Getting started with AT32F425R8T7-7

Introduction

AT-START-F425 is designed to help you explore the high performance of the 32-bit microcontroller AT32F425 that embeds ARM Cortex®-M4 core, and expedite application development.

AT-START-F425 is an evaluation board based on AT32F425R8T7-7 microcontroller. The device contains such peripherals as LEDs, buttons, USB micro-B connector, type-A connector, Arduino™ Uno R3 extension interface. This evaluation board embeds AT-Link-EZ for debugging/programming without the need of other development tools.

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1 Overview

1.1 Features

AT-START-F425 has the following characteristics:

- AT-START-F425 has an on-board AT32F425R8T7-7microcontroller that embeds ARM Cortex®-M4 32-bit core, 64 KB Flash memory and 20 KB SRAM, in LQFP64 7x7mm packages.
- On-board AT-Link interface:
  - On-board AT-Link-EZ can be used for programming and debugging (AT-Link-EZ is a simplified version of AT-Link, without offline mode support)
  - If AT-Link-EZ were disassembled from the board by bending it along the joint, this interface can be connected to an independent AT-Link for programming and debugging.
- Various power supply methods:
  - USB bus of AT-Link-EZ
  - USB OTG bus (V_{BUS}) of AT-START-F425
  - External 5 V power supply (E5V)
  - External 3.3 V power supply
- 4 x LED indicators:
  - LED1 (red) indicates 3.3 V power-on
  - 3 x USER LEDs, LED2 (red),LED3 (yellow) and LED4 (green), indicate operation status
- User button and Reset button
- 8 MHz HEXT crystal
- 32.768 kHz LEXT crystal
- On-board USB type-A and micro-B connectors in order to demonstrate OTG1 function
- Rich extension interfaces are available for quick prototyping
  - Arduino™ Uno R3 extension interface
  - LQFP64 I/O extension interface

1.2 Definition of terms

- **Jumper JPx ON**
  Jumper is installed.
- **Jumper JPx OFF**
  Jumped is not installed.
- **Resistor Rx ON**
  Short by solder or 0Ω resistor.
- **Resistor Rx OFF**
  Open.

2 Quick start

2.1 Get started

Configure the AT-START-F425 board in the following sequence:

1. Check the Jumper's position on board:

   JP1 is connected to GND or OFF (BOOT0 = 0, and BOOT0 has an pull-down resistor in the AT32F425R8T7-7);

   JP2 is connected to USART1.

2. Connect AT_Link_EZ to PC via a USB cable (Type A to micro-B), and supply power to the evaluation board via a USB connector CN6. LED1 (red) is always on, and three other LEDs (LED2 to LED4) start to blink in turn.

3. After pressing the user button (B2), the blinking frequency of three LEDs are changed.

2.2 AT-START-F425 development toolchains

- ARM® Keil®: MDK-ARM™
- IAR™: EWARM

3   Hardware and layout

AT-START-F425 board is designed around an AT32F425R8T7-7 microcontroller in LQFP64 7x7 mm package.

Figure 1 shows the connections between AT-Link-EZ, AT32F425R8T7-7 and their peripherals (buttons, LEDs, USB OTG, and extension connectors)

Figure 2 and *Figure 3* shows their respective locations on the AT-Link-EZ and AT-START-F425 board.
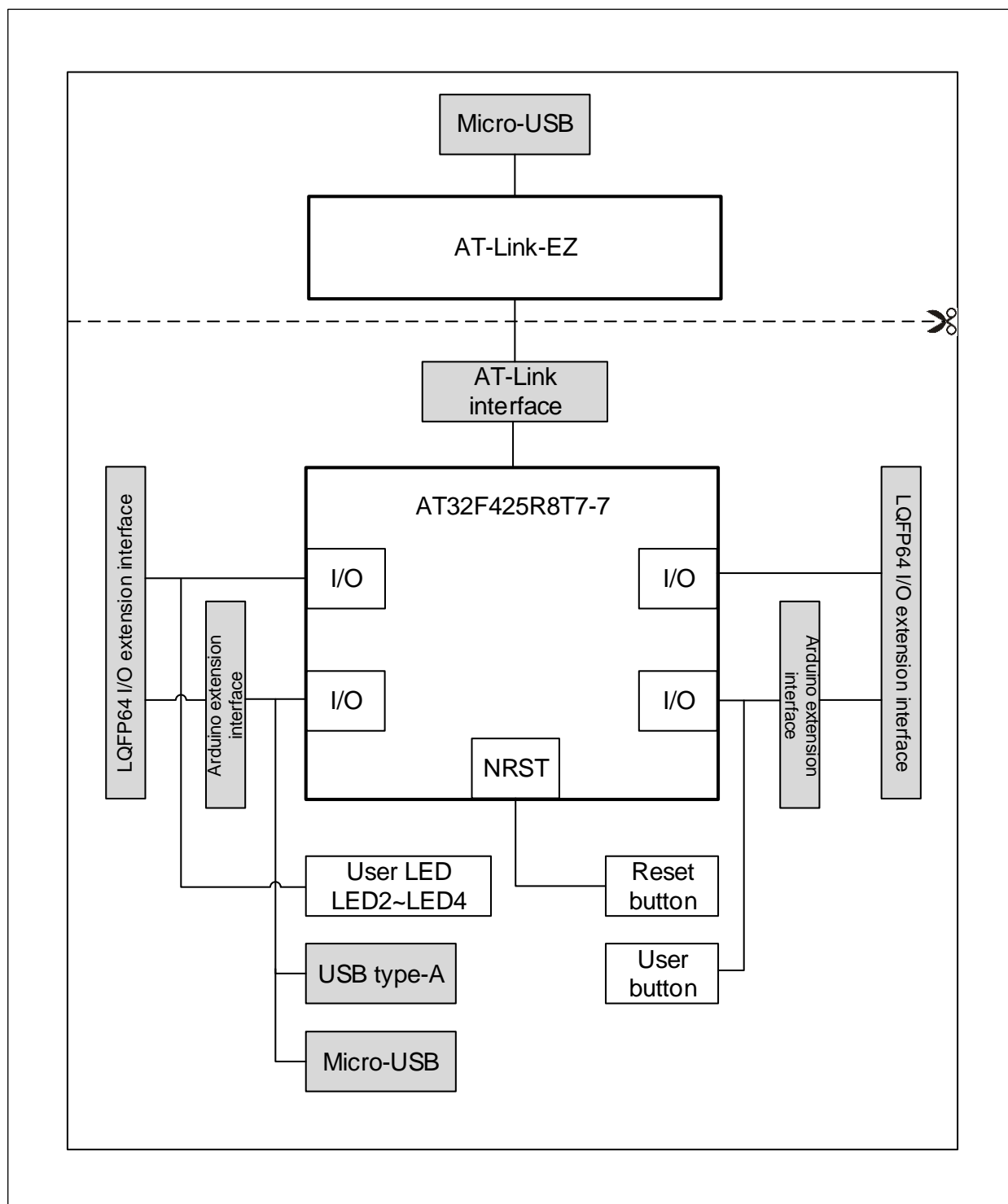
Figure 1. Hardware block diagram
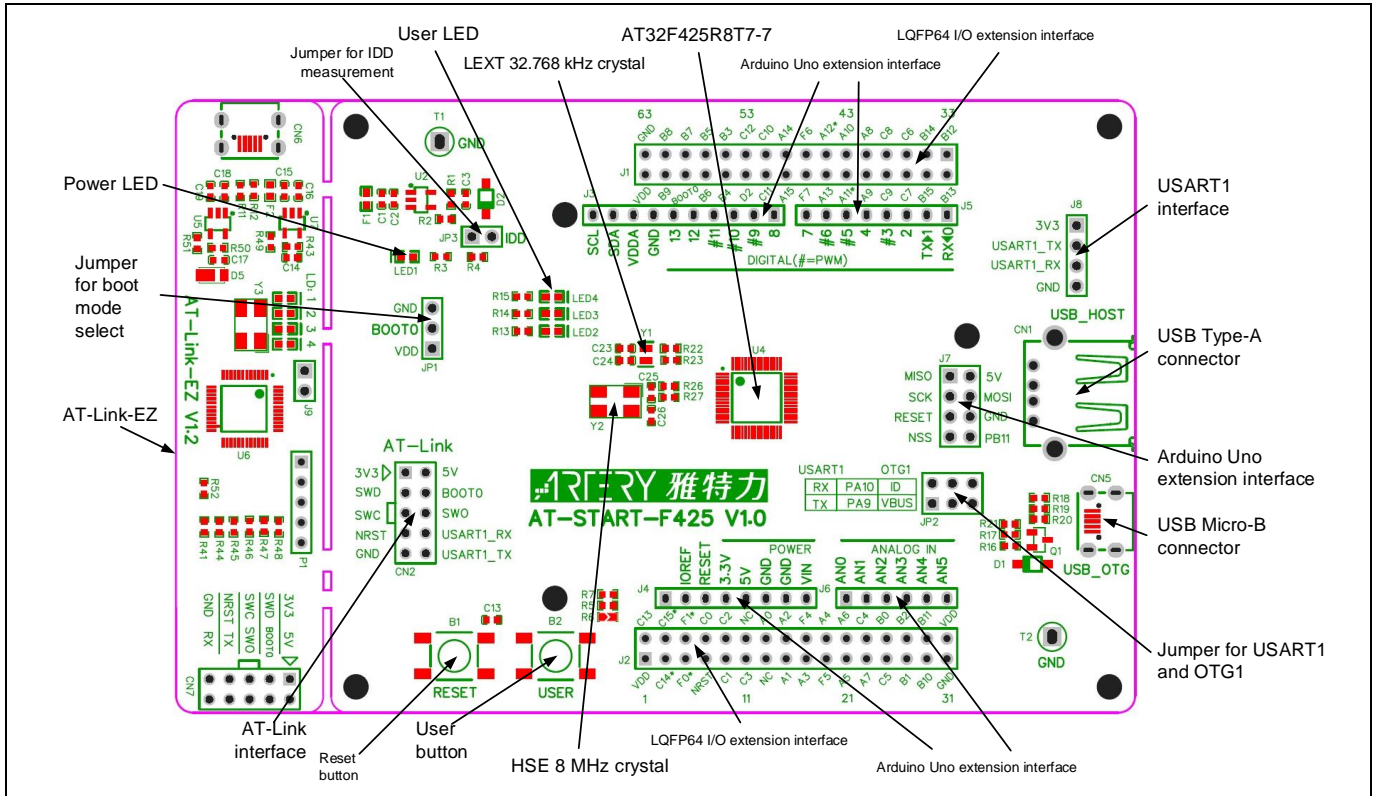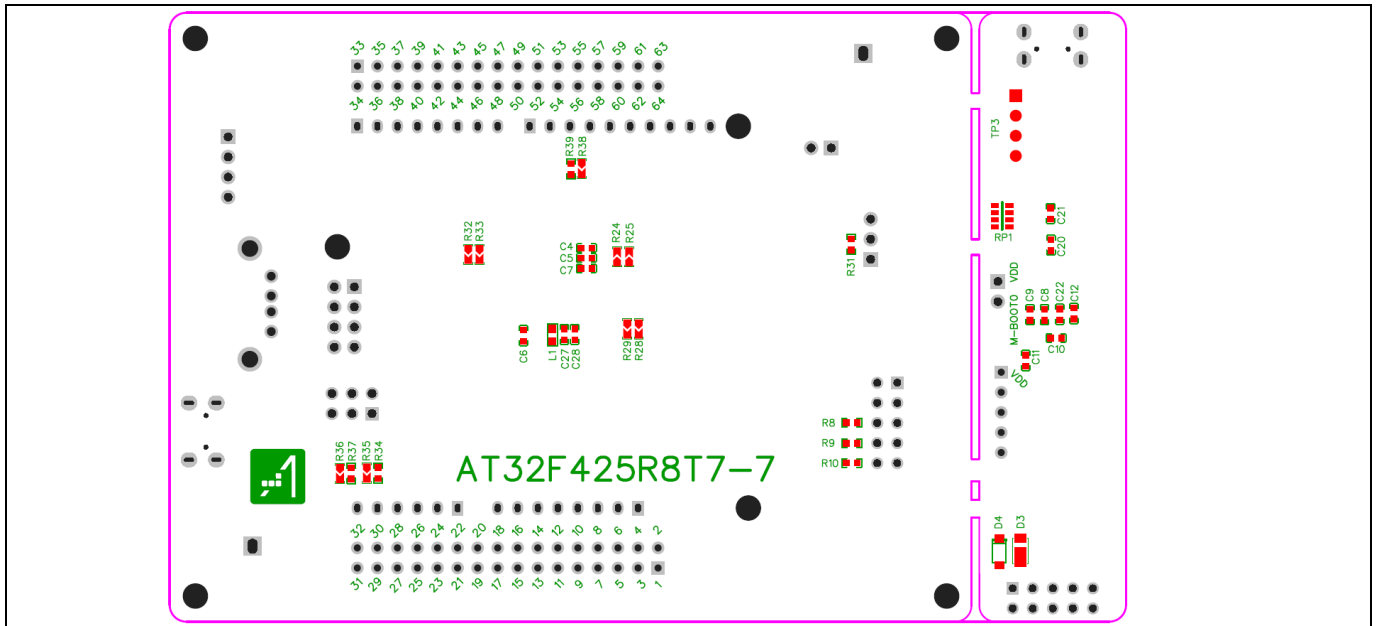
Figure 2. Top layer

Figure 3. Bottom layer

3.1 Power supply selection

The AT-START-F425 can not only be provided with 5 V through a USB cable (either through USB connector CN6 on AT-Link-EZ or USB OTG connector CN5 on AT-START-F425), but also be provided with an external 5 V power supply (E5V). Then 5 V power provides 3.3 V for the microcontroller and its peripherals using on-board 3.3 V voltage regulator (U2).

5 V pin of J4 or J7 can also be used as an input power, so the AT-START-F425 board can be supplied through a 5 V power unit.

The 3.3 V pin of J4, or the VDD of J1 and J2 can be used as 3.3 V input directly, so AT-START-F425 board can also be supplied by a 3.3 V power unit.

Note: *5 V power supply must be provided through USB connector (CN6) on AT-Link-EZ. Any other method cannot power the AT-Link-EZ.*

When another board is connected to J4, 5 V and 3.3 V can be used output power, J7's 5V pin as 5 V output power, the VDD pin of J1 and J2 as 3.3 V output power.

3.2 IDD

When JP3 OFF (symbol IDD) and R4 OFF, an ammeter can be connected to measure the power consumption of AT32F425R8T7-7.

- **JP3 OFF, R4 ON:**

  AT32F425R8T7-7 is powered. (Default setting and JP3 plug is not mounted before shipping)

- **JP3 ON, R4 OFF:**

  AT32F425R8T7-7 is powered.

- **JP3 OFF, R4 OFF:**

  An ammeter must be connected to measure the power consumption of AT32F425R8T7-7. If

  there is no ammeter available, the AT32F425R8T7-7 cannot be powered.

3.3 Programming and debugging: embedded AT-Link-EZ

The evaluation board integrates Artery AT-Link-EZ for users to program/debug the AT32F425R8T7-7 on the AT-START-F425 board. AT-Link-EZ supports SWD interface mode, SWO debug, and a set of virtual COM ports (VCP) to connect to the USART1_TX/USART1_RX (PA9/PA10) of AT32F425R8T7-7.

Please refer to AT-Link User Manual for complete details on AT-Link-EZ.

The AT-Link-EZ on board can be disassembled or separated from the AT-START-F425. In this case, the AT-START-F425 can still be connected to the CN7 interface (not mounted before leaving factory) of AT-Link-EZ through CN2 interface (not mounted before leaving factory), or to AT-Link, in order to continue to program and debug the AT32F425R8T7-7.

3.4 Boot mode selection

At startup, three different boot modes are available for selection through pin configuration.

Table 1. Boot mode selection jumper settings

Jumper	BOOT0 pin configuration	Boot mode
JP1 to GND or be OFF	0	Boot from internal Flash memory (factory default setting)
JP1 to VDD	1	Boot from boot loader code area or internal SRAM [1]

(1) Depending on the Nboot1 bit of the user system area.

3.5 External clock source

3.5.1 HEXT clock source

There are three methods to configure the external high-speed clock sources by hardware:

● **On-board crystal (Factory default setting)**

On-board 8 MHz crystal is used as HSE clock source. The hardware must be configured: R26 and R27 ON, R28 and R29 OFF.

● **External oscillator from PH0**

External oscillator is injected from the pin_75 of J2. The hardware must be configured: R28 ON, R26 and R27 OFF. To use PH1 as GPIO, R29 ON can be connected to the pin_6 of J2.

● **HSE unused**

PH0 and PH1 are used as GPIOs. The hardware must be configured: R28 and R29 ON, R26 and R27 OFF.

3.5.2 LEXT clock source

There are three methods to configure the external low-speed clock sources by hardware:

● **On-board crystal (Factory default setting)**

On-board 32.768 kHz crystal is used as LEXT clock source. The hardware must be configured: R22 and R23 ON, R24 and R25 OFF

● **External oscillator from PC14**

External oscillator is injected from the pin_3 of J2. The hardware must be configured: R24 and R25 ON, R22 and R23 OFF.

● **LEXT unused**

PC14 and PC15 are used as GPIOs. The hardware must be configured: R24 and R25 ON, R22 and R23 OFF.

3.6 LEDs

- **Power LED1**

  Red LED indicates that the AT-START-F425 is powered by 3.3 V.

- **User LED2**

  Red LED is connected to the PC2 pin of AT32F425R8T7-7.

- **User LED3**

  Yellow LED is connected to the PC3 pin of AT32F425R8T7-7.

- **User LED4**

  Green LED is connected to the PC5 pin of AT32F425R8T7-7.

3.7 Buttons

- **Reset B1: Reset button**

  It is connected to NRST to reset AT32F425R8T7-7 microcontroller.

- **User B2: User button**

  It is connected to the PA0 of AT32F425R8T7-7to act as a wakeup button (R5 ON and R6 OFF), or to the PC13 to acts as TAMPER-RTC button (R5 OFF and R6 ON).

3.8 USB OTG

AT-START-F425 board supports USB full-speed/low-speed host or full-speed device mode via a USB micro-B connector (CN5). In device mode, AT32F425R8T7-7 can be directly connected to the host through USB micro-B, and V_{BUS} can be used as 5 V input of AT- START-F425 board. In host mode, an external USB OTG cable is needed to connect to the external device. The device is powered via USB micro-B interface, which is done by PD2 controlling SI2301 switch.

AT-START-F425 board has a USB type-A extension interface (CN1). This is a USB host interface for connecting to U disk and other devices, without the need of USB OTG cable. The USB type-A interface has no power switch control.

When the PA9 or PA10 of the AT32F425R8T7-7 is used as OTGFS_VBUS or OTGFS_ID, the JP2 jumper must select OTG1. In this case, the PA9 or PA10 is connected to USB micro-B interface, but disconnected from AT-Link interface (CN2).

3.9   0Ω resistors

Table 2. 0Ωresistor settings

Resistors	State[1]	Description
R4 (MCU power consumption measurement)	**ON**	When JP3 OFF, 3.3V is connected to the microcontroller power to supply AT32F425R8T7-7.
	OFF	When JP3 OFF, 3.3V can be connected to an ammeter to measure the power consumption of the AT32F425R8T7-7. (AT32F425R8T7-7 cannot be powered without ammeter)
R26, R27, R28, R29 (HEXT)	**ON, ON, OFF, OFF**	HEXT clock source comes from on-board crystal Y2
	OFF, OFF, ON, ON	HEXT clock source: external oscillator from PF0, or when PF0 and PF1 are used as GPIOs.
R22, R23, R24, R25 (LEXT)	**ON, ON, OFF, OFF**	LEXT clock source comes from on-board crystal Y1
	OFF, OFF, ON, ON	LEXT clock source: external oscillator from PC14, or when PC14 and PC15 are used as GPIOs.
R5，R6 (User button B2)	**ON, OFF**	User button B2 is connected to PA0
	OFF, ON	User button B2 is connected to PC13
R32, R33 (PA11, PA12)	**OFF, OFF**	As USB, PA11 and PA12 are disconnected from the pin_12 and pin_13 of J1.
	ON, ON	When they are not used as USB, PA11 and PA12 are connected to the pin_12 and pin_13 of J1.
R34, R35, R36, R37 (Arduino™ A4, A5)	**ON, OFF, OFF, ON**	Arduino™ A4 and A5 are connected to ADC1_IN11 and ADC1_IN10
	OFF, ON, ON, OFF	Arduino™ A4 and A5 are connected to I2C1_SDA and I2C1_SCL
R38, R39 (Arduino™ D10)	**OFF, ON**	Arduino™ D10 is connected to SPI1_SS
	ON, OFF	Arduino™ D10 is connected to PWM (TMR4_CH1)

(1) Rx and RPx factory default state is shown in BOLD.

3.10 Extension interfaces

3.10.1 Arduino™ Uno R3 interface

Female plug J3~J6 and male plug J7 support Arduino™ Uno R3 connector. Most of the daughter boards built on Arduino™ Uno R3 are applicable to AT-START-F425 board.

Note: *AT32F425R8T7-7 I/Os are 3.3 V-compatible with Arduino™ Uno R3, but not 5 V.*

Note: *The pin_8 of J3 is VDDA, equivalent level to VDD, without Arduino™ Uno R3-defined AREF feature.*

Table 3. Arduino™ Uno R3 extension interface pin definition

Connector	Pin number	Arduino pin name	AT32F425 pin name	Description
J4 (Power supply)	1	NC	-	-
	2	IOREF	-	3.3 V reference
	3	RESET	NRST	External reset
	4	3.3V	-	3.3 V input/output
	5	5V	-	5 V input/output
	6	GND	-	Ground
	7	GND	-	Ground
	8	NC	-	-
J6 (Analog input)	1	A0	PA0	ADC1_IN0
	2	A1	PA1	ADC1_IN1
	3	A2	PA4	ADC1_IN4
	4	A3	PB0	ADC1_IN8
	5	A4	PC1 or PB9[1]	ADC1_IN11 or I2C1_SDA
	6	A5	PC0 or PB8[1]	ADC1_IN10 or I2C1_SCL
J5 (Logic input/output low byte)	1	D0	PA3	USART2_RX
	2	D1	PA2	USART2_TX
	3	D2	PA10	-
	4	D3	PB3	TMR2_CH2
	5	D4	PB5	-
	6	D5	PB4	TMR3_CH1
	7	D6	PB10	TMR2_CH3
	8	D7	PA8	-
J3 (Logic input/output high byte)	1	D8	PA9	-
	2	D9	PC7	TMR1_CH2
	3	D10	PA15 or PB6[1]	SPI1_NSS or TMR4_CH1
	4	D11	PA7	TMR3_CH2 or SPI1_MOSI
	5	D12	PA6	SPI1_MISO
	6	D13	PA5	SPI1_SCK
	7	GND	-	Ground
	8	VDDA	-	VDDA output
	9	SDA	PB9	I2C1_SDA
	10	SCL	PB8	I2C1_SCL
J7 (Others)	1	MISO	PB14	SPI2_MISO
	2	5V	-	5 V input/output

Connector	Pin number	Arduino pin name	AT32F425 pin name	Description
	3	SCK	PB13	SPI2_SCK
	4	MOSI	PB15	SPI2_MOSI
	5	RESET	NRST	External reset
	6	GND	-	Ground
	7	NSS	PB12	SPI2_NSS
	8	PB11	PB11	-

(1) Refer to *Table 2* for details on 0Ω resistors.

3.10.2 LQFP64 I/O extension interface

The I/Os of AT32F425R8T7-7 microcontroller can be connected to external devices through extension interfaces J1 and J2. All I/Os on the AT32F425R8T7-7 are available on these extension interfaces. J1 and J2 can also be measured with oscilloscope, logic analyzer or voltmeter probe.
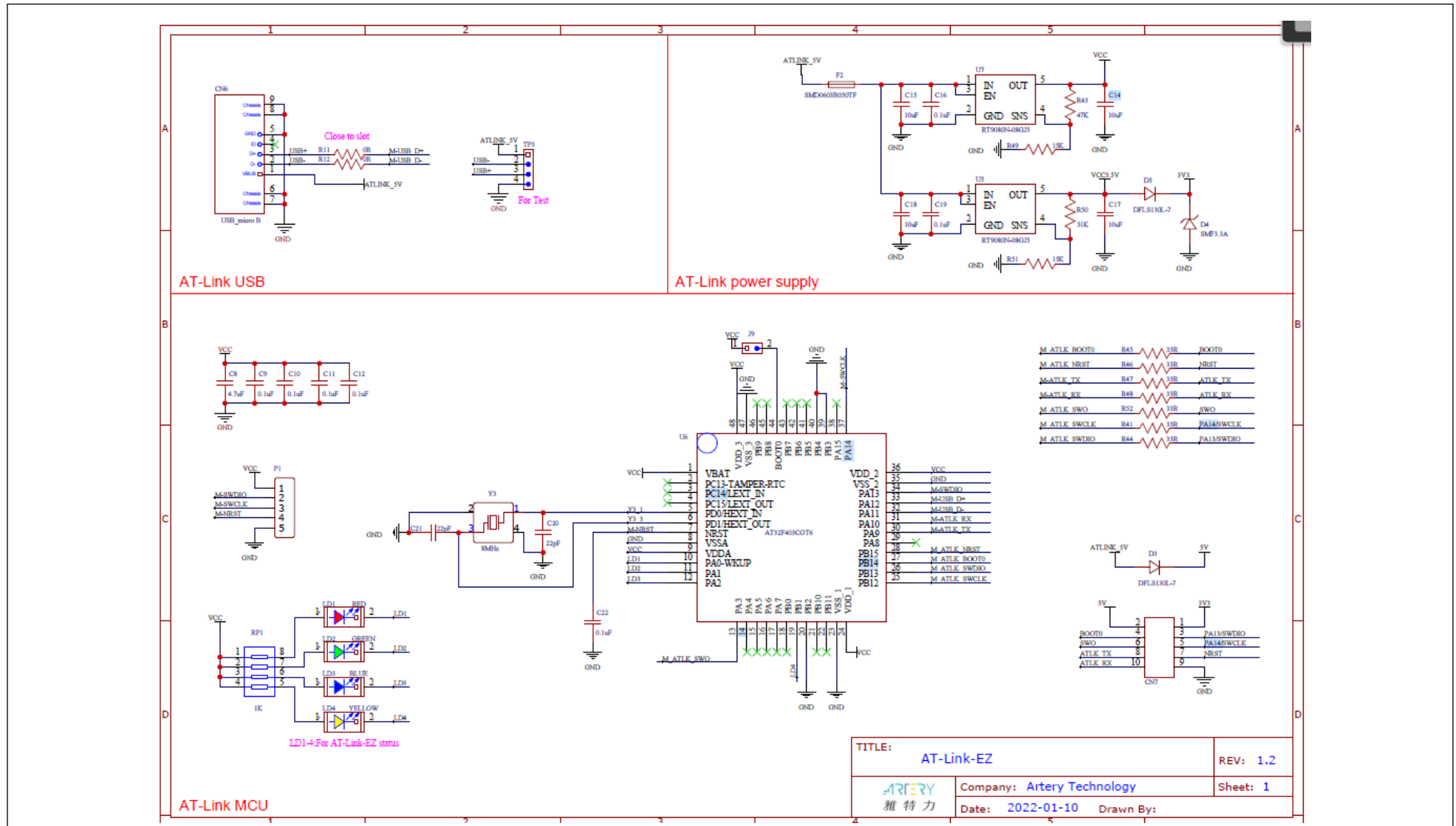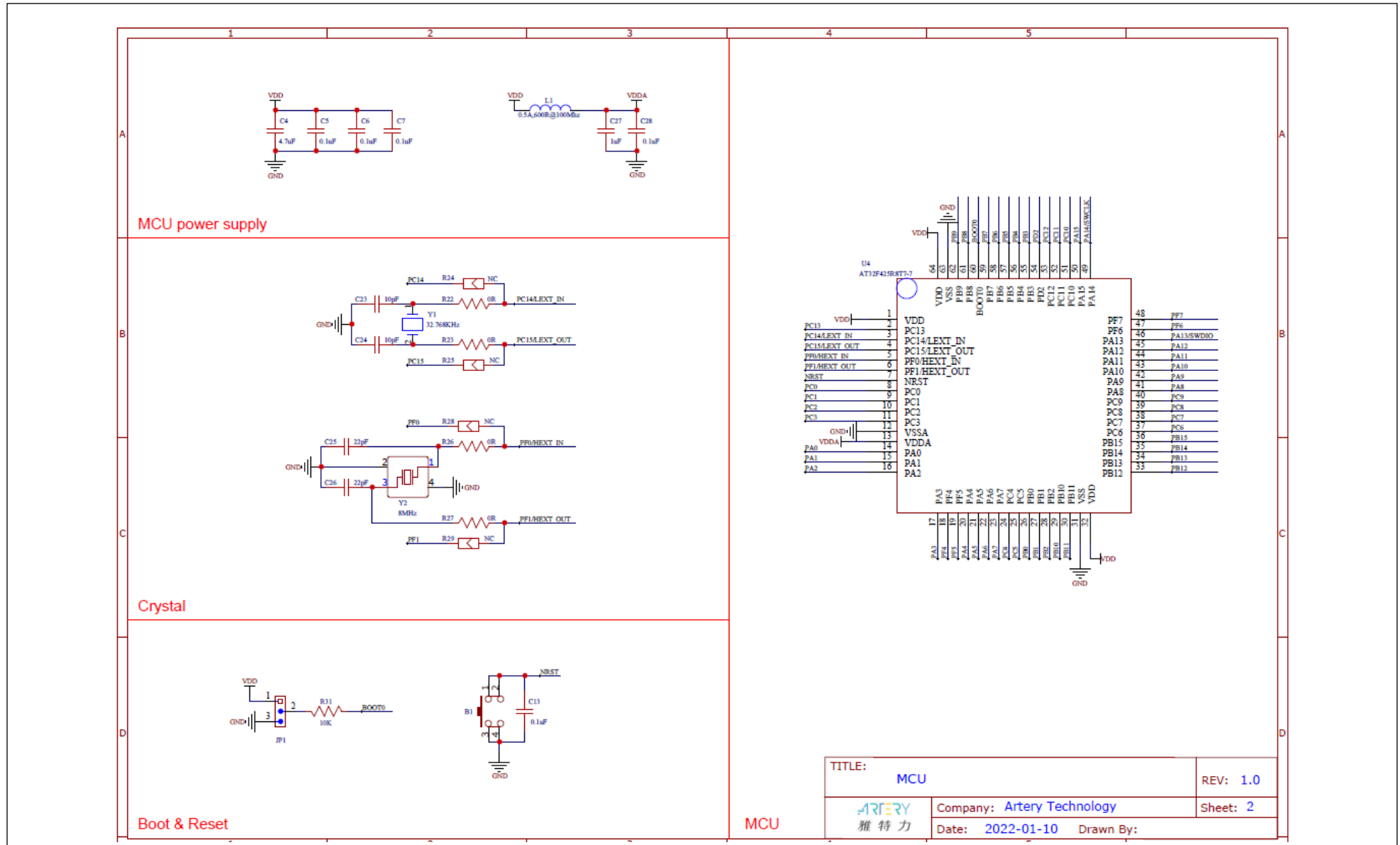
4 Schematic

Figure 4. Schematic (AT-Link-EZ)

Figure 5. Schematic (microcontroller)

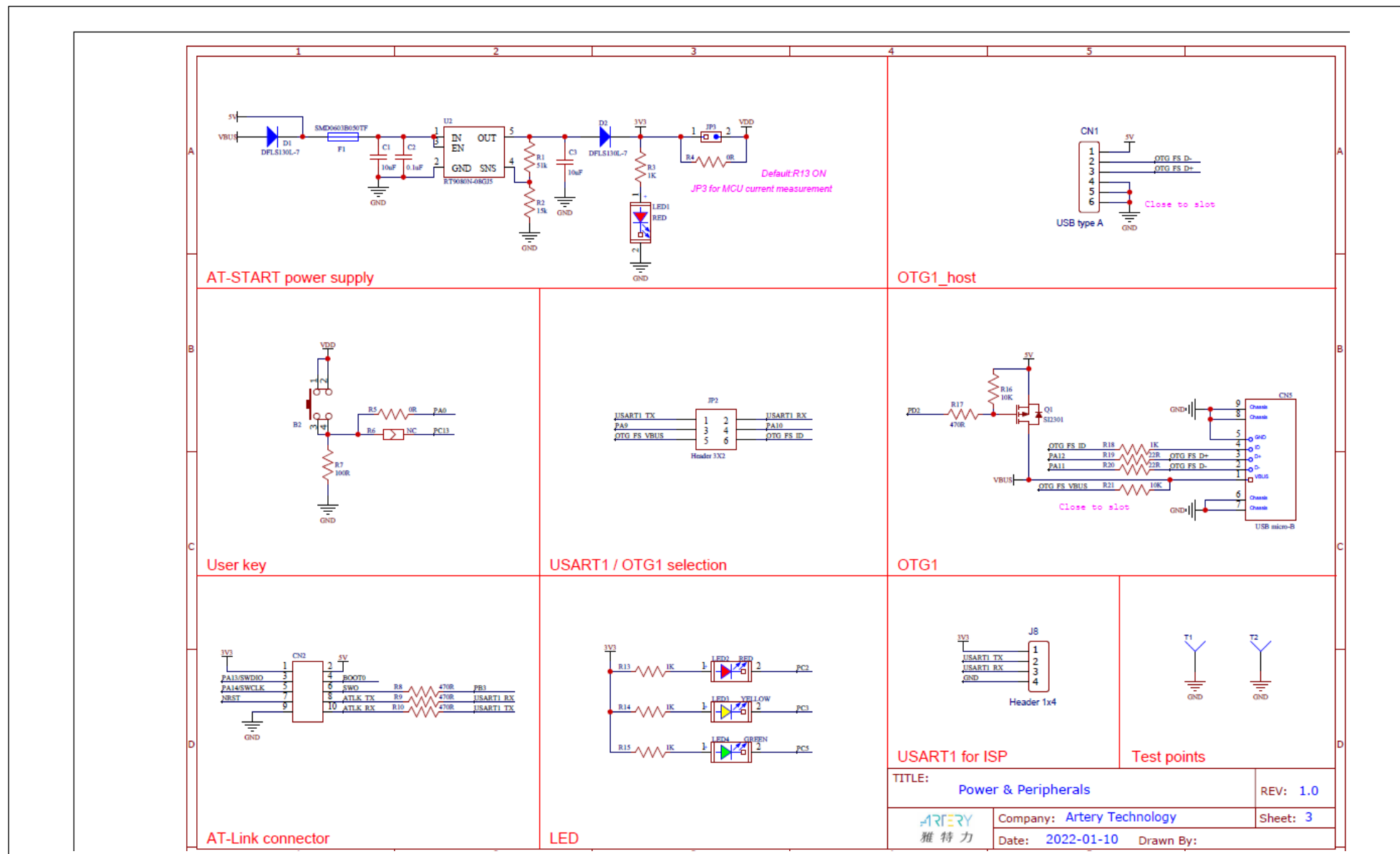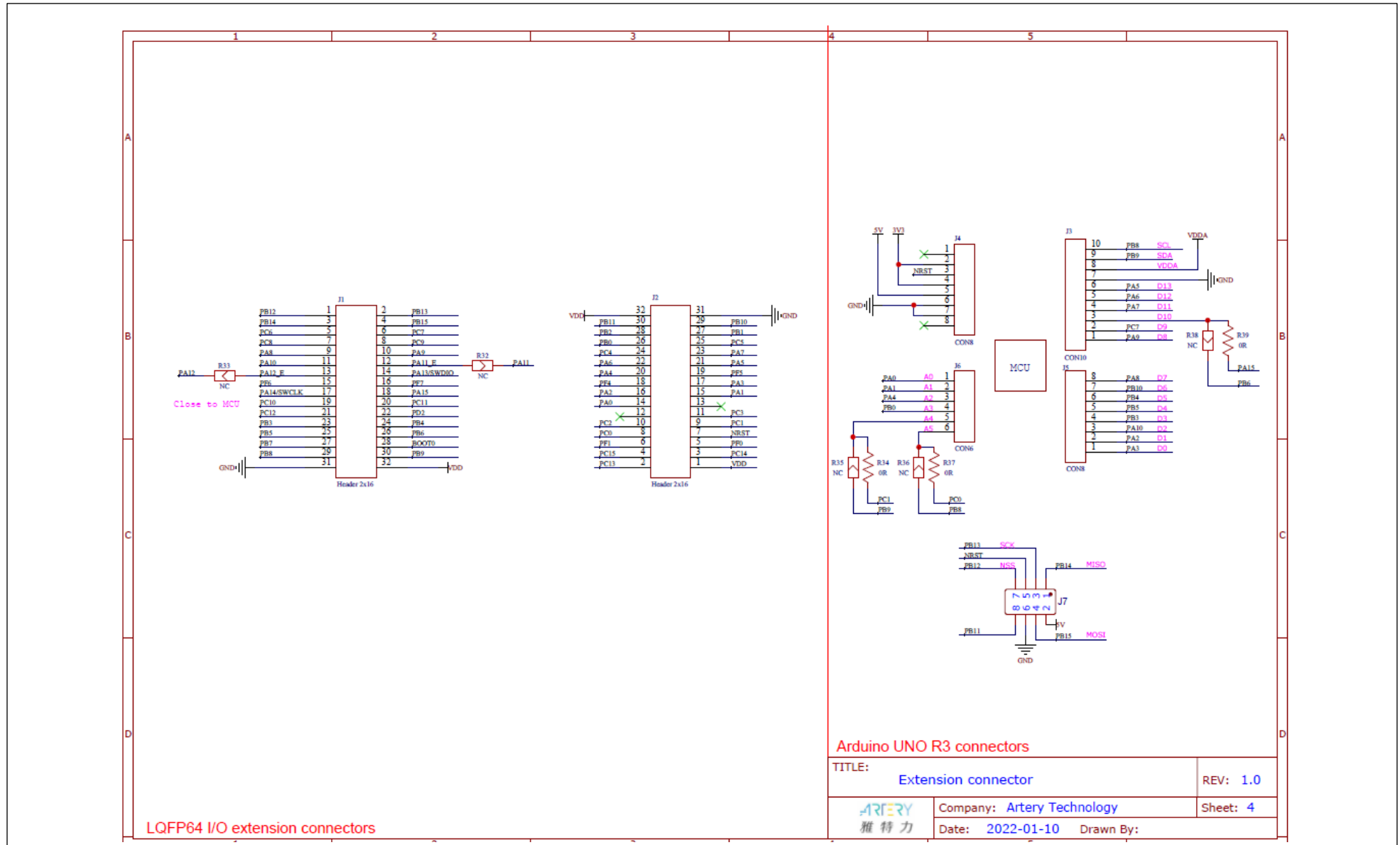## Figure 6. Schematic (power supply and peripherals)

Figure 7. Schematic (extension interfaces)

5   Revision history

Table 4. Document revision history

Date	Revision	Changes
2021.10.20	1.00	Initial release

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