ATM33/e Bluetooth® Angle-of-Arrival (AoA) Demo

User Guide

SUMMARY: This document provides instructions on how to operate the Bluetooth Angle-of-Arrival demo with the ATM33/e wireless Bluetooth SoC.

Atmosic™

Table of Contents

List of Figures

List of Tables

Acronyms and Abbreviations

Acronyms	Definition
AoA	Angle-of-Arrival
ATM33/e	ATM3325 ATM3330 ATM3330e
GUI	Graphical User Interface
SDK	Software Development Kit

1.   Overview

1.1   Angle-of-Arrival: A Brief Overview

Angle-of-Arrival (AoA) is a method of calculating the signal direction of a transmitting device, such as an asset Tag that uses a single antenna to transmit a special signal. The Tag transmits signals to a Locator, typically stationary that has multiple antennas. Using phase differences of the signals, the Locator calculates the angle and estimates the direction of the Tag relative to itself.

Applications can include:

- Asset tracking

- Personal trackers

- Access control

1.2   AoA Using ATM33/e

Bluetooth's AoA technology that can support high-accuracy indoor location services and the ATM33/e AoA evaluation kit consists of two (2) key hardware blocks which are preloaded with firmware. A Windows® GUI application package is available for download via the Atmosic Support Website.

1.2.1 Tag

- 1x   ATM3325 Tag Reference Design (pre-loaded with AOA_dir_finding_tag firmware)

- 1x   CR-2032 Coin battery

The Tag is powered by a coin cell battery (included) and transmits its beacon from the 2.4 GHz Bluetooth antenna on the Tag.

Figure 1 - ATM3325 Tag Reference Design

In addition, the ATM3325 Tag Reference Design Board with developer extension is provided in the kit. This board is provided as a development platform for application development, debugging, and testing with additional sensors and peripherals.

Figure 2 - ATM3325 Tag Reference Board with Sensor Extension

1.2.2 Locator

- 1x   Antenna Array Board
- 1x   ATM33/e evaluation board (preloaded with 'Locator' firmware)
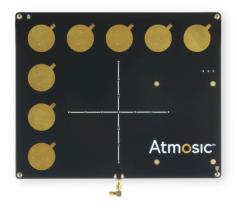- 1x   USB cable

Figure 3 - Locator Antenna Array (Top Side)

The Locator section (upper side) of the evaluation kit consists of an antenna array with the antennas configured in an inverted 'L' configuration.

In the center of the antenna board is an LED array which will be used to indicate the relative positioning of the Tag.

Three (3) additional LEDs in the top right provide additional status information.

Figure 4 - Locator Antenna Array (Bottom Side)

The Locator section (lower side) of the evaluation kit consists of the antenna switching circuit and a standard ATM33/e evaluation kit preloaded with firmware for the locator functionality.

The antenna array is mounted to the ATM33/e evaluation kit via the 50-pin I/O header and a short coaxial cable. The 50-pin header provides the I/O connection for the LED display and antenna switching circuit. The Locator is powered via a USB cable (provided).

2. Using the AoA Demonstration Kit

The kit has been created using standard evaluation kits so developers can create their application code and perform any lab testing that they may choose after their initial evaluation.

This document assumes that developers have not changed any preloaded firmware but if they have, the firmware is also available as part of the SDK package.

2.1 Items Needed for Demonstration

- GUI Software (Atmosic Utilities)
- ATM3325 Tag Reference Design as an AoA Tag
- AoA Locator Board

3. Installing the GUI Software

1) Do not plug any hardware into the Windows PC at this point

2) Download the Atmosic Utilities Zip File from the Atmosic website, under the Tools -> Software Tools section in the main Customer Portal (submit a request for access credential)

3) After the download is complete, unzip the compressed 'Atmosic Utilities 1.x.x' file.

4) From the unzipped 'Atmosic Utilities 1.x.x' folder
   - Run 'VC_redist.x64' and follow the instructions for installation.
   - Open the embedded folder, v#.#.# where the # corresponds to the current version number of the software.
   - Open the x64 folder and then run the 'Atmosic.Sales Tool.App' file which has the msix extension to start the installer application.

5) Ensure that 'Launch when ready' is checked as shown in Figure 5 below, as this will trigger the application to automatically start once the installation is complete.

Figure 5 - Install Atmosic Utilities

6) After the GUI launches, it will try to communicate with the Locator which has not been plugged in yet resulting in an error message, see Figure 6.
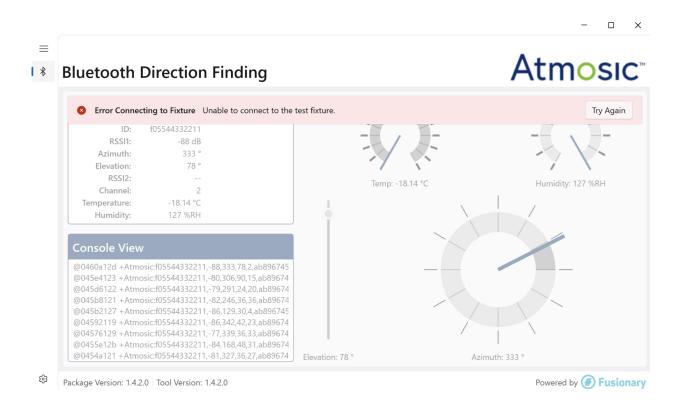

Figure 6 - Error Connecting to Fixture Message

Note: *The interface of the GUI will be translucent because the Locator has not been connected yet.*

4. Set Up the ATM3325 Tag Reference Design as an AoA Tag

ATM3325 Tag Reference Design included in the kit is pre-loaded with AOA_dir_finding_tag firmware. Insert a coin cell battery into the battery holder on the ATM3325 Tag Reference Design (make sure the '+' sign on the coin cell is facing upward), and the ATM3325 Tag Reference Design will start to send out beacons with CTE (Constant Tone Extension). Please refer to ATM3325 Tag Reference Design User Guide for operation details.

5. Set up the AoA Locator Board

1) Connect the Locator board to the PC using the supplied USB cable.

2) Once connected, two LEDs will light:

- The LED adjacent to the USB connector on the ATM33/e evaluation board. This will indicate the successful connection of the ATM33/e evaluation board to the PC.

- The left-most LED of the status LEDs on the antenna array board indicates that the antenna board is correctly powered by the ATM33/e board.

3) Return to the GUI and click 'Try Again' after the Locator has been connected to the computer. See Figure 7.
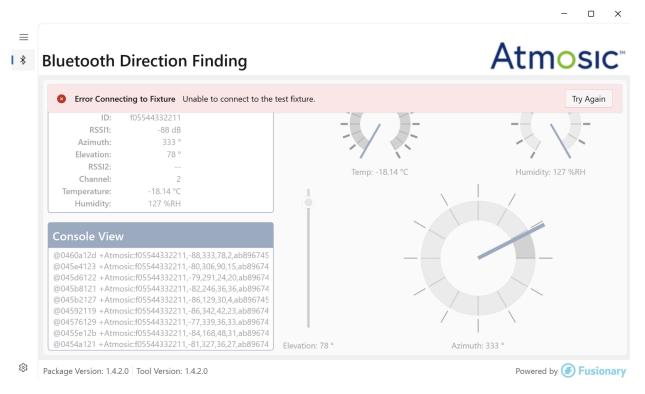
Figure 7 – 'Try Again' Button in the GUI Software

Once the Locator is successfully connected and the Tag is powered, the GUI dashboard will be populated with data, see Figure 8.
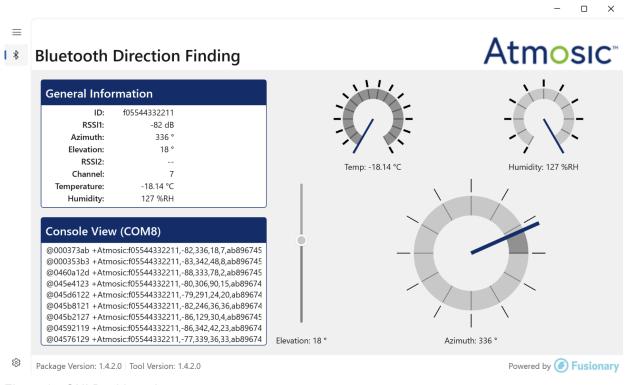

Figure 8 - GUI Dashboard

Note: The data displayed may vary slightly based on the firmware or hardware configurations of the Tag and Locator used. For example; In the figure shown above, temperature and humidity data is not supported by the particular Tag/firmware combination and is therefore being reflected as 'no data'.

6.   Using the Demo

Position the Tag next to the Locator as shown in Figure 9. The Locator should be put vertically to the table so that the positioning LEDs on the Locator can be observed easily. In the meantime, the Tag should be positioned in parallel to the Locator board and moved along the same plane as the antenna arrays on the Locator. The position of the Tag relative to the Locator can be seen in the console view, general information, and the gauges.

The console view represents the data streaming into the PC via the USB cable which is decoded and highlighted both in the General Information section and on the gauges.

Figure 9 - GUI Display if Tag is Located on the left of the Locator

Next, move the Tag above the Locator as shown in Figure 10. The data seen in both the general information and gauges sections will update to reflect the new Tag position.
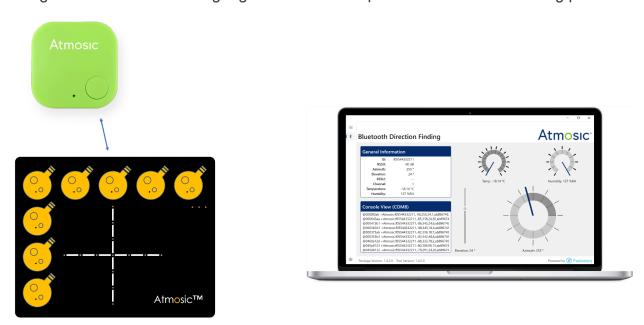

Figure 10 - GUI Display if Tag is Above the Locator

[Figure 11](#) depicts the GUI display when the Tag is moved to the right of the Locator.

Figure 11 - GUI Display if Tag is Located on the Right of the Locator

7. Decoding the Data

The GUI displays the live location data of the Tag. This includes the elevation of the Tag (vertical angle relative to the Locator) and the azimuth (horizontal angle relative to the Locator).

In the General Information section of the GUI, it displays the ID, RSSI1, Azimuth, Elevation, RSSI2, Channel, Temperature, Humidity, Anchor ID, System Uptime, and Device Type which is decoded from the raw data obtained from the Locator board seen in the Console View section. See Table 1 for the description of the variables.

Variable	Description
ID	Identification code of the Tag
RSSI1	RSSI value of the Tag
Azimuth	Horizontal angle of Tag relative to Locator
Elevation	Vertical angle of Tag relative to Locator
RSSI2	Not displayed
Channel	Bluetooth channel
Temperature	Temperature of the Tag's environment
Humidity	Humidity of Tag's environment
Anchor ID	Identification code of Locator
System Uptime	Duration of time the GUI has been active

Table 1 - Variable Description

8. FAQ/Troubleshooting

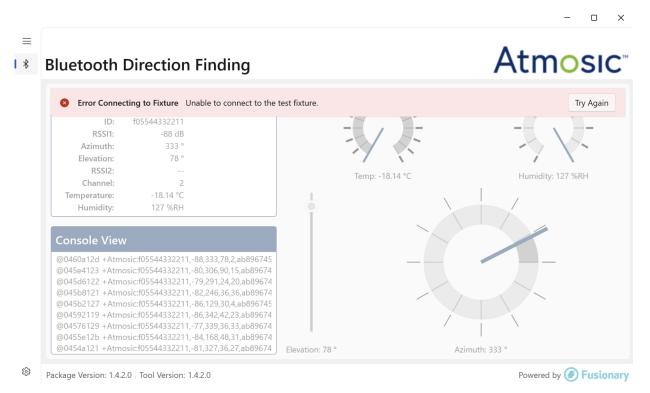## 8.1 The USB cable is connected but the GUI suggests there is no connection.

Figure 12 - USB Cable Connected But No Connection Recognized

There are many reasons why the GUI might be getting the "**Error Connecting to Fixture Unable to connect to the test fixture**." message as shown in <u>Figure 12</u>.

1) Make sure that the Locator is plugged into the computer properly.

2) Check to see if other debug tools such as PuTTY or Tera Term are using the COM ports and blocking access to the GUI.

3) Make sure the correct AoA Locator binary is loaded in the Locator board.

After addressing these potential issues, click on the "**Try Again**" button to see if the error is resolved.

8.2 The GUI is populated but does not appear to be updating.

Some data may have been initially received but then stopped if the Tag is moved out of range or loses power. Verify that the Tag is within range, the power jumper is in the COIN position and restart the GUI. If the issue persists, replace the battery.

8.3 Where can I find the source code for the GUI?

Please contact Atmosic Sales

8.4 Where can I find the example source code for the Tag?

The example source code is supplied in the SDK version 5.4 or later.

The example is called AOA_dir_finding_tag.

8.5 Where can I find the source code for the locator?

The example source code is supplied in the SDK version 5.4 or later.

The example is called AOA_dir_finding_locator. The example is provided for functional evaluation only. Additional development is required to scale the solution for tracking multiple tags. Please refer to the README under the AOA_dir_finding_locator directory in the SDK.

8.6 Why is there no data shown for temperature and humidity?

When using Atmosic reference hardware, make sure to program the firmware with the compiler option CFG_REF_SENSOR:=1

8.7 Display does not align with the evaluation board position, why?

 The signal comes from the antenna, not the evaluation board, as such the locator will be pointing to the antenna and not the board itself.

Reference Documents

Title	Document Number
ATM3325 Tag Reference Design User Guide	ATM3325-UGTAG

Revision History

Date	Version	Description
November 21, 2024	0.63	Updated 8.5
April 3, 2024	0.62	Changed document title. No content change.
August 25, 2023	0.61	Updated Tag, Items Needed for Demonstration, Set Up ATM3325 Tag Reference Design As An AoA Tag, Figure 10 - GUI Display if Tag is Above the Locator, Figure 11 - GUI Display if Tag is Located on the Right of the Locator, Figure 12 - USB Cable Connected But No Connection Recognised, FAQ/Troubleshooting sections.
September 6, 2022	0.60	Initial version created.

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