

## AT32 EdgeAI Sensor EV Board Application Note

### Introduction

With the rise of the EdgeAI technology, the development of the EdgeAI applications based on AT32 MCU is being made easier and more convenient. In response to the growing market demands, Artery launches its EdgeAI-enabled evaluation board featuring rich sensors.

The purpose of this document is to illustrate the usage of the AT32 EdgeAI Sensor EV Board, detailing embedded sensors and driver codes, along with application examples.

Applicable product series:

Product series	AT32F403A series
	AT32F407 series

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## 1 Hardware and software resource requirements

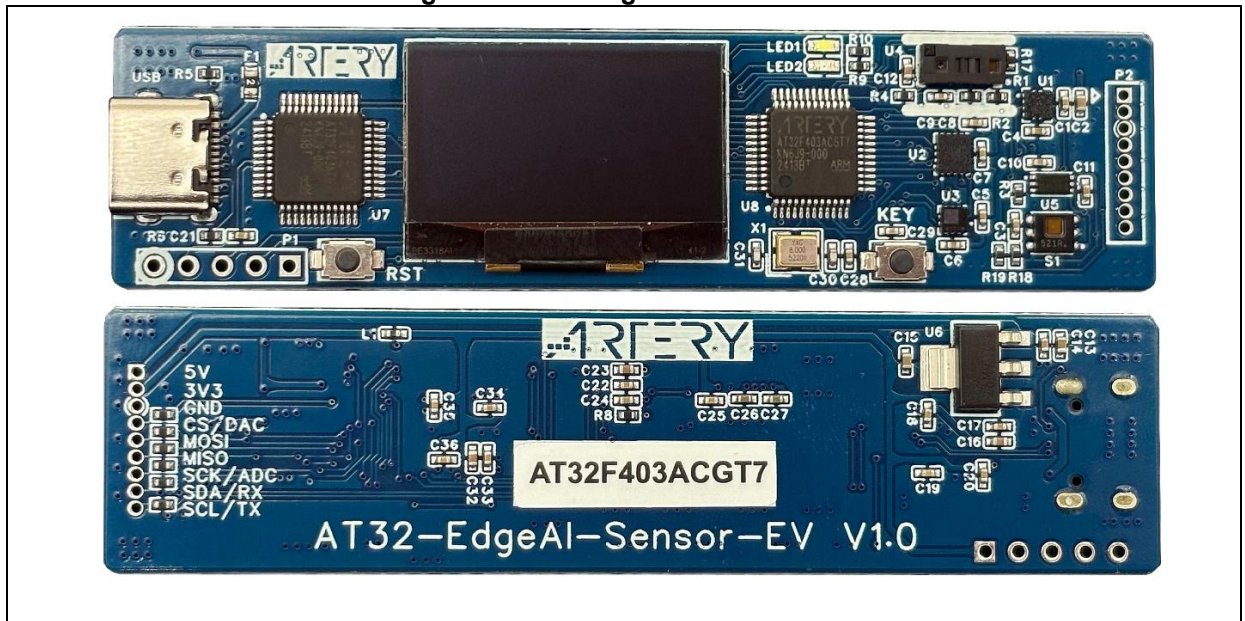
This chapter describes the hardware and software resources as well as on-board devices required to run this evaluation board.

### 1.1 Hardware resources

Built based on the AT32F403A series microcontroller, the AT32-EdgeAI-Sensor-EV board incorporates multiple sensors, including:

- Microcontroller (AT32F403ACxT7)
- AT\_Link\_EZ
- 0.96" OLED panel
- Time-of-Flight (ToF) sensor (VL53L7CX)
- 3D magnetic sensor (LIS2MDL)
- 3D accelerometer and 3D gyroscope sensor (LSM6DS3TR)
- Ambient light sensor (BH1750FVI)
- Temperature and humidity sensor (HDC1080)
- Pressure sensor (LPS22HB)

Figure 1. AT32-EdgeAI-Sensor-EV Board



## 1.2 Software resources

Application codes used in this document can be found under the file directory below:

- SourceCode\AN0286\_SourceCode\_V2.x.x\project

*Note: The project described in this document is created upon Keil 5 environment. If there is a need to use it in other compiling environment, please refer to the following templates for more details and making necessary modifications.*

*File location: AT32F403A\_407\_Firmware\_Library\_V2.x.x\project\at\_start\_f403a\templates.*

*This file folder contains various compiling environments such as IAR6/7, keil 4/5 for user reference.*

## 1.3 Embedded devices on the board

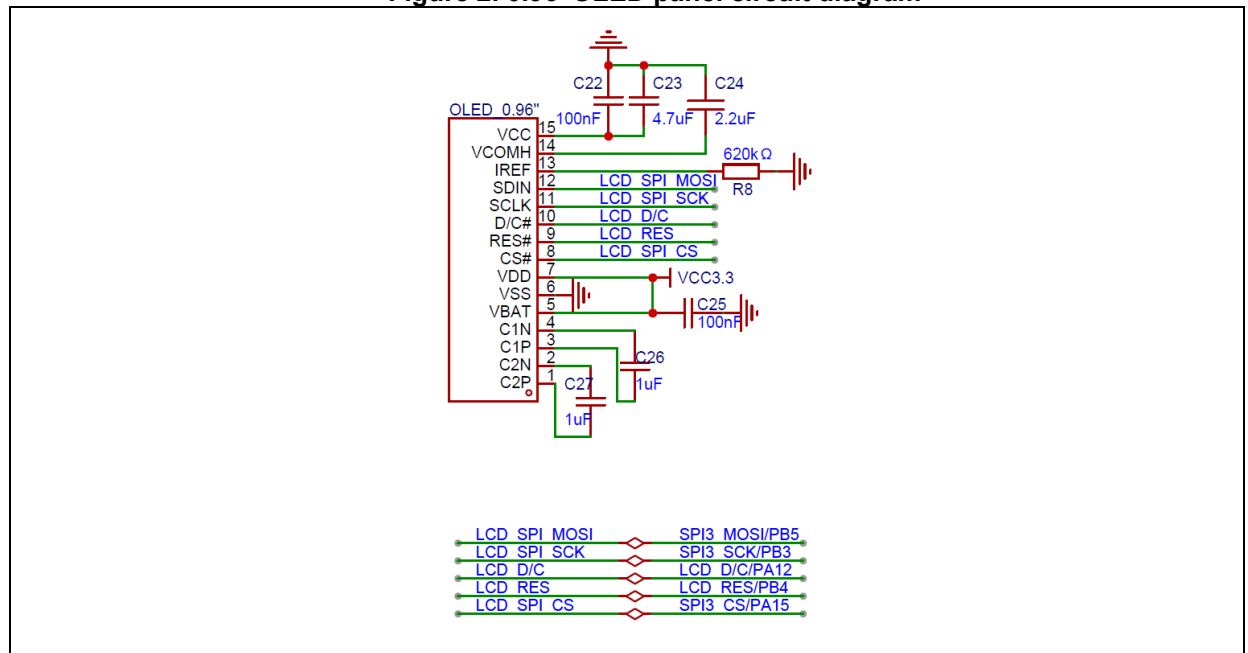
### 1.3.1 0.96' OLED panel

It is a single-chip OLED panel and can be read out via SPI interface. The panel displays data directly from internal 128\*64 bits Graphic Display Data RAM (GDDRAM). For full details about OLED, please refer to the datasheet located at the path below:

- SensorDataSheet\0.96\_OLED

Figure 2 illustrates the circuit diagram of the OLED on the AT32-EdgeAI-Sensor-EV Board.

**Figure 2. 0.96' OLED panel circuit diagram**



## 1.3.2 Time-of-Flight sensor (VL53L7CX)

Specifically designed for applications requiring an ultra wide FoV, the VL53L7CX Time-of-Flight sensor offers a 90° diagonal FoV.

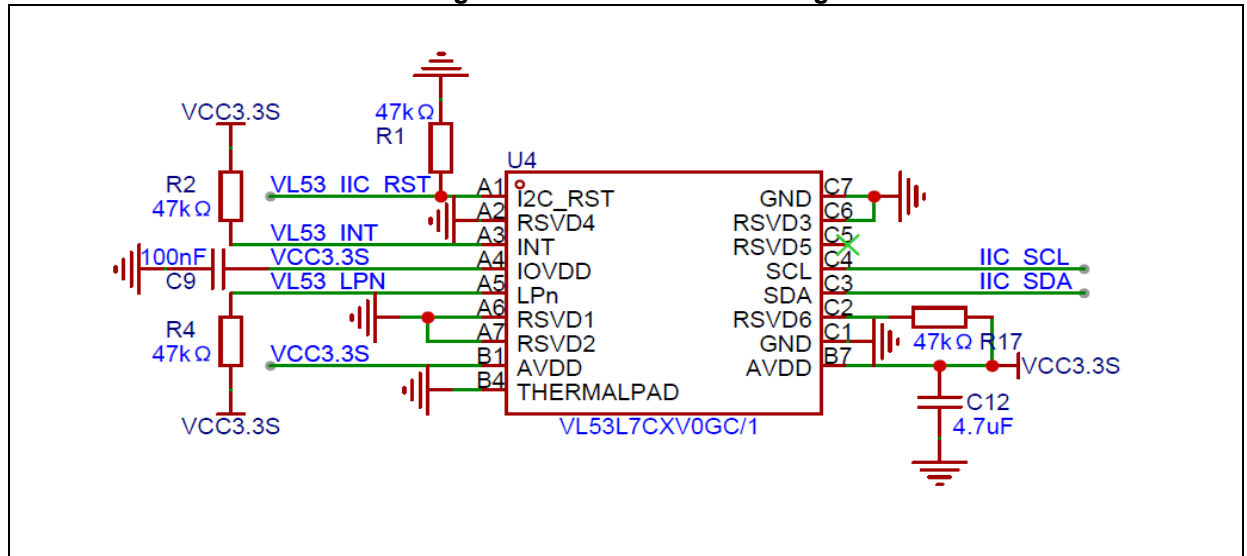
Based on FlightSense technology, the VL53L7CX incorporates an efficient metasurface lens placed on the laser emitter enabling the projection of a 60° x 60° square FoV onto the scene.

For more details about this sensor, please refer to the datasheet located at the path below:

- SensorDataSheet\VL53L7CX

Figure 3 illustrates the circuit diagram of the sensor on the AT32-EdgeAI-Sensor-EV Board.

**Figure 3. VL53L7CX circuit diagram**



## 1.3.3 3-axis magnetometer (LIS2MDL)

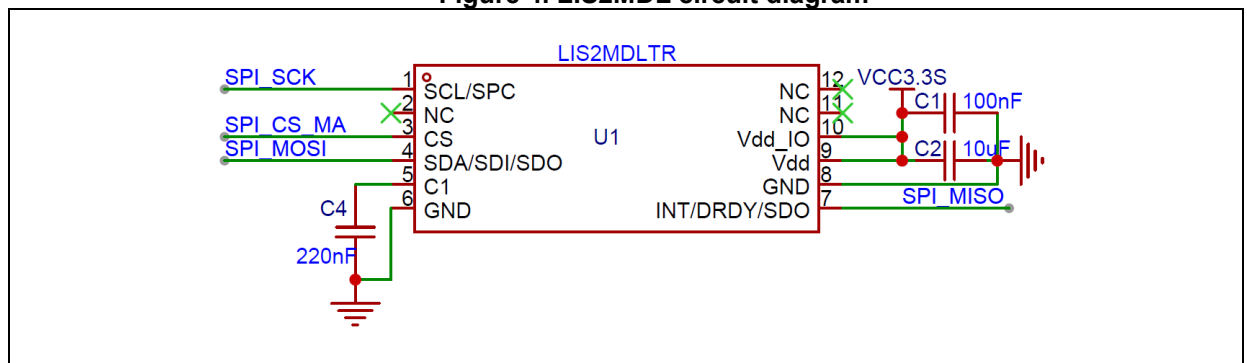
The LIS2MDLTR is an ultra-low-power, high-performance 3-axis digital magnetic sensor. The LIS2MDLTR has a magnetic field dynamic range of  $\pm 50$  gauss. It includes an I2C and SPI interfaces. The device can be configured to generate an interrupt signal for magnetic field detection.

For more details about this sensor, please refer to the datasheet located at the path below:

- SensorDataSheet\LIS2MDL

Figure 4 illustrates the circuit diagram of the sensor on the AT32-EdgeAI-Sensor-EV Board.

**Figure 4. LIS2MDL circuit diagram**



## 1.3.4 3D accelerometer/gyroscope (LSM6DS3TR)

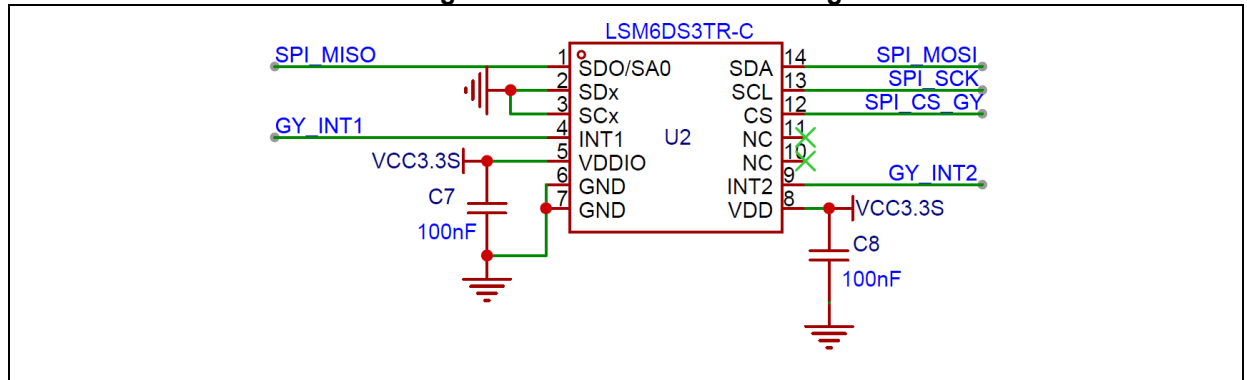
The LSM6DS3TR is a system-in-package featuring a 3D digital accelerometer and a 3D digital gyroscope performing at 0.90 mA in high-performance mode and enabling always-on low-power features for an optimal motion experience for the consumer.

For more details about this sensor, please refer to the datasheet located at the path below:

- SensorDataSheet\LSM6DS3TR

Figure 5 illustrates the circuit diagram of the sensor on the AT32-EdgeAI-Sensor-EV Board.

**Figure 5. LSM6DS3TR circuit diagram**



## 1.3.5 Ambient light sensor (BH1750FVI)

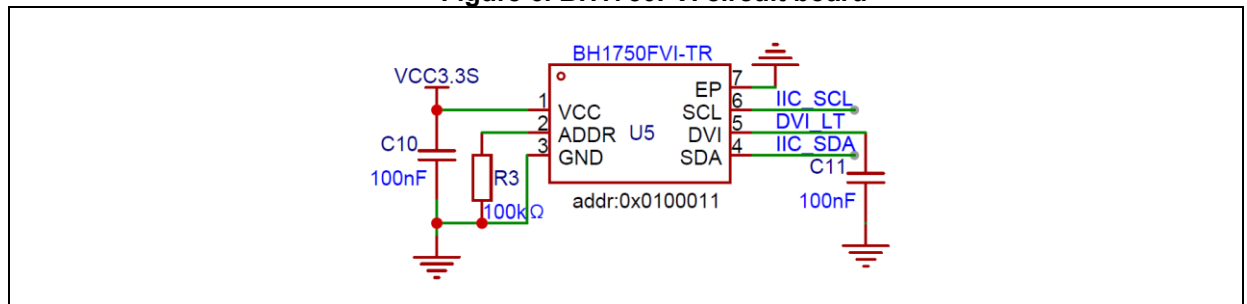
The BH1750FVI is a digital Ambient Light Sensor IC for I2C interface. This sensor is the most suitable to obtain the ambient light data. It is possible to detect wide range at high resolution of 1-65535 lx. It embeds a 16-bit AD converter.

For more details about this sensor, please refer to the datasheet located at the path below:

- SensorDataSheet\BH1750FVI

Figure 6 illustrates the circuit diagram of the sensor on the AT32-EdgeAI-Sensor-EV Board.

**Figure 6. BH1750FVI circuit board**



## 1.3.6 Temperature and humidity sensor (HDC1080)

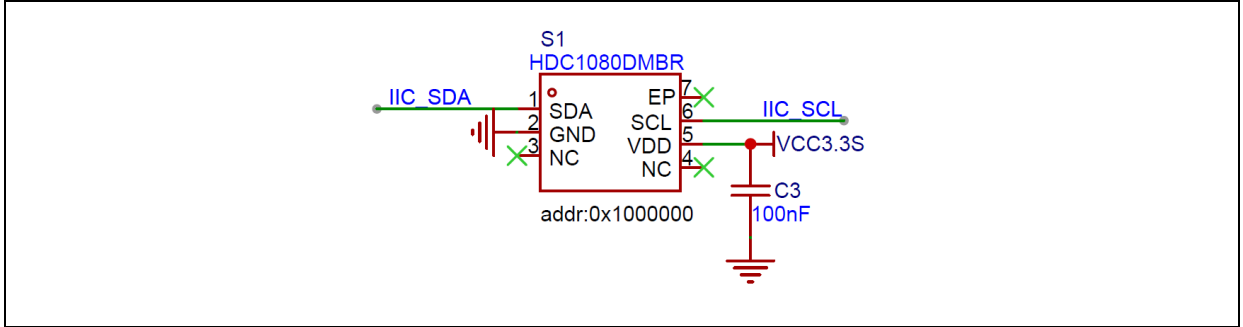
The HDC1080 is a digital humidity sensor with integrated temperature sensor that provides excellent measurement accuracy at very low power. It is able to perform well in a wider range of operating voltage supplies. The humidity and temperature sensor has been calibrated before shipment.

For more details about this sensor, please refer to the datasheet located at the path below:

- SensorDataSheet\HDC1080

Figure 7 illustrates the circuit diagram of the sensor on the AT32-EdgeAI-Sensor-EV Board.

**Figure 7. HDC1080 circuit diagram**



## 1.3.7 Pressure sensor (LPS22HB)

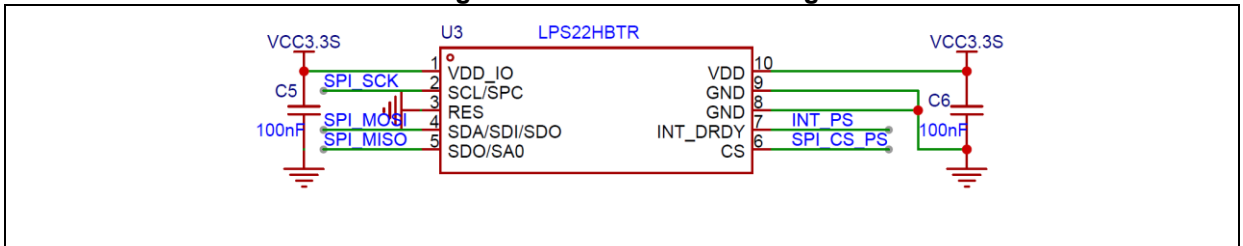
The LPS22HB is an ultra-compact piezoresistive absolute pressure sensor which functions as a digital output barometer. The device comprises a sensing element and an IC interface which communicates through I2C or SPI from the sensing element to the application.

For more details about this sensor, please refer to the datasheet located at the path below:

- SensorDataSheet\LPS22HB

Figure 8 illustrates the circuit diagram of the sensor on the AT32-EdgeAI-Sensor-EV Board.

**Figure 8. LPS22HB circuit diagram**



## 2 Software configuration

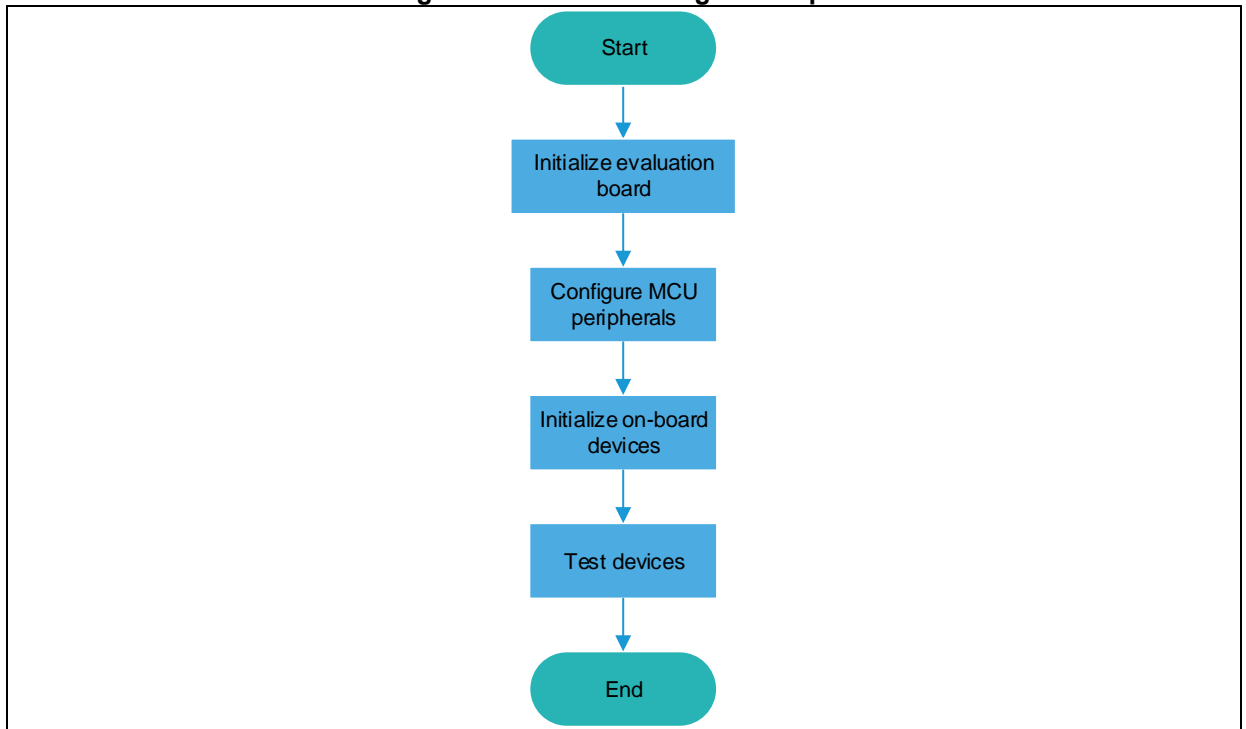
This chapter describes software configuration of the evaluation board.

### 2.1 Configuration procedure

- Configure a system clock
- Initialize the evaluation board, including LED, buttons, time delay system, etc.
- Configure MCU peripherals such as I2C, SPI, TMR
- Initialize OLED panel and sensors
- Call test functions

Figure 9 illustrates the flowchart of the software configuration.

Figure 9. Software configuration process



### 2.2 Code description

Application codes consists of two parts: MCU and sensor configuration, and test program.

Driver codes of the sensors are stored in the folder below:

- SourceCode\AN0286\_SourceCode\_V2.0.0\middlewares

Here are the descriptions about main function and test function.

- Main function code:

```
int main(void)
{
    hi2cx.i2cx = I2C1;

    system_clock_config();

    at32_board_init();

    button_exint_init();

    uart_print_init(460800);

    spi1_config();
}
```

```
tmr6_config();

i2c_config(&hi2cx);

delay_ms(200);

oled_config();

lsm6ds3tr_c_init();

lis2mdl_init();

lps22hb_init();

bh1750_init();

hdc1080_init();

vl5317_init();

factory_test();

while(1)
{
}
}
```

#### ■ factory\_test code:

```
void factory_test(void)
{
    uint32_t num, test_cnt=0, status;

    printf("AT32 EdgeAI Sensor EV Board start testing...\r\n");
    sensor_flag = 0;
    num = bh1750_get_data();
    printf("Ambient Light [lx]: %4d\r\n", num);
    if(num > 10 && num < 1000)
    {
        OLED_ShowString(0,20,"bh1750: OK",16,1);
        test_cnt++;
    }
    else
    {
        OLED_ShowString(0,20,"bh1750: ERROR",16,1);
    }
    OLED_Refresh();
    delay_sec(2);
    OLED_Clear();

    hdc1080_read_temperature_humidity(&temperature_raw, &temperature_s,
    &humidity_raw, &humidity_s);
    printf("Temperature [C]: %3.2f, Humidity [%] %3.2f\r\n", temperature_s,
    humidity_s);
    if((temperature_s > 0 && temperature_s < 50) && (humidity_s > 0 &&
    humidity_s < 60))
    {
        OLED_ShowString(0,20,"hdc1080: OK",16,1);
        test_cnt++;
    }
    else
    {
        OLED_ShowString(0,20,"hdc1080: ERROR",16,1);
    }
}
```

```
OLED_Refresh();
delay_sec(2);
OLED_Clear();

lps22hb_read_data_polling();
if (pressure_hPa > 800 && pressure_hPa < 1200)
{
    OLED_ShowString(0,20,"lps22hb: OK",16,1);
    test_cnt++;
}
else
{
    OLED_ShowString(0,20,"lps22hb: ERROR",16,1);
}
OLED_Refresh();
delay_sec(2);
OLED_Clear();

lsm6ds3tr_c_read_data_polling();
if (acceleration_mg[0] != 0 || acceleration_mg[1] != 0 ||
acceleration_mg[2] != 0)
{
    OLED_ShowString(0,20,"lsm6ds3: OK",16,1);
    test_cnt++;
}
else
{
    OLED_ShowString(0,20,"lsm6ds3: ERROR",16,1);
}
OLED_Refresh();
delay_sec(2);
OLED_Clear();

lis2mdl_read_data_polling();
if (magnetic_mG[0] != 0 || magnetic_mG[1] != 0 || magnetic_mG[2] != 0)
{
    OLED_ShowString(0,20,"lis2mdl: OK",16,1);
    test_cnt++;
}
else
{
    OLED_ShowString(0,20,"lis2mdl: ERROR",16,1);
}
OLED_Refresh();
delay_sec(2);
OLED_Clear();

status = v15317_ranging_data_collect();
if (status == 0)
{
    OLED_ShowString(0,20,"v15317cx: OK",16,1);
    test_cnt++;
}
else
{
    OLED_ShowString(0,20,"v15317cx: ERROR",16,1);
}
OLED_Refresh();
delay_sec(2);
OLED_Clear();

OLED_ShowString(4,10,"OK: ",16,1);
OLED_ShowNum(28,10,test_cnt,1,16,1);
OLED_ShowString(36,10," ERROR: ",16,1);
```

```
OLED_ShowNum(100,10,6-test_cnt,1,16,1);
if(test_cnt == 6)
    OLED_ShowString(4,30,"PASS",24,1);
else
    OLED_ShowString(4,30,"FAIL",24,1);
OLED_Refresh();
delay_sec(2);
OLED_Clear();

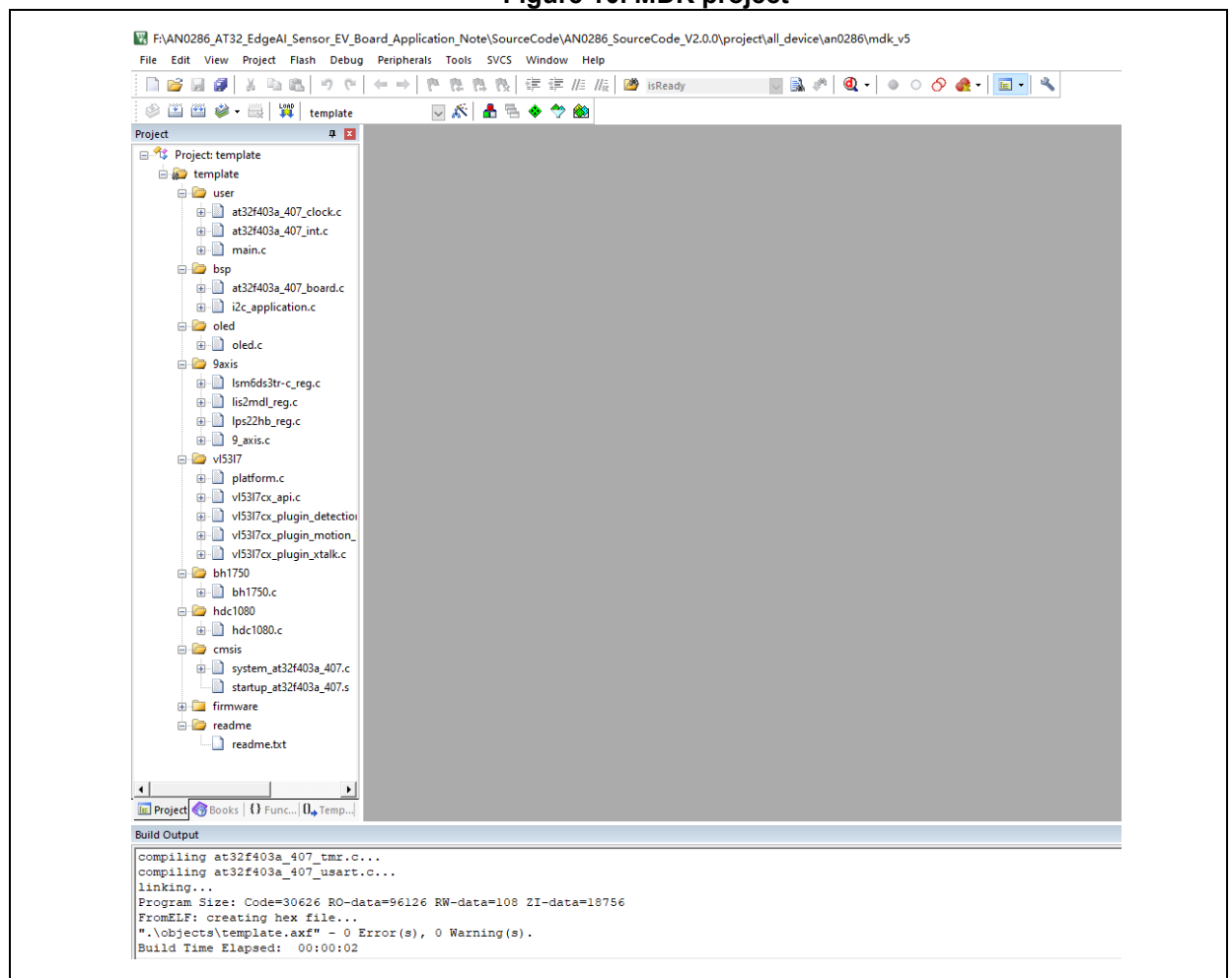
OLED_ShowString(4,10,"Press KEY",16,1);
OLED_ShowString(4,30,"Test LED",16,1);
OLED_Refresh();
printf("AT32 EdgeAI Sensor EV Board test is completed.\r\n");
}
```

### 3 Case example

This chapter describes the steps about how to use demo projects included in this file.

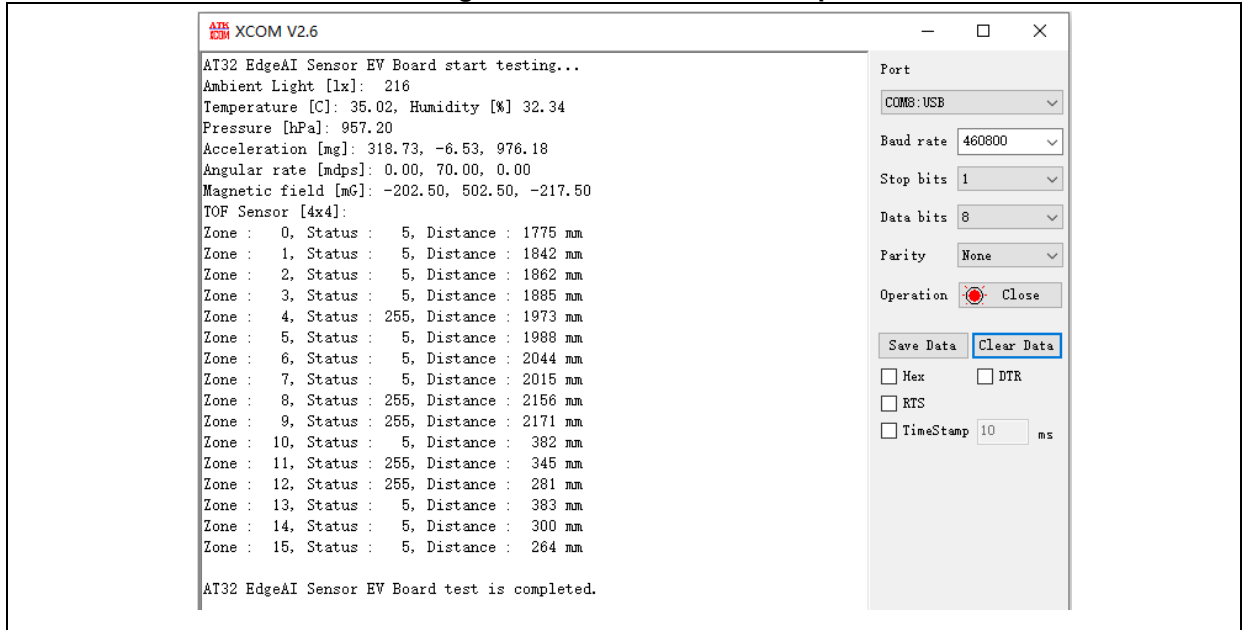
- 1) Go to "SourceCode\AN0286\_SourceCode\_V2.x.x\project\all\_device\an0286\mdk\_v5". Open "MDK5" project and compile it, and then you can find all of the code files on the left side of Figure 10.

Figure 10. MDK project



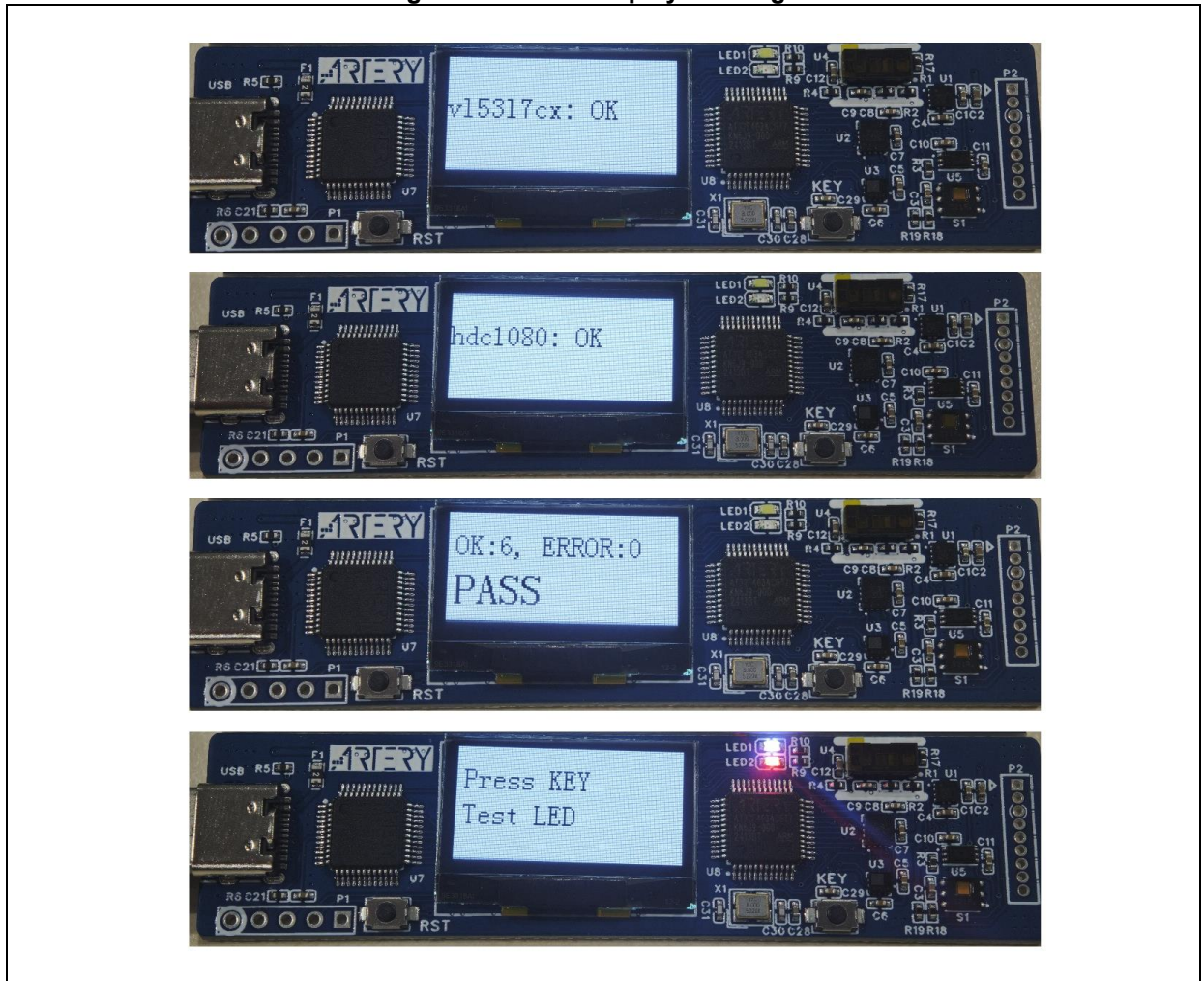
- 2) After the completion of compiling operation, connect the AT\_Link\_EZ to start download. After download operation, the evaluation board starts testing, and the serial port prints data of each of the sensors, as shown in Figure 11.

**Figure 11. Print data via serial port**



- 3) Meanwhile, OLED displays testing results, as shown in Figure 12.

**Figure 12. OLED displays testing results**





## 4 Revision history

Table 1. Document revision history

Date	Revision	Changes
2025.08.28	2.0.0	Initial release

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