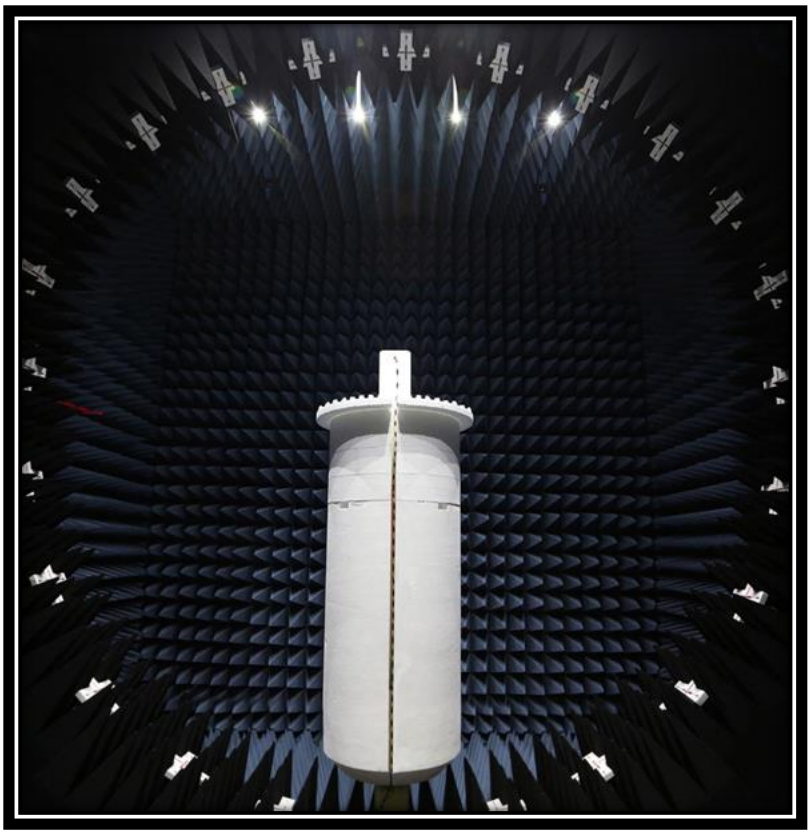
Cardiac Insight, Inc

M400

Antenna Pattern Measurements

Report: CAIN0005.2 Rev. 0, Issue Date: February 13, 2024



Approved by:

Eric Brandon, Department Manager

REVISION HISTORY

Revision Number	Description	Date (yyyy-mm-dd)	Page Number
00	None		

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element
2023.04.17

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ACCREDITATIONS AND AUTHORIZATIONS

element
2021.09.01

United States

FCC - Designated by the FCC as a Telecommunications Certification Body (TCB). Certification chambers, Open Area Test Sites, and conducted measurement facilities are listed with the FCC.

A2LA - Each laboratory is accredited by A2LA to ISO / IEC 17025, and as a product certifier to ISO / IEC 17065 which allows Element to certify transmitters to FCC and IC specifications.

Canada

ISED - Recognized by Innovation, Science and Economic Development Canada as a Certification Body (CB) and as a CAB for the acceptance of test data.

European Union

European Commission – Recognized as an EU Notified Body validated for the EMCD and RED Directives.

United Kingdom

BEIS – Recognized by the UK as an Approved Body under the UK Radio Equipment and UK EMC Regulations.

Australia/New Zealand

ACMA - Recognized by ACMA as a CAB for the acceptance of test data.

Korea

MSIT / RRA - Recognized by KCC's RRA as a CAB for the acceptance of test data.

Japan

VCCI - Associate Member of the VCCI. Conducted and radiated measurement facilities are registered.

Taiwan

BSMI – Recognized by BSMI as a CAB for the acceptance of test data.

NCC - Recognized by NCC as a CAB for the acceptance of test data.

Singapore

IDA – Recognized by IDA as a CAB for the acceptance of test data.

Israel

MOC – Recognized by MOC as a CAB for the acceptance of test data.

Hong Kong

OFCA – Recognized by OFCA as a CAB for the acceptance of test data.

Vietnam

MIC – Recognized by MIC as a CAB for the acceptance of test data.

SCOPE

For details on the Scopes of our Accreditations, please visit:

California Minnesota Oregon Texas Washington

FACILITIES

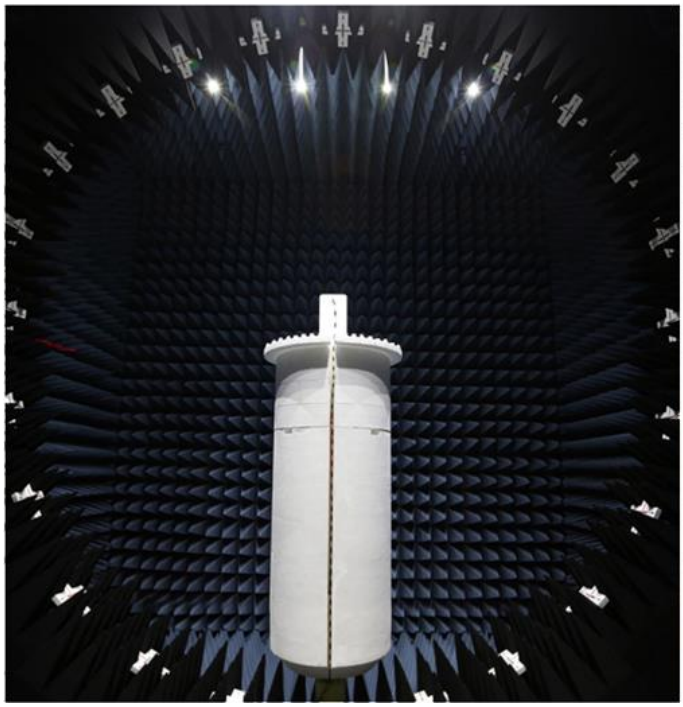
element
2023.09.21

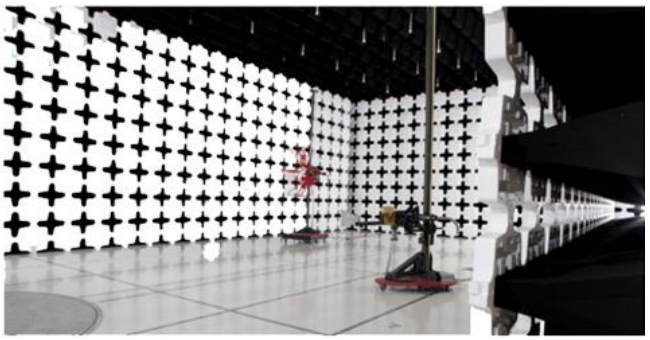
Testing was performed at the following location(s)

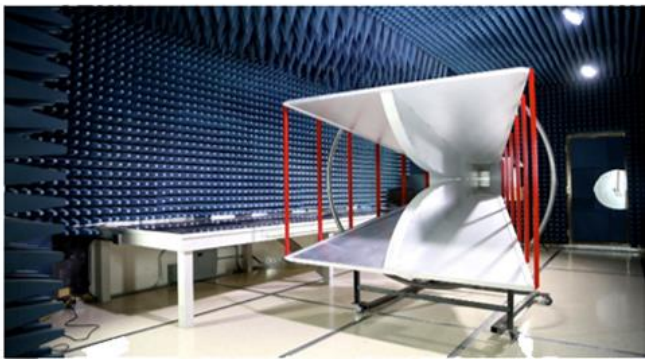
	Location	Labs (1)	Address	A2LA (2)	ISED (3)	BSMI (4)	VCCI (5)	CAB (6)	FDA (7)
☐	California	OC01-17	41 Tesla Irvine, CA 92618 (949) 861-8918	3310.04	2834B	SL2-IN-E-1154R	A-0029	US0158	TL-55
☐	Minnesota	MN01-11	9349 W Broadway Ave. Brooklyn Park, MN 55445 (612) 638-5136	3310.05	2834E	SL2-IN-E-1152R	A-0109	US0175	TL-57
☒	Oregon	EV01-12	6775 NE Evergreen Pkwy #400 Hillsboro, OR 97124 (503) 844-4066	3310.02	2834D	SL2-IN-E-1017	A-0108	US0017	TL-56
☐	Texas	TX01-09	3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	3310.03	2834G	SL2-IN-E-1158R	A-0201	US0191	TL-54
☐	Washington	NC01-05	19201 120th Ave NE Bothell, WA 98011 (425) 984-6600	3310.06	2834F	SL2-IN-E-1153R	A-0110	US0157	TL-67
☐	Offsite	N/A	See Product Description	N/A	N/A	N/A	N/A	N/A	N/A

See data sheets for specific labs

(1) The lab designations denote individual rooms within each location. (OC01, OC02, OC03, etc.)
(2) A2LA Certificate No.
(3) ISED Company No.
(4) BSMI No.
(5) VCCI Site Filing No.
(6) CAB Identifier. Recognized Phase I CAB for ISED, ACMA, BSMI, IDA, KCC/RRA, MIC, MOC, NCC, OFCA
(7) FDA ASCA No.







PRODUCT DESCRIPTION

Client and Equipment under Test (EUT) Information

Company Name:	Cardiac Insight, Inc
Address:	2375 130th Ave NE Suite 101
City, State, Zip:	Bellevue, WA 98005
Test Requested By:	Rick Myers
EUT:	M400
First Date of Test:	December 28, 2023
Last Date of Test:	December 29, 2023
Receipt Date of Samples:	December 28, 2023
Equipment Design Stage:	Prototype
Equipment Condition:	No Damage
Purchase Authorization:	Verified

Information Provided by the Party Requesting the Test

Functional Description of the EUT:
Disposable battery powered wearable ECG sensor with Bluetooth LE. The ECG sensor does not have the ability to be recharge.

Testing Objective:
To obtain 2D antenna pattern measurements and calculated antenna performance values.

MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2023-12-29	Antenna Pattern Measurements	Tested as delivered to test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

2D ANTENNA PATTERN MEASUREMENTS

PSA-ESCI 2023.04.25.0

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

MODES OF OPERATION

CW: 2480 MHz
CW: 2442 MHz
CW: 2402 MHz

POWER SETTINGS INVESTIGATED

Battery

CONFIGURATIONS INVESTIGATED

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FREQUENCY RANGE INVESTIGATED

Start Frequency	2402 MHz	Stop Frequency	2480 MHz

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	2023-10-04	2024-10-04
Cable	N/A	Double Ridge Horn Cables	EVB	2023-03-26	2024-03-26
Antenna - Double Ridge	ETS Lindgren	3115	AIZ	2022-03-02	2024-03-02
Antenna - Double Ridge	EMCO	3115	AHC	2022-07-08	2024-07-08
Power Sensor	Agilent	E9300H	SQO	2023-10-02	2024-10-02
Meter - Power	Agilent	N1913A	SQR	2023-10-02	2024-10-02
Generator - Signal	Keysight	N5182B	TFU	2022-12-02	2024-12-02

TEST DESCRIPTION

Measurements were performed in a semi-anechoic chamber at a 3 m distance. To simulate free space, the ground plane was covered with RF absorbing cones. The reference antenna and EUT were placed on a block of approximately 1.8 m low permittivity foam.

A direct connect sample of the AUT was configured to transmit a CW tone at Low, Mid, and High channels. The output power of the conducted sample was mesaured and recorded in this report.

A signal generator was connected to the reference antenna with a low loss RF cable. To minimize the influence of the RF cable in the radiating pattern, the cable was lined with snap on ferrites at a separating distance of 10 cm.

A CW tone with was then provided to the calibrated reference antenna and reference scan was then collected at the frequencies noted in this test report. The amplitude of the CW tone was measured and adjusted until it was confirmed to be the same level that was measured on the conducted sample.

Using the same test setup, the antenna under test (AUT) was placed into the chamber.

A polar plot was then collected at the antenna height of maximum field strength. This plot was then compared to the reference antenna scan. Using the antenna gain (dBi) of the reference antenna the absolute gain of the AUT was calculated.

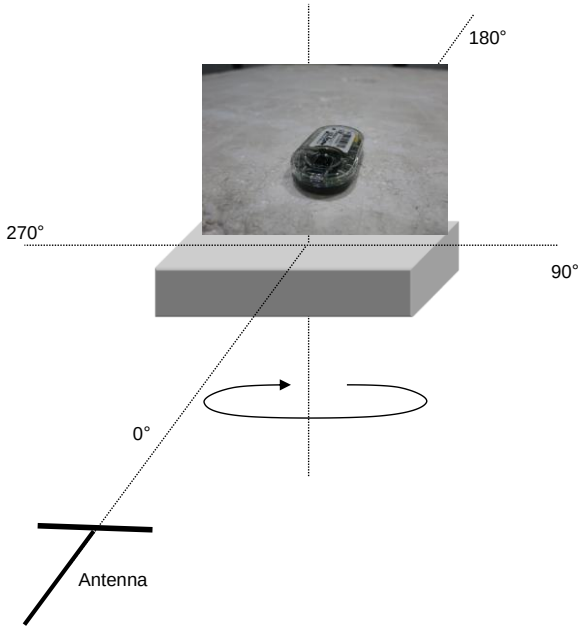
2D ANTENNA PATTERN MEASUREMENTS

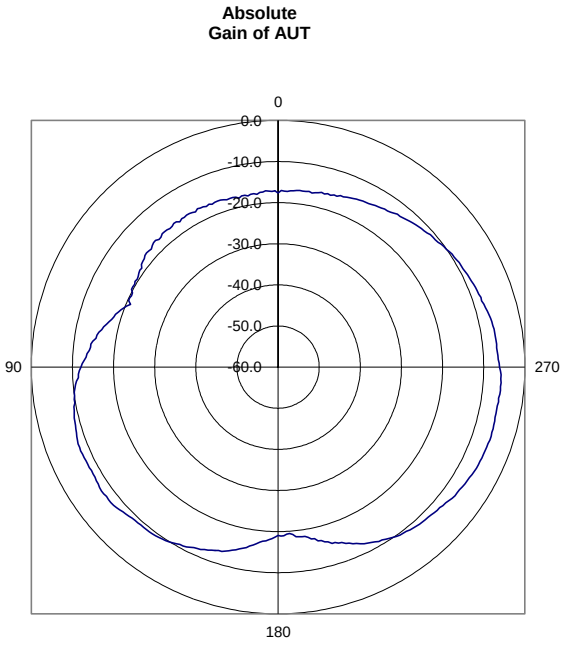
EmiR5 2023.08.29.0 PSA-ESCI 2023.04.25.0

Work Order:	CAIN0005	**Date:**	2023-12-29		
Project:	None	**Temperature:**	22°C		
Job Site:	EV01	**Humidity:**	36%		
Serial Number:	1000009H	**Barometric Pres.:**	1009 mbar	**Tested by:**	Jeff Alcoke
EUT:	M400				
Configuration:	CAIN0005-8				
Customer:	Cardiac Insight, Inc				
Attendees:	Rick Myers				
EUT Power:	Battery				
Operating Mode:	CW: 2402 MHz				
Deviations:	None				
Comments:	Conducted AUT sample serial number = 1000009K				

Frequency	**2402**	Absolute Gain of Reference Antenna (dBi)	9.46
Measurement Antenna Polarity	**Horizontal**	Reference Antenna Relative Gain Max (dBuV/m)	108.27
Antenna Under Test (AUT) Polarity	**Horizontal**	AUT Relative Gain Max (dBuV/m)	93.27
Maximum Absolute Gain of AUT (dBi)	**-5.54**	Difference (Reference Antenna - AUT) (dB)	15.00
Average Absolute Gain of AUT (dBi)	**-12.46**	AUT Setup Loss (dB)	**0**
		Correction Factor (Convert Relative to Absolute Gain) (dB)	**98.81**
3 dB Beamwidth	**71°**		
		Reference Antenna Measured Input Power (dBm)	2.50
		EUT Conducted Output Power (dBm)	2.50
		Power Delta (Antenna Power-Output Power) (dB)	0.00

Run #		**Test Distance (m)**		**Antenna Height(s)**		**Results**	NA





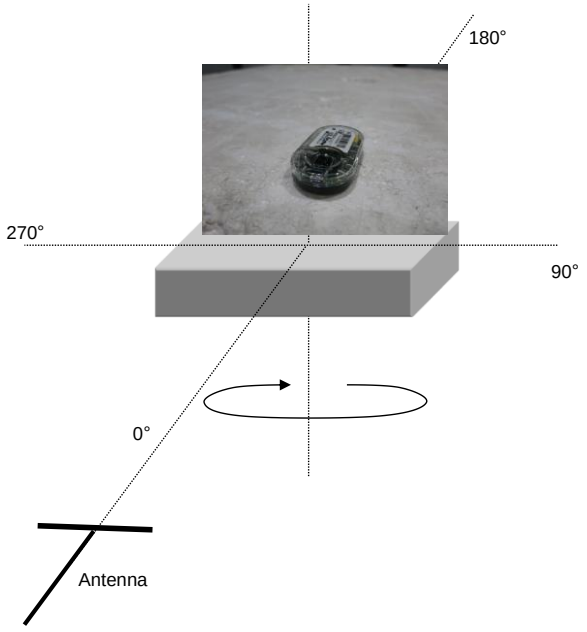
2D ANTENNA PATTERN MEASUREMENTS

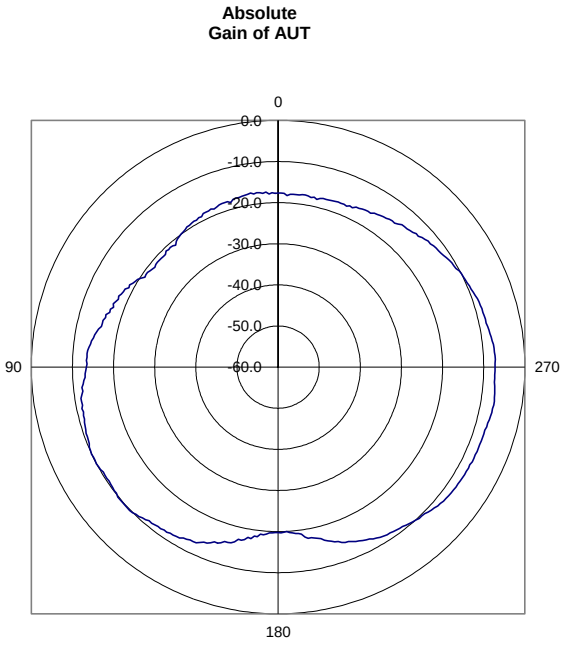
EmiR5 2023.08.29.0 PSA-ESCI 2023.04.25.0

Work Order:	CAIN0005	**Date:**	2023-12-29		
Project:	None	**Temperature:**	23°C		
Job Site:	EV01	**Humidity:**	36%		
Serial Number:	1000009H	**Barometric Pres.:**	1009 mbar	**Tested by:**	Jeff Alcoke
EUT:	M400				
Configuration:	CAIN0005-8				
Customer:	Cardiac Insight, Inc				
Attendees:	Rick Myers				
EUT Power:	Battery				
Operating Mode:	CW: 2442 MHz				
Deviations:	None				
Comments:	Conducted AUT sample serial number = 1000009K				

Frequency	**2442**	Absolute Gain of Reference Antenna (dBi)	9.55
Measurement Antenna Polarity	**Horizontal**	Reference Antenna Relative Gain Max (dBuV/m)	107.35
Antenna Under Test (AUT) Polarity	**Horizontal**	AUT Relative Gain Max (dBuV/m)	91.05
Maximum Absolute Gain of AUT (dBi)	**-6.75**	Difference (Reference Antenna - AUT) (dB)	16.30
Average Absolute Gain of AUT (dBi)	**-13.76**	AUT Setup Loss (dB)	**0**
		Correction Factor (Convert Relative to Absolute Gain) (dB)	**97.80**
3 dB Beamwidth	**73°**		
		Reference Antenna Measured Input Power (dBm)	2.00
		EUT Conducted Output Power (dBm)	2.00
		Power Delta (Antenna Power-Output Power) (dB)	0.00

Run #		**Test Distance (m)**		**Antenna Height(s)**		**Results**	NA





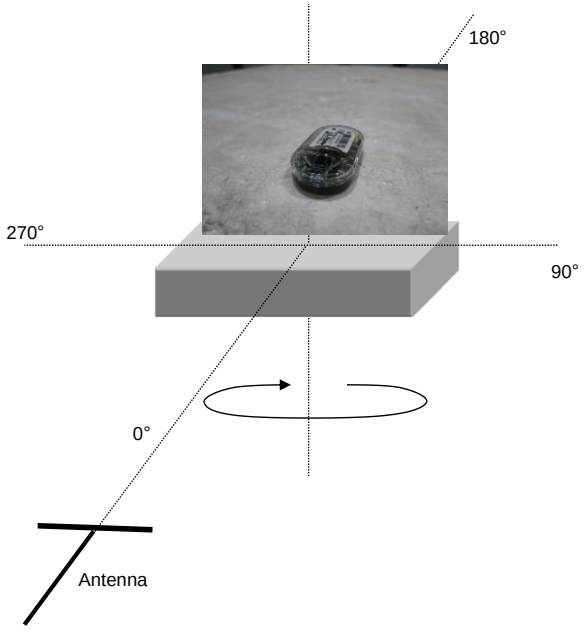
2D ANTENNA PATTERN MEASUREMENTS

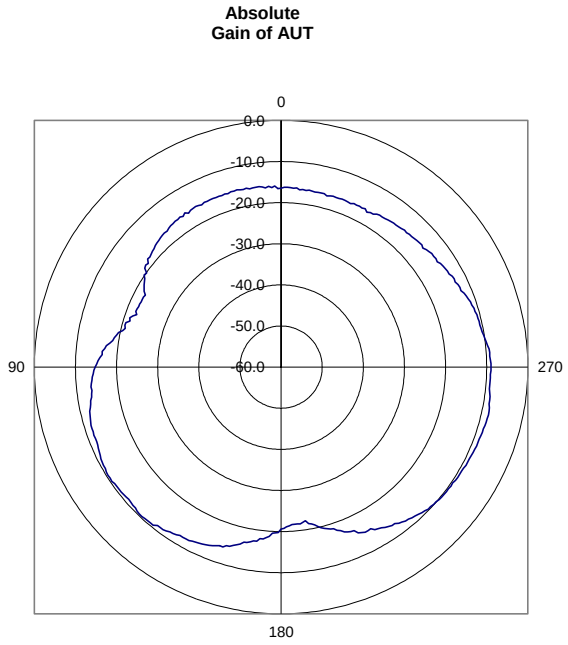
EmiR5 2023.08.29.0 PSA-ESCI 2023.04.25.0

Work Order:	CAIN0005	**Date:**	2023-12-29		
Project:	None	**Temperature:**	23°C		
Job Site:	EV01	**Humidity:**	36%		
Serial Number:	1000009H	**Barometric Pres.:**	1009 mbar	**Tested by:**	Jeff Alcoke
EUT:	M400				
Configuration:	CAIN0005-8				
Customer:	Cardiac Insight, Inc				
Attendees:	Rick Myers				
EUT Power:	Battery				
Operating Mode:	CW: 2480 MHz				
Deviations:	None				
Comments:	Conducted AUT sample serial number = 1000009K				

Frequency	**2480**	Absolute Gain of Reference Antenna (dBi)	9.64
Measurement Antenna Polarity	**Horizontal**	Reference Antenna Relative Gain Max (dBuV/m)	106.81
Antenna Under Test (AUT) Polarity	**Horizontal**	AUT Relative Gain Max (dBuV/m)	88.91
Maximum Absolute Gain of AUT (dBi)	**-8.26**	Difference (Reference Antenna - AUT) (dB)	17.90
Average Absolute Gain of AUT (dBi)	**-14.47**	AUT Setup Loss (dB)	**0**
		Correction Factor (Convert Relative to Absolute Gain) (dB)	**97.17**
3 dB Beamwidth	**66°**		
		Reference Antenna Measured Input Power (dBm)	1.50
		EUT Conducted Output Power (dBm)	1.50
		Power Delta (Antenna Power-Output Power) (dB)	0.00

Run #		**Test Distance (m)**		**Antenna Height(s)**		**Results**	NA





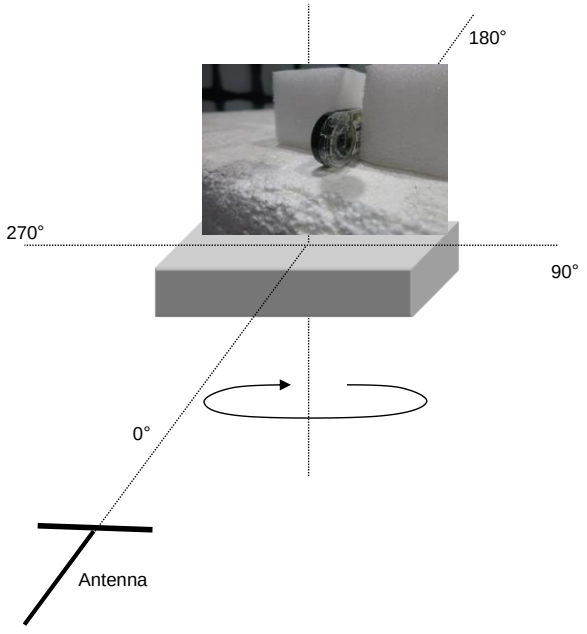
2D ANTENNA PATTERN MEASUREMENTS

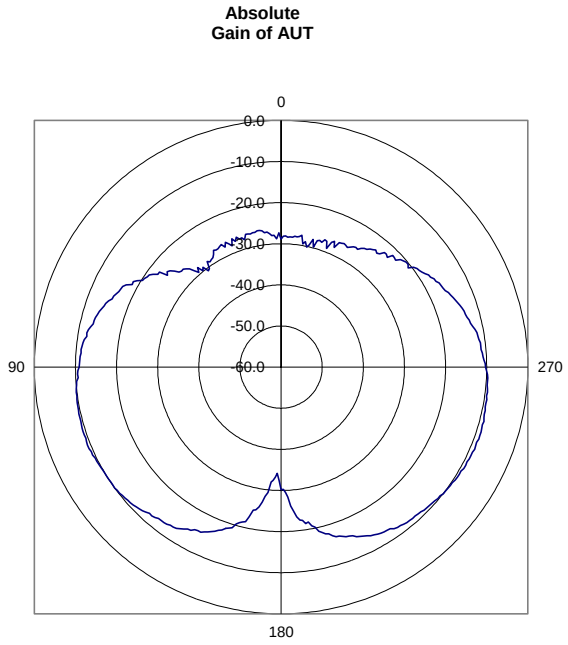
EmiR5 2023.08.29.0 PSA-ESCI 2023.04.25.0

Work Order:	CAIN0005	**Date:**	2023-12-29		
Project:	None	**Temperature:**	23°C		
Job Site:	EV01	**Humidity:**	36%		
Serial Number:	1000009H	**Barometric Pres.:**	1009 mbar	**Tested by:**	Jeff Alcoke
EUT:	M400				
Configuration:	CAIN0005-8				
Customer:	Cardiac Insight, Inc				
Attendees:	Rick Myers				
EUT Power:	Battery				
Operating Mode:	CW: 2480 MHz				
Deviations:	None				
Comments:	Conducted AUT sample serial number = 1000009K				

Frequency	**2480**	Absolute Gain of Reference Antenna (dBi)	9.64
Measurement Antenna Polarity	**Horizontal**	Reference Antenna Relative Gain Max (dBuV/m)	106.81
Antenna Under Test (AUT) Polarity	**on Side**	AUT Relative Gain Max (dBuV/m)	88.31
Maximum Absolute Gain of AUT (dBi)	**-8.86**	Difference (Reference Antenna - AUT) (dB)	18.50
Average Absolute Gain of AUT (dBi)	**-17.76**	AUT Setup Loss (dB)	**0**
		Correction Factor (Convert Relative to Absolute Gain) (dB)	**97.17**
3 dB Beamwidth	**65°**		
		Reference Antenna Measured Input Power (dBm)	1.50
		EUT Conducted Output Power (dBm)	1.50
		Power Delta (Antenna Power-Output Power) (dB)	0.00

Run #		**Test Distance (m)**		**Antenna Height(s)**		**Results**	NA





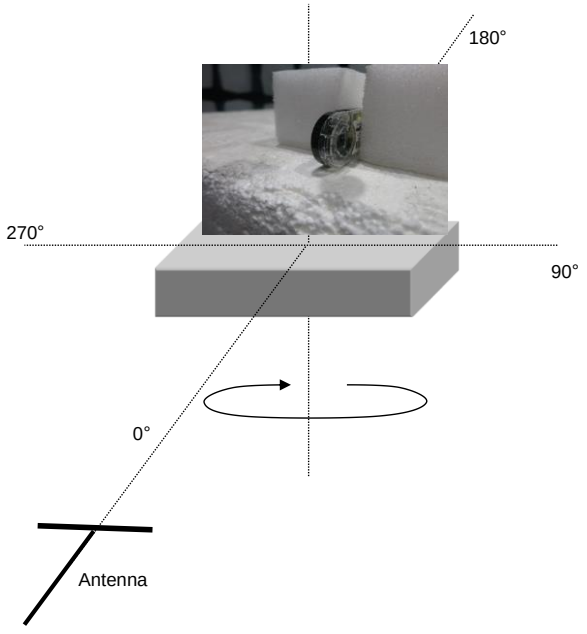
2D ANTENNA PATTERN MEASUREMENTS

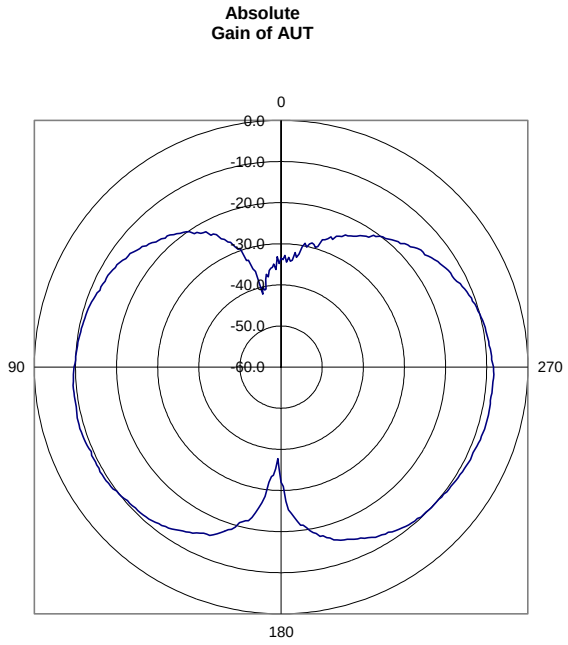
EmiR5 2023.08.29.0 PSA-ESCI 2023.04.25.0

Work Order:	CAIN0005	**Date:**	2023-12-29		
Project:	None	**Temperature:**	23°C		
Job Site:	EV01	**Humidity:**	36%		
Serial Number:	1000009H	**Barometric Pres.:**	1009 mbar	**Tested by:**	Jeff Alcoke
EUT:	M400				
Configuration:	CAIN0005-8				
Customer:	Cardiac Insight, Inc				
Attendees:	Rick Myers				
EUT Power:	Battery				
Operating Mode:	CW: 2442 MHz				
Deviations:	None				
Comments:	Conducted AUT sample serial number = 1000009K				

Frequency	**2442**	Absolute Gain of Reference Antenna (dBi)	9.55
Measurement Antenna Polarity	**Horizontal**	Reference Antenna Relative Gain Max (dBuV/m)	107.35
Antenna Under Test (AUT) Polarity	**on Side**	AUT Relative Gain Max (dBuV/m)	89.55
Maximum Absolute Gain of AUT (dBi)	**-8.25**	Difference (Reference Antenna - AUT) (dB)	17.80
Average Absolute Gain of AUT (dBi)	**-16.44**	AUT Setup Loss (dB)	**0**
		Correction Factor (Convert Relative to Absolute Gain) (dB)	**97.80**
3 dB Beamwidth	**76°**		
		Reference Antenna Measured Input Power (dBm)	2.00
		EUT Conducted Output Power (dBm)	2.00
		Power Delta (Antenna Power-Output Power) (dB)	0.00

Run #		**Test Distance (m)**		**Antenna Height(s)**		**Results**	NA





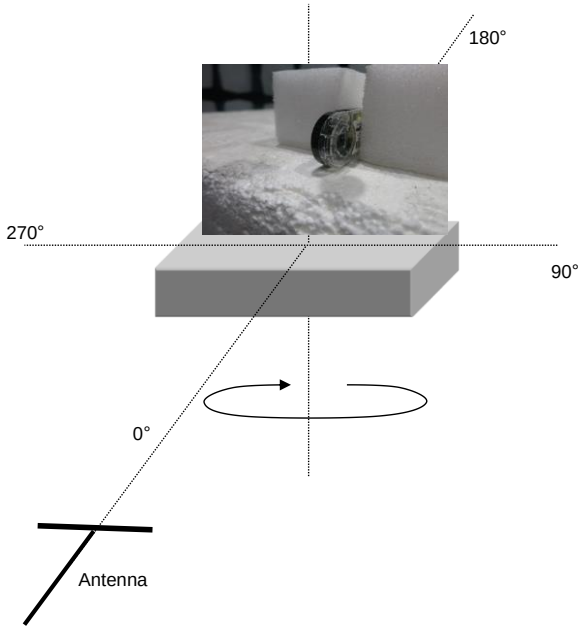
2D ANTENNA PATTERN MEASUREMENTS

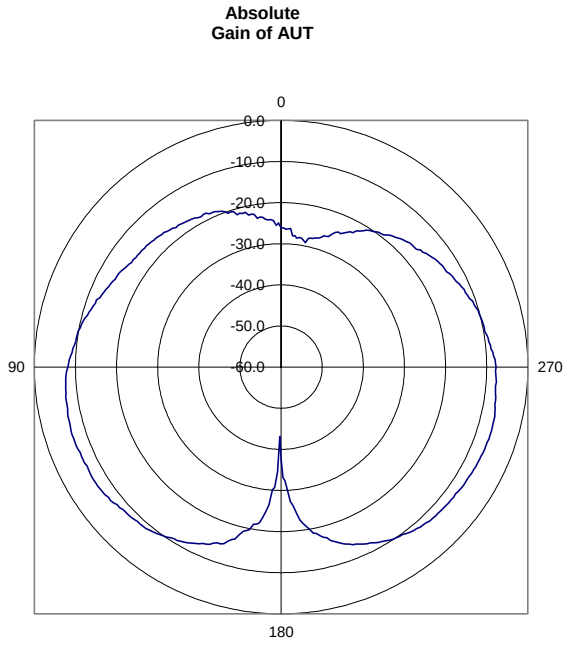
EmiR5 2023.08.29.0 PSA-ESCI 2023.04.25.0

Work Order:	CAIN0005	**Date:**	2023-12-29		
Project:	None	**Temperature:**	23°C		
Job Site:	EV01	**Humidity:**	36%		
Serial Number:	1000009H	**Barometric Pres.:**	1009 mbar	**Tested by:**	Jeff Alcoke
EUT:	M400				
Configuration:	CAIN0005-8				
Customer:	Cardiac Insight, Inc				
Attendees:	Rick Myers				
EUT Power:	Battery				
Operating Mode:	CW: 2402 MHz				
Deviations:	None				
Comments:	Conducted AUT sample serial number = 1000009K				

Frequency	**2402**	Absolute Gain of Reference Antenna (dBi)	9.46
Measurement Antenna Polarity	**Horizontal**	Reference Antenna Relative Gain Max (dBuV/m)	108.27
Antenna Under Test (AUT) Polarity	**on Side**	AUT Relative Gain Max (dBuV/m)	92.27
Maximum Absolute Gain of AUT (dBi)	**-6.54**	Difference (Reference Antenna - AUT) (dB)	16.00
Average Absolute Gain of AUT (dBi)	**-14.32**	AUT Setup Loss (dB)	**0**
		Correction Factor (Convert Relative to Absolute Gain) (dB)	**98.81**
3 dB Beamwidth	**64°**		
		Reference Antenna Measured Input Power (dBm)	2.50
		EUT Conducted Output Power (dBm)	2.50
		Power Delta (Antenna Power-Output Power) (dB)	0.00

Run #		**Test Distance (m)**		**Antenna Height(s)**		**Results**	NA





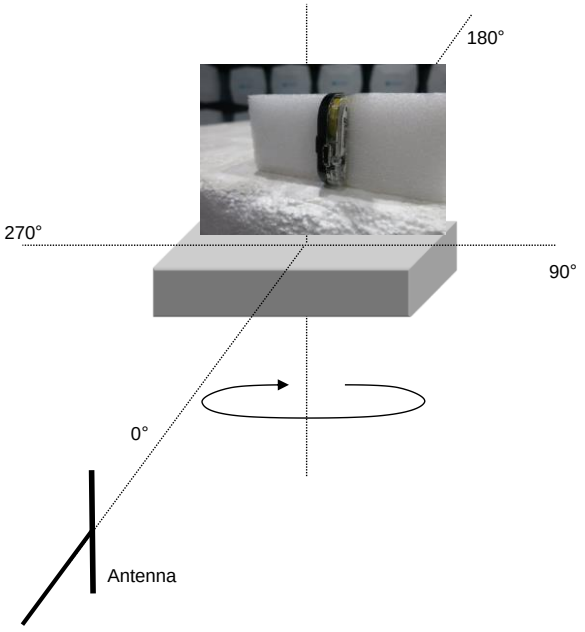
2D ANTENNA PATTERN MEASUREMENTS

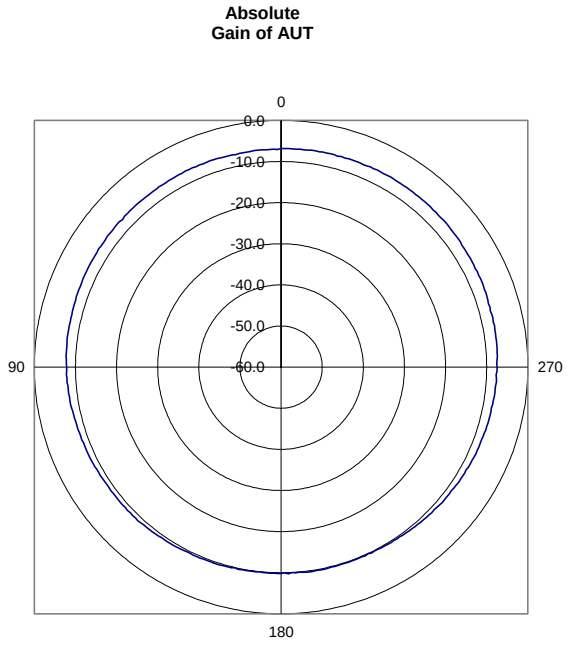
EmiR5 2023.08.29.0 PSA-ESCI 2023.04.25.0

Work Order:	CAIN0005	**Date:**	2023-12-29		
Project:	None	**Temperature:**	23°C		
Job Site:	EV01	**Humidity:**	36%		
Serial Number:	1000009H	**Barometric Pres.:**	1009 mbar	**Tested by:**	Jeff Alcoke
EUT:	M400				
Configuration:	CAIN0005-8				
Customer:	Cardiac Insight, Inc				
Attendees:	Rick Myers				
EUT Power:	Battery				
Operating Mode:	CW: 2402 MHz				
Deviations:	None				
Comments:	Conducted AUT sample serial number = 1000009K				

Frequency	**2402**	Absolute Gain of Reference Antenna (dBi)	9.46
Measurement Antenna Polarity	**Vertical**	Reference Antenna Relative Gain Max (dBuV/m)	108.27
Antenna Under Test (AUT) Polarity	**Vertical**	AUT Relative Gain Max (dBuV/m)	92.17
Maximum Absolute Gain of AUT (dBi)	**-6.64**	Difference (Reference Antenna - AUT) (dB)	16.10
Average Absolute Gain of AUT (dBi)	**-8.02**	AUT Setup Loss (dB)	**0**
		Correction Factor (Convert Relative to Absolute Gain) (dB)	**98.81**
3 dB Beamwidth	**298°**		
		Reference Antenna Measured Input Power (dBm)	2.50
		EUT Conducted Output Power (dBm)	2.50
		Power Delta (Antenna Power-Output Power) (dB)	0.00

Run #		**Test Distance (m)**		**Antenna Height(s)**		**Results**	NA





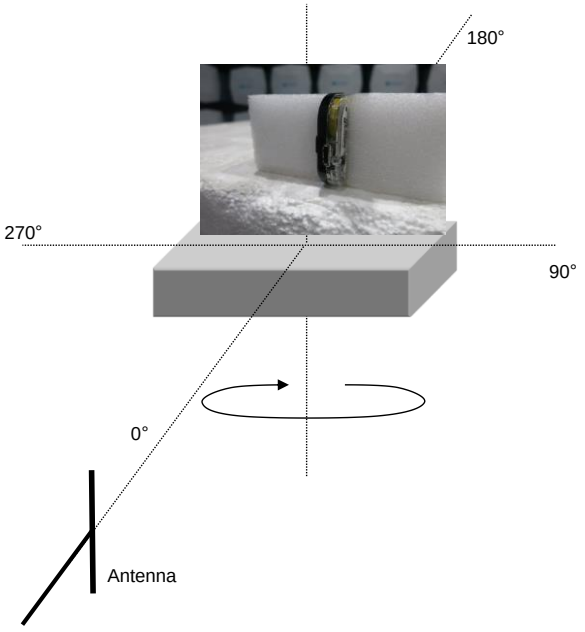
2D ANTENNA PATTERN MEASUREMENTS

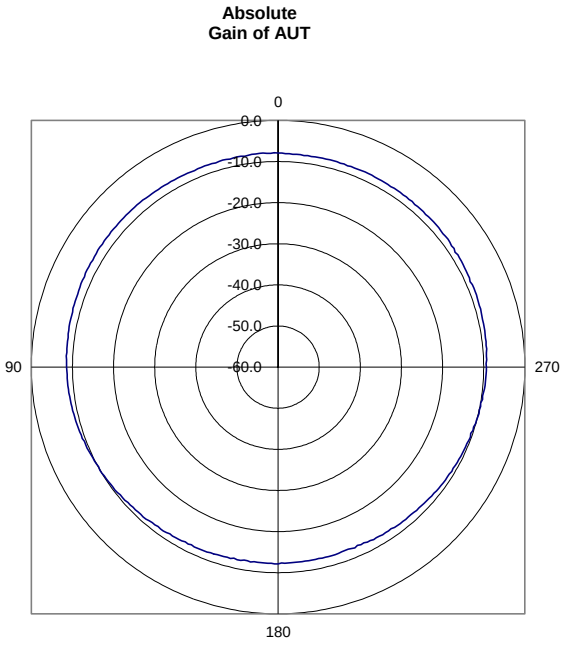
EmiR5 2023.08.29.0 PSA-ESCI 2023.04.25.0

Work Order:	CAIN0005	**Date:**	2023-12-29		
Project:	None	**Temperature:**	23°C		
Job Site:	EV01	**Humidity:**	36%		
Serial Number:	1000009H	**Barometric Pres.:**	1009 mbar	**Tested by:**	Jeff Alcoke
EUT:	M400				
Configuration:	CAIN0005-8				
Customer:	Cardiac Insight, Inc				
Attendees:	Rick Myers				
EUT Power:	Battery				
Operating Mode:	CW: 2442 MHz				
Deviations:	None				
Comments:	Conducted AUT sample serial number = 1000009K				

Frequency	**2442**	Absolute Gain of Reference Antenna (dBi)	9.55
Measurement Antenna Polarity	**Vertical**	Reference Antenna Relative Gain Max (dBuV/m)	107.35
Antenna Under Test (AUT) Polarity	**Vertical**	AUT Relative Gain Max (dBuV/m)	90.05
Maximum Absolute Gain of AUT (dBi)	**-7.75**	Difference (Reference Antenna - AUT) (dB)	17.30
Average Absolute Gain of AUT (dBi)	**-9.61**	AUT Setup Loss (dB)	**0**
		Correction Factor (Convert Relative to Absolute Gain) (dB)	**97.80**
3 dB Beamwidth	**251°**		
		Reference Antenna Measured Input Power (dBm)	2.00
		EUT Conducted Output Power (dBm)	2.00
		Power Delta (Antenna Power-Output Power) (dB)	0.00

Run #		**Test Distance (m)**		**Antenna Height(s)**		**Results**	NA





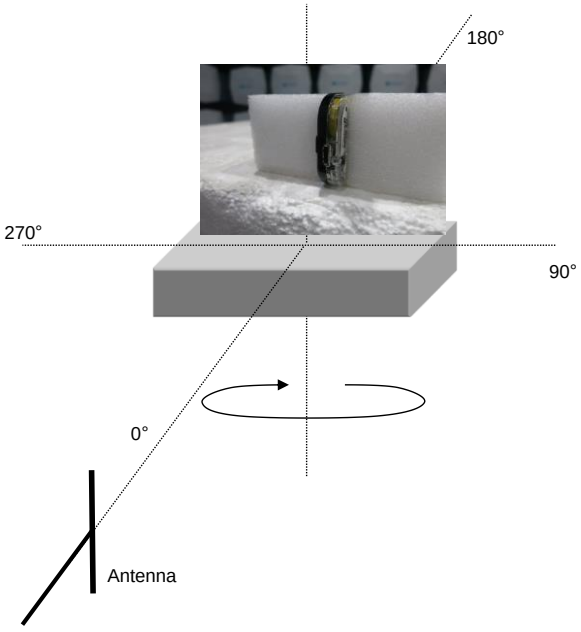
2D ANTENNA PATTERN MEASUREMENTS

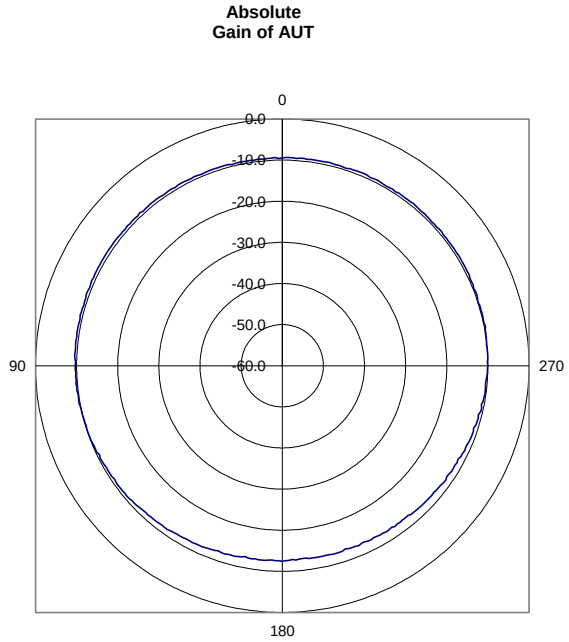
EmiR5 2023.08.29.0 PSA-ESCI 2023.04.25.0

Work Order:	CAIN0005	**Date:**	2023-12-29		
Project:	None	**Temperature:**	23°C		
Job Site:	EV01	**Humidity:**	36%		
Serial Number:	1000009H	**Barometric Pres.:**	1009 mbar	**Tested by:**	Jeff Alcoke
EUT:	M400				
Configuration:	CAIN0005-8				
Customer:	Cardiac Insight, Inc				
Attendees:	Rick Myers				
EUT Power:	Battery				
Operating Mode:	CW: 2480 MHz				
Deviations:	None				
Comments:	Conducted AUT sample serial number = 1000009K				

Frequency	**2480**	Absolute Gain of Reference Antenna (dBi)	9.64
Measurement Antenna Polarity	**Vertical**	Reference Antenna Relative Gain Max (dBuV/m)	106.81
Antenna Under Test (AUT) Polarity	**Vertical**	AUT Relative Gain Max (dBuV/m)	88.01
Maximum Absolute Gain of AUT (dBi)	**-9.16**	Difference (Reference Antenna - AUT) (dB)	18.80
Average Absolute Gain of AUT (dBi)	**-10.45**	AUT Setup Loss (dB)	**0**
		Correction Factor (Convert Relative to Absolute Gain) (dB)	**97.17**
3 dB Beamwidth	**297°**		
		Reference Antenna Measured Input Power (dBm)	1.50
		EUT Conducted Output Power (dBm)	1.50
		Power Delta (Antenna Power-Output Power) (dB)	0.00

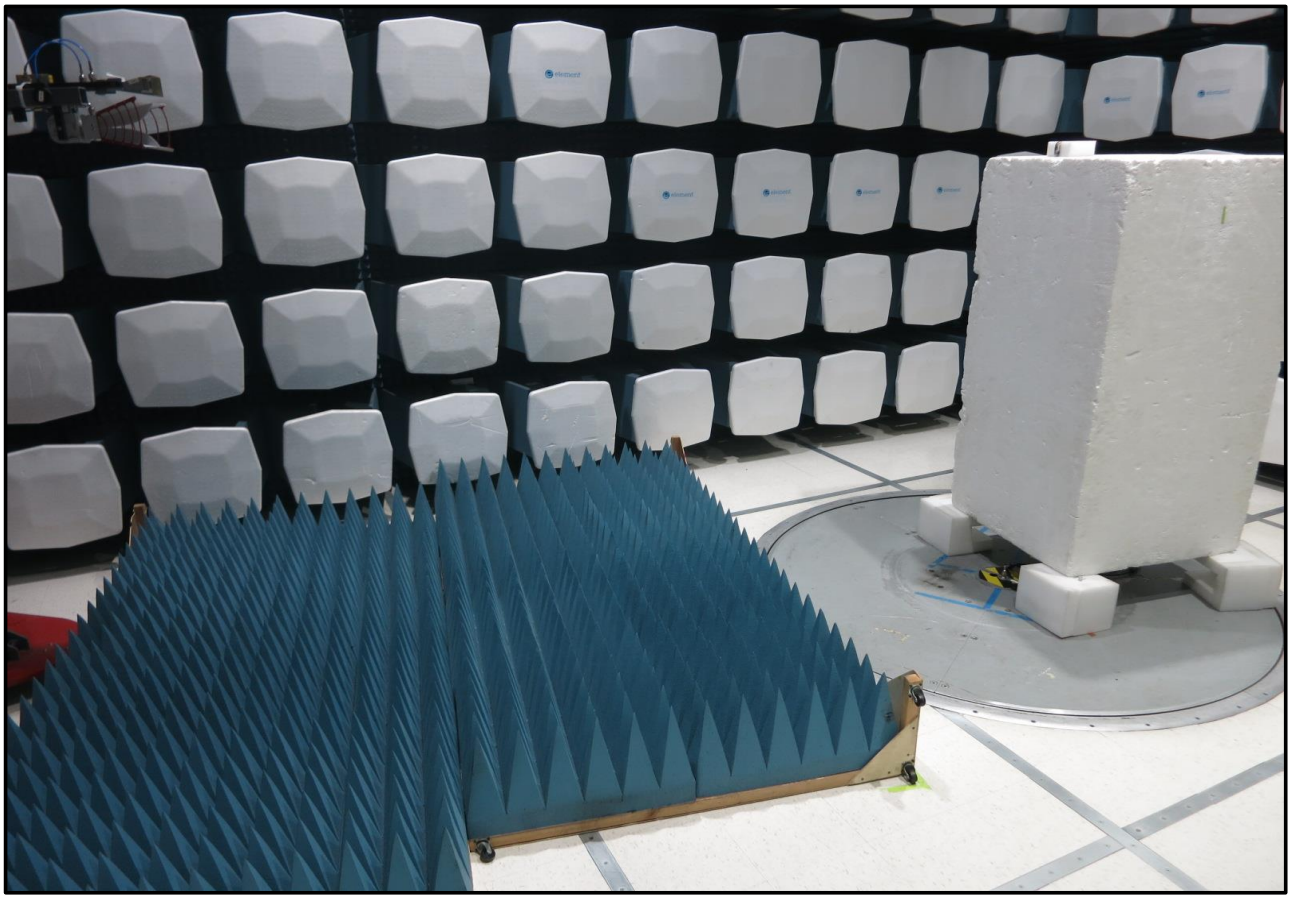
Run #		**Test Distance (m)**		**Antenna Height(s)**		**Results**	NA





2D ANTENNA PATTERN MEASUREMENTS

PSA-ESCI 2023.04.25.0



End of Test Report