



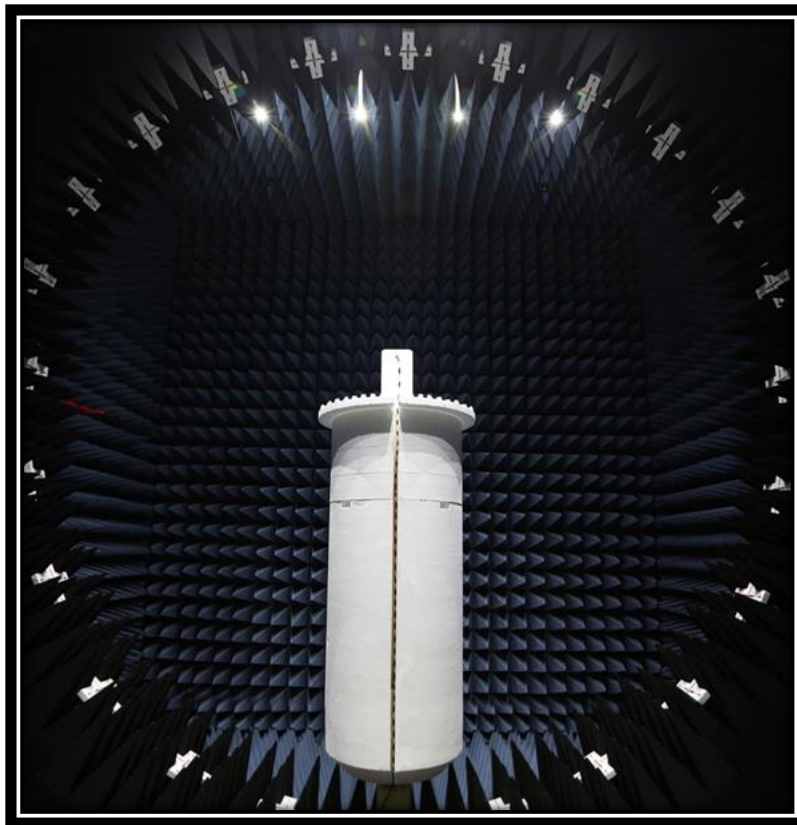
# element

**Ademco, Inc.**

**Fuji Thermostat**

**Antenna Pattern Measurements**

**Report: ADEM0044.0 Rev. 0, Issue Date: August 24, 2024**



Approved by:

*Trevor Buls*  
Trevor Buls, Principal EMC Test Engineer  
Signed for and on behalf of Element

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# REVISION HISTORY



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

# ACCREDITATIONS AND AUTHORIZATIONS



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## 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.

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## 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.

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## European Union

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

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## United Kingdom

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

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## Australia/New Zealand

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

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## Korea

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

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## Japan

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

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## 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.

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## Singapore

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

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## Israel

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

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## Hong Kong

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

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## Vietnam

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

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## SCOPE

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

[California](#)

[Minnesota](#)

[Oregon](#)

[Texas](#)

[Washington](#)

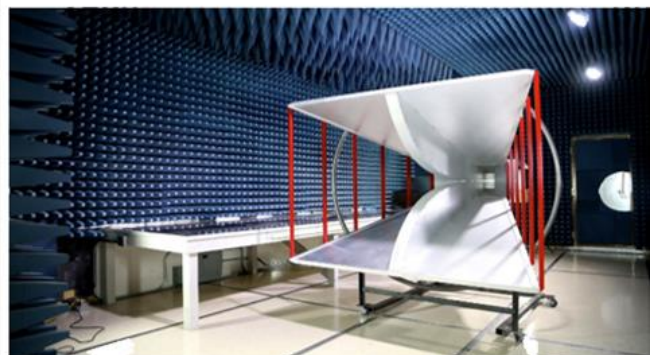
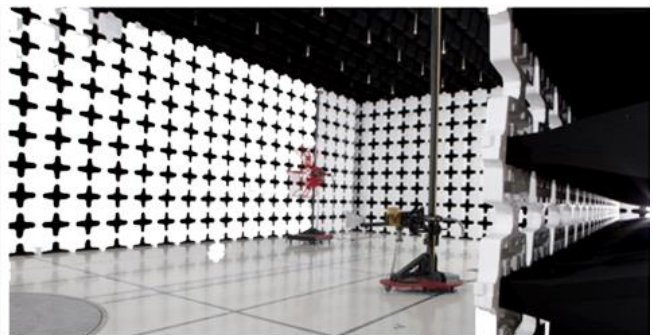
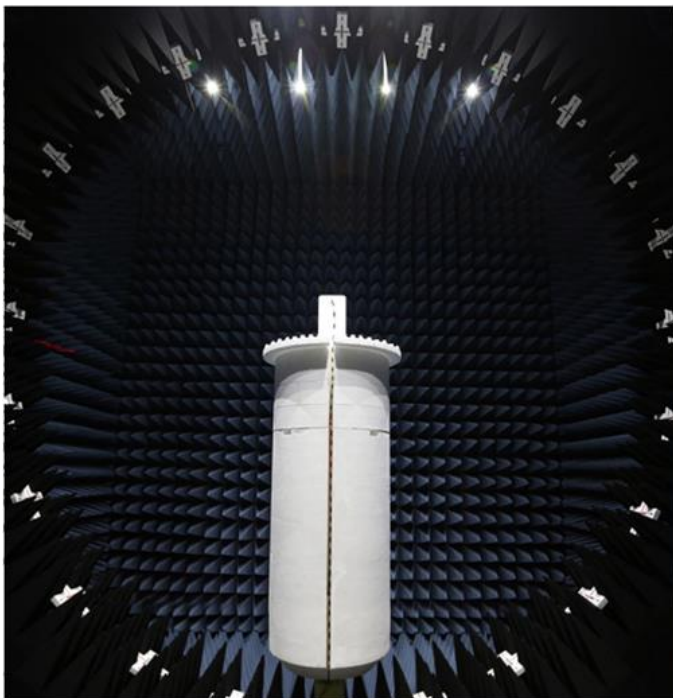
# FACILITIES

Testing was performed at the following location(s)

Location	Labs <sup>(1)</sup>	Address	A2LA <sup>(2)</sup>	ISED <sup>(3)</sup>	BSMI <sup>(4)</sup>	VCCI <sup>(5)</sup>	CAB <sup>(6)</sup>	FDA <sup>(7)</sup>
<input type="checkbox"/> California	OC01-17	41 Tesla Irvine, CA 92618 (949) 861-8918	3310.04	2834B	SL2-IN-E-1154R	A-0029	US0158	TL-55
<input checked="" type="checkbox"/> 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
<input type="checkbox"/> 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
<input type="checkbox"/> Plano Texas	PT01-15	1701 E Plano Pkwy, Ste 150 Plano, TX 75074 (972) 509-2566	214.19	32637	SL2-IN-E-057R	N/A	US0054	N/A
<input type="checkbox"/> Texas	TX01-09	3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	3310.03	2834G	SL2-IN-E-1158R	N/A	US0191	TL-54
<input type="checkbox"/> 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
<input type="checkbox"/> 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

<b>Company Name:</b>	Ademco, Inc.
<b>Address:</b>	251 Little Falls Drive
<b>City, State, Zip:</b>	Wilmington, DE 19808
<b>Test Requested By:</b>	Christian Fouth
<b>EUT:</b>	Fuji Thermostat
<b>First Date of Test:</b>	July 18, 2024
<b>Last Date of Test:</b>	July 18, 2024
<b>Receipt Date of Samples:</b>	July 18, 2024
<b>Equipment Design Stage:</b>	Prototype
<b>Equipment Condition:</b>	No Damage
<b>Purchase Authorization:</b>	Verified

## Information Provided by the Party Requesting the Test

### Functional Description of the EUT:

Fuji is a Wi-Fi (802.11 a/b/g/n 1x1, 2.4GHz & 5GHz )/BLE 5.0 enabled thermostat with only one antenna.

### Testing Objective:

To obtain 3D antenna pattern measurements and calculated antenna performance values (gain, efficiency, TRP, etc)

# CONFIGURATIONS



## Configuration ADEM0044-4

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
Thermostat	Resideo	TH2320WF4010	52202030005061

# MODIFICATIONS



## Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2024-07-18	Passive 3D Antenna Pattern Measurements	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.



# OTA TEST DESCRIPTION



OTA 2018.01.04

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.

## TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval
Analyzer - Network Analyzer	Agilent	E5071C	NAM	11/19/2022	36 mo
Chamber - OTA	ETS Lindgren	AMS-8923-195	OTA	5/15/2024	36 mo
Antenna - Dipole	ETS Lindgren	3126-5500	OTL	2/16/2023	36 mo
Antenna - Dipole	ETS Lindgren	3126-2450	OTF2	4/18/2024	36 mo

## TEST DESCRIPTION

The test begins with a measurement path configured (via ETS-Lindgren EMQuest Data Acquisition and Analysis Software) such that an electrical path is present from the Theta polarization element of the -165° detector antenna, to port 2 of the VNA. The VNA drives the EUT through the desired frequency range at the desired IFBW and an insertion loss measurement is obtained. The measurement path is then reconfigured (again via EMQuest) such that an electrical path is present from the Phi polarization element of the -165° detector antenna, to port 2 of the VNA. The VNA drives the EUT through the desired frequency range at the desired IFBW and an insertion loss measurement is obtained. This process is repeated at each of the 23 detector antennas in turn. This process is repeated for every rotation of the Phi Axis Positioner up to 180° - Phi Axis Resolution. When this process is complete, EMQuest applies factors from a Range Calibration and Normalization to produce a final data set with 1D/2D/3D patterns and tabular values such as antenna efficiency, Equivalent Isotropic Radiated Power (EIRP), Total Radiated Power (TRP), etc.

A measurement uncertainty estimation has been performed for this testing. When a measurement is made, the result will be different from the true or theoretically correct value. The difference is the result of tolerances in the measurement system that cannot be completely eliminated. To the extent that technology allows us, it has been our aim to minimize this error. Measurement uncertainty is a statistical expression of measurement error qualified by a probability distribution. The expanded measurement uncertainty, 95% confidence level (K=2), for Maximum Gain / Efficiency for 2400-2483.5 MHz on active measurements is +/-1.08 dB. The expanded measurement uncertainty, 95% confidence level (K=2), for Maximum Gain / Efficiency for 2400-2483.5 MHz on passive measurements is +/-1.29. The calculations for estimating measurement uncertainty are available upon request.

Procedures for the Range Calibration and Normalization can be found in Element Materials Technology document: WP Antenna Pattern Measurements (3D)

# PASSIVE 3D ANTENNA PATTERN MEASUREMENTS



EUT:	Fuji Thermostat
Serial Number:	52202030005061
Customer:	Ademco, Inc.
Attendees:	None
Customer Project:	None
Tested By:	Christopher Heintzelman
Test Run Description:	Passive_1

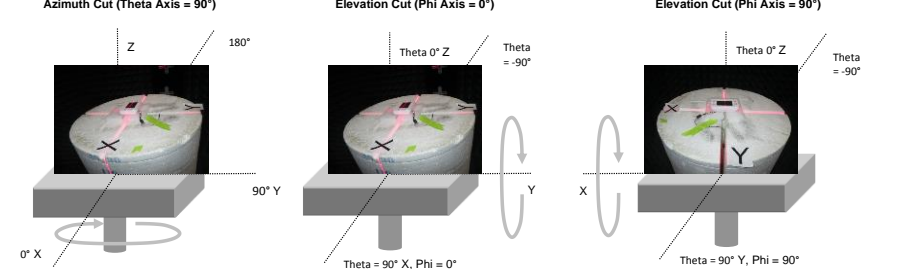
Work Order:	ADEM0044
Date:	7/18/2024
Temperature:	21.8 °C
Relative Humidity:	49.9% RH
Bar. Pressure:	1024 mbar
Job Site:	MN10

OTA 2018.01.04

## COMMENTS

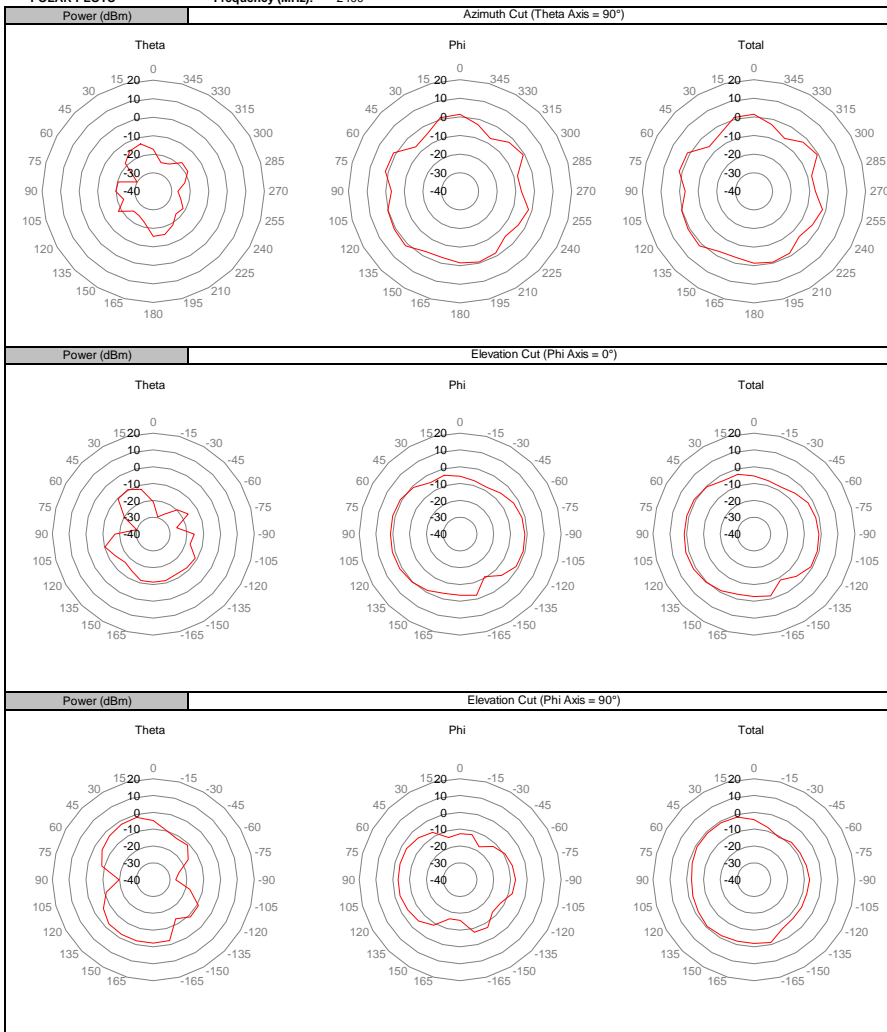
Configuration 4

3D PATTERN DATA											
Frequency (MHz)	2400	2410	2420	2430	2440	2450	2460	2470	2480	2482	2486
Ant. Port Input Pwr. (dBm)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tot. Rad. Pwr. (dBm)	-1.44	-1.49	-1.50	-1.53	-1.53	-1.61	-1.71	-1.92	-2.08	-2.08	-2.05
Peak EIRP (dBm)	2.43	2.38	2.24	2.19	2.17	1.98	1.72	1.42	1.51	1.55	1.67
Directivity (dB)	3.87	3.87	3.74	3.72	3.69	3.60	3.43	3.34	3.59	3.64	3.72
Efficiency (dB)	-1.44	-1.49	-1.50	-1.53	-1.53	-1.61	-1.71	-1.92	-2.08	-2.08	-2.05
Efficiency (%)	71.70	70.94	70.75	70.30	70.36	68.96	67.46	64.34	61.92	61.90	62.34
Gain (dB)	2.43	2.38	2.24	2.19	2.17	1.98	1.72	1.42	1.51	1.55	1.67
Average Gain (dB)	-1.44	-1.49	-1.50	-1.53	-1.53	-1.61	-1.71	-1.92	-2.08	-2.08	-2.05
E-Plane 3 dB BW (°)	82.00	81.00	81.00	95.00	96.00	97.00	98.00	52.00	54.00	54.00	54.00



## POLAR PLOTS

Frequency (MHz): 2400



# PASSIVE 3D ANTENNA PATTERN MEASUREMENTS



OTA 2018.01.04

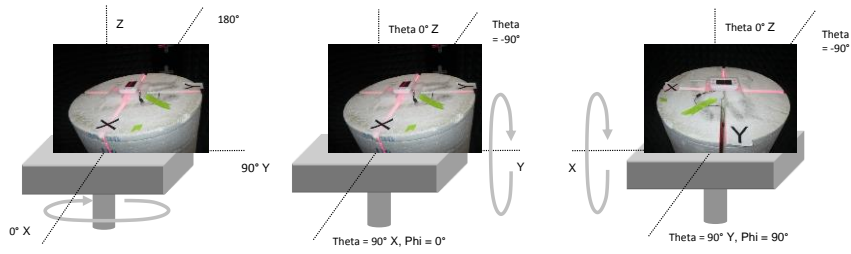
EUT:	Fuji Thermostat
Serial Number:	52202030005061
Customer:	Ademco, Inc.
Attendees:	None
Customer Project:	None
Tested By:	Christopher Heintzelman
Test Run Description:	Passive_2

Work Order:	ADEM0044
Date:	7/18/2024
Temperature:	21.8 °C
Relative Humidity:	49.9% RH
Bar. Pressure:	1024 mbar
Job Site:	MN10

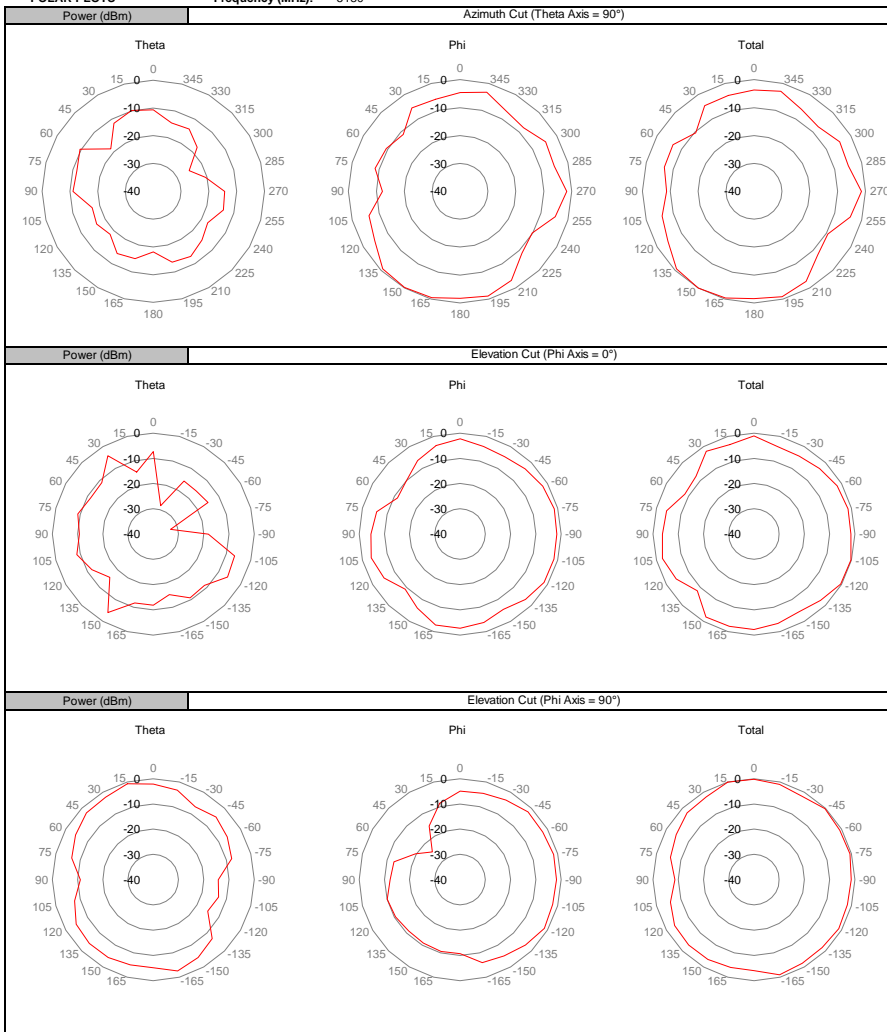
## COMMENTS

Configuration 4

3D PATTERN DATA										
Frequency (MHz)	5180	5240	5260	5320	5500	5600	5700	5745	5785	5825
Ant. Port Input Pwr. (dBm)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tot. Rad. Pwr. (dBm)	-3.08	-3.06	-2.86	-2.70	-2.48	-2.34	-2.23	-2.27	-2.51	-2.44
Peak EIRP (dBm)	1.31	1.75	1.67	1.84	1.44	1.82	2.22	1.99	1.87	2.15
Directivity (dB)	4.39	4.81	4.53	4.55	3.92	4.16	4.45	4.26	4.38	4.60
Efficiency (dB)	-3.08	-3.06	-2.86	-2.70	-2.48	-2.34	-2.23	-2.27	-2.51	-2.44
Efficiency (%)	49.24	49.46	51.76	53.68	56.48	58.36	59.86	59.28	56.13	56.97
Gain (dB)	1.31	1.75	1.67	1.84	1.44	1.82	2.22	1.99	1.87	2.15
Average Gain (dB)	-3.08	-3.06	-2.86	-2.70	-2.48	-2.34	-2.23	-2.27	-2.51	-2.44
E-Plane 3 dB BW (°)	83.00	62.00	80.00	61.00	99.00	83.00	78.00	78.00	76.00	75.00



POLAR PLOTS Frequency (MHz): 5180



End of Test Report