



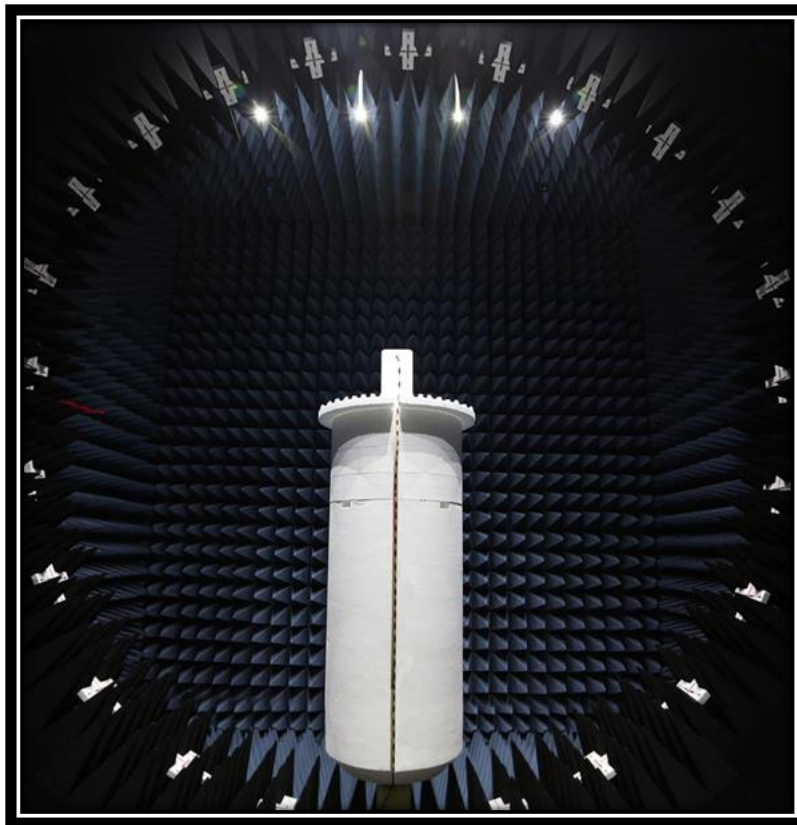
# element

**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<br>(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](#)

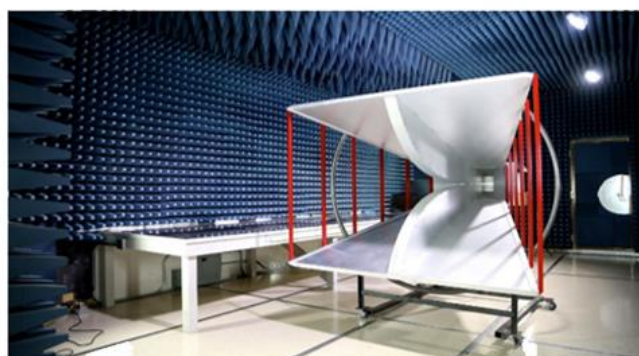
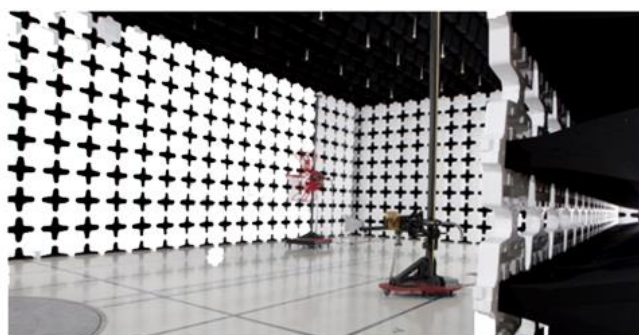
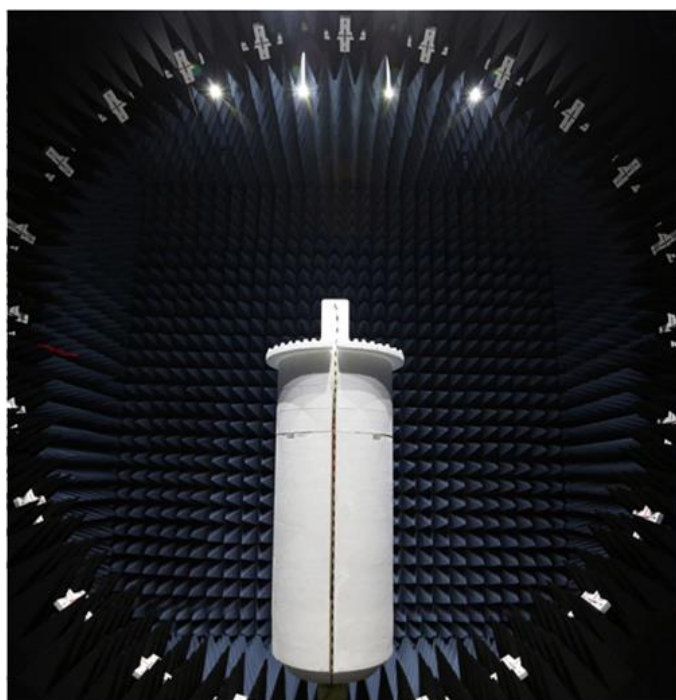
# FACILITIES

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<br>Irvine, CA 92618<br>(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.<br>Brooklyn Park, MN 55445<br>(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<br>Hillsboro, OR 97124<br>(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<br>Plano, TX 75074<br>(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<br>Plano, TX 75074<br>(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<br>Bothell, WA 98011<br>(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

|                                                                                                                  |
|------------------------------------------------------------------------------------------------------------------|
| <b>Functional Description of the EUT:</b>                                                                        |
| Fuji is a Wi-Fi (802.11 a/b/g/n 1x1, 2.4GHz & 5GHz )/BLE 5.0 enabled thermostat with only one antenna.           |
| <b>Testing Objective:</b>                                                                                        |
| 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

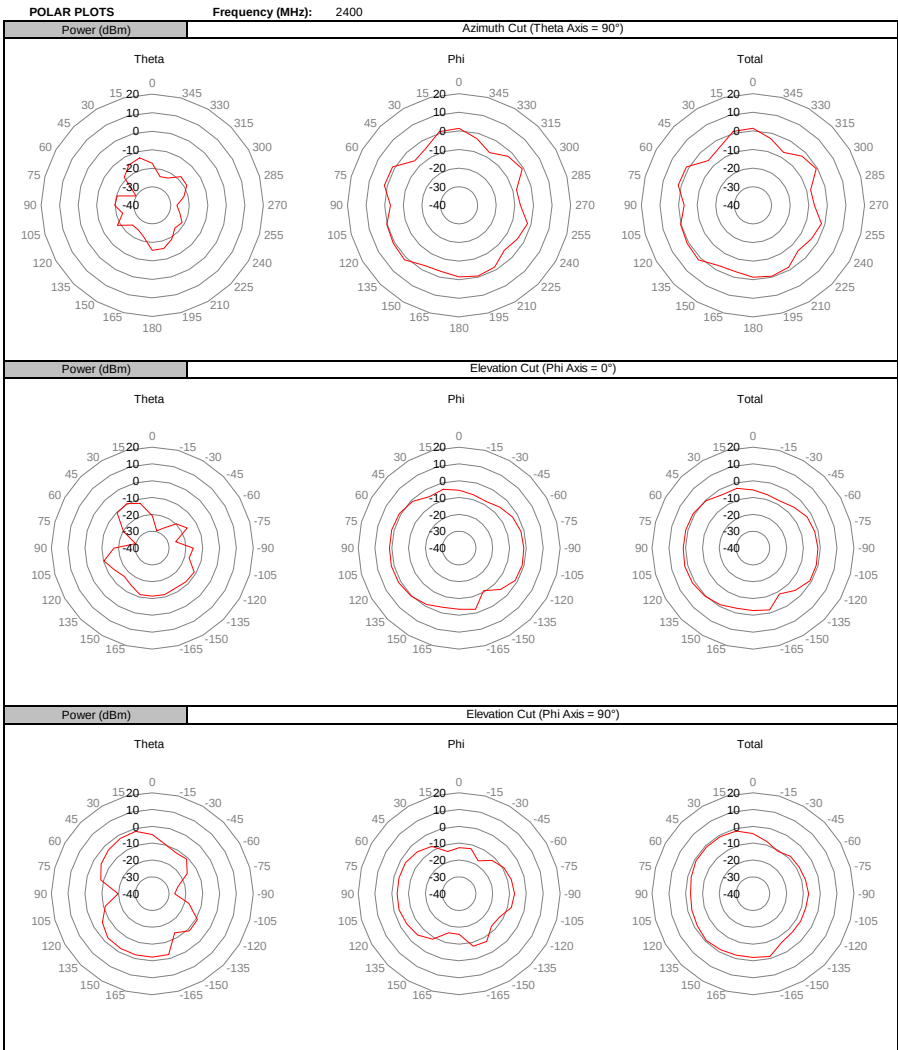
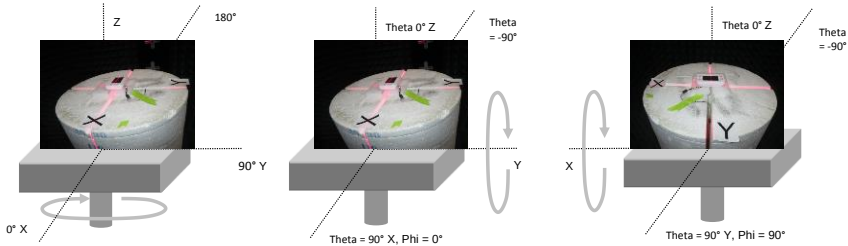


|                       |                         |
|-----------------------|-------------------------|
| EUT:                  | Fuji Thermostat         |
| Serial Number:        | 52202030005061          |
| Customer:             | Ademco, Inc.            |
| Attendees:            | None                    |
| 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      |

|                 |
|-----------------|
| COMMENTS        |
| Configuration 4 |

|                            |       |       |       |       |       |       |       |       |       |       |       |
|----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 3D PATTERN DATA            | 2400  | 2410  | 2420  | 2430  | 2440  | 2450  | 2460  | 2470  | 2480  | 2482  | 2486  |
| 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 |



PASSIVE 3D ANTENNA PATTERN MEASUREMENTS

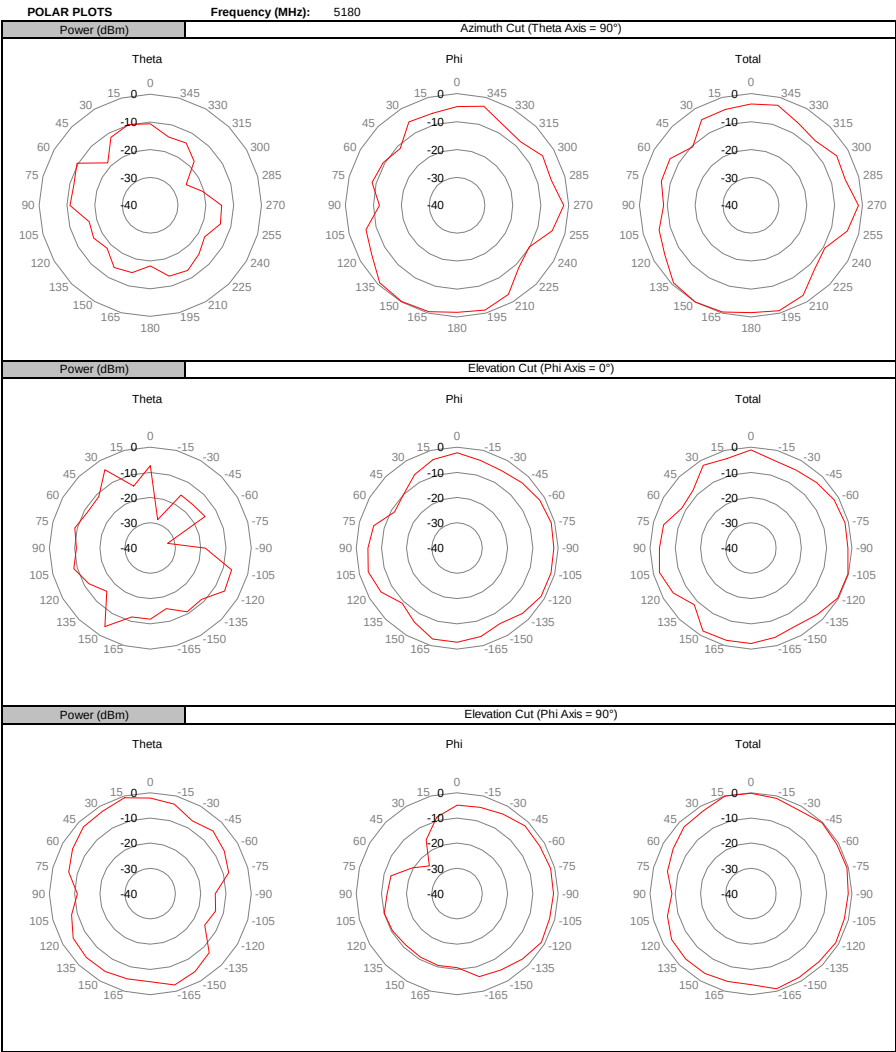
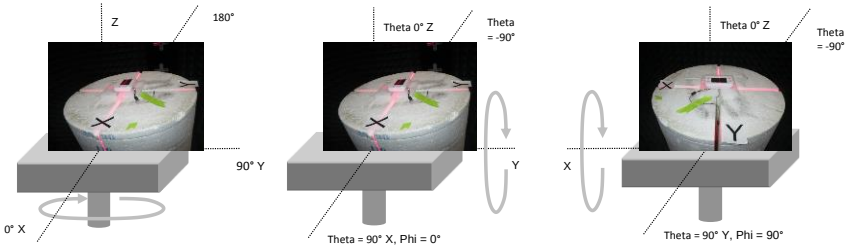


|                       |                         |
|-----------------------|-------------------------|
| EUT:                  | Fuji Thermostat         |
| Serial Number:        | 52202030005061          |
| Customer:             | Ademco, Inc.            |
| Attendees:            | None                    |
| Customer Project:     | None                    |
| Tested By:            | Christopher Heintzelman |
| Test Run Description: | Passive_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            | 5180  | 5240  | 5260  | 5320  | 5500  | 5600  | 5700  | 5745  | 5785  | 5825  |
| 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 (dBi)                 | 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 |



## End of Test Report