



Address all correspondences regarding this report to:

Timothy Milam  
Custom Integrated Antennas  
1322 Butcher Hollow, PO Box 116  
Van Lear, KY 41265  
Tel: (512) 638-2643  
E-mail: [an10a@cia-aa.com](mailto:an10a@cia-aa.com)

Document #: CIA 2020-0017.002

# Custom Integrated Antennas (CIA)

## “Zygo Coach’s Unit Bluetooth Antenna Report”

02/17/2020)

(Reference “Zygo Coach’s Unit VHF Antenna Report CIA 09-  
20-2022” for That Antenna Data Analysis.)

Originally Submitted to Zygo on:

February 17, 2020



# Table of Contents

|            |                                          |          |
|------------|------------------------------------------|----------|
| <b>1</b>   | <b>DUT Description.....</b>              | <b>4</b> |
| <b>1.1</b> | <b>Zygo Coach's Unit .....</b>           | <b>4</b> |
| 1.1.1      | External View .....                      | 4        |
| 1.1.2      | Internal View .....                      | 4        |
| <b>1.2</b> | <b>PIFA Antenna Component.....</b>       | <b>4</b> |
| <b>2</b>   | <b>Test Equipment Used .....</b>         | <b>5</b> |
| <b>3</b>   | <b>Key Antenna Specifications .....</b>  | <b>5</b> |
| <b>4</b>   | <b>Measured Data .....</b>               | <b>6</b> |
| <b>4.1</b> | <b>VSWR.....</b>                         | <b>6</b> |
| <b>4.2</b> | <b>Principal Radiated Patterns .....</b> | <b>6</b> |
| 4.2.1      | Vertically Polarized DUT (V-Pol).....    | 6        |
| 4.2.2      | Horizontally Polarized DUT (H-Pol).....  | 7        |
| <b>4.3</b> | <b>Tabular Data Summary.....</b>         | <b>7</b> |
| <b>5</b>   | <b>Conclusion .....</b>                  | <b>7</b> |



## **Zygo Coach's Unit Bluetooth Antenna Analysis**

Document #: CIA 2020-0017.002

### **Revision History**

| <b>Date of Revision</b> | <b>Revision Comments</b>                                                                                                                                                                                                                                                                                    | <b>Pages Affected</b> |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| 11/07/2019              | Entire Document                                                                                                                                                                                                                                                                                             | All                   |
| 09/20/2022              | Updated title with current information, added the "Key Antenna Specifications" table on page 7, added note on page 8 regarding the DUT name, added the "Peak Gain" details paragraph at the end of the "Conclusions" section on page 9. Also, the "Table of Contents" changed as a result of the additions. | 1, 2, 7, 8, and 9     |
|                         |                                                                                                                                                                                                                                                                                                             |                       |
|                         |                                                                                                                                                                                                                                                                                                             |                       |
|                         |                                                                                                                                                                                                                                                                                                             |                       |
|                         |                                                                                                                                                                                                                                                                                                             |                       |
|                         |                                                                                                                                                                                                                                                                                                             |                       |
|                         |                                                                                                                                                                                                                                                                                                             |                       |

**Zygo Coach's Unit Bluetooth Antenna Report (CIA 02/17/2020)**

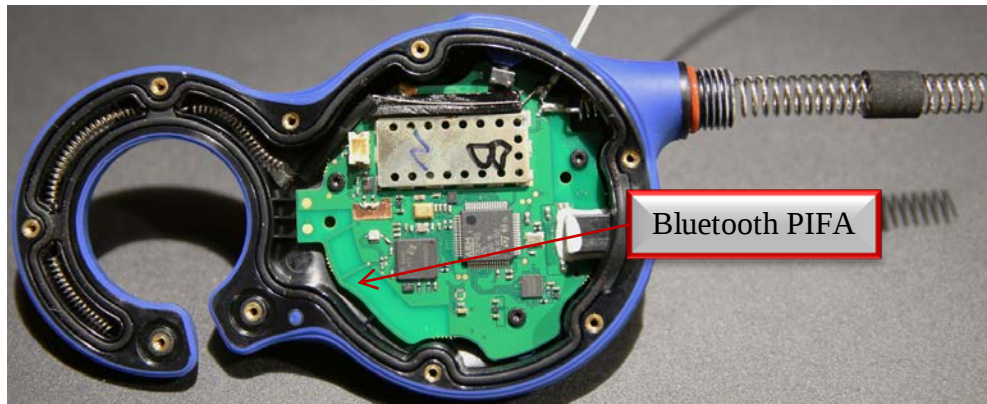
**1 DUT Description**

**1.1 Zygo Coach's Unit**

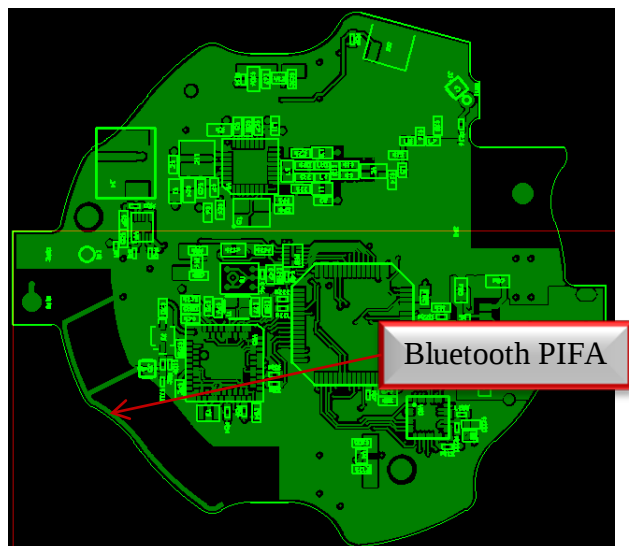
**1.1.1 External View**



**1.1.2 Internal View**



**1.2 PIFA Antenna Component**



### 2 Test Equipment Used

- Test Range = 13 ft. x 9 ft. x 9 ft. Rectangular Anechoic Chamber with Cummings Microwave C-RAM SFC-18 in. pyrimidal absorber total coverage, except for 72 inches of SFC-18 Walkway and full corner treatment with 3 in. C-RAM Cornerblock. The DUT / Test antenna seperation was 46 inches.
- Test (Site Source) Antenna = RFSpin Model QRH11, 700 MHz – 11 GHz Quadridge Horn, S/N: 200721Q11
- Vector Network Analyzer “VNA” = Pico Technology Model “PicoVNA 106 300 kHz – 6 GHz Quad RX, S/N: A0063/08671.
- TX Coaxial Cable = 20 ft. Times Microwave LMR-240 Low Loss cable with Pasternack PE44637 Crimp/Solder SMA-Male connectors on both ends.
- RX Coaxial Cable = 37 ft. Times Microwave LMR-400 Low Loss cable with Pasternack PE44668 Crimp/Solder Type N-Male connectors on both ends.
- TX Adapter = Pasternack PE91339, N-Male to SMA-Female Adapter to VNA
- RX Adapter = Pasternack PE9082 N-Female to SMA-Male Adapter to DUT
- Channel Master 360 degree programmable turntable with Styrofoam pedestal DUT mounting platform

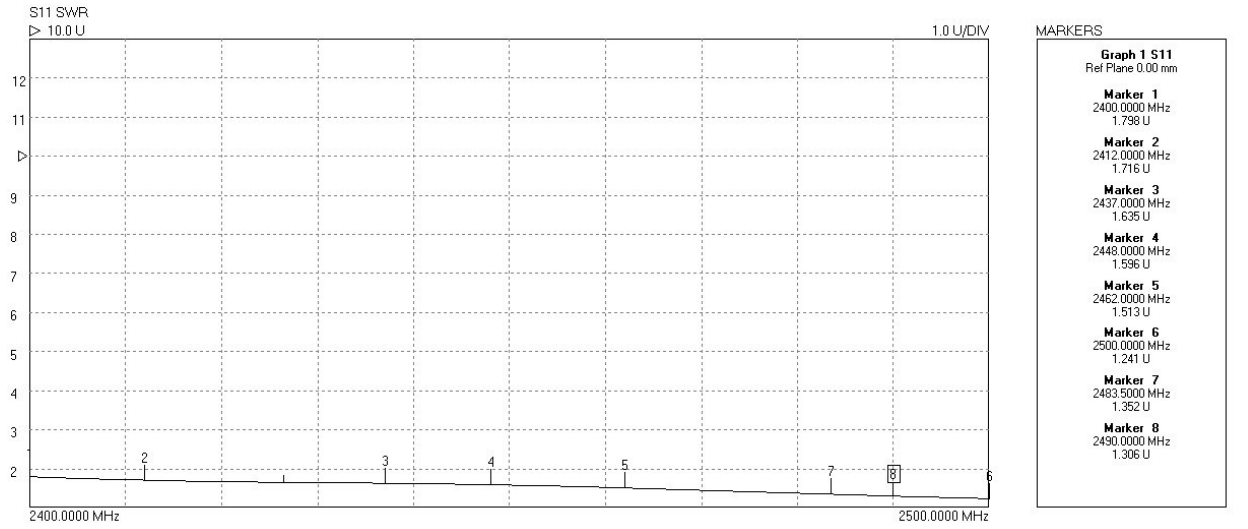
### 3 Key Antenna Specifications

| Antenna Parameter                                                | Values / Comments                                                                       |
|------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Antenna Type                                                     | Custom PCB Trace PIFA                                                                   |
| Frequency Band (MHz)                                             | 2400 - 2500                                                                             |
| Nominal Impedance                                                | 50 $\Omega$                                                                             |
| Peak Gain (dBi)<br>Highest gain measured of all data points      | -0.52 (Found at 2448 MHz and angle 247.5 degrees in the V-Pol Azimuth plane plot below) |
| Efficiency (%)<br>Average efficiency of all data points measured | 24.6                                                                                    |
| Pattern Characteristics                                          |                                                                                         |
| Overall Pattern Shape                                            | Omni-Directional                                                                        |
| <b>HPBW (Half Power Beam Width)</b><br>Typical                   | (N/A)                                                                                   |
| Front-to-back Ratio (Typical)                                    | (N/A)                                                                                   |
| 2:1 VSWR Band Width (MHz)                                        | 100+                                                                                    |
| Connection Requirement                                           | None (PCB Trace)                                                                        |
| Power Handling (Watts)                                           | 5                                                                                       |
| Physical Dimensions                                              |                                                                                         |
| Length (mm)                                                      | 26                                                                                      |
| Width or diameter (mm)                                           | 6                                                                                       |
| Depth or thickness (mm)                                          | 1 oz.                                                                                   |
| Material                                                         | Copper PCB trace                                                                        |

## 4 Measured Data

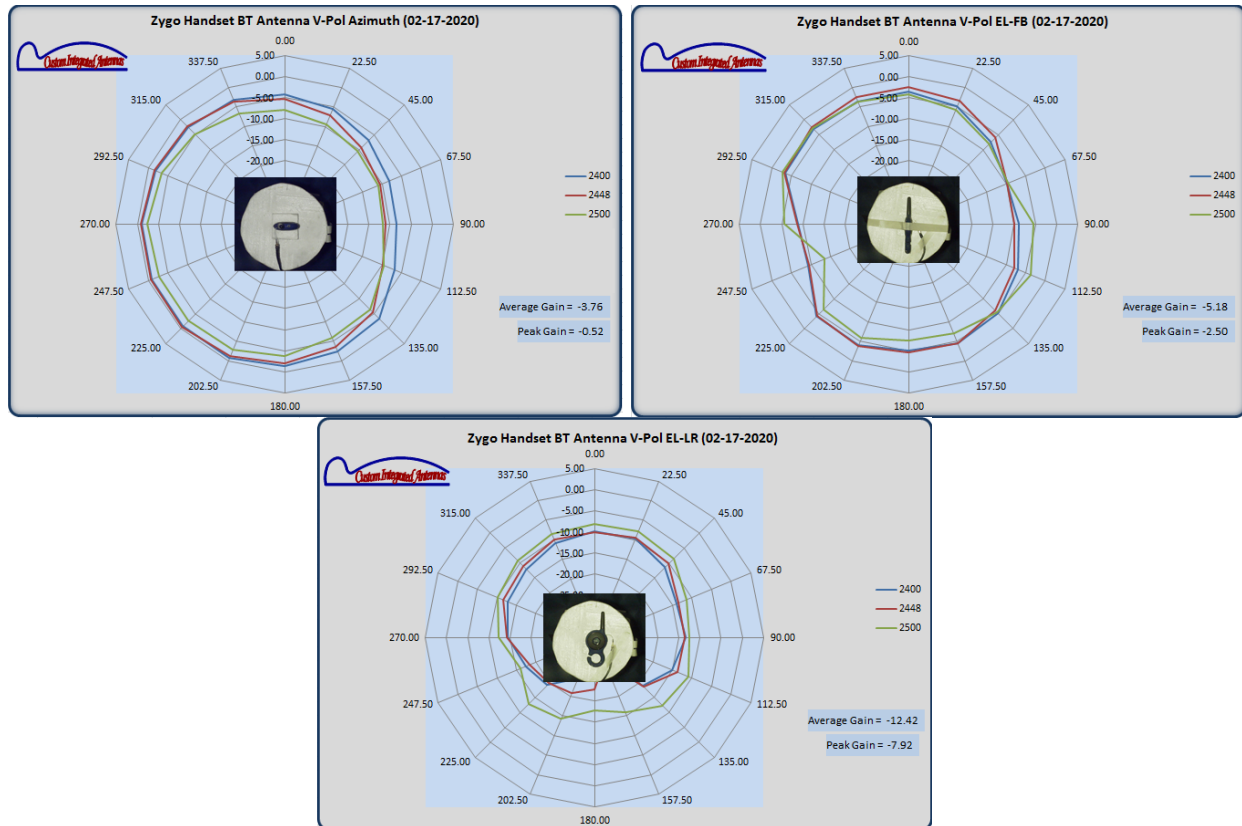
**NOTE:** The DUT referred to in the measured data below as "Handset" is referred to as "Coach's Unit" elsewhere in this report and other filing documents.

### 4.1 VSWR

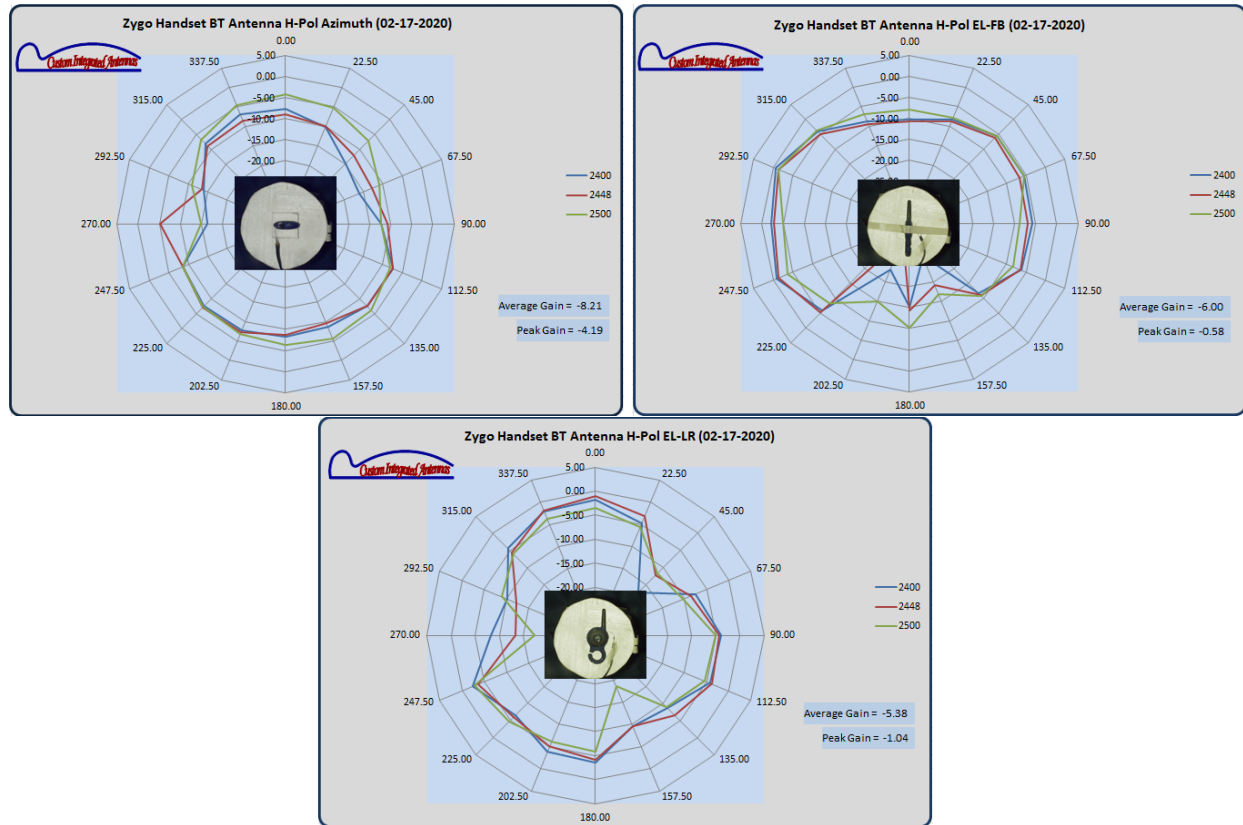


### 4.2 Principal Radiated Patterns

#### 4.2.1 Vertically Polarized DUT (V-Pol)



#### 4.2.2 Horizontally Polarized DUT (H-Pol)



#### 4.3 Tabular Data Summary

| Average Gain Comparison: All data points averaged for each frequency and all angles (dBi) |        |        |        | Average Gain 2.4 GHz ISM Band (dBi) | Maximum Gain (dBi) |
|-------------------------------------------------------------------------------------------|--------|--------|--------|-------------------------------------|--------------------|
| Frequency (MHz)                                                                           | 2400   | 2448   | 2500   | Radiation Plane Average             | Maximum (dBi)      |
| Zygo Handset BT Antenna V-Pol Azimuth (02-17-2020)                                        | -2.93  | -3.41  | -5.28  | -3.76                               | -0.52              |
| Zygo Handset BT Antenna V-Pol EL-FB (02-17-2020)                                          | -5.28  | -4.87  | -5.42  | -5.18                               | -2.50              |
| Zygo Handset BT Antenna V-Pol EL-LR (02-17-2020)                                          | -13.72 | -13.15 | -10.93 | -12.42                              | -7.92              |
| Zygo Handset BT Antenna H-Pol Azimuth (02-17-2020)                                        | -9.18  | -8.66  | -7.09  | -8.21                               | -4.19              |
| Zygo Handset BT Antenna H-Pol EL-FB (02-17-2020)                                          | -5.51  | -6.08  | -6.47  | -6.00                               | -0.58              |
| Zygo Handset BT Antenna H-Pol EL-LR (02-17-2020)                                          | -4.97  | -5.03  | -6.24  | -5.38                               | -1.04              |

**Red Highlighted Cell** is the DUT's Peak Gain (dBi) of all data points measured.

#### 5 Conclusion

The performance of the Bluetooth antenna was much better than the VHF antenna, due to its more conventional size and construction.

The peak gain of the Bluetooth antenna is -0.52 dBi. The peak gain value was measured at 2448 MHz at the 247.5 degree data point of the polar plot provided above, i.e., "Zygo Handset BT Antenna V-Pol Azimuth (02/17/2020).