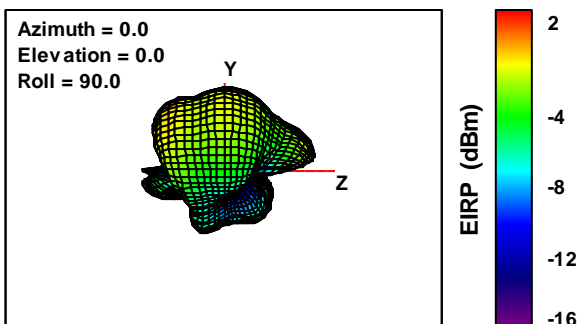
Phi Polarization, Front Face View



Phi Polarization, Back Face View



Phi Polarization, Left Side View



Phi Polarization, Right Side View

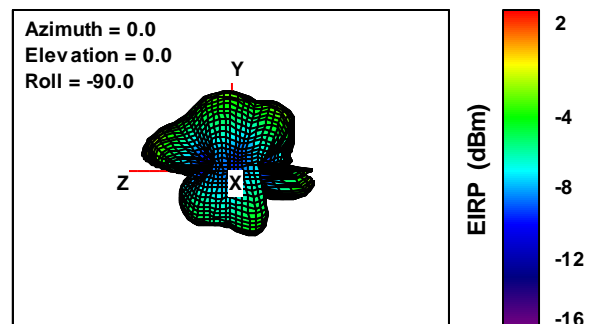


Fig. 14. Phi Polarization (Vertical) EIRP, Free Space, 863.1 MHz.

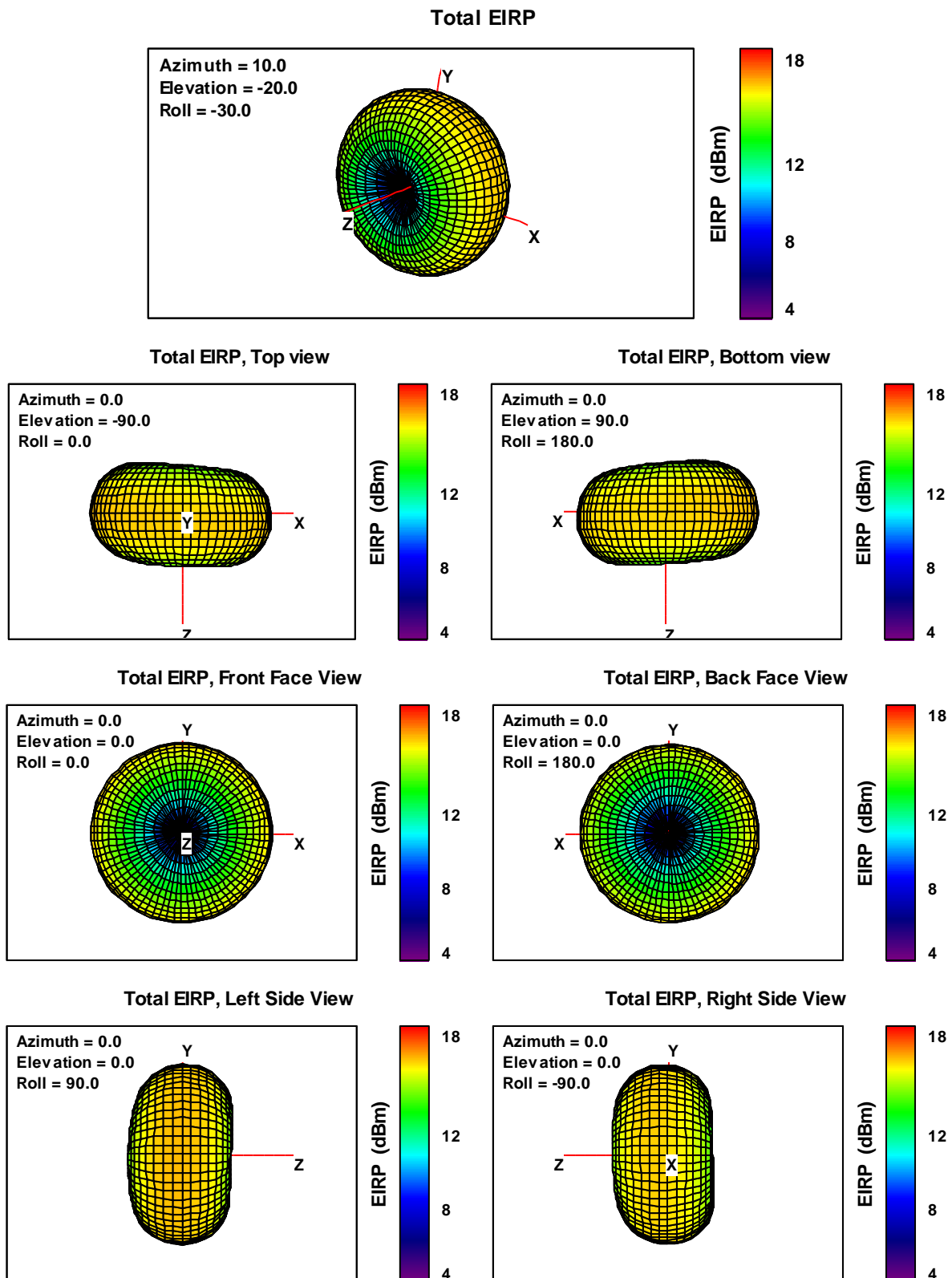


Fig. 15. Total EIRP, Free Space, 863.1 MHz.

5.2 TRP 868.3 MHz – Free Space

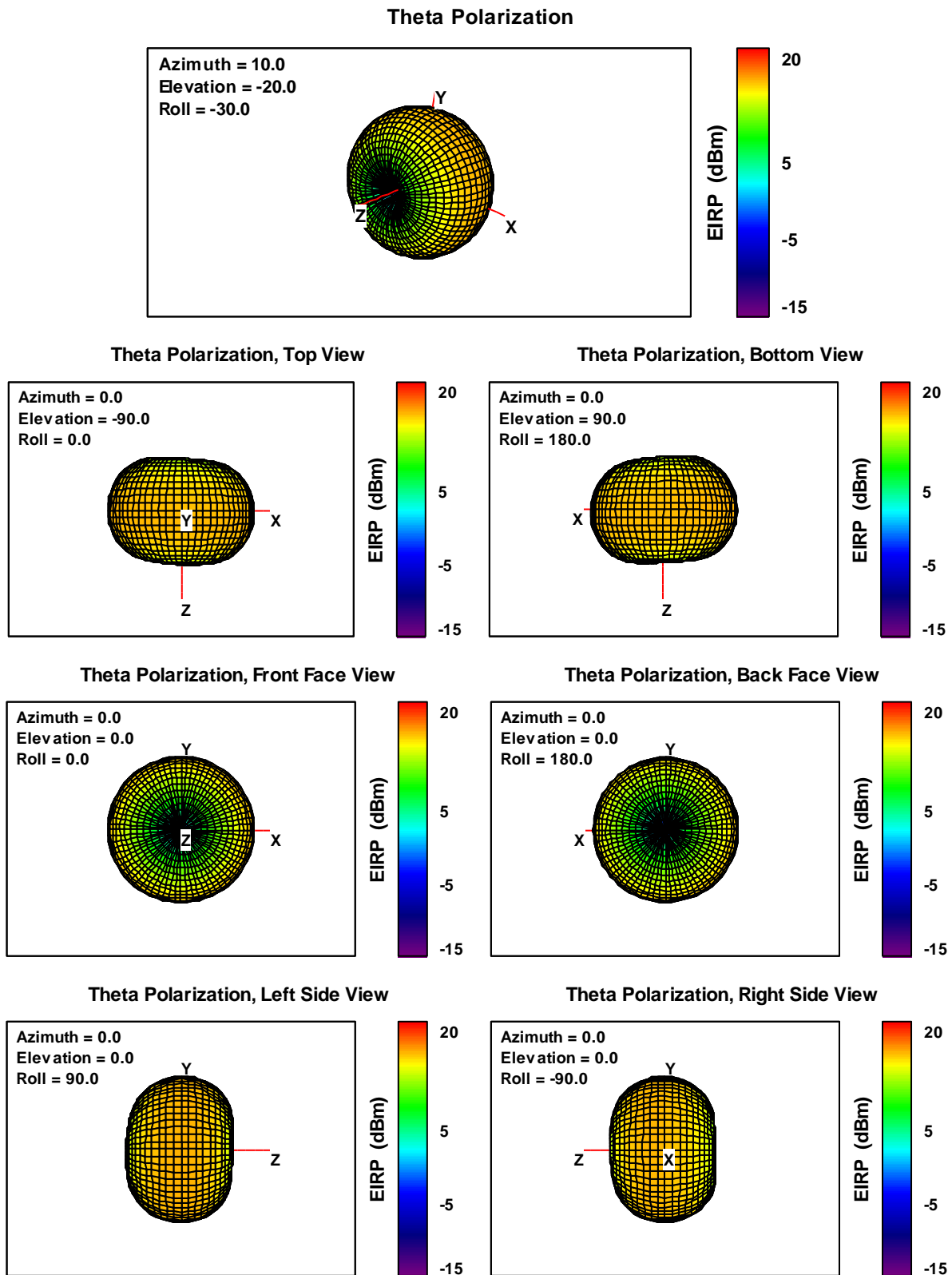
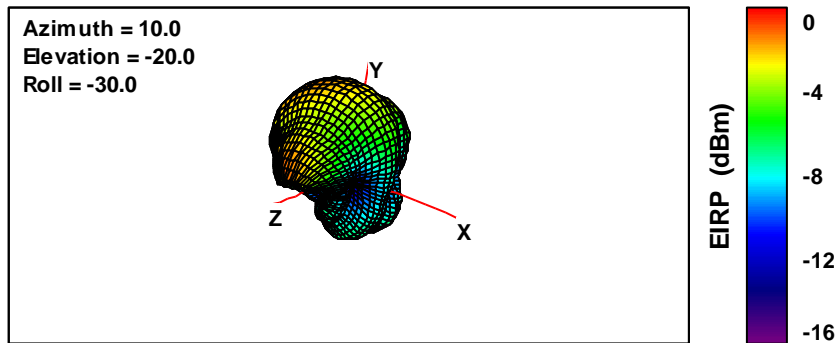
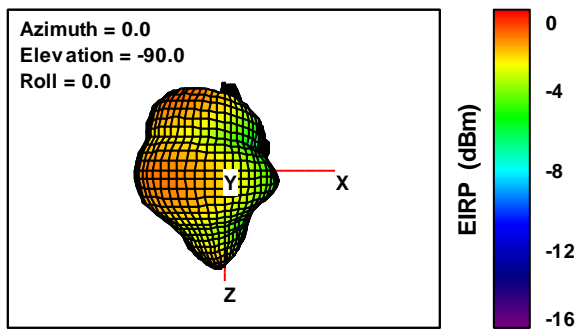


Fig. 16. Theta Polarization (Horizontal) EIRP, Free Space, 868.3 MHz.

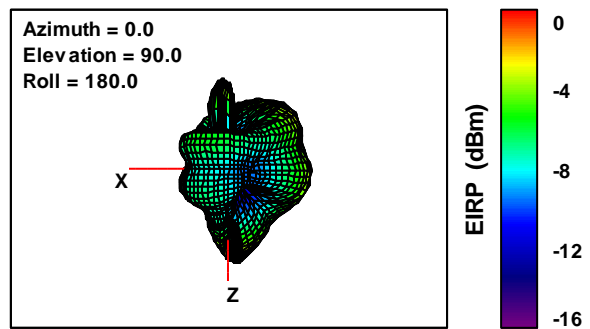
Phi Polarization



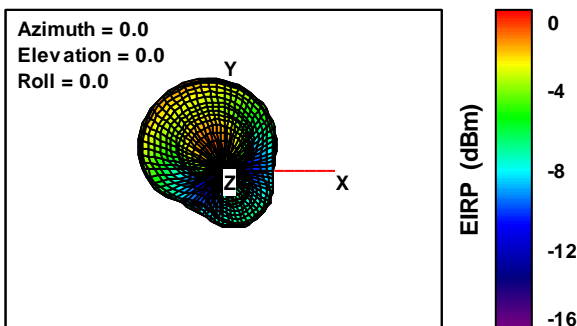
Phi Polarization, Top View



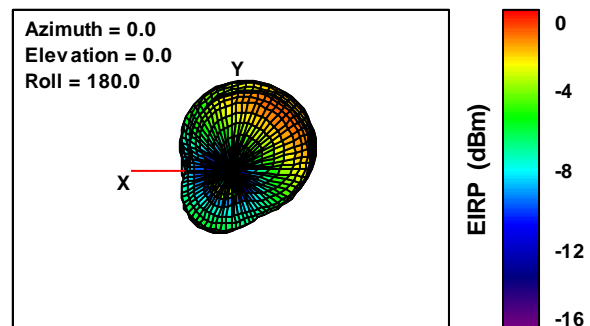
Phi Polarization, Bottom View



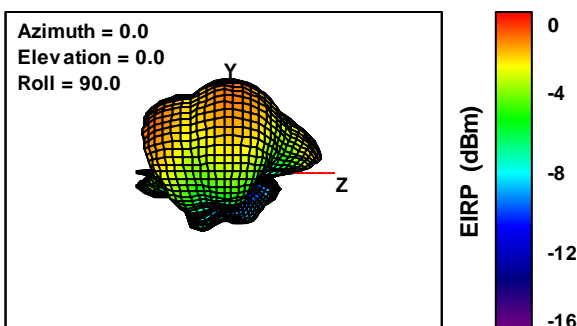
Phi Polarization, Front Face View



Phi Polarization, Back Face View



Phi Polarization, Left Side View



Phi Polarization, Right Side View

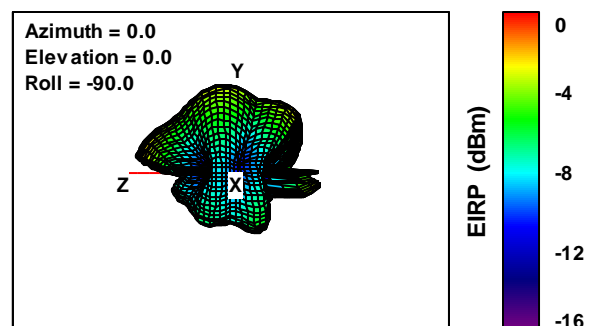


Fig. 17. Phi Polarization (Vertical) EIRP, Free Space, 868.3 MHz.

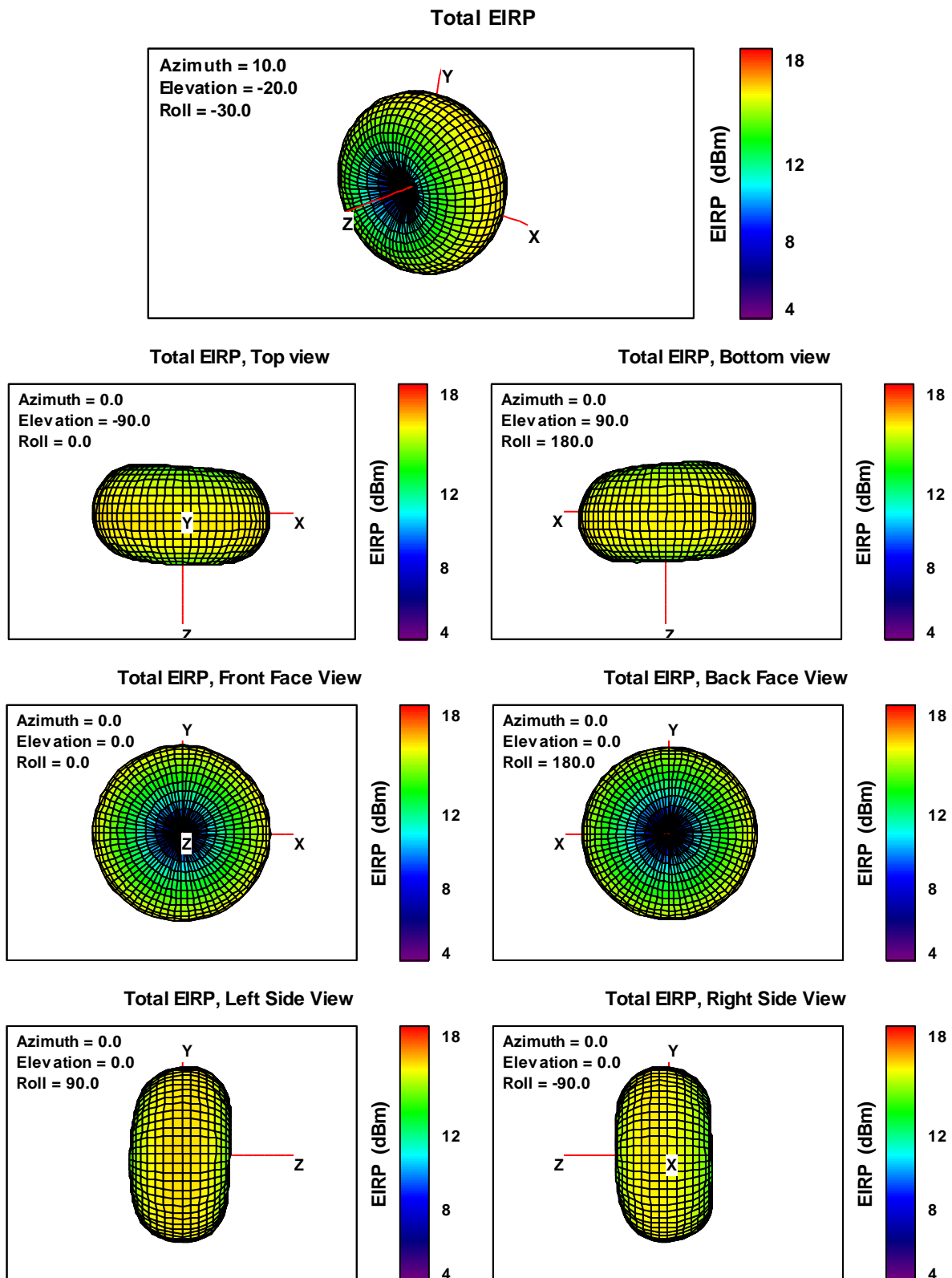


Fig. 18. Total EIRP, Free Space, 868.3 MHz.

5.3 TRP 869.525 MHz – Free Space

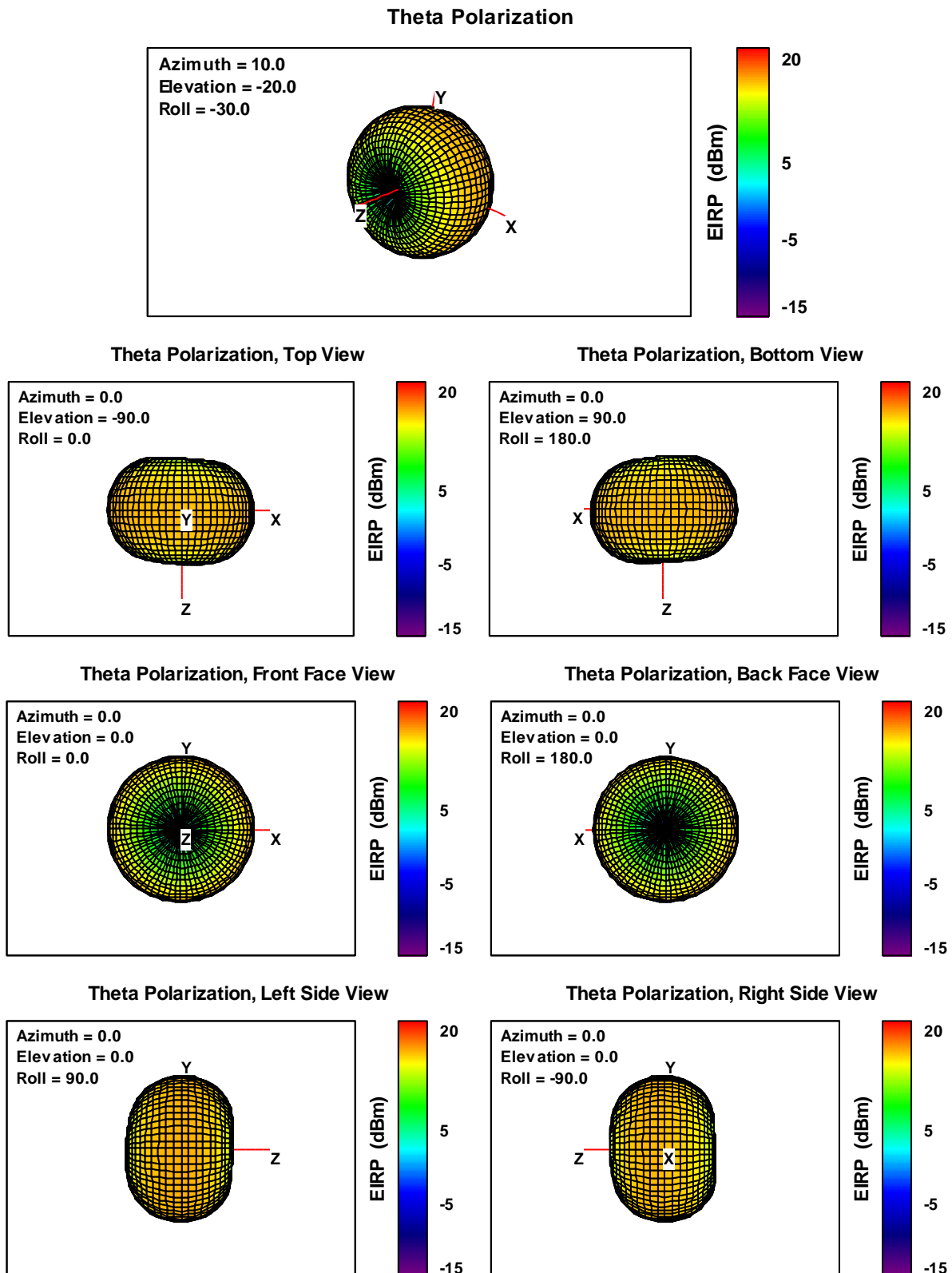
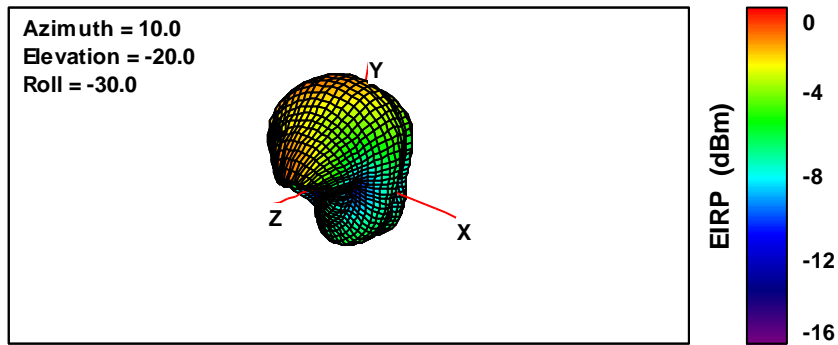
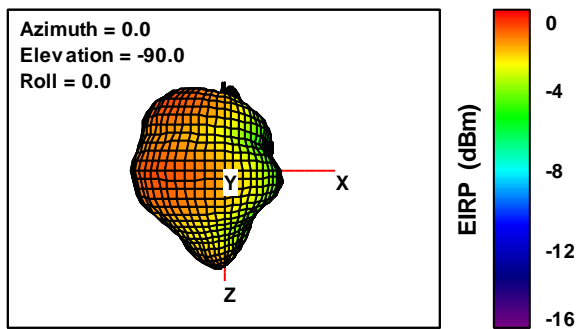


Fig. 19. Theta Polarization (Horizontal) EIRP, Free Space, 869.525 MHz.

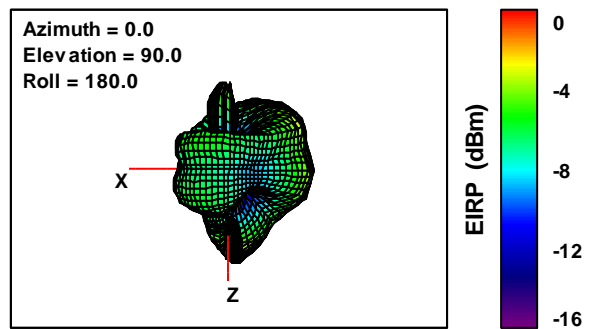
Phi Polarization



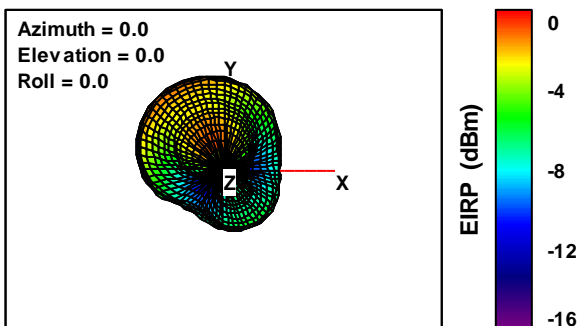
Phi Polarization, Top View



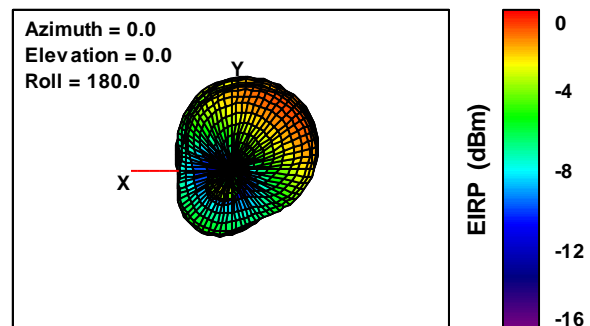
Phi Polarization, Bottom View



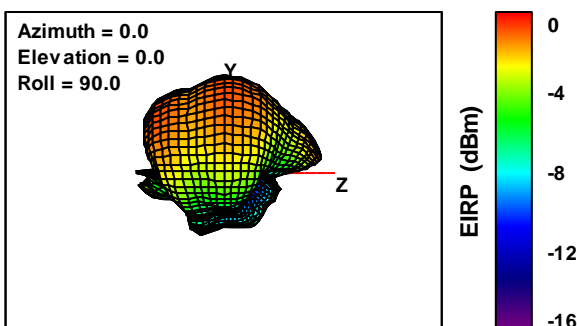
Phi Polarization, Front Face View



Phi Polarization, Back Face View



Phi Polarization, Left Side View



Phi Polarization, Right Side View

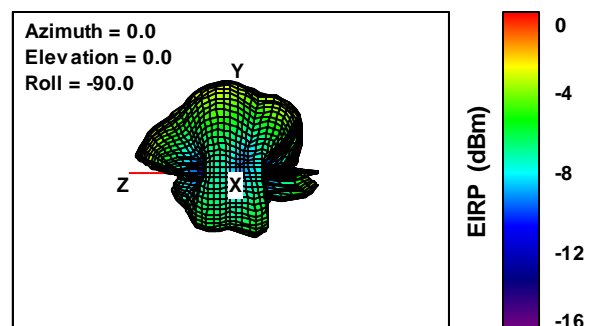


Fig. 20. Phi Polarization (Vertical) EIRP, Free Space, 869.525 MHz.

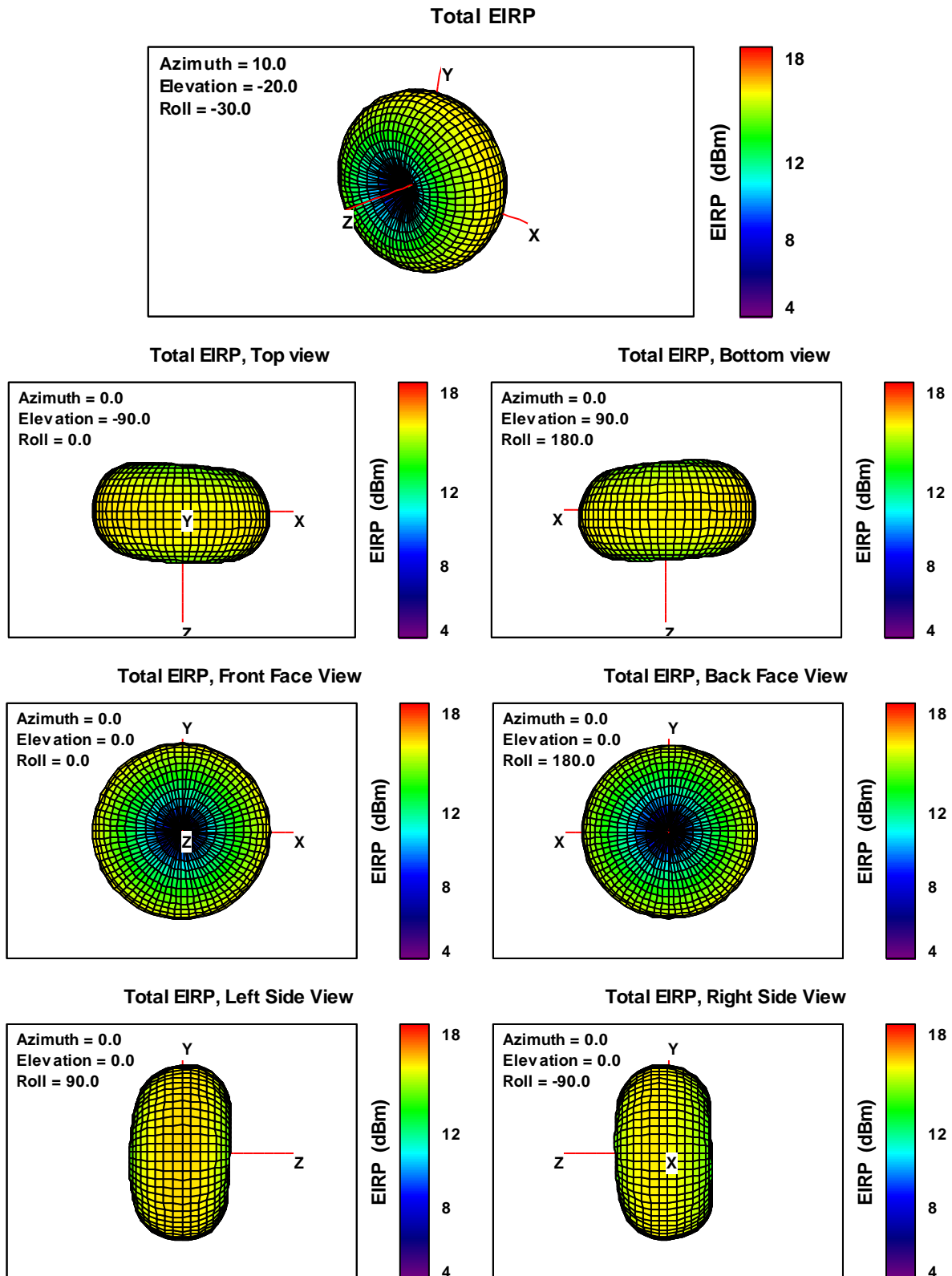


Fig. 21. Total EIRP, Free Space, 869.525 MHz.

6. RANGE REFERENCE MEASUREMENT DATA

Measurement Date:			2016-04-12						
Reference Antenna(s):			ETS Lindgren Dipole antenna 880 MHz, model 3126-880 (Cellular Band)						
Polarization:			Theta (Horizontal)						
Signal Path:			Theta Polarization to Spectrum Analyzer (TRP)						
Band	Freq. Design.	Freq. (MHz)	Cable Ref. (dBm)	Test Port (dBm)	Noise Floor (dBm)	Test Port - Cable (dB)	Test Port - Noise (dB)	Ref. Ant. Gain (dBi)	Path Loss (dB)
EU 868 MHz	LOW-TX	863.1	-	-	-	46.00	-	1.71	47.71
EU 868 MHz	DEFAULT-TX	868.3	-	-	-	46.02	-	1.72	47.74
EU 868 MHz	HIGH-TX	869.5	-	-	-	46.03	-	1.71	47.74

Measurement Date:			2016-04-12						
Reference Antenna(s):			ETS Lindgren Dipole antenna 880 MHz, model 3126-880 (Cellular Band)						
Polarization:			Phi (Vertical)						
Signal Path:			Phi Polarization to Spectrum Analyzer (TRP)						
Band	Freq. Design.	Freq. (MHz)	Cable Ref. (dBm)	Test Port (dBm)	Noise Floor (dBm)	Test Port - Cable (dB)	Test Port - Noise (dB)	Ref. Ant. Gain (dBi)	Path Loss (dB)
EU 868 MHz	LOW-TX	863.1	-	-	-	46.01	-	1.71	47.72
EU 868 MHz	DEFAULT-TX	868.3	-	-	-	46.04	-	1.72	47.76
EU 868 MHz	HIGH-TX	869.5	-	-	-	46.02	-	1.71	47.73

The path loss referenced in the following tables corresponds to the NSA value used in section 2 to determine the EIS level.

Measurement Date:			2016-04-12						
Reference Antenna(s):			ETS Lindgren Dipole antenna 880 MHz, model 3126-880 (Cellular Band)						
Polarization:			Theta						
Signal Path:			Theta Polarization to Communication Tester (TIS)						
Band	Freq. Design.	Freq. (MHz)	Cable Ref. (dBm)	Test Port (dBm)	Noise Floor (dBm)	Test Port – Cable (dB)	Test Port - Noise (dB)	Ref. Ant. Gain (dBi)	Path Loss (dB)
EU 868 MHz	DEFAULT-TX	868.3	-	-	-	46.05	-	1.72	47.77
EU 868 MHz	HIGH-TX	869.5	-	-	-	46.06	-	1.71	47.77

Measurement Date:			2016-04-12						
Reference Antenna(s):			ETS Lindgren Dipole antenna 880 MHz, model 3126-880 (Cellular Band)						
Polarization:			Phi						
Signal Path:			Phi Polarization to Communication Tester (TIS)						
Band	Freq. Design.	Freq. (MHz)	Cable Ref. (dBm)	Test Port (dBm)	Noise Floor (dBm)	Test Port – Cable (dB)	Test Port - Noise (dB)	Ref. Ant. Gain (dBi)	Path Loss (dB)
EU 868 MHz	DEFAULT-TX	868.3	-	-	-	46.06	-	1.72	47.78
EU 868 MHz	HIGH-TX	869.5	-	-	-	46.06	-	1.71	47.77

Appendix B – Photographs

Equipment under test:

- **EUT front view:**



Fig 22. EUT front view.

- **EUT back view:**

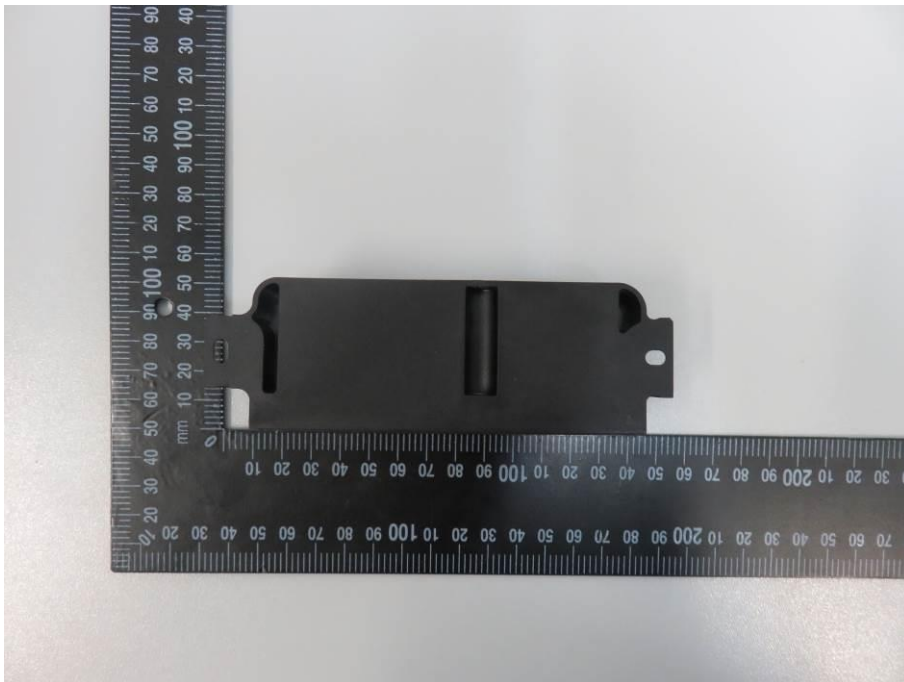


Fig 23. EUT back view.

Test set:

- **Free Space set-up: Initial position: Theta = 0°, Phi = 0°**

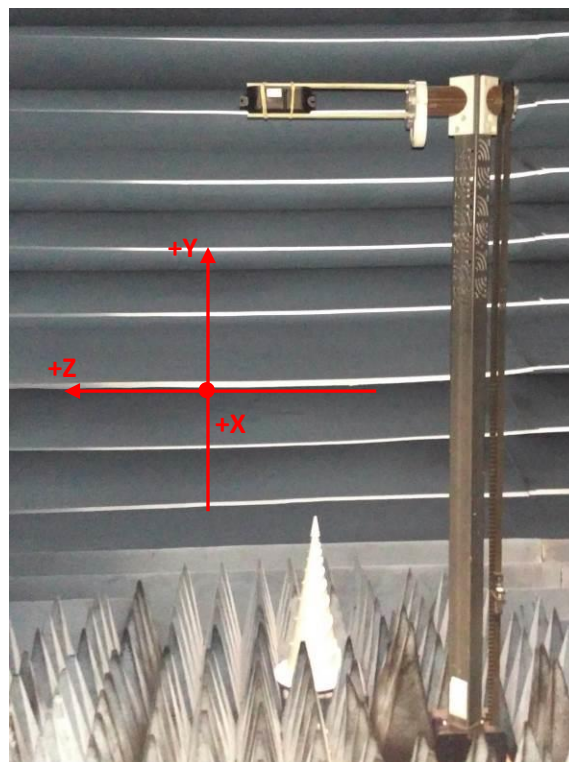
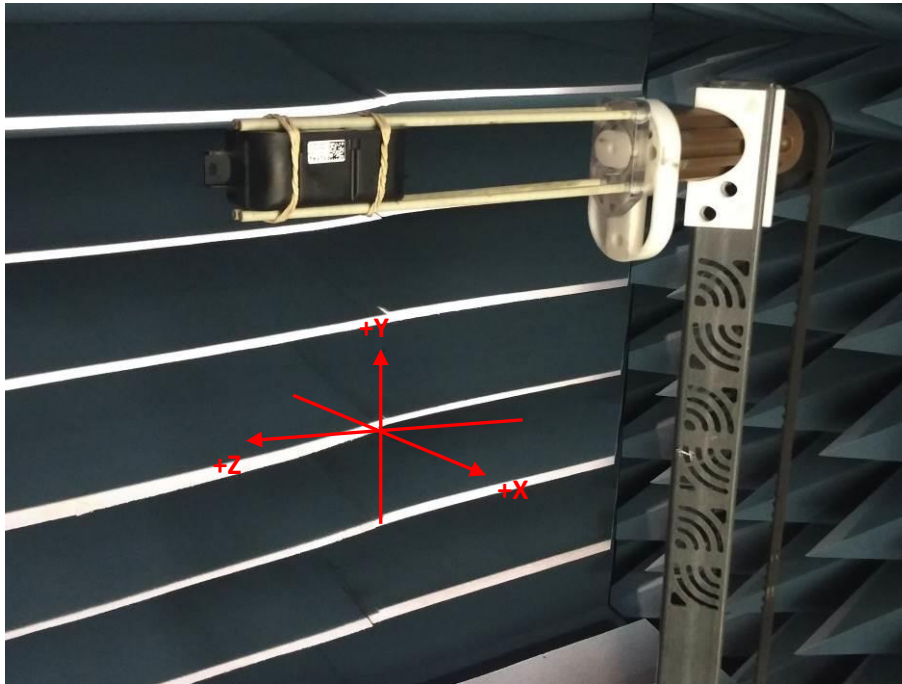


Fig 24. Free Space configuration set-up view.