41039 Boyce Road
Fremont, CA. 94538
510-578-3500 Phone

Over the Air Pseudo Active Antenna Measurements

iRhythm Technologies Inc.

Model: Zio MCT ECG Monitor
PN: DSB0002

APPLICANT:	iRhythm Technologies Inc. 699 8th St #600 San Francisco, CA 64103 US
TEST SITE(S):	NTS Labs LLC 41039 Boyce Road. Fremont, CA. 94538-2435
PROJECT NUMBER:	PR134700
REPORT DATE:	September 21, 2022
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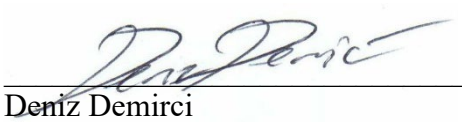
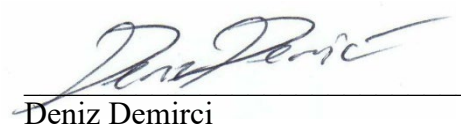


Deniz Demirci
Senior Wireless / EMC Engineer

FINAL REPORT PREPARER:



Deniz Demirci
Senior Wireless / EMC Engineer

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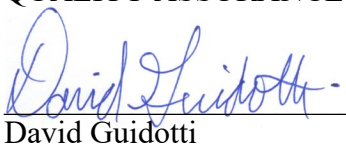


David Guidotti
Senior Technical Writer

REVISION HISTORY

Rev #	Date	Comments	Modified By
0	September 21, 2022	Draft Release	-
1	April 12, 2023	Antenna gain information calculated. TRP, Directivity and Efficiency results removed.	Deniz Demirci

TABLE OF CONTENTS

Physical Layout and Site Description

Wireless Test Facility

All tests were performed in NTS Labs LLC' state-of-the-art Wireless Test Facility consisting of a fully anechoic chamber equipped with a heavy duty pedestal turntable, a dual polarized multi-measurement antenna ring, goniometer, and two circularly polarized communication antennas. A base station simulator is used to establish communication with the EUT and place it in the proper mode and a spectrum analyzer and RF switch combination is used for measuring the signal from the EUT at each position and polarization. ETS-Lindgren's proprietary EMQuest EMQ-100 Pattern Measurement Software is used for data acquisition, post-processing and generation of the required output.

Anechoic Chamber

The chamber consists of a 16 ft. x 16 ft. x 16 ft. shielded enclosure and is constructed with shielded modular panel sections that are assembled with a clamping system into a self-supporting room structure. The three-quarter inch thick panels with 28 gauge galvanized steel laminates on both sides provide the best shielding effect to magnetic and electric fields and plane waves. To attenuated electromagnetic interference inside, the chamber is lined with pyramidal shaped microwave absorbers. The absorbers are treated with a FlexSorb coating to resist breakage. Lighting in the chamber is RF-filtered and consists of fiber optic LED light fixtures in the chamber ceiling. The chamber uses forced air ventilation to maintain a consistent ambient temperature. A single leaf semi-automatic pneumatic locking/unlocking RF shielded door is provided for equipment and personal access into the chamber. The Anechoic Chamber is capable of meeting RF attenuation level of over 100 dB throughout the frequency range of 200 kHz to 10 GHz. Therefore testing performed within the chamber does not interfere with other testing activities at the facility and vice versa. All power supplied to the chamber are routed through a power line filter on separate circuits. All power filters provide a minimum of 100 dB attenuation over a frequency range of 14 kHz to 18 GHz when tested per MIL STD 220A, MIL-F-15733 and UL 1283 standards.

Multi Axes Positioning System (MAPS)

The Multi Axes Positioning System consist a ring housing an array of 23 dual polarized antennas, a goniometer, and a heavy duty pedestal turntable. The array of dual polarized antennas support measurements over the range of 400 MHz to 6 GHz and are permanently fixed at every 15 degree along the ring with anechoic absorbing materials. This enables measurements from -165° to +165° in the Theta axis with a 1.95 m path length to the EUT. The goniometer will enable the pedestal to shift ± 7.5° allowing the EUT be measured at a higher angular resolution - down to 0.1 degrees. The heavy pedestal turntable allows the EUT to rotate in the Phi Axis with full 360 degree angular range. In conjunction with the EM Q-100 Pattern Measurement Software, it can perform positioning for data acquisition in both continuous and stepped movement modes.

A EUT and SAM head and/or hand is positioned on the polystyrene foam pedestal to minimize RF obstruction during measurement. The electrically driven MAPS does not introduce conducted or radiated electrical noise above the ambient levels existing within the chamber. The pedestal turntable rotation and array antenna switching is controlled by EMCenter Modular RF Platform Model 7000 with IEEE-488 data/control for automation.

Quiet Zone

A standard 30 cm diameter by 30 cm tall cylindrical quite zone and an extended 50 cm diameter by 36 cm tall cylindrical quiet zone for large EUT were qualified on each axis of the MAPS and polarization of the receive antenna per requirements of the CTIA test plan for Wireless Device Over-the-Air Performance. The associated effects are included in the measurement uncertainty section of this report.

EMQuest Software

ETS-Lindgren's EMQuest proprietary pattern measurement software is used to automate the data acquisition process and provides all post-processing calculations and data output required by the CTIA. Its parameterized test configuration system and conscientiously validated design helps to insure repeatable and correct results. Safeguards prevent data tampering and ensure that the original "raw" measured data is always available for review.

Test Methods

Total Radiated Power

The Total Radiated Power (TRP) test is performed with the conical cut test method according to CTIA Test Plan for Wireless Device Over-the-Air Performance. At each position on the phi axis, the measurement antennas on the ring housing will electronically switch on and activate each measurement antenna in 15 degree increments between -165 and 165 degrees along the theta axis. The EUT will then rotate 15 degrees in the phi axis from 0-180 degrees to complete the data acquisition. Data is recorded using the spectrum analyzer for both theta and phi polarization at each position. Depending on the protocol, an appropriate filter is used in the EMQuest software to process the data per Appendix E of the CTIA Test Plan for Wireless Device Over-the-Air Performance. Upon completion of the test, the net power (Angular dependent EIRP) is calculated at each measurement point and the required values of TRP and Near Horizontal Partial Radiated Power (NHPRP) are automatically calculated. This test procedure is repeated for each channel, band, and configuration as required.

Equipment under Test (EUT) Information

The sample was received on September 21, 2022 and tested on September 21, 2022.

Manufacturer	iRhythm Technologies Inc
Model	DSB0002
Serial number	CAA23TTAYV
Firmware Version	SFW0210.02

MODIFICATIONS

No modifications were made to the EUT during the time the product was at NTS Labs LLC.

Measurements

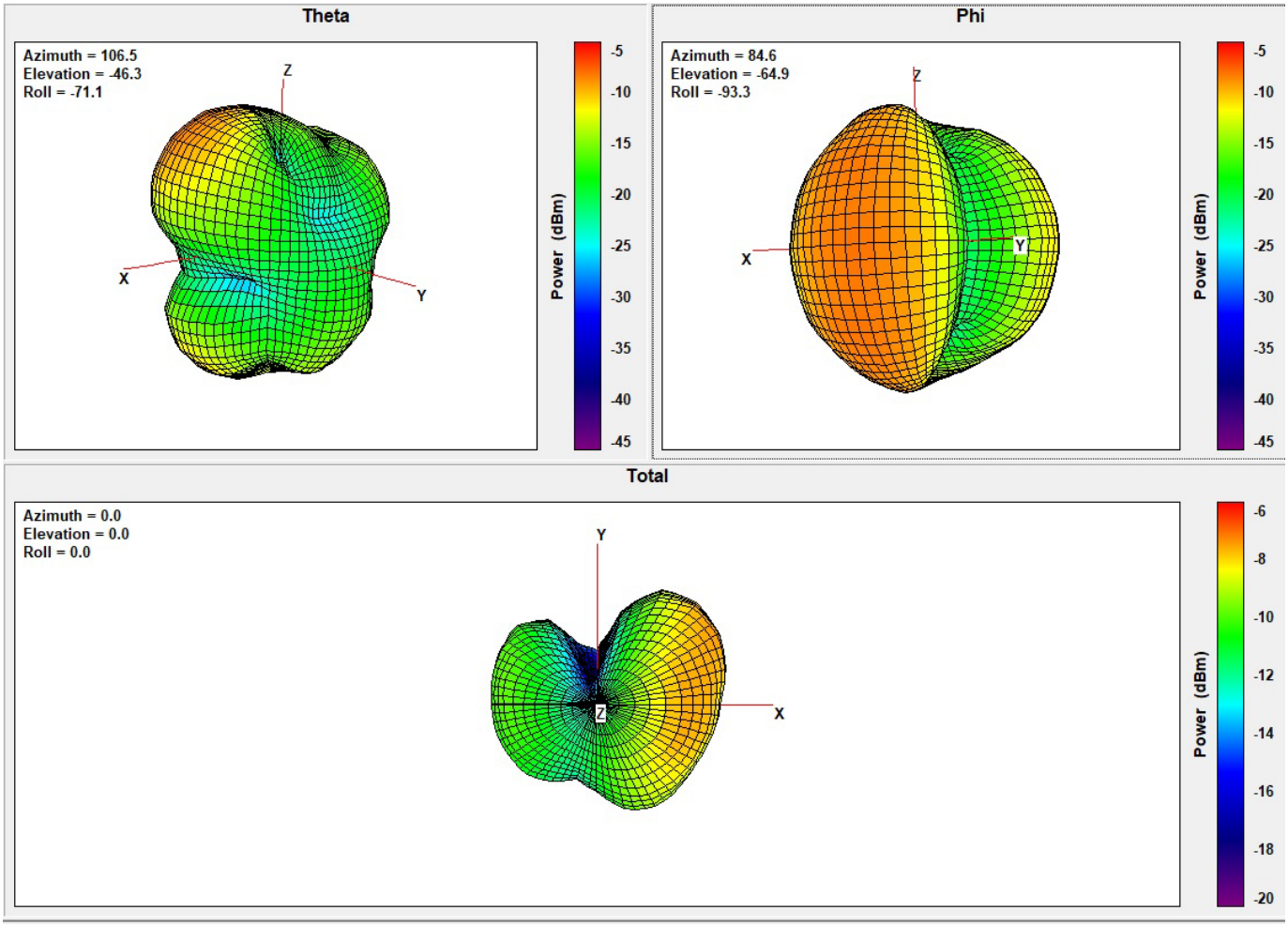
Test summary

EUT serial number	Peak EIRP (dBm)			Conducted RF (dBm)			Antenna gain (dBi)		
	Frequency (MHz)			Frequency (MHz)			Frequency (MHz)		
	2402	2440	2480	2402	2440	2480	2402	2440	2480
CAA23TTAYV	-7.4	-7.1	-8.3	-8.1	-8	-7.9	0.7	0.9	-0.4

Note: *Antenna gain (dBi) = Peak EIRP (dBm) – Conducted RF (dBm)*

RBW: 3 MHz
VBW: 10 MHz
Detector: RMS
Span: Zero span
Sweep time: 0.7 ms
Point per trace: 10001
Trigger mode: Video

SN: CAA23TTAYV
2402 MHz



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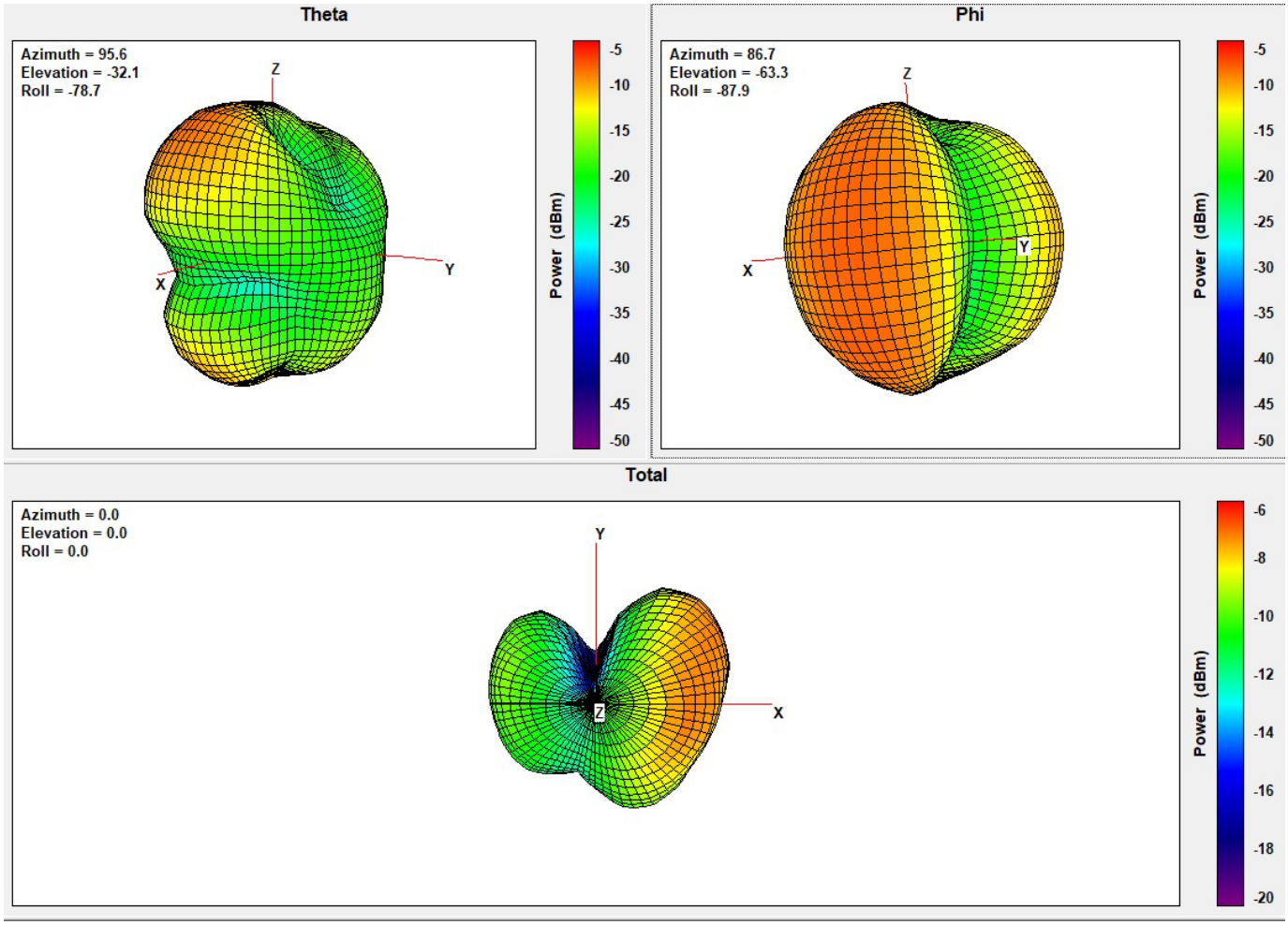
2440 MHz



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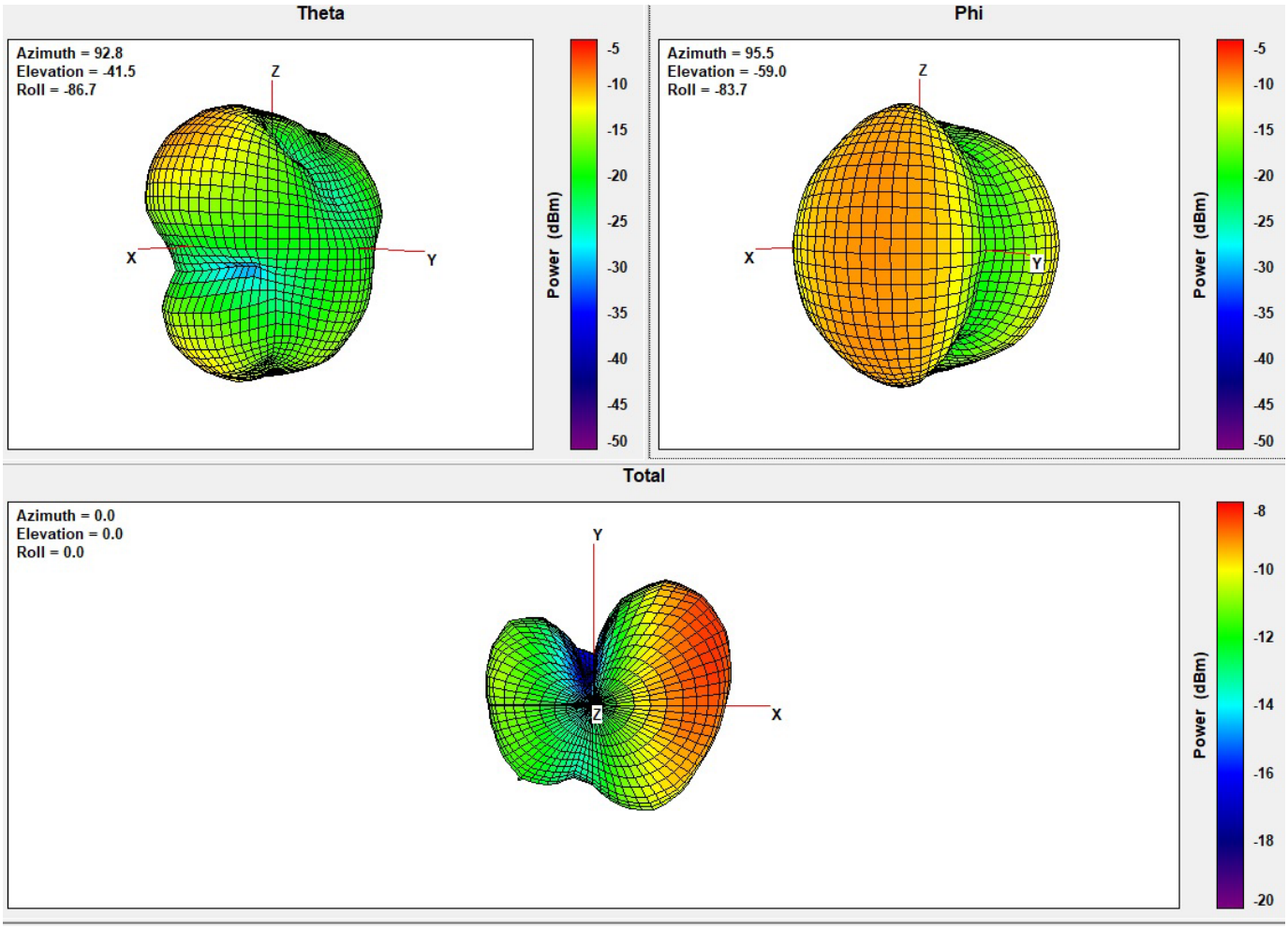

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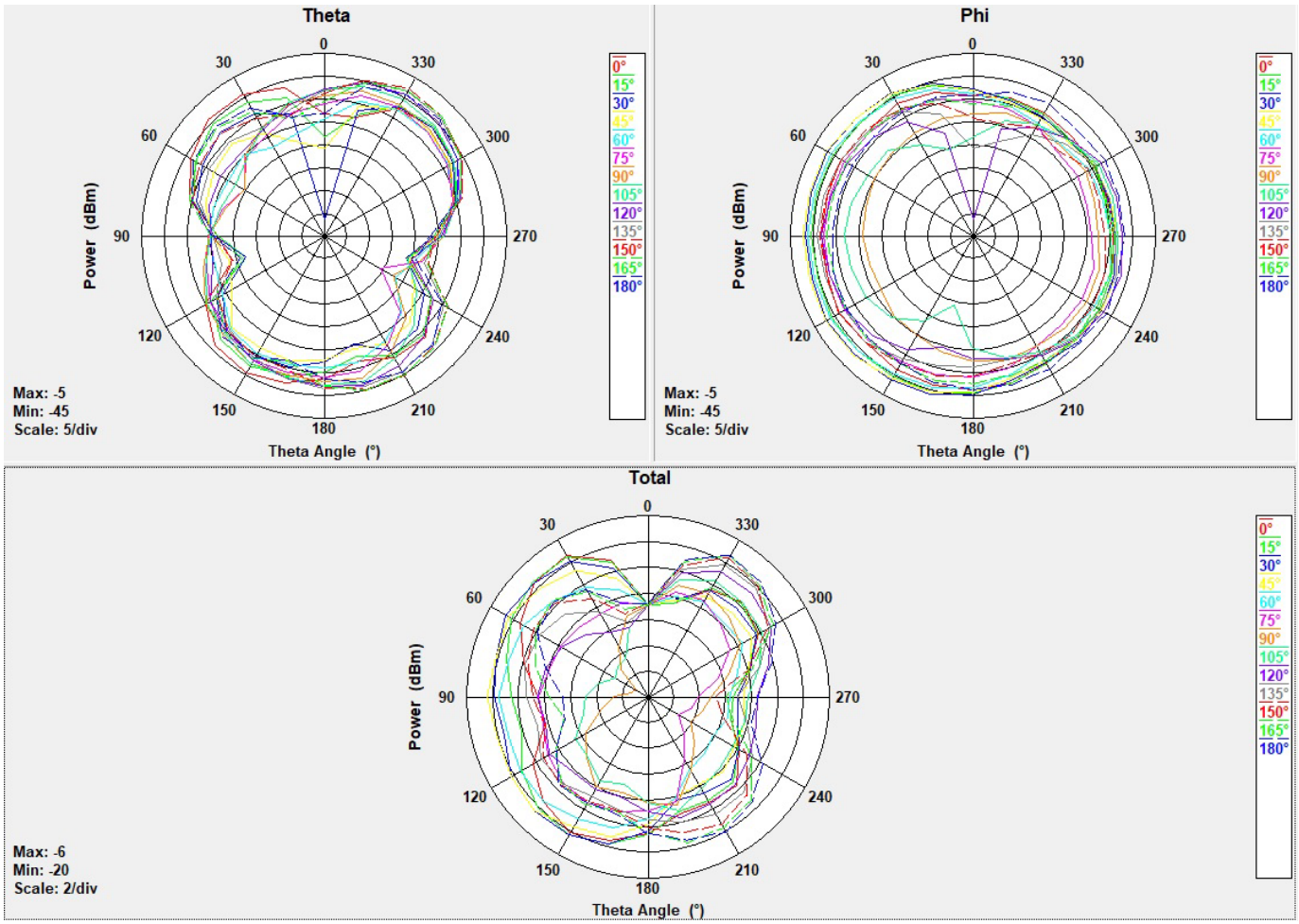

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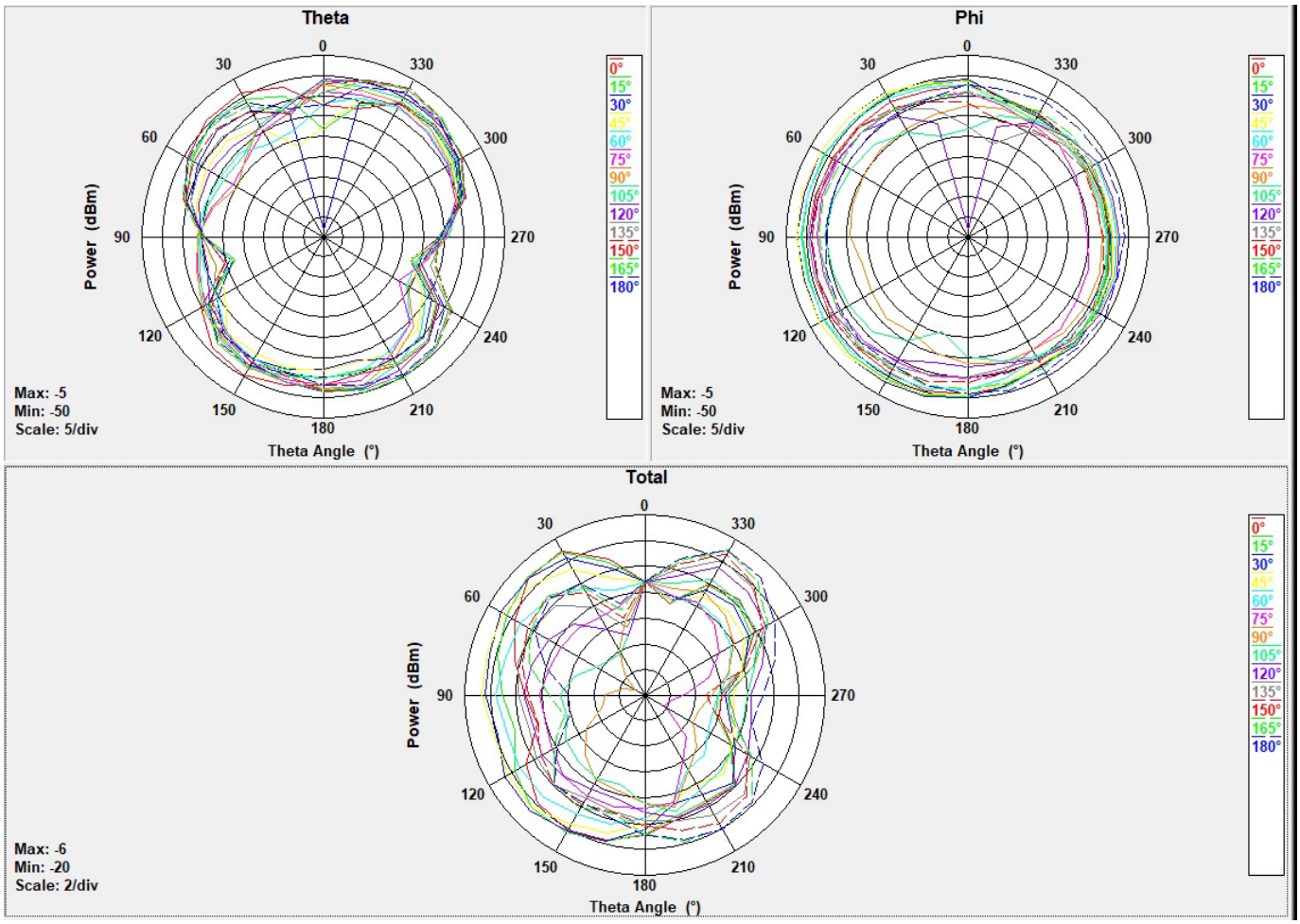

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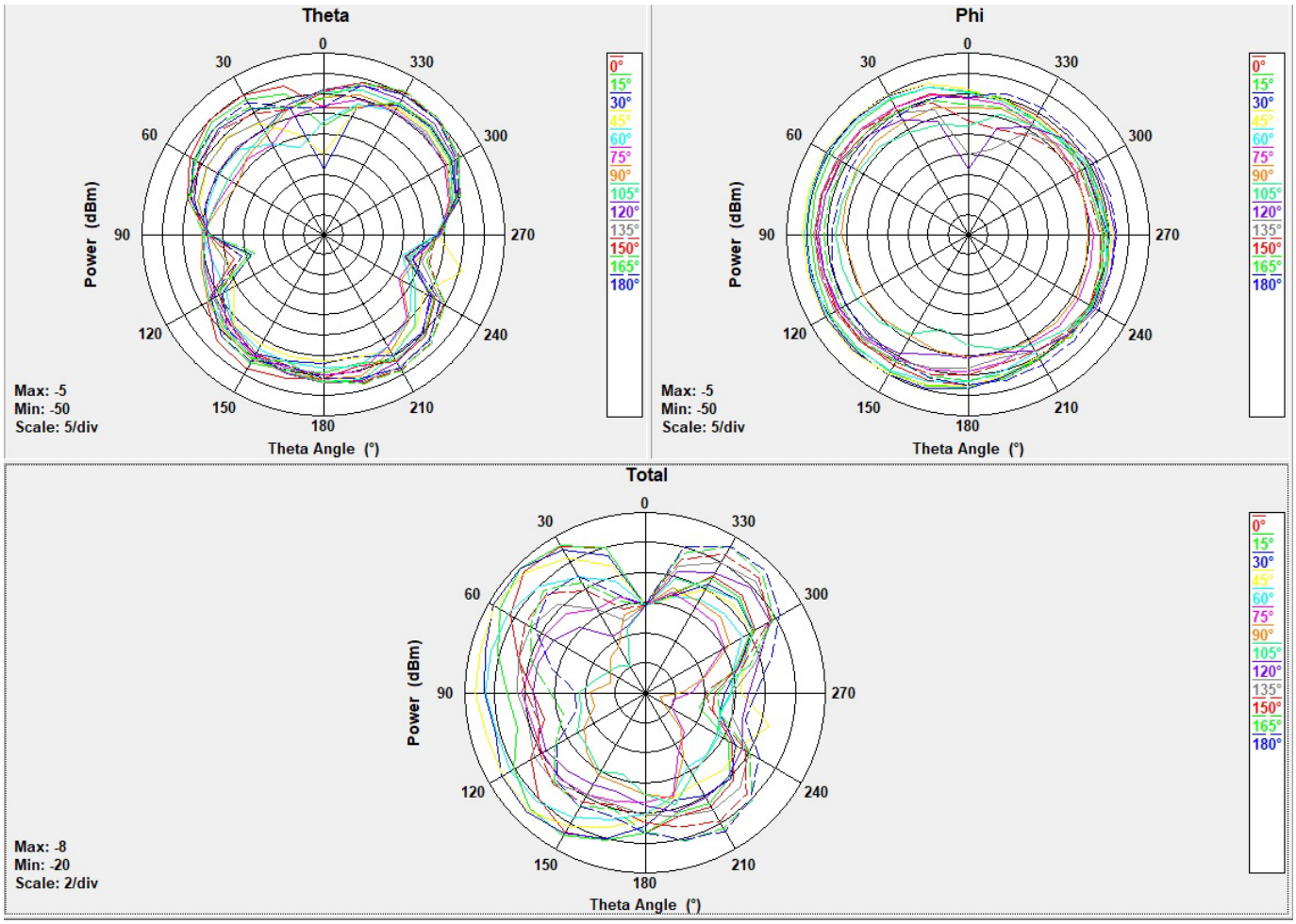


TESTED BY

Deniz Demirci on September 21, 2022

TRP Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with UKAS document LAB 34.

Free Space	LTE / WLAN / BT 2300 - 2800 MHz	WLAN 5150 - 5825 MHz
Standard Uncertainty, u	0.5 dB	0.6 dB
Expanded Uncertainty, U, with 95% Confidence Interval	1.1 dB	1.3 dB

Laptops over 30 cm	2300 - 2800 MHz	5150 - 5825 MHz
Standard Uncertainty, u	0.6 dB	0.8 dB
Expanded Uncertainty, U, with 95% Confidence Interval	1.2 dB	1.5 dB

Alternate Methods (Worst Case)		
Free Space	2300 - 2800 MHz	5150 - 5825 MHz
Standard Uncertainty, u	0.6 dB	0.7 dB
Expanded Uncertainty, U, with 95% Confidence Interval	1.2 dB	1.3 dB

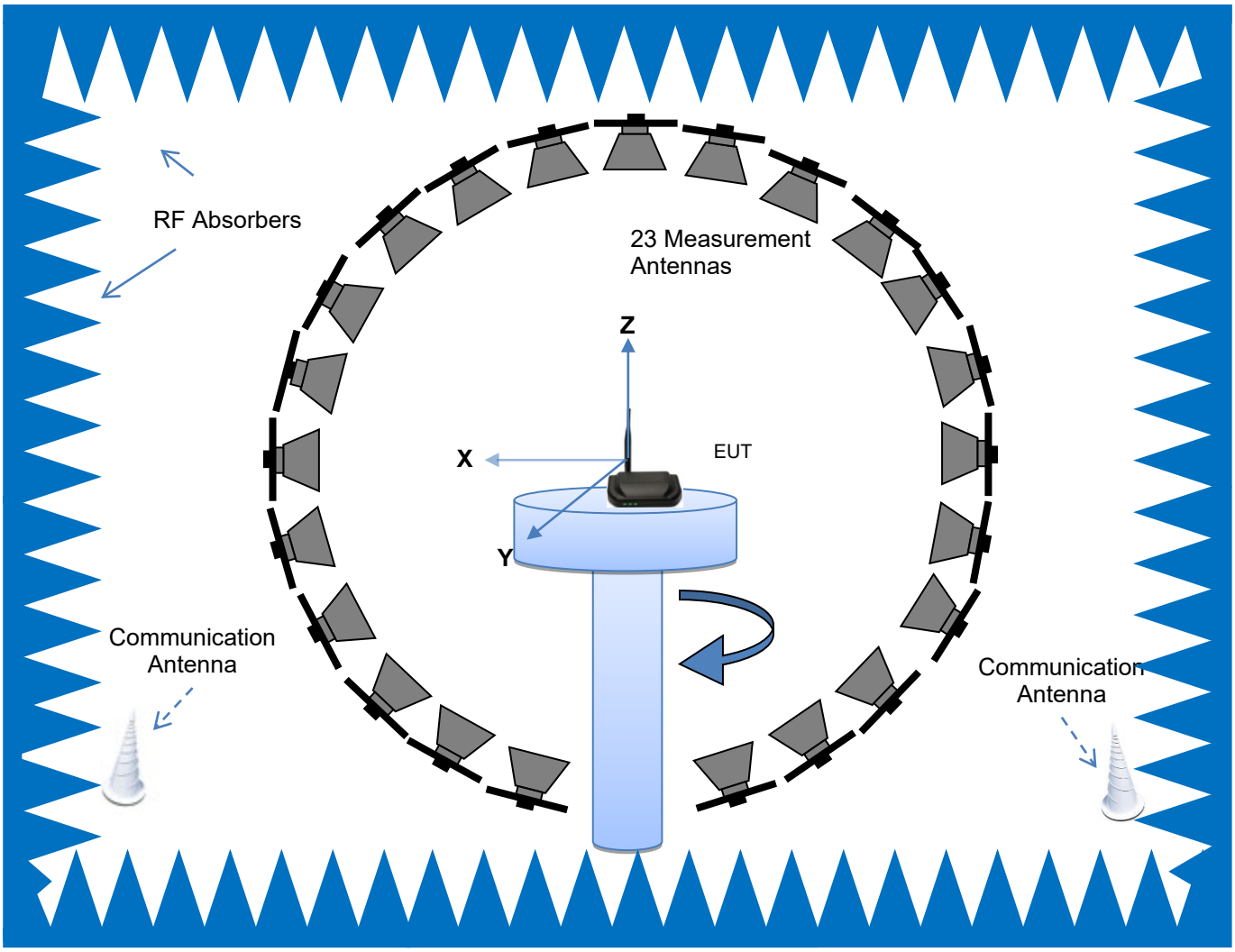
Laptops over 30 cm	2300 - 2800 MHz	5150 - 5825 MHz
Standard Uncertainty, u	0.6 dB	0.8 dB
Expanded Uncertainty, U, with 95% Confidence Interval	1.3 dB	1.5 dB

Test Equipment List

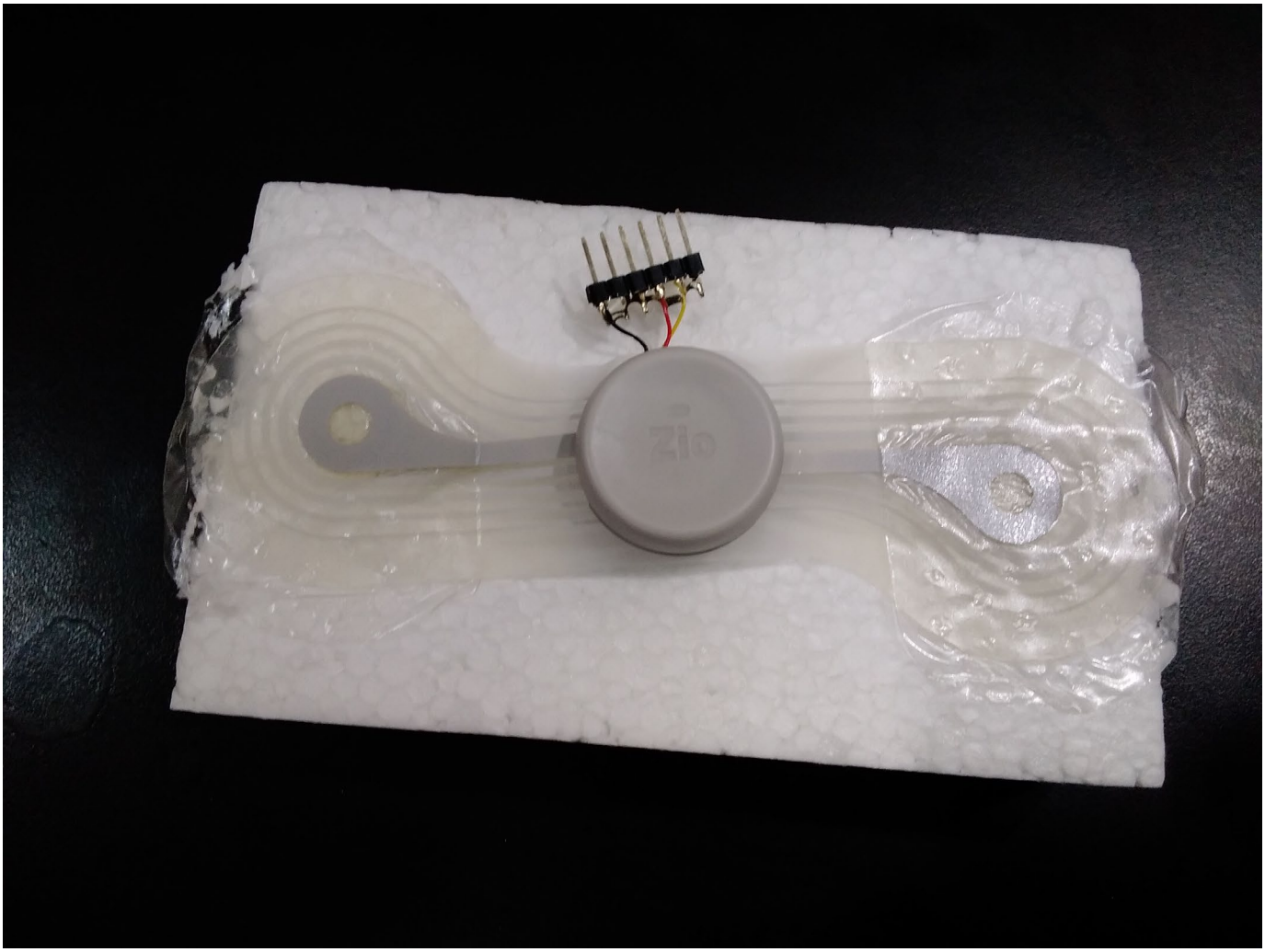
TYPE OF EQUIPMENT	MODEL NUMBER	MANUFACTURER	Asset #	CALIBRATION DATE	CALIBRATION DUE DATE
Anechoic Chamber	AMS 8923-195	ETS-Lindgren	WC062429	10/26/2021	10/26/2022
Reference Sleeve Dipole Antenna	3126-2500	ETS-Lindgren	WC064964	10/05/2021	10/05/2023
Multi-Antenna Array with 23 Dual Polarized Antennas (400 MHz - 6 GHz)	11870-1	ETS-Lindgren	WC062429	N/R	N/R
Circularly Polarized Communication Antenna	3102, 3102L	ETS-Lindgren	WC062429	N/R	N/R
Antenna Position Controller / RF Switch	EMCenter 7000-001	ETS-Lindgren	WC062429	N/R	N/R
Desktop Computer	Dell Workstation Tower 5810	Dell Computer	WC072264	N/R	N/R
Pattern Measurement Software	EMQuest^{tm} EMQ-100	ETS-Lindgren	-	N/R	N/R
Signal analyzer	FSV	Rhode & Schwarz	WC064873	05/12/2022	05/12/2023

Note:
N/A = Equipment does not need to be calibrated.
N/R = Equipment is not required to be calibrated, due to the fact that it is included in the chamber calibration

APPENDIX A: Chamber Reference Setup

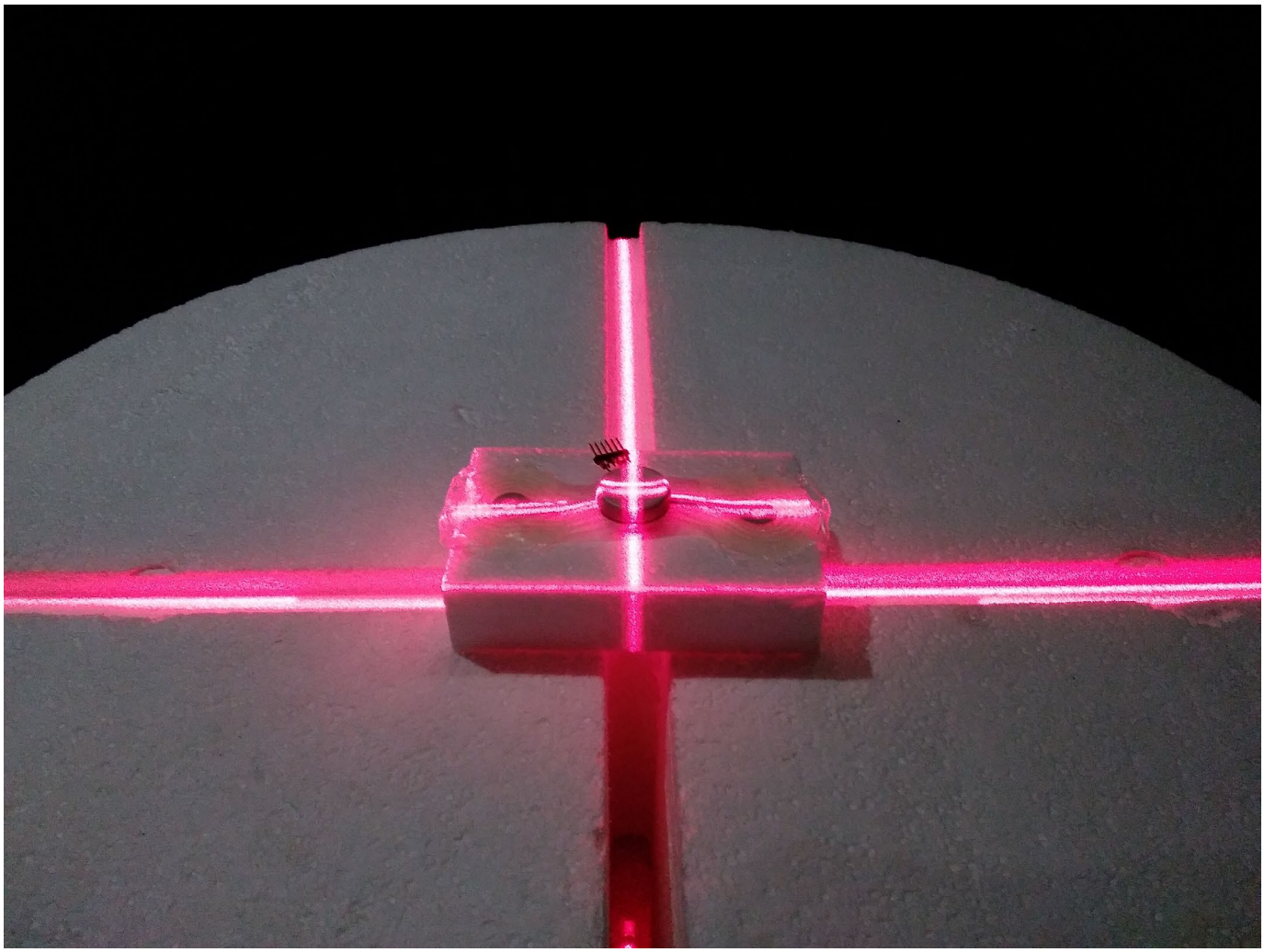


APPENDIX B: EUT Photos



EUT Photos

APPENDIX C: Test Setup Photos



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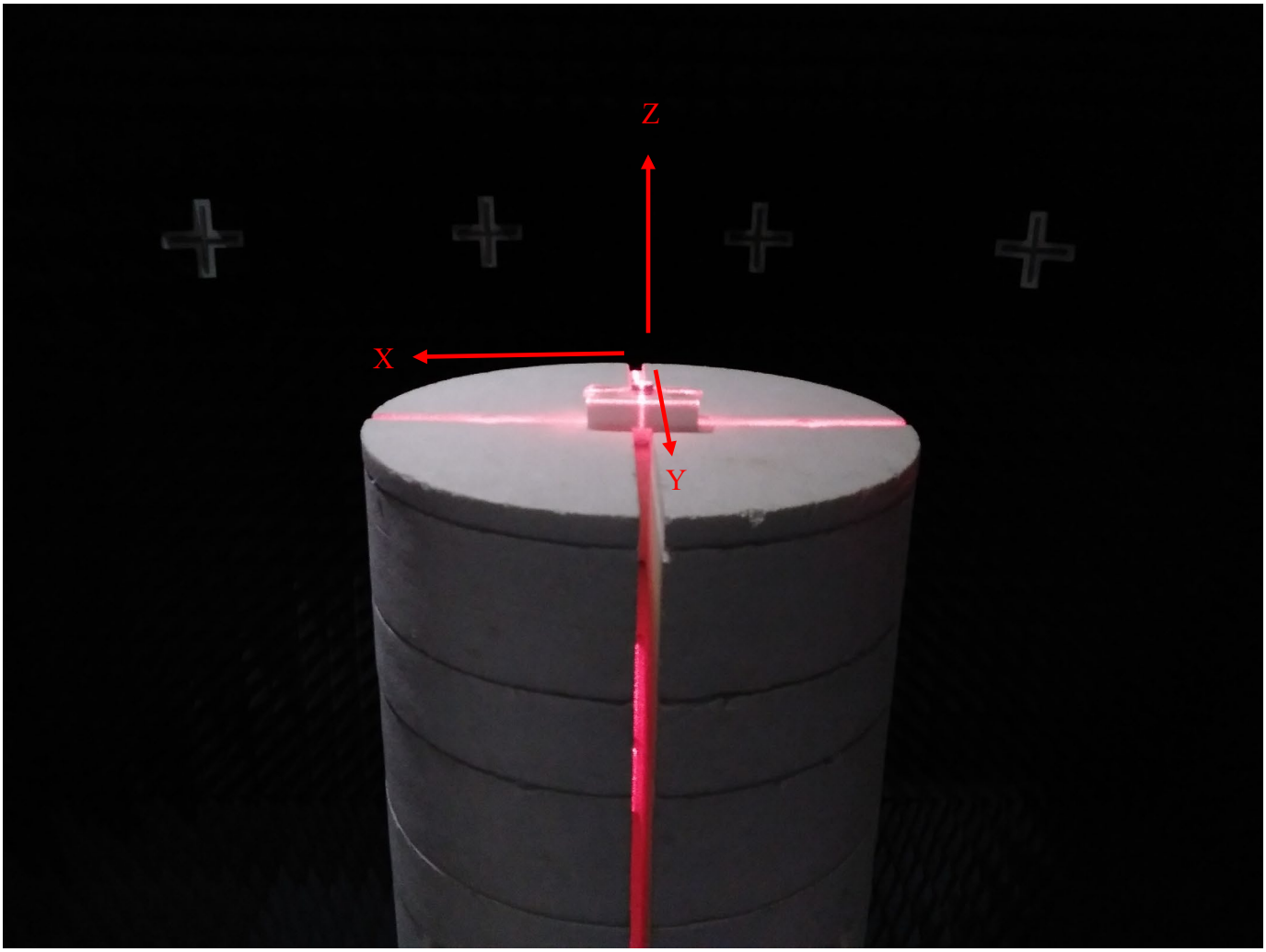

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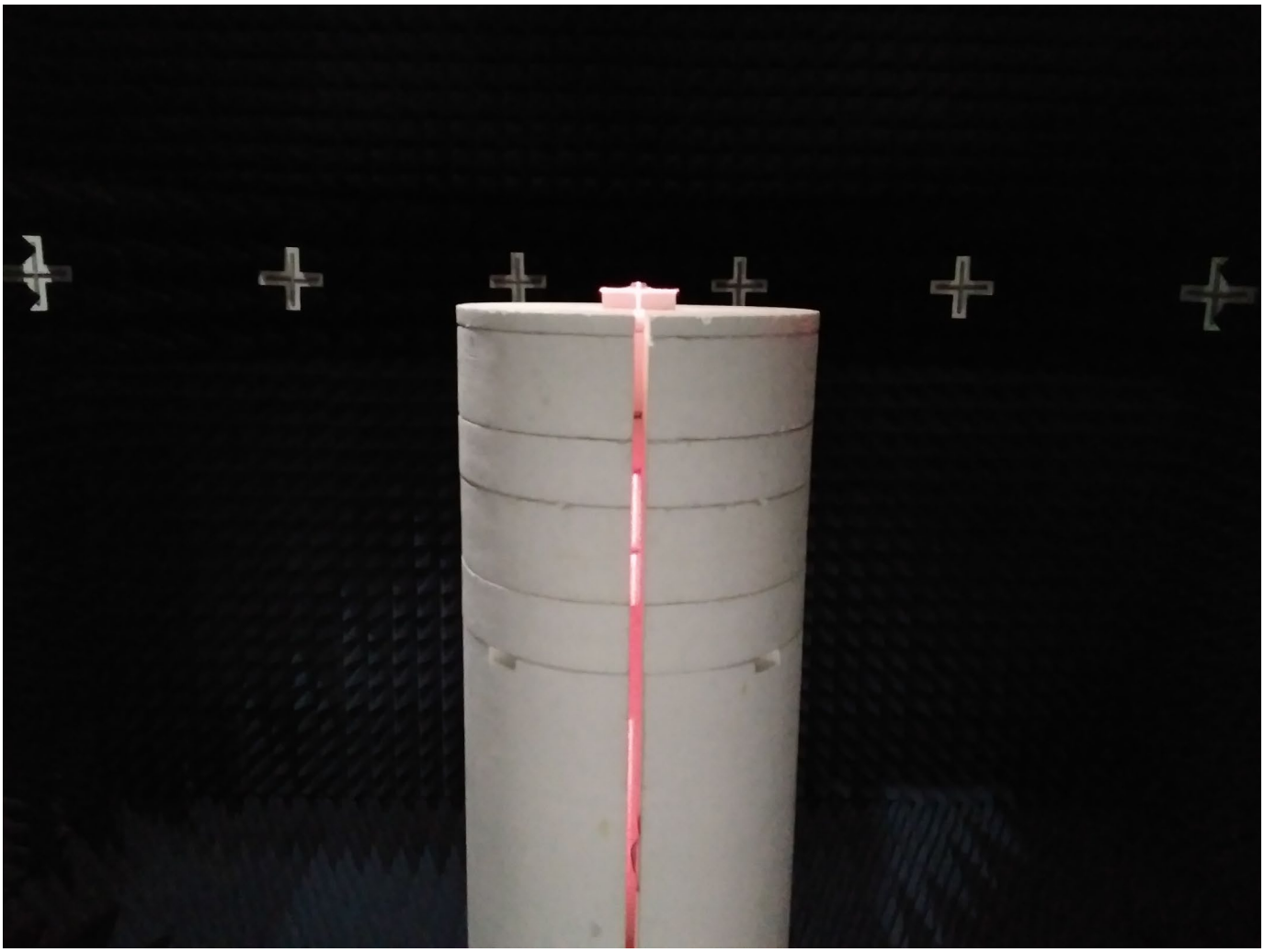

End of Report

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