ATM3405 Tag Reference Design

User Guide

SUMMARY: This document describes the features and usage of the ATM3405 Tag Reference Design. ATM3405 Tag is a compact form factor and can be used in many applications. This document describes configuring this tag into the following applications: Bluetooth Channel Sounding (BTCS) Reflector, Multi-Mode Consumer Asset Tracking Tag, and Sensor Beacon. The ATM3405 Tag Reference Design can also be used as an IoT development platform.

Atmosic™

ATM3405 Tag Reference Design User Guide
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Table of Contents

List of Figures

List of Tables

Acronyms and Abbreviations

Acronyms	Definition
BTCS	Bluetooth Channel Sounding
BIDS	Board Identification System

LE	Low Energy
PCBA	Printed Circuit Board Assembly
RDK	Reference Design Kit
SDK	Software Development Kit
SoC	System-on-Chip

1. Overview

This document describes the features and usage of the Atmosic Bluetooth LE Tag reference design based on the ATM3405 SoC and powered by a CR2032 coin cell battery.

The ATM3405 Tag reference design demonstrates the low power consumption of the Atmosic Bluetooth LE device and many applications in a compact form factor. Three applications can be realized based on this design:

- BTCS Reflector
- Multi-mode Consumer Asset Tracker
- Sensor Beacon

Users can configure the ATM3405 Tag in any of the above three applications according to this guide. This guide also provides information such as the schematic block diagrams, application behaviors, and power consumption.

In addition to the supported applications listed above, the ATM3405 Tag Reference Design can also be used as an IoT development platform through integration of external sensors or peripherals through the IoT expansion board (included in the ATMBTCSTAG-IOT-3405 or the ATMBTCSTAG-IOT-STARTER-3405 kit).

The Atmosic ATM3405 Tag Reference Design is provided for demonstration and evaluation purposes only. It is not supported by Atmosic as a commercial product available for retail sale.

2. Hardware and Software Requirements

2.1 Supported Hardware

See Table 2-1 for information regarding the supported hardware

Hardware	SoC Package	SoC Part Number	Design Package Part Number
Atmosic ATM34 Bluetooth Channel Sounding and Consumer Tag reference design kit, with tag enclosure.	40-pin 5x5 mm QFN	ATM3405-5WCAQK	ATMBTCSTAG-3405
Starter Kit. ATM34 Bluetooth Channel Sounding Tag reference design with IoT expansion board and	40-pin 5x5 mm QFN	ATM3405-5WCAQK	ATMBTCSTAG-IOT-STARTER-3405

Hardware	SoC Package	SoC Part Number	Design Package Part Number
ATMRPB-FJ. Tag Enclosure not included.			
ATM34 Bluetooth Channel Sounding and Consumer Tag reference design kit, with IoT expansion board. Tag Enclosure not included	40-pin 5x5 mm QFN	ATM3405-5WCAQK	ATMBTCSTAG-IOT-3405

Table 2-1 - Supported Hardware

Figure 2-1 - ATMBTCSTAG-3405

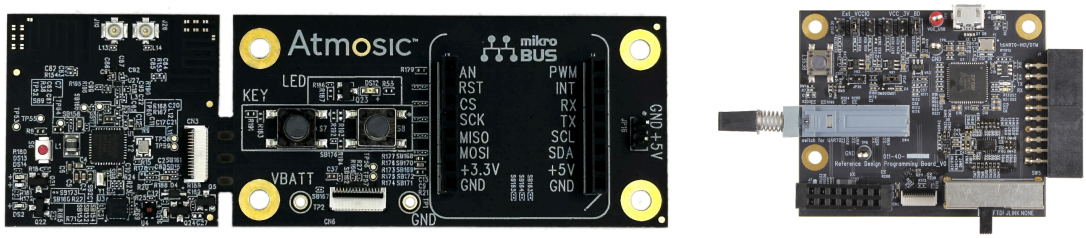


Figure 2-2 - ATMBTCSTAG-IOT-STARTER-3405

Figure 2-3 - ATMBTCSTAG-IOT-3405

2.2 Supported Software

Atmosic OpenAir Zephyr SDK 25.07.1 or a later version is required to build the image to run on the ATM3405 Tag reference design. The Atmosic OpenAir Zephyr repository is located at https://github.com/Atmosic/openair. Please select the latest release version documented.

3. Features

3.1 Hardware Block Diagram

A simplified hardware block diagram of the complete PCBA is shown in the ATM3405 Tag Reference Design Block Diagram, which consists of Board A (see Board A Block Diagram) and Board B (see Board B Block Diagram).

Board A consists of:

- LIS3DH Accelerometer
- ENS210 Humidity and Temperature Sensor
- One Push Button
- One Buzzer
- One LED with red and green for power status and operation status
- One green LED for battery level indication
- One green LED for buzzer operations
- ATM3405 Bluetooth SoC
- 2 PCB antennas controlled through an antenna switch
- Firmware Program and Debug Interface
- CR2032 Battery Holder

Board B consists of:

- Push Button
- PWD Reset Push Button
- One LED (yellow)
- mikroBUS™ socket. Please note - for the sensors that require 5V input, the 5V must be supplied through the 5V connector on board B, which supplies 5V of mikroBUS™ (indicated as “Ext. Pwr.” in Board B Block Diagram)
- Firmware Program and Debug Interface

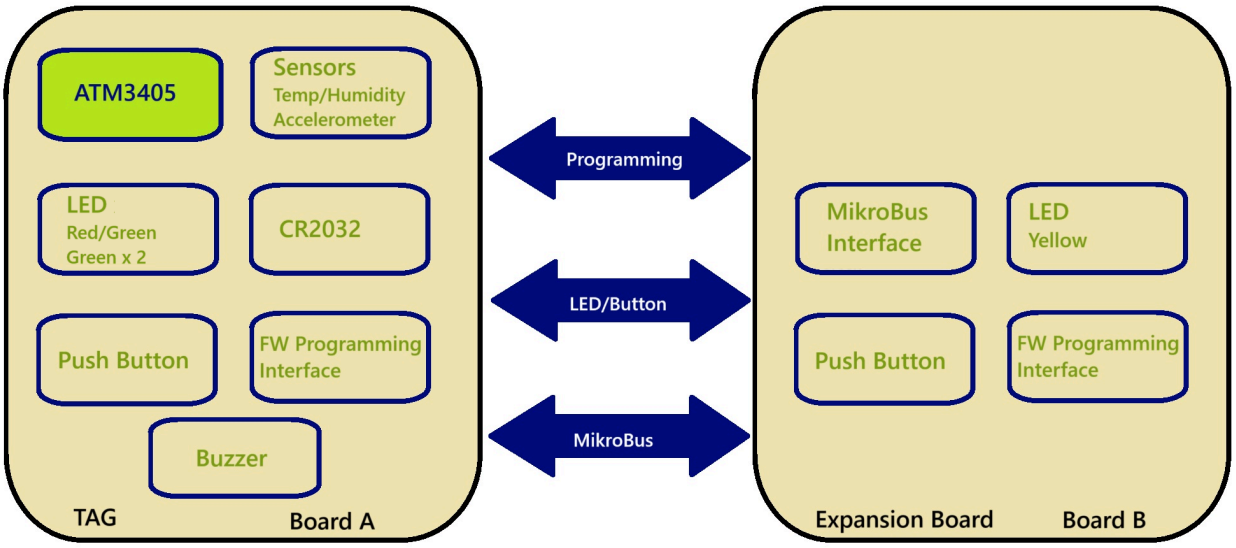


Figure 3-1 - ATM3405 Tag Reference Design Block Diagram

Boards A (Tag) and B (Expansion) are designed to enable developers to optimize their configuration based on requirements. This is intended to provide developers with options:

1) When used together (A+B), a developer can add additional sensors that may be required for code development, unique to their own application
2) When Boards A and B are separated, Board A (Tag) can be installed in an enclosure as a standalone, form-factor tag that can be used for field testing. To separate Board A from Board B, developers can snap the board at the joint.

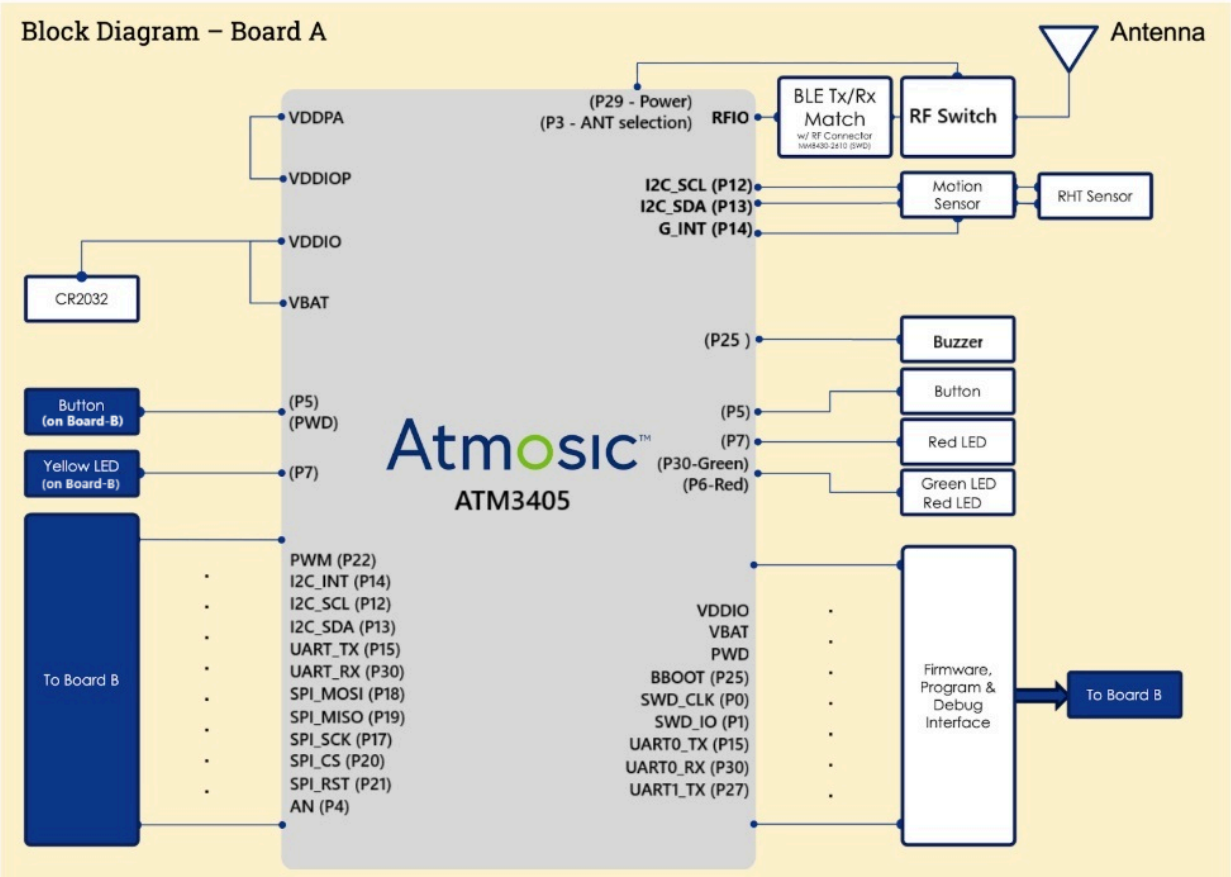


Figure 3-2 - Board A Block Diagram

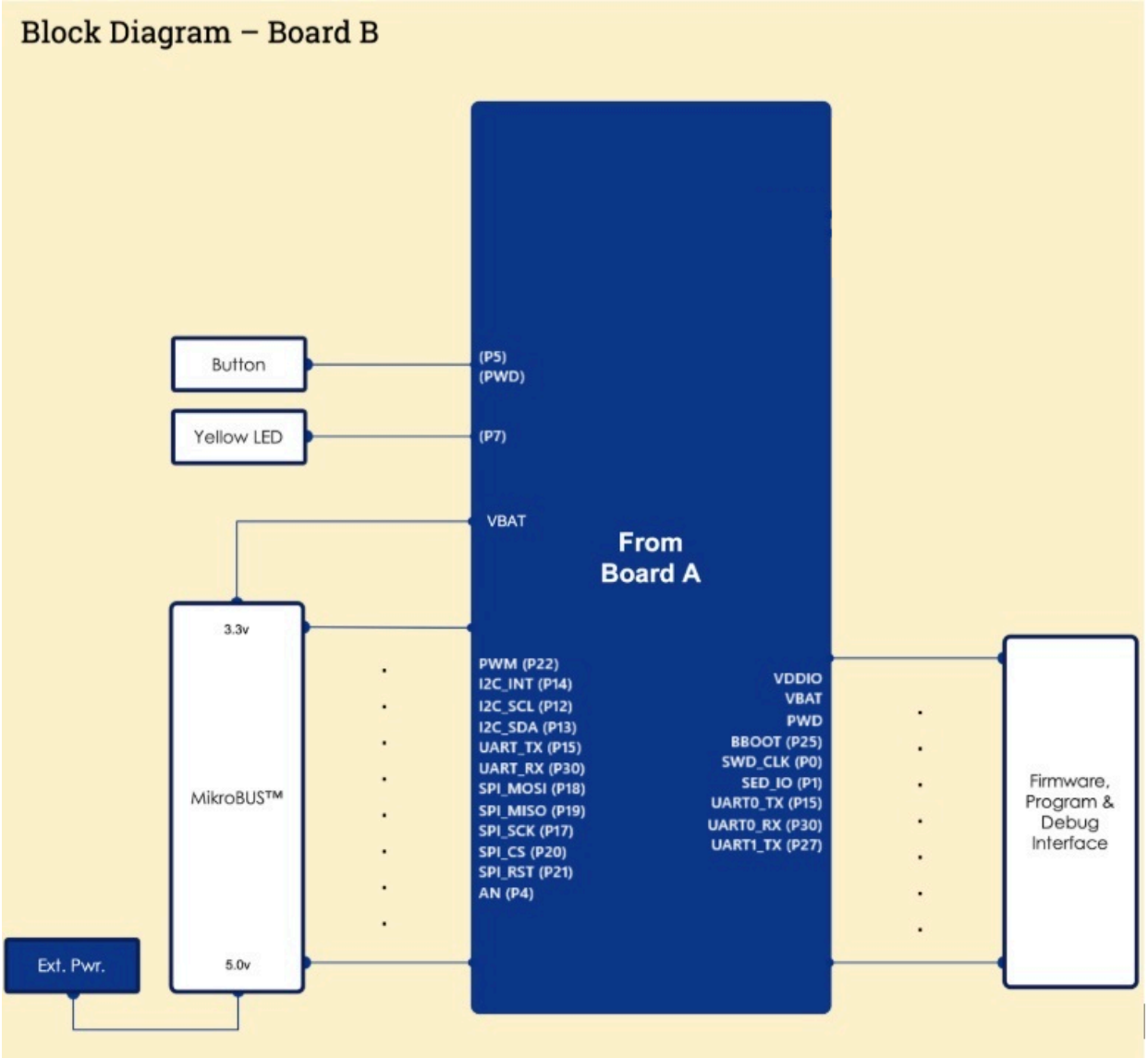


Figure 3-3 - Board B Block Diagram

3.2 Tag PCBA

The complete PCBA of the Atmosic Tag reference design is shown in ATM3405 Tag (Board A) and the Extension Board (Board B). It is a combined PCBA with two parts: Board A (left) and Board B (right). Board A is the main function board, and Board B is the extension board; they can be broken off from the vias at the edge of these two parts.

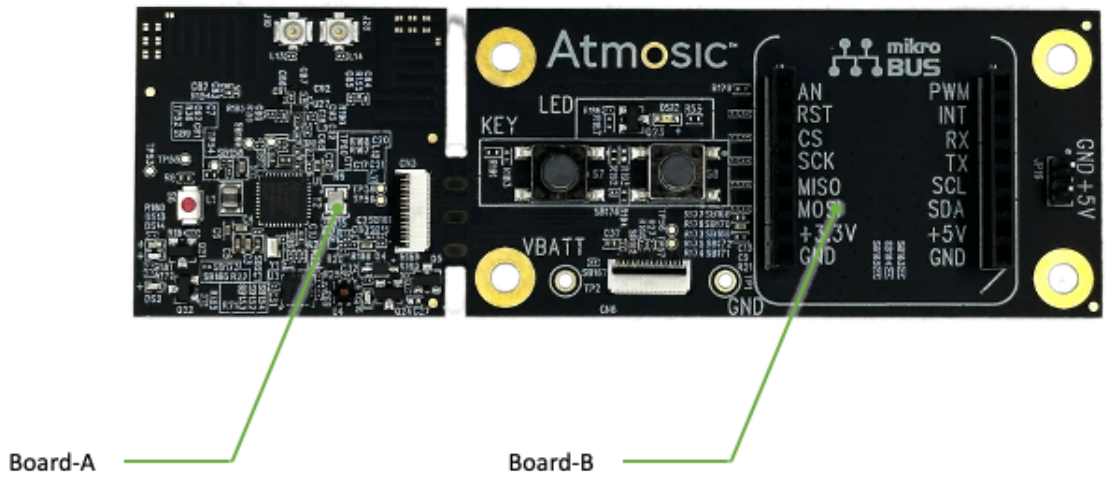


Figure 3-4 - ATM3405 Tag (Board A) and the Extension Board (Board B)

3.3 Tag Enclosure

When Board A is broken off from the complete PCBA, it can be assembled into the tag enclosure, as shown in Tag Enclosure. The tag enclosure has a press button and holes for the LEDs.

Figure 3-5 - Tag Enclosure

3.4 Expansion Function

Board B is the expansion board, which provides users with additional peripherals as listed in the Supported MIKROE CLICK Boards section.

3.5 Reference Design Package Options

Two different package options are provided:

- Package ATMBTCSTAG-3405 includes Board A in the enclosure
- Package ATMBTCSTAG-IOT-3405 includes Board A+B, without the enclosure
    - Enclosures can not be ordered separately

Please refer to Supported Hardware for details.

4. Applications

4.1 BTCS Reflector

4.1.1 General Operation

ATM3405 Tag Reference Design can be used as a Bluetooth Channel Sounding reflector with the ras_rrsp_reflector application. There is one button, three LEDs, and one buzzer, and the detailed operations are listed in sections below. In addition, the maximum supported antenna number for CS is two. The antenna switch would be controlled using the CS procedure.

When the product is shipped, it is in the standby SoC Off state. Users can press the button to power on and then start the advertising with “Atmosic_RRSP” and RAS UUID. There is a three-minutes timeout for advertising, and then enter SoC Off.

- Sample Application: openair/applications/ras_rrsp_reflector
- Build/Flash command using sysbuild with the OTA feature is as follows:

```
west build -p always -b ATMBTCSTAG-3405@mcuboot//ns
openair/applications/ras_rrsp_reflector --sysbuild -T
applications.ras_rrsp_reflector.atm.mcuboot.ota
```

```
west flash --skip-rebuild --verify --dl --device ATMDL22060000513 --fast_load
--erase_all
```

Note 1: ATMDL22060000513 is the <Device ID> assigned to the Programming Board. It can be obtained by issuing in Linux using the command `ls /dev/serial/by-id/`. In Windows, go to the Device Manager and right-click on one of the Serial Ports that were enumerated and select Properties. Then, select Events. The device ID will be displayed in the Information section.

Note 2: '--dl' represents using the FTDI on the Programming Board as a SWD interface for firmware download. This flash option is supported from OpenAir SDK 25.11.0. For the older SDK versions, setting the environment variable `SWDBOARD=DL` is still required.

4.1.2 Button Operations

Board A button operations:

Current Status	Button Operation	Next Status
Advertising/Idle	Press the button for 2 seconds	SoC Off state
SoC Off state	Press the button for 2 seconds	System in Advertising/Idle state
Advertising/Operation	Press the button for 10 seconds	Factory reset and enter the SoC Off state
Advertising/Operation	Quick button press 5 times	Battery level detection

Table 4-1 - Button Operations for BTCS Reflector Application

4.1.3 LED Indicator

Operating State	LED Behavior
System start	Status Green LED blinking 3 times
System goes to SOC OFF mode	Status Red LED blinking 3 times, then stops blinking
Advertising	Status Green LED ->Red LED blinking every 5 sec
Connected	Status Green LED blinking every 20 seconds
Channel Sounding operation	Status GREEN LED blinking every 1s
Battery level detection	>3.0V 5 Battery Green LED blinks >2.9 V 4 Battery Green LED blinks >2.8V 3 Battery Green LED blinks >2.6V 2 Battery Green LED blinks <= 2.6V single Battery Green LED blink

Table 4-2 - LED Indicator Operations for BTCS Reflector Application

4.1.4 Buzzer Indicator

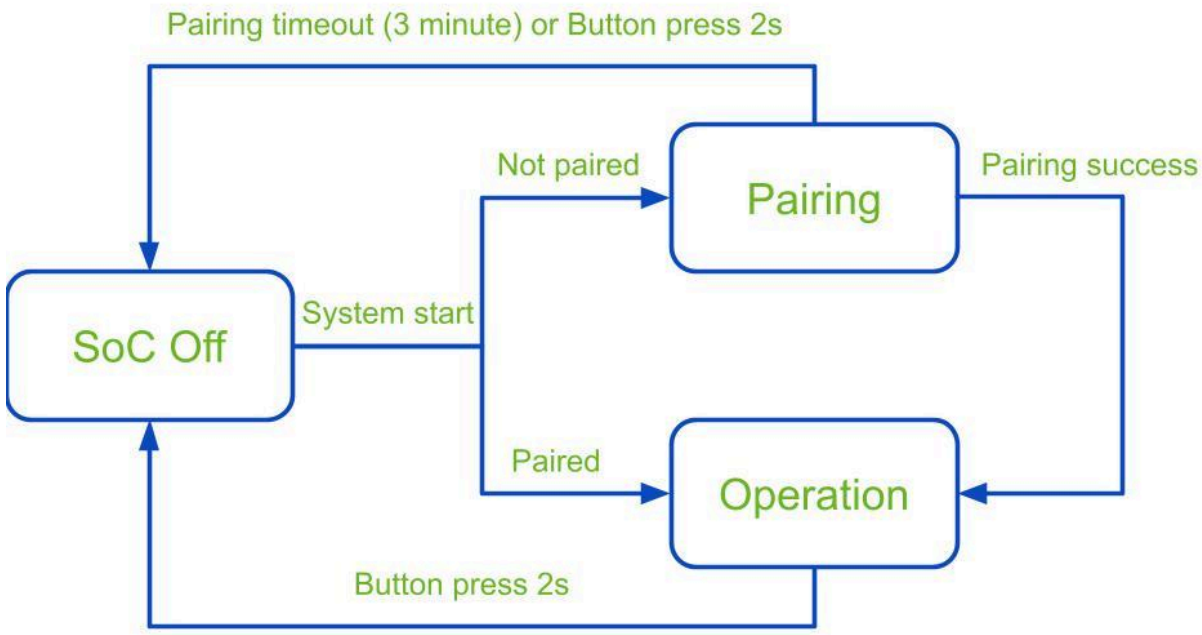
Operating State	Buzzer Behavior
Factory Reset Triggered	Audio feedback with 0.5s

Table 4-3 - Buzzer Indicator Operation for BTCS Reflector Application

4.2 Multi-Mode Consumer Asset Tracking Tag

4.2.1 General Operation

This sample demonstrates the functionality of a combo tag that is compatible with both the `Apple Find My Network` and the `Google Find Hub Network`. It integrates button, LED, and buzzer capabilities. The basic state machine is illustrated below:



- Sample Application: openair/applications/combo_tag
- Build/Flash command using sysbuild:

```
west build -p always -b ATMBTCSTAG-3405//ns openair/applications/combo_tag
--sysbuild -T applications.combo_tag.atm.atm34
```

```
west flash --skip-rebuild --verify --dl --device <DEVICE_ID> --fast_load
--erase_all
```

4.2.2 Button Operation

Board A button operation:

Current Status	Button Operation	Next Status
SoC Off state	Press the button for 2 seconds	System in Pairing/Operation state
Pairing/Operation	Press the button for 2 seconds	SoC Off state
Pairing/Operation	Press the button for 10 seconds	Factory reset and enter the SoC Off state
Pairing/Operation	Quick button press 5 times	Battery level detection

Table 4-4 - Button Operations for Consumer Asset Tracking Tag Application

4.2.3 LED Indicator

Operating State	LED Behavior
System start	Status Green LED blinking 3 times
System goes to SOC OFF mode	Status Red LED blinking 3 times, then stops blinking
Pairing	Status Green LED ->Red LED blinking every 5 sec
Operation	Status Green LED blinking every 20 seconds
Battery level detection	>90% 5 Battery Green LED blinks >60% 4 Battery Green LED blinks >30% 3 Battery Green LED blinks >10% 2 Battery Green LED blinks <= 10% single Battery Green LED blink

Table 4-5 - LED Indicator Operations for Consumer Asset Tracking Tag Application

4.2.4 Buzzer Indicator

Operating State	Buzzer Behavior
Sound Start via Native FindMy App	Buzzer beeping
Factory Reset Triggered	Audio feedback with 1s

Table 4-6 - Buzzer Indicator Operation for Consumer Asset Tracking Tag Application

4.3 Sensor Beacon

4.3.1 General Operation

The ATM3405 Tag Reference Design can be configured as a Sensor Beacon that continuously broadcasts environmental sensor data via Bluetooth Low Energy advertisements. This application demonstrates ultra-low power sensor monitoring capabilities suitable for IoT deployments.

The sensor beacon automatically collects data from the onboard sensors:

- ENS210: Temperature and humidity measurements
- LIS3DH: 3-axis accelerometer data
- Battery Monitor: Storage and battery voltage levels

The collected sensor data is packaged into BLE manufacturer-specific advertising data using the Atmosic Company ID (0x0A24) and broadcast at regular intervals. The beacon operates in non-connectable advertising mode for maximum power efficiency.

Key Features:

- Continuous sensor data broadcasting
- Ultra-low power operation with a CR2032 battery
- Compatible with the Atmosic Android BLE SDK for data visualization
- Standardized sensor data format for client applications

Power Management:

The sensor beacon operates in two main states:

- Active: Sensor sampling and advertising
- Sleep: Low-power sleep between sensor readings

Data Format:

The sensor data is broadcast in a standardized format for client compatibility:

- Temperature: 16-bit signed, scaled by 256
- Humidity: 16-bit unsigned, scaled by 256
- Accelerometer: 16-bit signed for X, Y, Z axes
- Voltages: 32-bit float for storage and battery voltages

The beacon starts automatically upon power-up and continuously broadcasts sensor data. Data can be monitored using the Atmosic Android BLE SDK toolbox application or any BLE scanner that can parse manufacturer-specific advertising data.

- Sample Application: openair/applications/ras_rrsp_reflector
- Build/Flash command using sysbuild with the OTA feature is as follows:

```
west build -p always -b ATMBTCSTAG-3405//ns openair/applications/sensor_beacon
--sysbuild -T applications.sensor_beacon.atm
```

```
west flash --skip-rebuild --verify --dl --device <DEVICE_ID> --fast_load
--erase_all
```

5. IOT Expansion Board (Board B)

5.1 General Description

The IoT Expansion Board (Board B) is designed to enhance the functionality of the ATM3405 Tag Reference Design by providing additional peripherals and expansion capabilities. When connected to Board A, it allows for the integration of various sensors and modules, making the ATM3405 Tag a versatile IoT development platform.

Key features of Board B include:

- Two Push Buttons (one connected to PWD and one connected to P5)
- A yellow LED indicator (P7)
- A mikroBUS™ socket for connecting a wide range of MIKROE CLICK boards
- An FFC connector for firmware program and debug Interface

This expansion board provides developers with the flexibility to customize the ATM3405 Tag for unique applications by easily adding external sensors and peripherals.

5.2 Supported MIKROE CLICK Boards

The mikroBUS™ socket on Board B allows for easy integration of various MIKROE CLICK boards, expanding the functionality of the ATM3405 Tag Reference Design. This

section lists some supported CLICK boards and provides basic information on their usage.

5.2.1 Weather Click

Product page URL: https://www.mikroe.com/weather-click

Description: The Weather Click board features the BME280 sensor, which measures temperature, humidity, and barometric pressure. It communicates with the ATM3405 SoC via the I2C or SPI interface.

- Sample Application: openair/samples/sensor/bme280
- Build command using sysbuild:
    - COMM_SEL is I2C (default):

```
west build -p always -b ATMBTCSTAG-3405//ns openair/samples/sensor/bme280
--sysbuild -T samples.sensor.bme280.atm
```

    - COMM_SEL is SPI (moved JP1-JP4 0-ohm jumpers from I2C to SPI):

```
west build -p always -b ATMBTCSTAG-3405//ns openair/samples/sensor/bme280
--sysbuild -T samples.sensor.bme280.atm.spi
```

- Flash command:

```
west flash --skip-rebuild --verify --dl --device <DEVICE_ID> --fast_load
--erase_all
```

Expected result:

> The ATM3405 Tag with Weather Click periodically reports temperature, pressure, and humidity in serial output as shown below:

```
temp: 26.959991; press: 100.144531; humidity: 47.459960
temp: 26.959991; press: 100.144531; humidity: 47.459960
temp: 26.959991; press: 100.144531; humidity: 47.118164
```

5.2.2 USB UART Click

Product page URL: https://www.mikroe.com/usb-uart-click

Description: The USB UART Click board features the FT232RL, a USB to serial UART bridge from FTDI. It communicates with the ATM3405 SoC via the UART interface.

- Sample Application: openair/applications/combo_tag
  - By default, the Atmosic serial uart debug console outputs to UART1. This example, along with the changes below, will route the debug console to output to UART0, which is routed to the USB UART Click board
- Changes to `openair/boards/atmosic/atm34evk/ATMBTCSTAG-3405_ns.dts`
  - Change the console to UART0

```
	model = "Atmosic BT CS Tag 3405";
	compatible = "atmosic,ATMBTCSTAG_3405";

	chosen {
		zephyr,console = &uart0;
		zephyr,shell-uart = &uart1;
		zephyr,uart-mcumgr = &uart0;
```

  - Enable UART0 by adding `status = "okay";`

```
&uart0 {
	rx-pin = <30>;
	tx-pin = <15>;
	rts-pin = <13>;
	cts-pin = <12>;
	status = "okay";
};
```

- Build/Flash command using sysbuild:

```
west build -p always -b ATMBTCSTAG-3405//ns openair/applications/combo_tag
--sysbuild -T applications.combo_tag.atm.atm34
```

```
west flash --skip-rebuild --verify --dl --device <DEVICE_ID> --fast_load
--erase_all
```

- Expected result:

  The ATM3405 Tag debug output will be displayed on the serial terminal connected to the USB UART Click serial console.

5.2.3 PIR Click

Product page URL: https://www.mikroe.com/pir-click

Description: (This feature will be supported in Atmosic OpenAir Zephyr SDK 25.11.0 or later) The PIR Click board features the PL-N823-01 pyroelectric sensor, which generates a voltage when exposed to infrared radiation emitted by live bodies. It communicates with the ATM3405 SoC via both GADC/AN and I2C(MCP3221) interfaces.

- Sample Application: openair/samples/shields/pir_click
- Build/Flash command using sysbuild:

```
west build -p always -b ATMBTCSTAG-3405//ns openair/samples/shields/pir_click
--sysbuild -T samples.shields.pir_click.atm
```

```
west flash --skip-rebuild --verify --dl --device <DEVICE_ID> --fast_load
--erase_all
```

Expected result:

The ATM3405 Tag with PIR Click periodically reports PIR sensor voltage in the serial output as shown below:

```
pir_click: ADC: 1580 mV, MCP3221: 1650 mV
pir_click: ADC: 1582 mV, MCP3221: 1648 mV
pir_click: ADC: 1579 mV, MCP3221: 1651 mV
pir_click: ADC: 1581 mV, MCP3221: 1649 mV
```

5.2.4 BUZZ 2 Click

Product page URL: https://www.mikroe.com/buzz-2-click

Description: (This feature will be supported in Atmosic OpenAir Zephyr SDK 25.11.0 or later) The Buzz 2 Click board features a piezoelectric buzzer driven by a PWM signal, allowing the ATM3405 SoC to generate sound signals such as beeps, tones, and alerts. It communicates with the MCU through a PWM pin and can produce a wide range of audible frequencies depending on the configured duty cycle and period.

By default, the Buzz 2 Click board's VCCIO SEL resistor is set for 5 V operation.

If the external 5 V input described in Section 3.1 is not available, the resistor must be switched to the 3.3 V position to ensure proper buzzer operation.

- Sample Application: openair/samples/shields/buzz_2_click
- Build/Flash command using sysbuild:

```
west build -p always -b ATMBTCSTAG-3405//ns openair/samples/shields/buzz_2_click
--sysbuild -T samples.shields.buzz_2_click.atm
```

```
west flash --skip-rebuild --verify --dl --device <DEVICE_ID> --fast_load
--erase_all
```

Expected result:

The ATM3405 Tag with Buzz 2 Click generates audible tones according to the PWM configuration. Different frequencies and duty cycles result in distinct sound patterns, which can be used for notifications or user feedback in various applications.

```
buzz_2_click: Playing C3 frequency: 131 Hz for 300 ms
buzz_2_click: Playing C4 frequency: 262 Hz for 200 ms
buzz_2_click: Playing E5 frequency: 659 Hz for 100 ms
buzz_2_click: Melody complete. Pausing before repeat...
```

6. Power Consumption Measurement

The ATM3405 Tag reference design supports direct current consumption measurements to demonstrate the low operating current of the ATM3405 SoC for the above-mentioned applications.

However, if the user's target is to check **only** the ATM3405 current, the following reworking will be necessary.

- Cut the SB160 to disconnect the VBAT and the power supply of the sensors and buzzer.
- P5, P6, P7, P25, and P30 need to be set as pull-low in FW.

Users can start the power measurement after supplying +3V from a testing equipment (for example, a DC power meter) to the marked position +BAT and -BAT in External Voltage Supply Connections for Measuring Power Consumption.

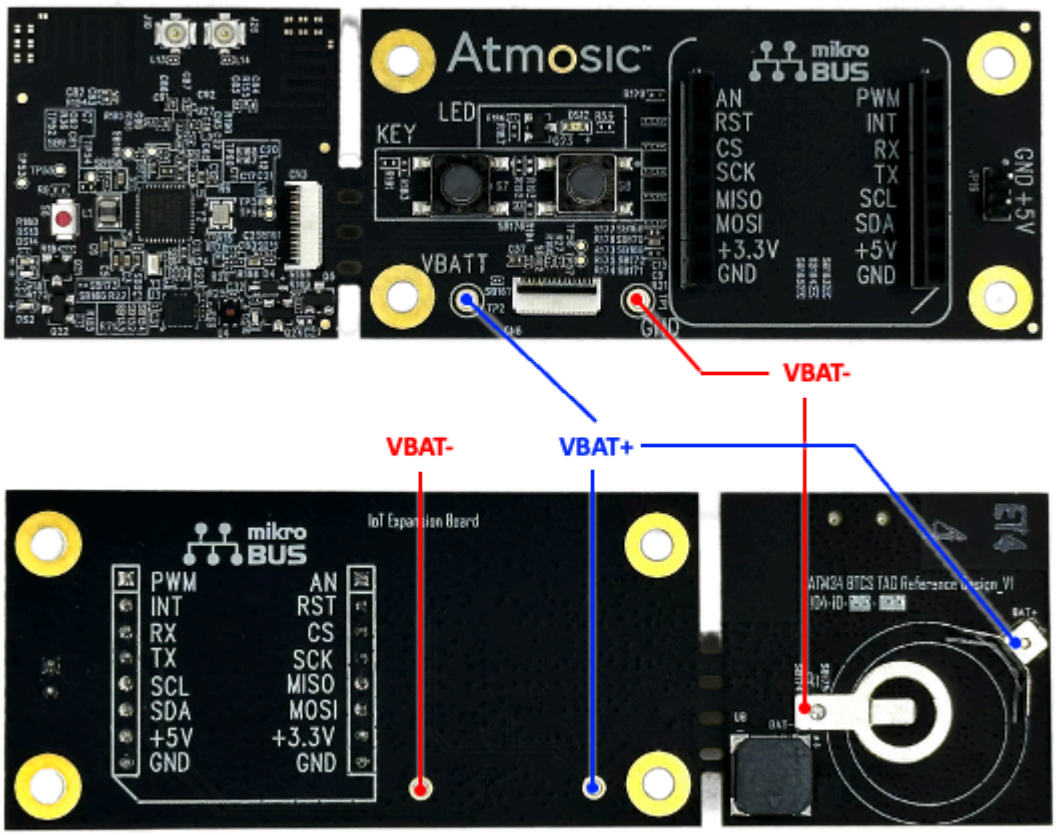


Figure 6-1 - External Voltage Supply Connections for Measuring Power Consumption

7. ATM3405 Tag Firmware Update

The ATM3405 Tag reference design has two FFC connectors (one on Board A and the other on Board B), which both can be used for flash programming as well as a debug interface. Please note that the FFC connector on Board B will no longer function after Board B is separated from Board A. To support the debug and programming functions, additional required hardware (`Reference Design Programming Board`, `ATMRPB-FJ`, listed in the References section) is available from Atmosic. See Figure 7-1: Firmware Programming and Debug Connection with TAG RDK(Board A) and Figure 7-2: Firmware Programming and Debug Connection with Expansion Board (Board B) for a depiction of how this additional hardware is connected.

Please refer to the `Reference Design Programming Board User Guide` (listed in the References section) for more details. By default, SW4 on the Programming Board should be pressed in.

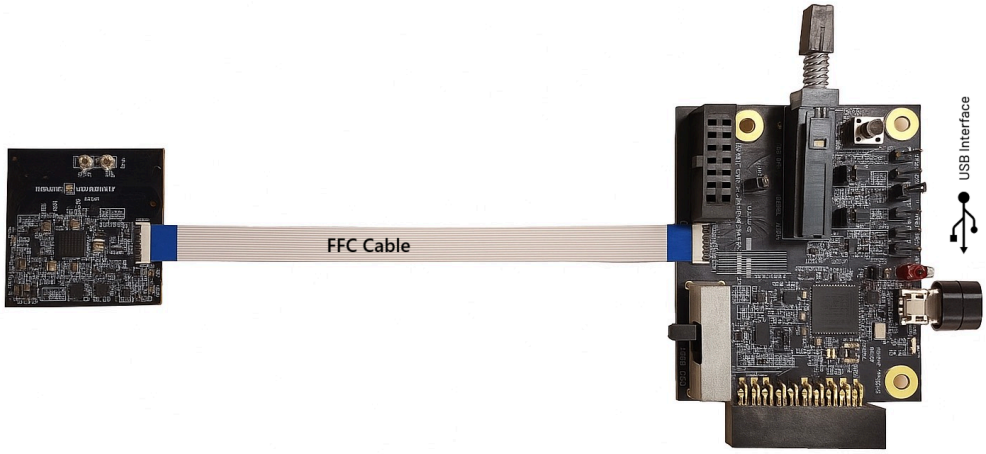


Figure 7-1 - Firmware Programming and Debug Connection with TAG RDK(Board A)

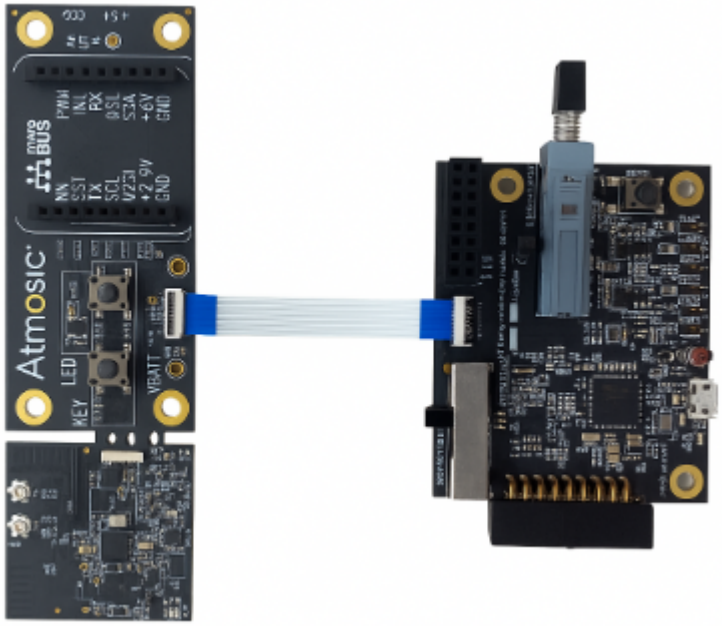


Figure 7-2 - Firmware Programming and Debug Connection with Expansion Board (Board B)

References

Title	Document Number
ATM34/e Series Datasheet	6494-xxxx-xxxx
ATM34/e Series Evaluation Kit User Guide	6441-xxxx-xxxx
Reference Design Programming Board User Guide	ATM-UGRPB
RF Test Tool User Guide	ATM-UGRF
Hardware	**Order Number**
Reference Design Programming Board	ATMRPB-FJ

Revision History

Date	Version	Description
November 4, 2025	0.50	Initial version created.

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