ATAVRFEB-P4

P4 Hardware User Guide

Introduction

This is the hardware user guide for the P4 field engagement board (ATAVRFEB-P4), based on the ATtiny416, a high performance tinyAVR® 8-bit microcontroller. The board is a hardware platform to demonstrate how to implement an electronic pillbox using the ATtiny416, taking advantage of some of its ultra low-power features.

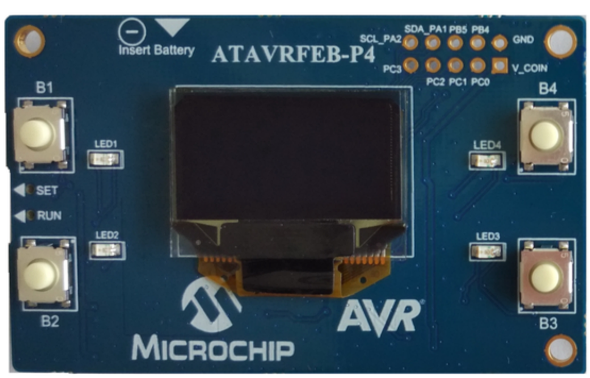
P4 incorporates ATtiny416 microcontroller, PFM/PWM Synchronous Boost Regulator MCP16251, 128*64 pixels OLED, Piezo Audio Transducer, LEDs and buttons to demonstrate a complete solution for a typical electronic pillbox.

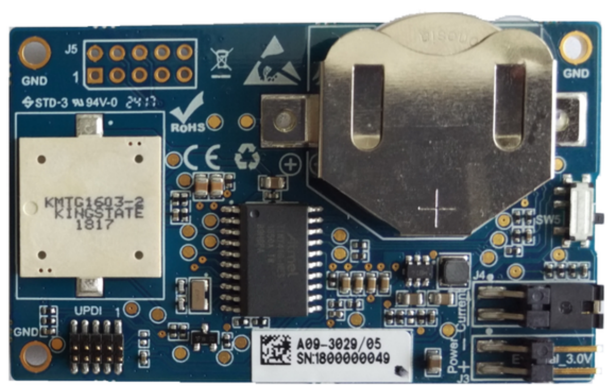
Supported by the Atmel START and Atmel Studio development platform, it has fully documented software and hardware that will significantly reduce design complexity and the time-to-market.

Users can refer to the source code and firmware user guide available at Atmel START http://www.microchip.com/start.

Features

- PFM/PWM Synchronous Boost Regulator MCP16251
- 128*64 Pixels OLED
- LED Indicators and Buttons for Indicating and Resetting Alarms
- Piezo Audio Transducer for the Sound Alarm
- 32.768 kHz Crystal for Accurate Timing
- Slide Switch for Setting the Working mode
- CR2450 Coin Cell or External 3V DC Act as Power
- Programming Via Single-wire UPDI





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  - ATAVRFEB-P4 field engagement board
  - CR2450 coin cell or external +3 V_{DC} power supply
  - Atmel-ICE
- Software
  - Atmel Studio 7
  - P4 firmware

2. Overview

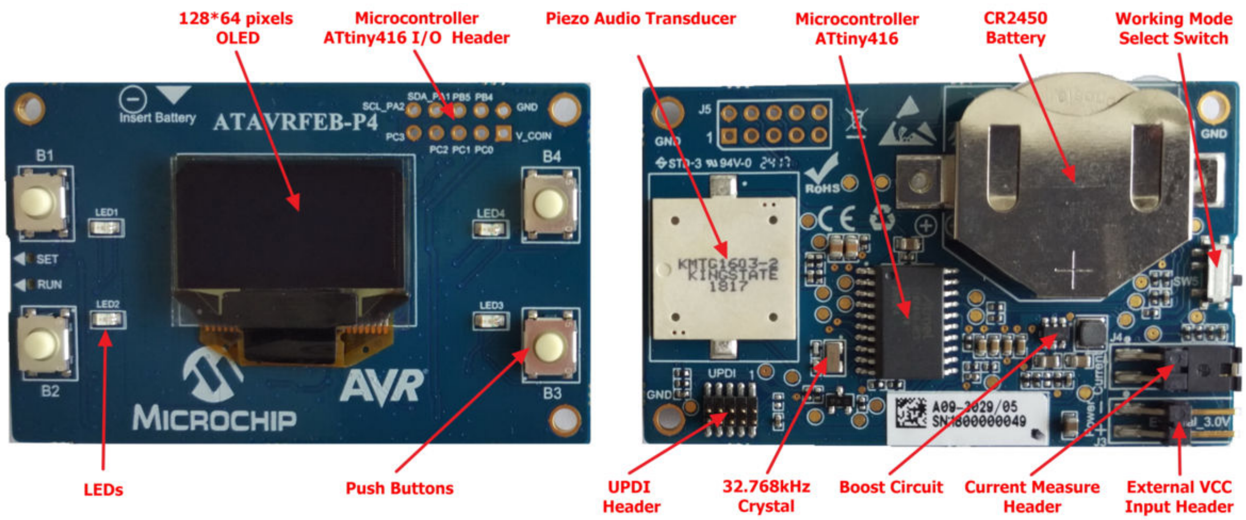
2.1 System Overview

The board includes:

- 128*64 pixels OLED that displays the setting information
- ATtiny416 I/O Header microcontroller
- LEDs and push buttons that function as the user interface
- Piezo Audio Transducer for the sound alarm
- ATtiny416 microcontroller
- CR2450 Cell battery that supplies power for the entire system
- Slide switch that sets the Working mode
- One 2-pin header, which connects to the external V_{CC}
- PFM/PWM Synchronous Boost Regulator MCP16251 powers the OLED
- 32.768 kHz crystal for accurate timing

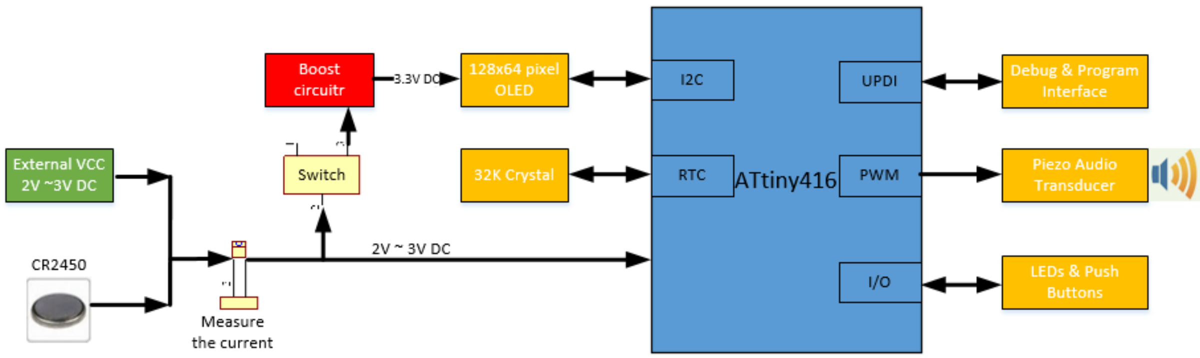
The images below show the components on the front and back of the board.

Figure 2-1. Overview of the P4



2.2 Block Diagram

Figure 2-2. Block Diagram of the P4 Board



2.3 Operation Guide

As shown in the block diagram above, the P4 field engagement board is powered using a CR2450 coin cell or by external DC power. The input voltage range of the external DC power is 2V to 3V DC. The boost regulator controls the coin cell or external voltage to 3.3V, which only provides power for the OLED. A jumper is used to measure the current of the entire system. The slide switch is used for setting the working mode of the kit, setting the alarm or time, and changing the system to the low-power working mode.

Power-on the board and push the slide switch to the "SET" position so that the OLED is brighten. There are four push buttons that are used to set different parameters of the alarm: turn on/off alarm, set the alarm time, and set the time of the system.

The B1 button is used to select the alarm or the time setting page. On the alarm setting page, the B2 and B3 buttons are used to set the alarm time, and the B4 button is used to turn on/off the alarm. On the time setting page, the B2 and B3 buttons are used to set the real time of the system, and B4 is not defined.

After setting the time and the alarm, push the slide switch to the "RUN" position. The OLED is turned off and the system is working in the low power mode. When the alarm time is reached, the system will alarm by flashing the LED and sounding the alarm. To stop the alarm push the buttons: LED1 and B1 is used for alarm1, LED2 and B2 is used for alarm2, LED3 and B3 is used for alarm3, LED4 and B4 is used for alarm4.

Figure 2-3. Display Alarm Setting Page on the OLED

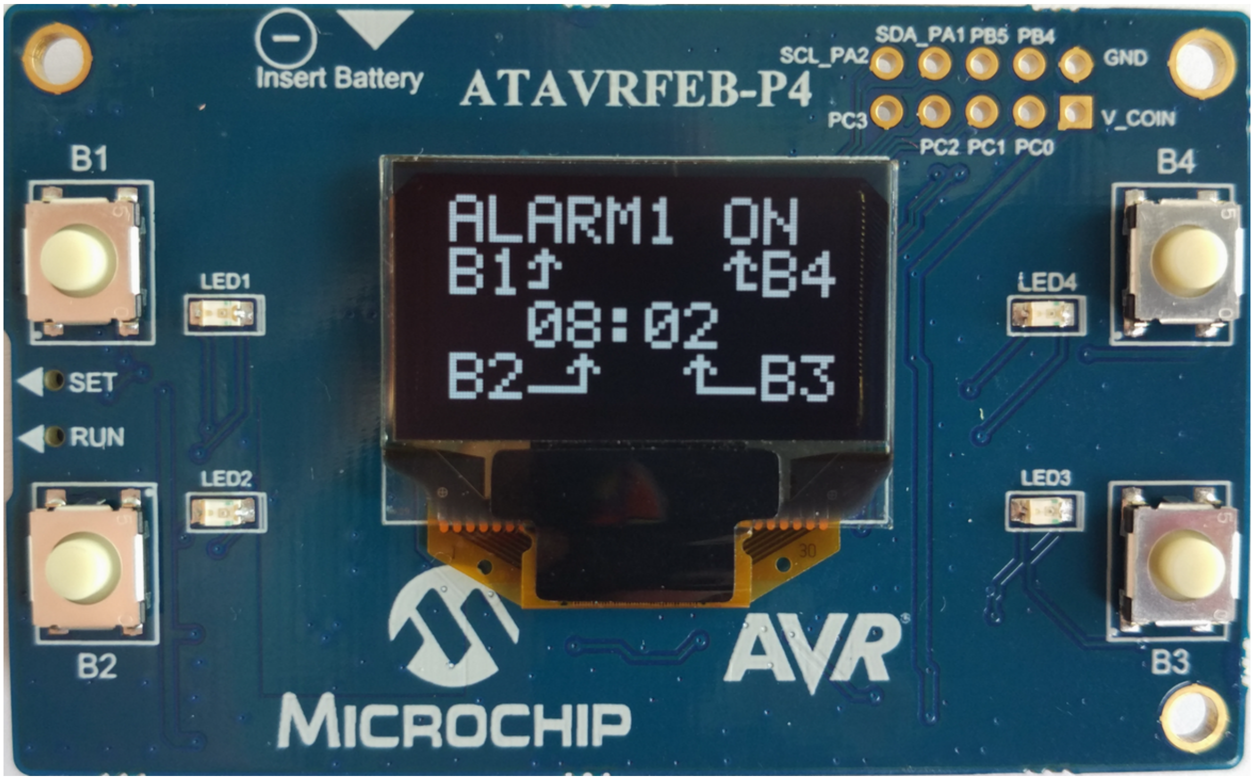
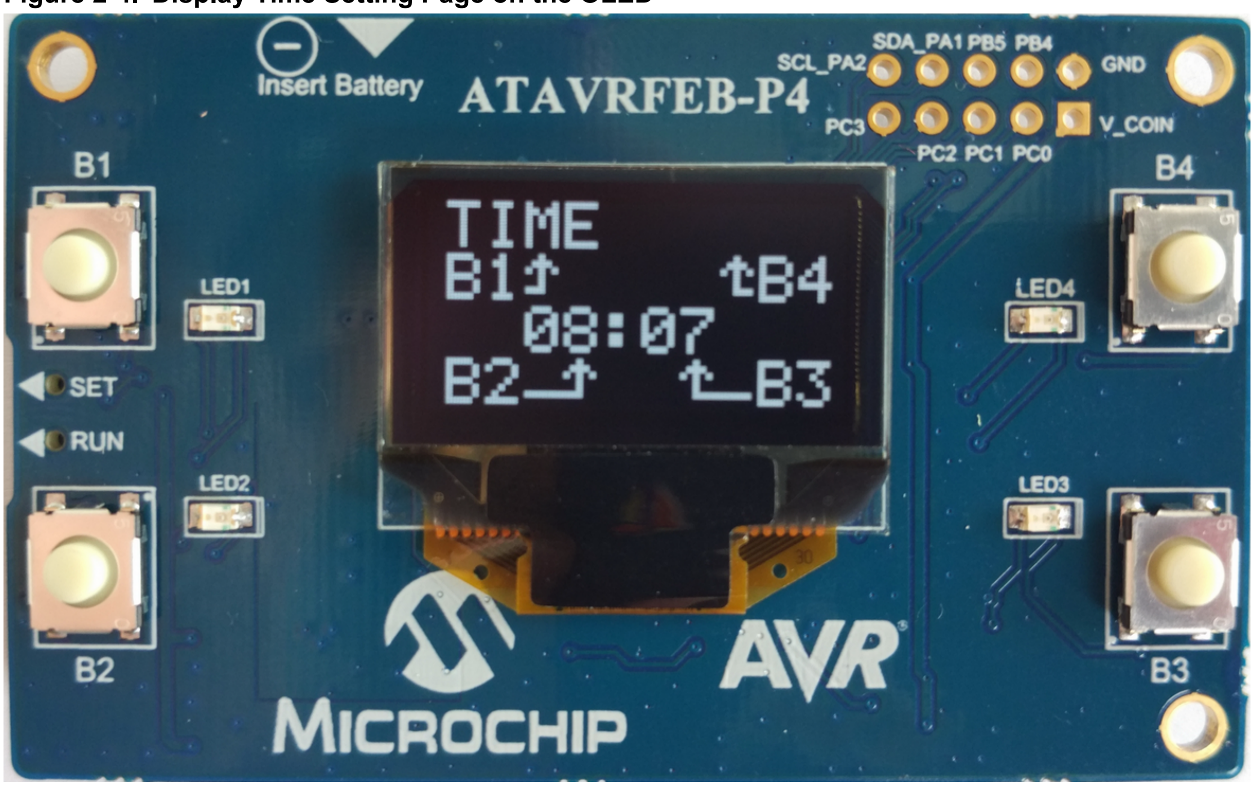


Figure 2-4. Display Time Setting Page on the OLED

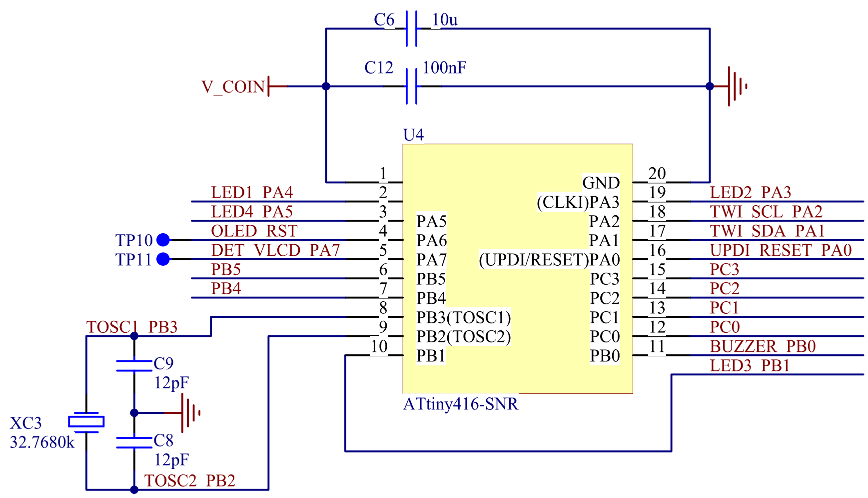


3. Hardware Details

3.1 Microcontroller

This board uses the ATtiny416, which is an 8-bit tinyAVR® microcontroller with 4 KB Flash, 256B SRAM, and 128B of EEPROM in a 20-pin package. The high-performance, low-power AVR RISC architecture on this microcontroller includes Event System, SleepWalking, accurate analog features, and advanced peripherals.

Figure 3-1. Schematic for the Microcontroller



3.2 Piezo Audio Transducer

A piezo audio transducer is used to play the sound alarm on the P4, and is connected to PB0 on the ATtiny416. Different frequencies from the PWM can be used to play tunes.

Figure 3-2. Piezo Audio Transducer

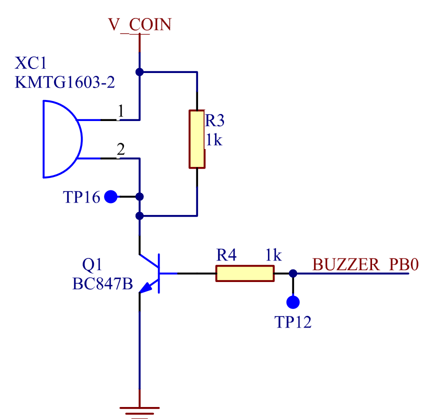


Table 3-1. Pin Map for the Piezo Audio Transducer

Signal name	MCU pin
BUZZER_PB0	PB0

3.3 Power Supply

As shown in the figure below, the board is supplied with +3V from either a CR2450 coin cell or external DC power source via the J3 connector. The applied PFM/PWM Synchronous Boost Regulator can source out more than 250 mA @ 3.3V power for OLED. The 1x2 connector is a 2.54 mm pitch surface mount header and used to measure the current. The SW5 slide switch is used to select the working mode of the kit, setting the alarm or time, and changing the system to the low-power working mode. The switch position and jumper position on the connector should be applied as shown in the table below.

Figure 3-3. Power Supply for the System

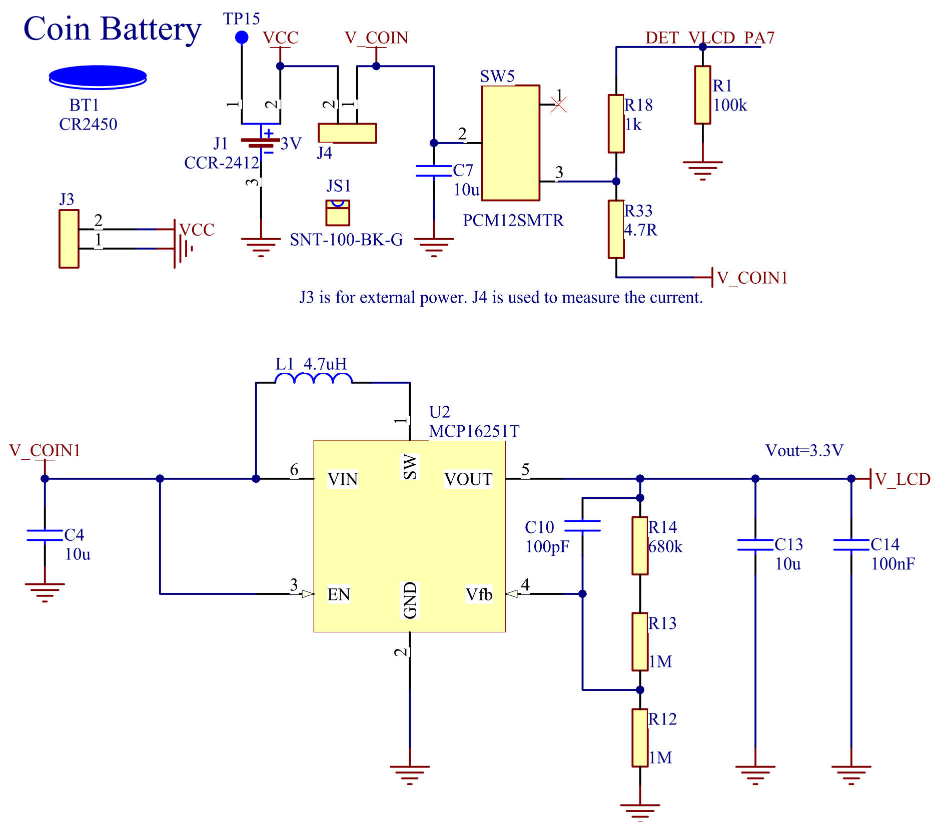


Table 3-2. Pin Map for the External DC Power

Pin on J3 connector	Description
1	Negative Pole of DC Power
2	Positive Pole of DC Power

Table 3-3. Pin Map for the Current Measurement Connector

Pin on J3 connector	Description
1	Current output
2	Current input

Table 3-4. Working Mode Select Switch Position

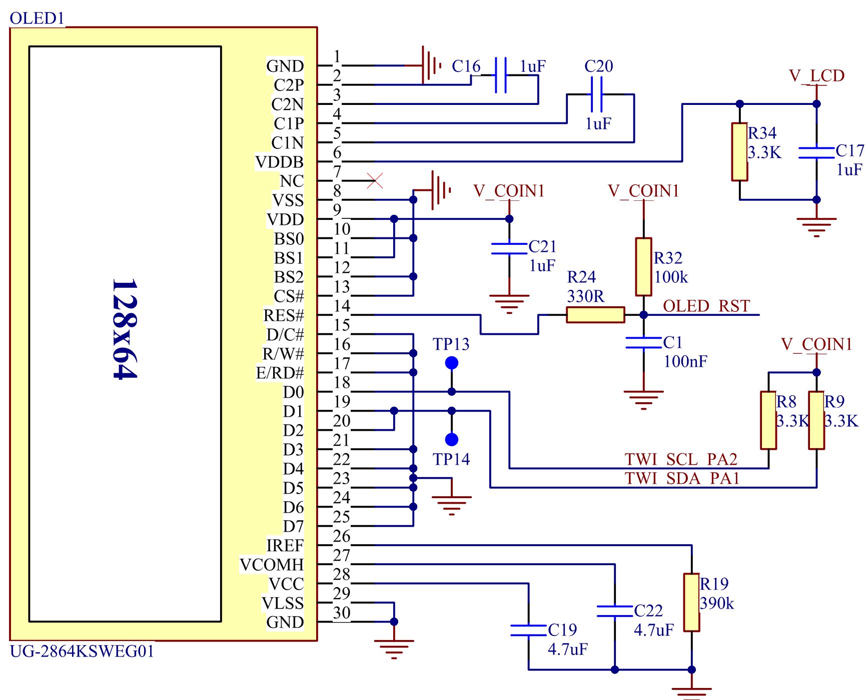
Switch Options	Description
1-2	Low-power mode
3-2	Setting mode

3.4 User Interface

3.4.1 OLED Display

On the board, the 128x64 pixels OLED is used to show setting information about the alarm and the current time. The communication is built between the OLED display and ATtiny416 via TWI, which is used for sending data to the OLED. In order to keep the same level of the TWI between the ATtiny416 and OLED, the logic part and internal buffer of the DC/DC voltage converter of the OLED display, have different power sources.

Figure 3-4. OLED Display



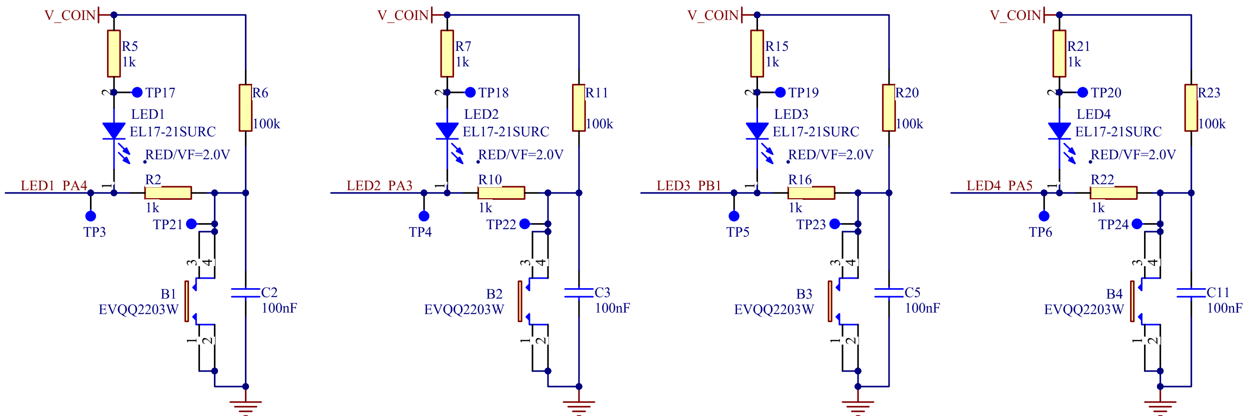
The detailed GPIO pin definition is shown in the table below.

Table 3-5. Pin Map for the OLED

Signal name	OLED Pin	MCU Pin
OLED_RST	RES#	PA6
TWI_SCL_PA2	D0	PA2
TWI_SDA_PA1	D1	PA1

3.4.2 LEDs and Push Buttons

There are four LEDs and push buttons to set a maximum of four different daily alarm times. By design, an LED and a push button are reused as one I/O port, saving the I/O resources of the microcontroller. In this design, to address the worst case scenario, the low level can be recognized by the microcontroller at the maximum supply voltage and minimum drop voltage of the LED when pressing the button.



The detailed GPIO pin definition is shown in the table below.

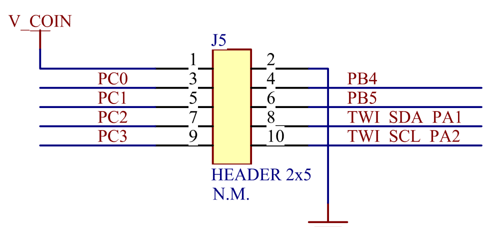
Table 3-6. Pin Map for the LEDs

LED Name	Push Buttons	Signal Name	Microcontroller Pin
Alarm1	B1	LED1_PA4	PA4
Alarm2	B2	LED2_PA3	PA3
Alarm3	B3	LED3_PB1	PB1
Alarm4	B4	LED4_PA5	PA5

3.4.3 I/O Connector

On the board, the 2x5 connector for the interface is reserved for the user and it is a 2.54 mm pitch through hole mount header.

Figure 3-5. I/O Connector



The detailed GPIO pin definition is shown in the table below.

Table 3-7. Pin Map for the I/O Connector

Signal name	Header Pin	MCU Pin
V_COIN	1	VCC
GND	2	GND
PC0	3	PC0

Signal name	Header Pin	MCU Pin
PB4	4	PB4
PC1	5	PC1
PB5	6	PB5
PC2	7	PC2
TWI_SDA_PA1	8	PA1
PC3	9	PC3
TWI_SCL_PA2	10	PA2

3.5 UPDI Programming Interface

Unified Program and Debug Interface (UPDI) is a Microchip proprietary interface for external programming and on-chip debugging of a device.

The 2x5 connector for the interface is a 1.27 mm pitch surface mount header.

Figure 3-6. UPDI Interface

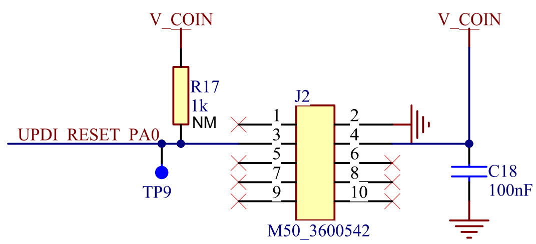


Table 3-8. Pin Map for ATtiny UPDI416 Interface

Signal name	Header Pin	MCU Pin
GND	2	GND
UPDI_RESET_PA0	3	PA0
V_COIN	4	V_{CC}

4. Firmware

4.1 ATtiny416 Default Firmware

The ATtiny416 device on the board comes preprogrammed with the Pillbox Alarm P4 firmware. The source code can be found in Atmel Start.

4.2 Firmware Programming

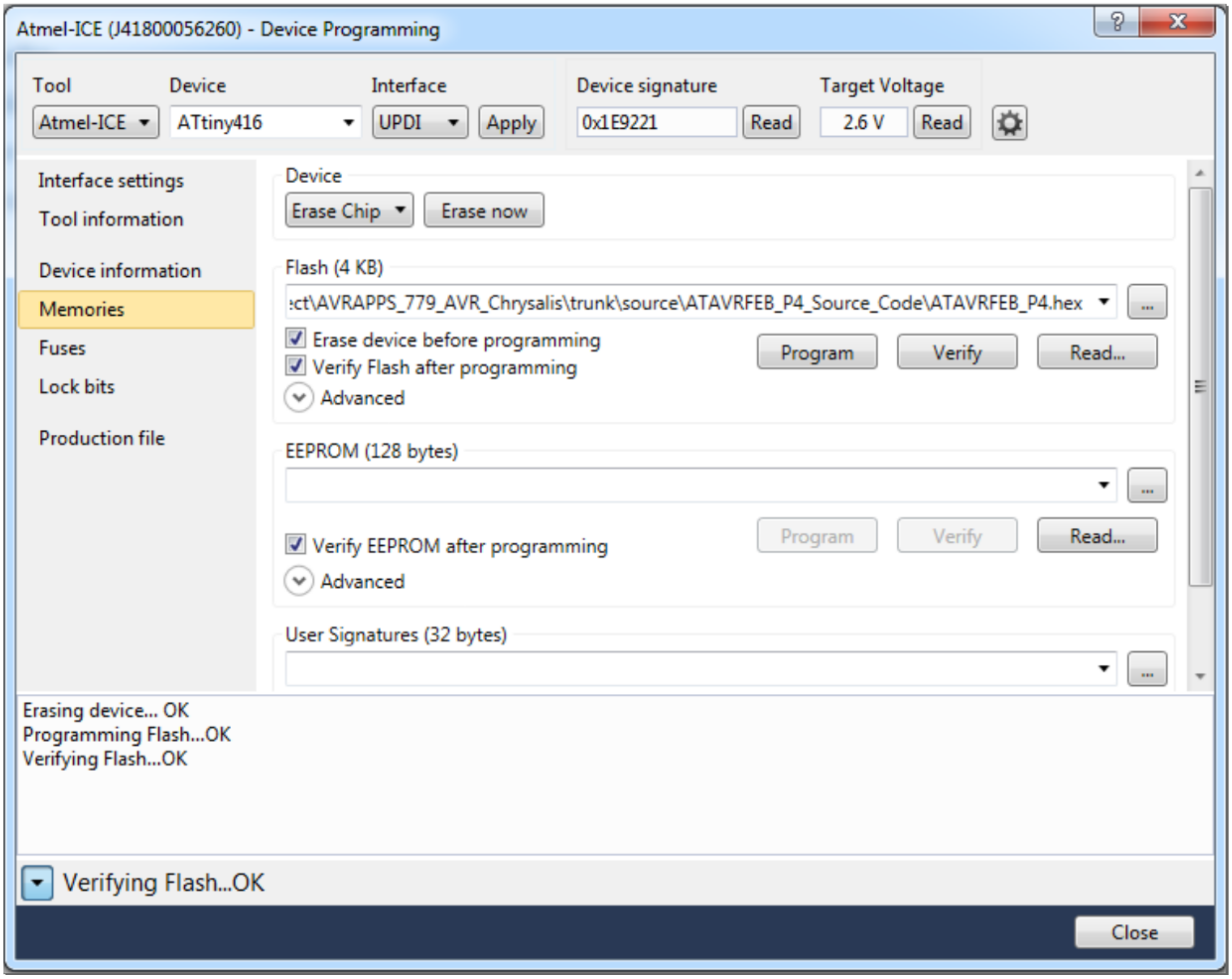
It is possible to reprogram the device using an Atmel-ICE or similar tool with UPDI support.

Figure 4-1. Connection of the Board and Programmer

Note: The AVR port of the Atmel-ICE must be used for programming and debugging the ATtiny416 device.

The programming interface of Atmel Studio is shown in the figure below:

Figure 4-2. Programming Interface in Atmel Studio



5. Revision History

Doc. Rev.	Date	Comments
A	12/2017	Initial document release

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