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Antenna Measurement Report

CR Mining

Copper Antenna V4.2 GET Sensor Antenna

REPORT: E2301-1621A Rev1
DATE: April, 2023

Antenna Measurement Report

EMC Bayswater Report: E2301-1621A Rev1
Issue Date: April, 2023

Product:	GET Sensor Antenna
Make:	CR Mining
Model No:	Copper Antenna V4.2

Customer Details:

Mr Julien Lopez
CR Mining
3/271 Treasure Road North
Welshpool
WA 6106

Phone No: +61 0466184116
e-mail: Julien.Lopez@crmining.com

Results Summary: Maximum Antenna Gain (903MHz to 927MHz) -8.5 dBi

Test Date(s): 24th January, 2023

Test House (Issued By)

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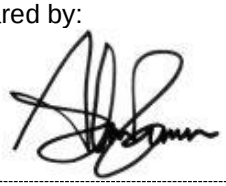
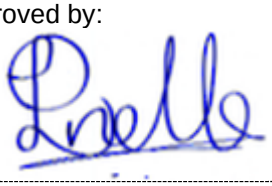
Prepared by: Approved by:





28/04/2023 11:07 AM

Adnan Zaman
(EMC Test Engineer)

Neville Liyanapatabendige
(Manager)

Date

Antenna Measurement Report
for
CR Mining

Contents

1. Introduction

Antenna gain and Radiation Pattern measurements were made for CR Mining on a GET Sensor Antenna.

2. Test Report Revision History

ISSUE	DATE	Description	AUTHORISED BY
E2301-1621A	06-02-2023	Original	Neville Liyanapatabendige (Manager)
E2301-1621A Rev 1	28-04-2023	Company name updated.	Neville Liyanapatabendige (Manager)

3. Product Sample, Configuration & Modifications

3.1. Product Sample Details

Product:	GET Sensor Antenna
Make:	CR Mining
Model No:	Copper Antenna V4.2
Sample No:	1

(Refer to photographs in Appendix B for views of the antenna)

3.2. Configuration

Radiation pattern measurements were performed in 5 degrees increments for X, Y and Z AUT orientation with vertical and horizontal receive antenna polarisation.

The Antenna Under Test (AUT) was connected to a signal generator.

3.3. Modifications

EMC Bayswater Pty Ltd did not modify the antennas.

4. Test Facility & Equipment

4.1. Test Facility

Measurements were made in a semi-anechoic chamber (indoor Open Area Test Site) at EMC Bayswater Pty Ltd, located at Unit 18, 88 Merrindale Drive, Croydon South, Victoria, Australia.

4.2. Test Equipment

Refer to Appendix A for the measurement instrument list.

5. Antenna Gain

5.1. Test Procedure

The test was performed in the indoor Open Area Test Site (iOATS) facility, which is a CISPR 16-1-4 compliant semi-anechoic chamber with ground plane. An area of 3m x 3.6m was covered between the measurement antenna and the AUT using RF absorbing material with a rated attenuation more than 20dB over the frequency range to minimise ground plane reflection.

The AUT was positioned on a non-conductive support at a height of 1.5m above the ground reference plane. The AUT was connected to a signal generator. The measuring antenna was located at a distance of 3m from the AUT. For both horizontal and vertical antenna polarizations, the peak detector was set to MAX-HOLD and the range selected continuously scanned as the antenna height was varied from 1 to 4 metres and the turntable slowly rotated. The EUT was orientated in each of the X, Y and Z-axis, in-turn, to find the worst case emissions. The maximum emissions were recorded.

The substitution method was used to determine the true EIRP. The highest level at the input of the substitution for the polarity of the antenna was then used to calculate the true EIRP.

The AUT was connected to a directional coupler. The input of the directional coupler was connected to a signal generator. The forward and reverse power to the antenna was measured with the power sensor and transmit power and antenna connector was calculated.

(Refer to photographs 1 to 5 in Appendix B for views of the test configuration)

5.2. Results

The maximum antenna gain measurements are detailed as follows:

Antenna Orientation	Frequency (MHz)	Maximum Antenna Gain (dBi)	Average Antenna Gain (dBi)[#1]	Measurement Antenna (Receive) Polarisation
X	903	**-8.5***	-9.8	Vertical
	916	-10.6	-12.4	
	927	-9.1	-11.8	
Y	903	-12.3	-19.7	Horizontal
	916	-12.0	-19.5	
	927	-10.9	-18.7	
Z	903	-12.9	-19.0	Horizontal
	916	-12.7	-19.2	
	927	-11.8	-18.8	

**Maximum gain*

[#1]Calculated from Antenna Radiation pattern measurement (normalised to the maximum antenna gain)

Table 1: Antenna Gain

The measurement uncertainty was calculated as follows:

Measurement method	Calculated measurement uncertainty
Conducted Method	±1.4dB
Radiated Method	±1.87dB (full substitution)
	±4.83dB (pre-scan)

The reported uncertainty is an expanded uncertainty calculated using a coverage factor of *k=2* which gives a level of confidence of approximately 95%.

Climatic Conditions	
Temperature:	24°C
Humidity:	46%
Atmospheric pressure:	1011 hPa

Table 2: Climatic conditions

6. Antenna Radiation Pattern

6.1. Test Procedure

In a semi-anechoic chamber (indoor Open Area Test Site), the AUT was placed on a non-conductive support at a height of 1.5m above the GRP (Ground Reference Plane), on a computer-controlled turntable. The measurement antenna was mounted on a computer-controlled mast and at a height of 1.5m above the GRP and at a distance of 3m from the AUT. The measurement antenna was a Bilog antenna and was vertically and horizontally polarised. The area on the ground reference plane, between the AUT and measurement antenna, was covered with pyramidal absorbers to minimise ground reflections (near free-space conditions).

The AUT input cable was connected a signal generator. The receive antenna output cable was connected to a spectrum analyser, external to the chamber.

The turntable and antenna mast were connected to a controller via optical fibre links.

The turntable was set to 0° and the measurement antenna mast to a height of 1.5m. The frequency of interest and the signal strength at the measurement antenna was measured on the spectrum analyser and recorded. The turntable was rotated through 360° at increments of 5° and the received signal strength recorded at each step.

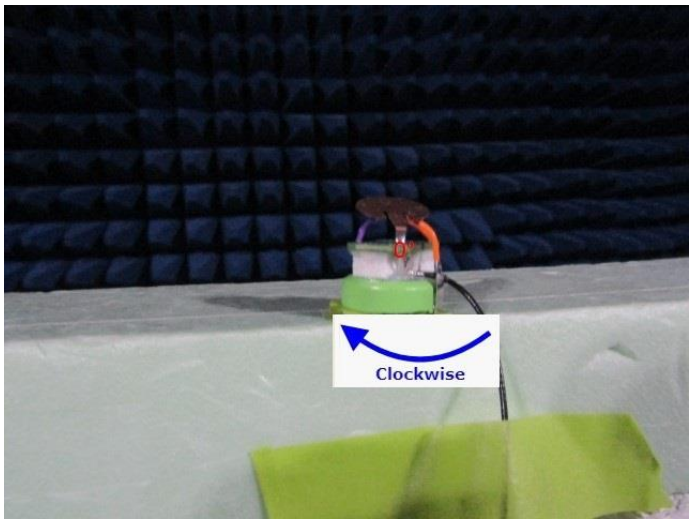
Correction factors of the receive antenna, cables, pathloss and attenuator were added to the measured signal strength (raw measurements) to find the absolute radiation pattern.

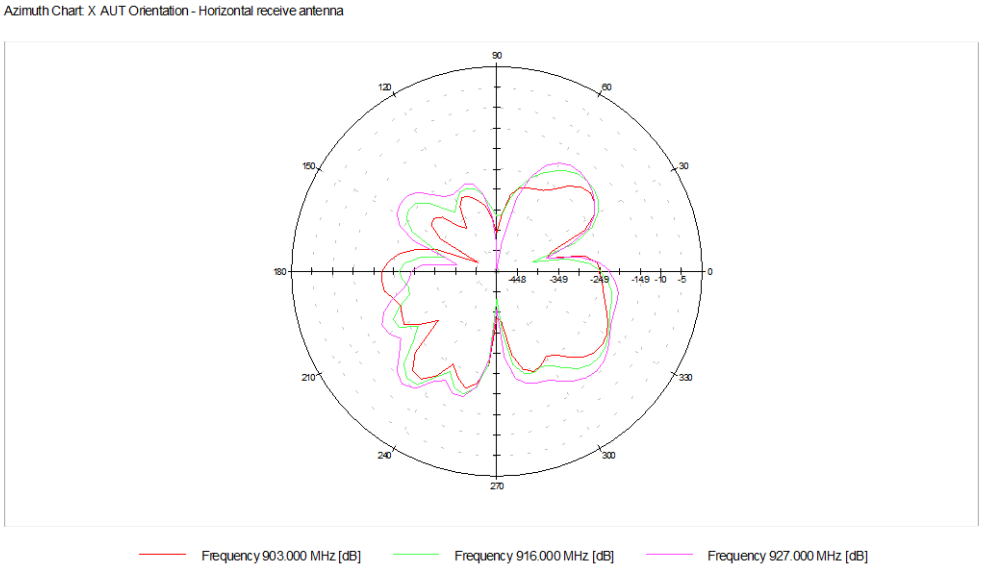
(Refer to Photographs 1 to 5 in Appendix B for views of the test configuration)

6.2. Test Results

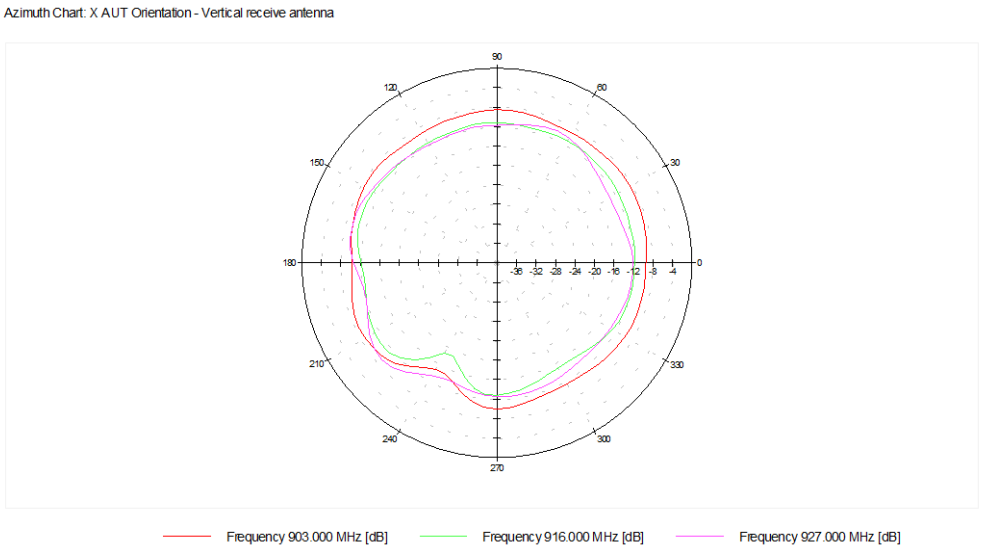
The best-case Antenna Radiation Pattern Measurements are detailed below:

6.2.1. X AUT Orientation (Azimuth X-Y Plane)



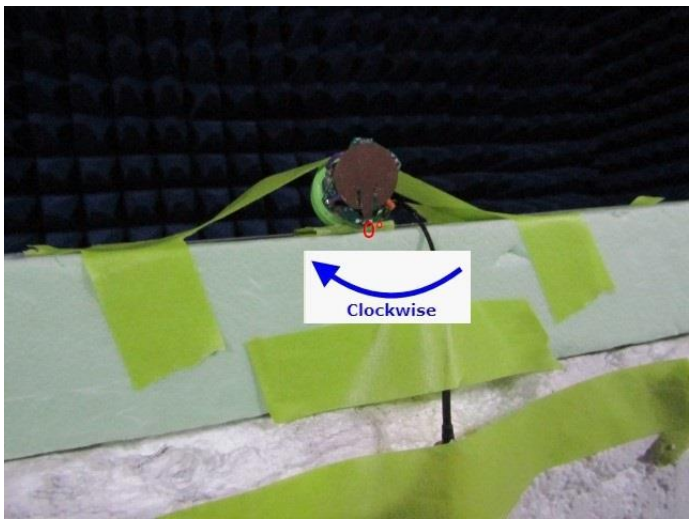


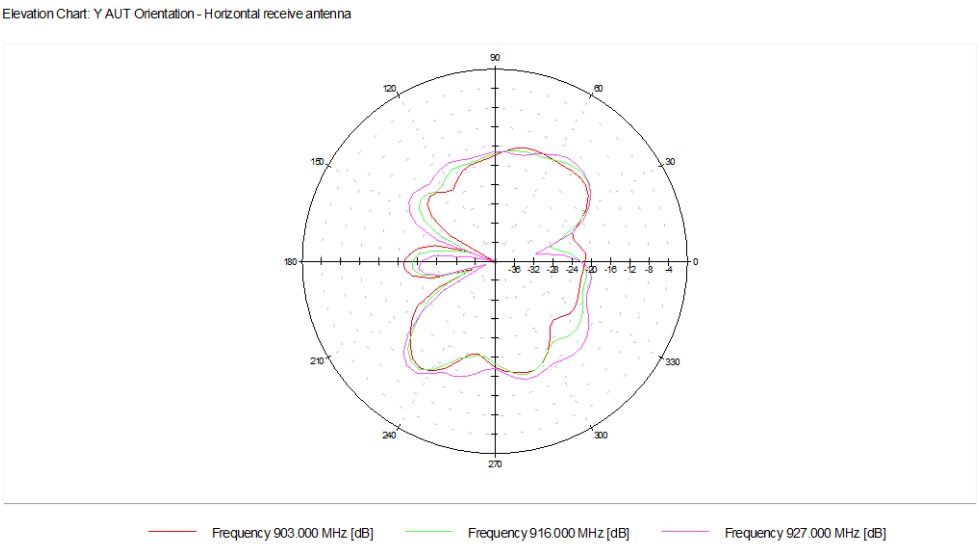
Graph 1: Radiation Pattern - X AUT Orientation – Horizontal receive antenna.



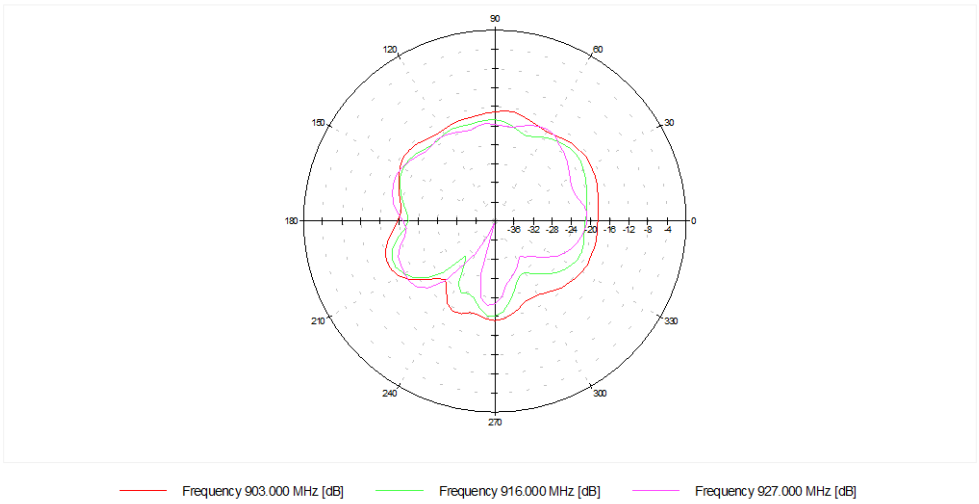
Graph 2: Radiation Pattern - X AUT Orientation – Vertical receive antenna.

6.2.2. Y AUT Orientation (Elevation X-Z Plane)



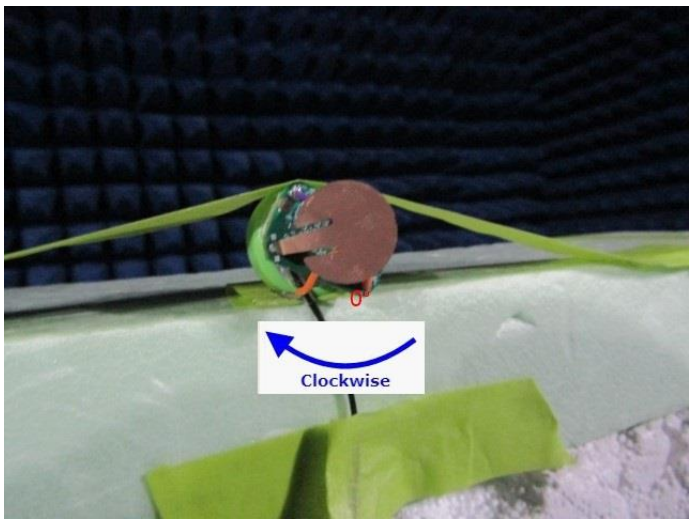


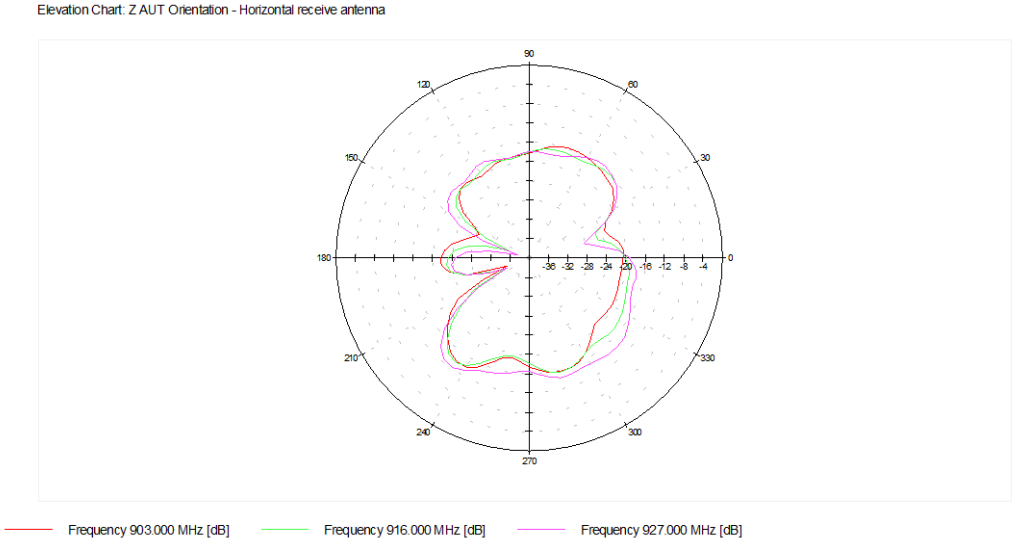
Graph 3: Radiation Pattern - Y AUT Orientation – Horizontal receive antenna.



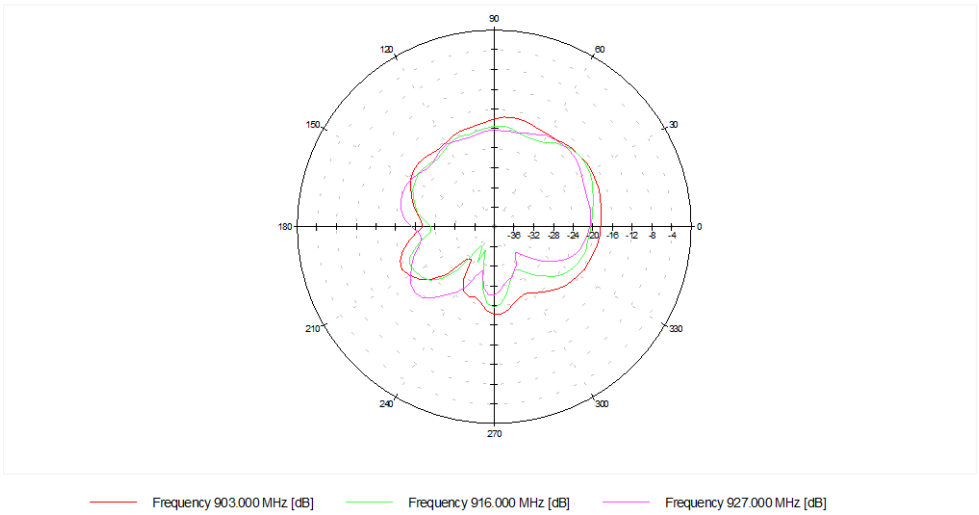
Graph 4: Radiation Pattern - Y AUT Orientation – Vertical receive antenna.

6.2.3. Z AUT Orientation (Elevation Y-Z Plane)





Graph 5: Radiation Pattern - Z AUT Orientation – Horizontal receive antenna.



Graph 6: Radiation Pattern - Z AUT Orientation – Vertical receive antenna.

The measurement uncertainty was calculated at ±3.25dB. The reported uncertainty is an expanded uncertainty calculated using a coverage factor of *k=2* which gives a level of confidence of approximately 95%.

Climatic Conditions	
Temperature:	24°C
Humidity:	46%
Atmospheric pressure:	1011 hPa

Table 3: Climatic conditions

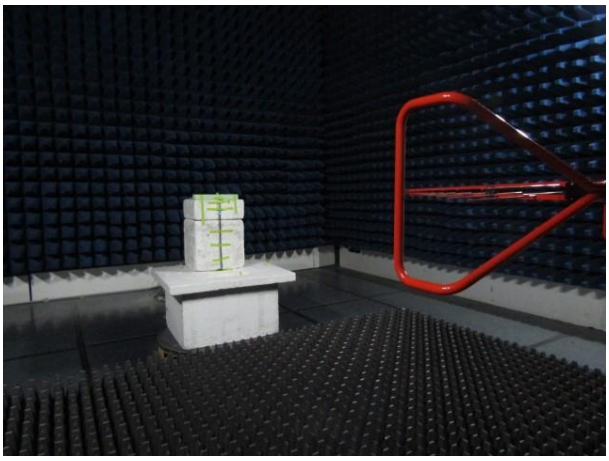
Appendix A – Test Equipment

Inv	Equipment	Make	Model No	Serial No	Calibration	
					Due Date	Type
1217	ANALYSER, EMI Receiver	Rohde & Schwarz	ESU40	100182	Jun-23	E
0932	CONTROLLER, Position	Sunol Sciences	SC104V-3	081006-1	N/A	V
0933	TURNTABLE	Sunol Sciences	SM46C	081006-2	N/A	V
0934	MAST, Antenna	Sunol Sciences	TLT2	081006-5	N/A	V
1276	GENERATOR, Signal, RF	Keysight Technologies Inc	N5183A	MY50140891	Mar-23	I
0836	ATTENUATOR, 6dB	JFW	50HF-006N	-	Dec-24	I
1280	CABLE, Coax, Sucoflex 126 E	Huber+ Suhner	2845494	517941/126EA	Sep-23	I
1287	RF Power meter Sensor, USB	Rohde & Schwarz	NRP6A	104228	Nov-23	V
0666	ENCLOSURE, Semi-Anechoic, No 1	RFI Industries	S800 iOATS	1229	Aug-25	I
1155	HYGROMETER, Temp, Humidity	DigiTech	QM7312	-	Jul-23	I

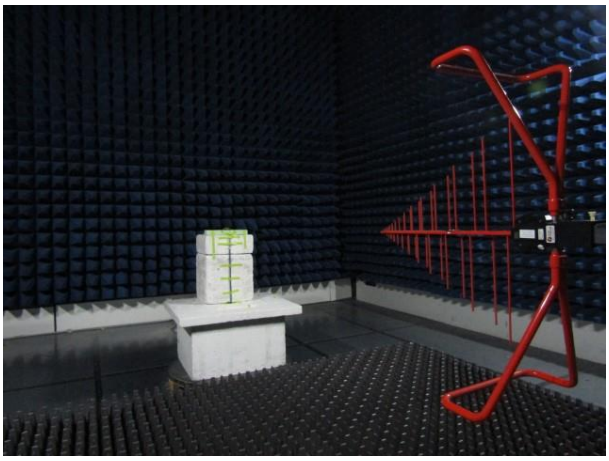
V: Verification of operation against an internal reference
I: Internal calibration against a traceable standard
E: External calibration by a NATA or MRA equivalent endorsed facility
N/A: Not Applicable

Appendix B – Photographs

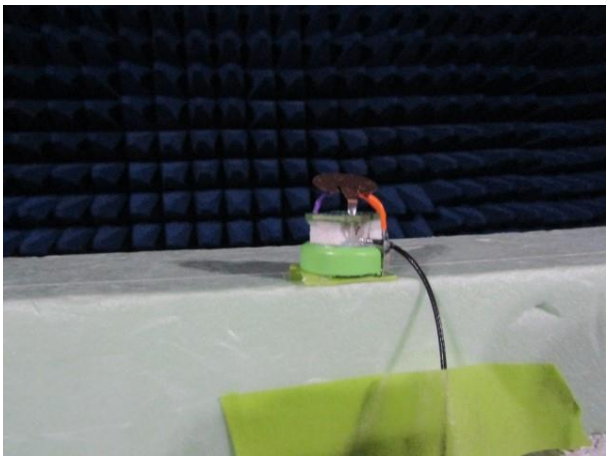
Number	Photograph Description
1	Radiation Pattern, Antenna Gain – Measurement Configuration – Horizontal Receive Antenna
2	Radiation Pattern, Antenna Gain – Measurement Configuration – Vertical Receive Antenna
3	Radiation Pattern – Measurement Configuration – 0° angle (Facing receive antenna) – X AUT Orientation
4	Radiation Pattern – Measurement Configuration – 0° angle (Facing receive antenna) – Y AUT Orientation
5	Radiation Pattern – Measurement Configuration – 0° angle (Facing receive antenna) – Z AUT Orientation
6	Views of AUT
7	
8	



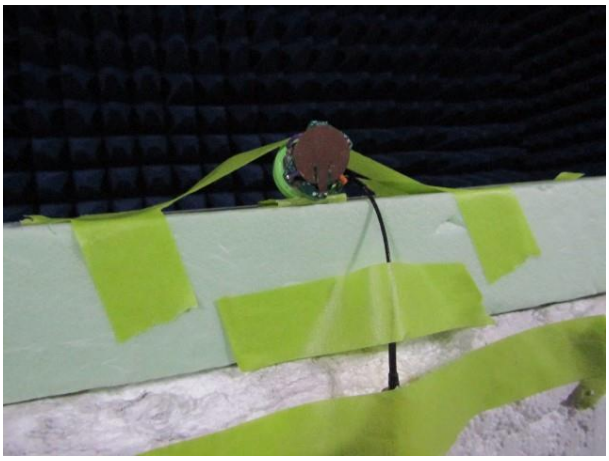
Photograph 1



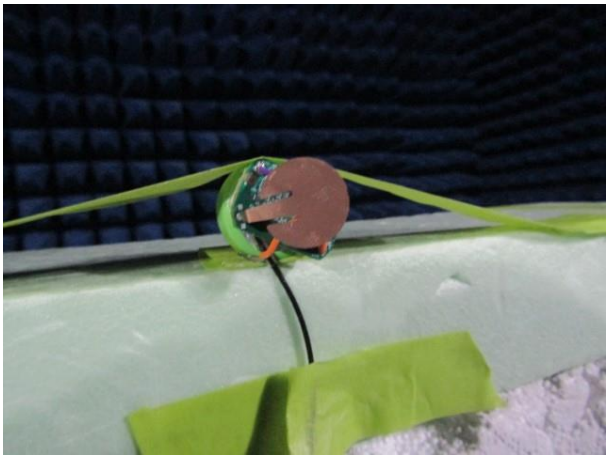
Photograph 2



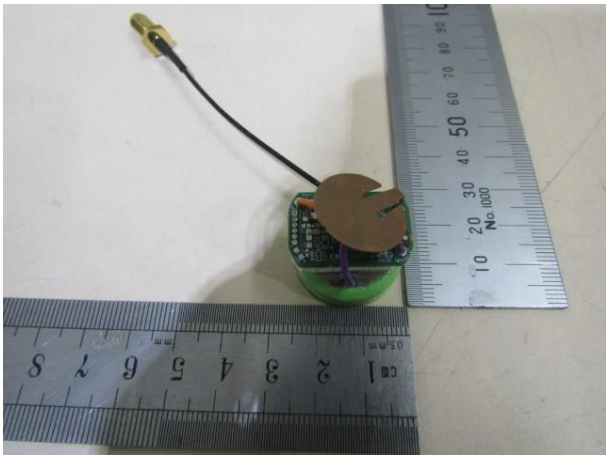
Photograph 3



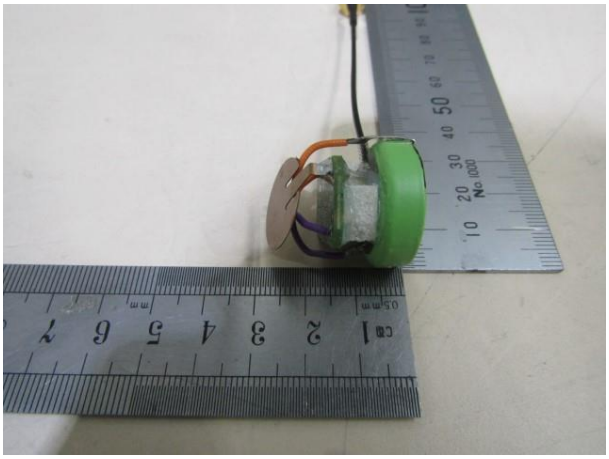
Photograph 4



Photograph 5



Photograph 6



Photograph 7

Photograph 8