Getting started with AT32L021C8T7

Introduction

AT-START-L021 evaluation board is designed to help you experience the high performance and low-power charicteristics of the 32-bit microcontroller, the ARM Cortex®-M0+ based AT32L021, and expedite development cycles and shorten time to the market.

AT-START-L021 is an evaluation board based on AT32L021C8T7 microcontroller. It features LEDs, buttons and Arduino™ Uno R3 extension connectors. This board comes with a built-in AT-Link-EZ, a tool designed to perform debugging/programming operations, without the need of other extra development tools.

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1 Overview

1.1 Features

AT-START-L021 has the following features:

- ARM Cortex®-M0+ based 32-bit AT32L021C8T7 microcontroller that embeds 64 KB Flash memory and 8+1 KB SRAM, in LQFP48 package
- On-board AT-Link-EZ for programming and debugging purposes (AT-Link-EZ is a simplified version of AT-Link, without offline mode support)
- Power supply source:
  - USB bus of AT-Link-EZ
  - External 5 V power supply (E5V)
  - External microcontroller power supply
- Optional 3.3 V or 1.8 V for AT32L021C8T7 microcontroller and its peripherals, allowing for experience of low power consumption at low operating voltage
- 4 x LED indicators:
  - LED1 (red) indicates that 3.3V power of the board is supplied
  - 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
- Rich extension connectors:
  - Arduino™ Uno R3 extension connectors
  - LQFP48 I/O extension connectors

1.2 Definition of terms

- **Jumper JPx ON**

  Jumper fitted
- **Jumper JPx OFF**

  Jumped not fitted
- **Resistor Rx ON**

  Short circuit by solder or 0 Ω resistor
- **Resistor Rx/ RPx OFF**

  Connections left Open

2 Quick start guide

2.1 Get started

Configure the AT-START-L021 board in the following sequence:

1. Check the Jumpers' position on board:
   JP1 is connected to GND or OFF (BOOT0= 0, and BOOT0 has an pull-down resistor in the AT32L021C8T7)
2. Connect the AT-Link-EZ to PC via USB cable (Type A to Type-C) so that the board is powered via USB connector CN6. LED1 (red) is always on, and three other LEDs (LED2 to LED4) start to blink in turn.
3. After pressing User button (B2), the blinking frequency of three LEDs is changed.

2.2 Toolchains supporting AT-START-L021

- ARM® Keil®: MDK-ARM™
- IAR™: EWARM
- AT32 IDE

3 Hardware layout and configuration

AT-START-L021 board is designed around an AT32L021C8T7 microcontroller in LQFP48 package.

Figure 1 shows the connection between AT-Link-EZ, AT32L021C8T7 and their peripherals (buttons, LEDs and extension connectors)

Figure 2 and *Figure 3* show their respective positions on the AT-Link-EZ and AT-START-L021.

Figure 1. Hardware block diagram

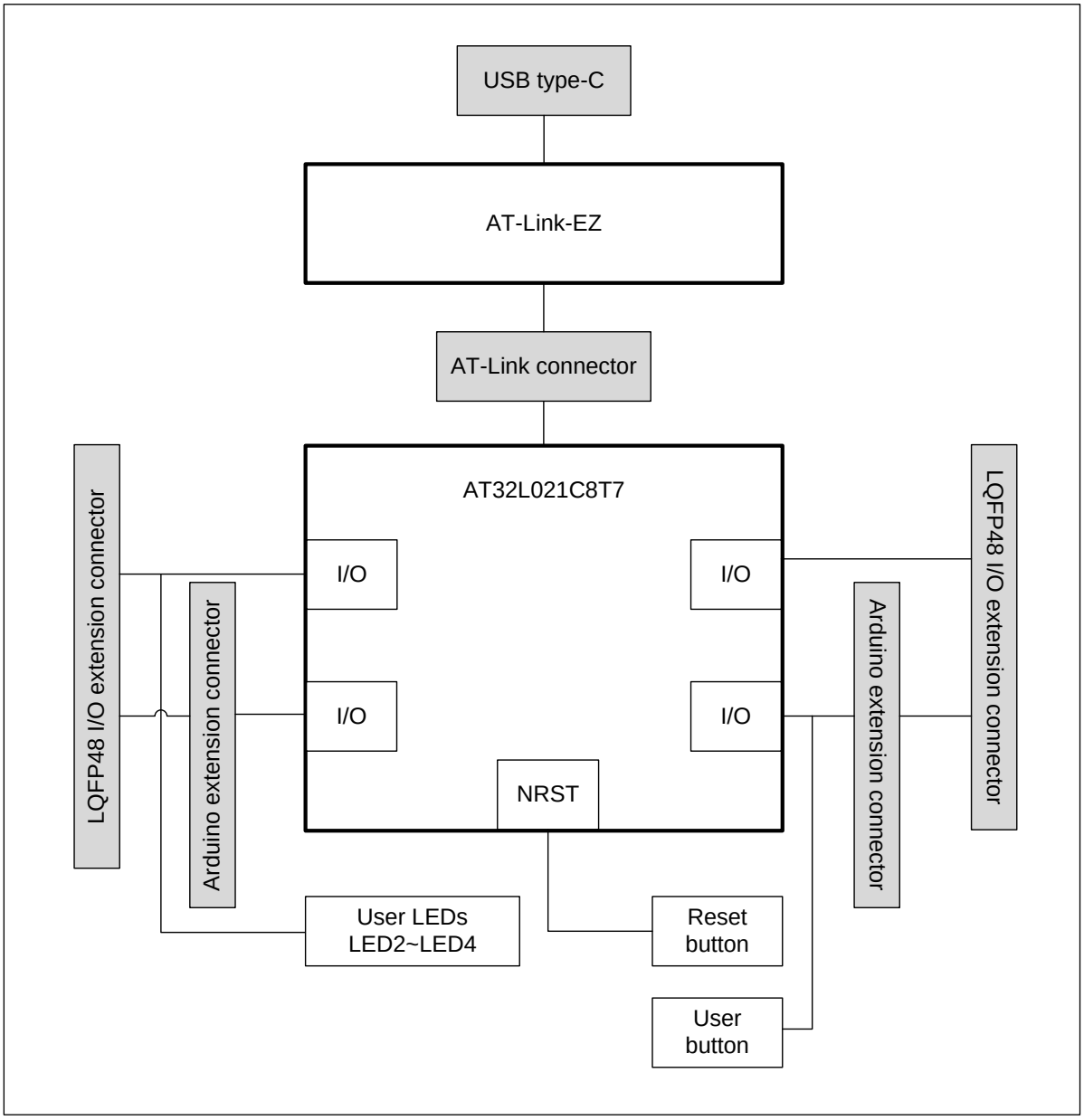


Figure 2. Top layer

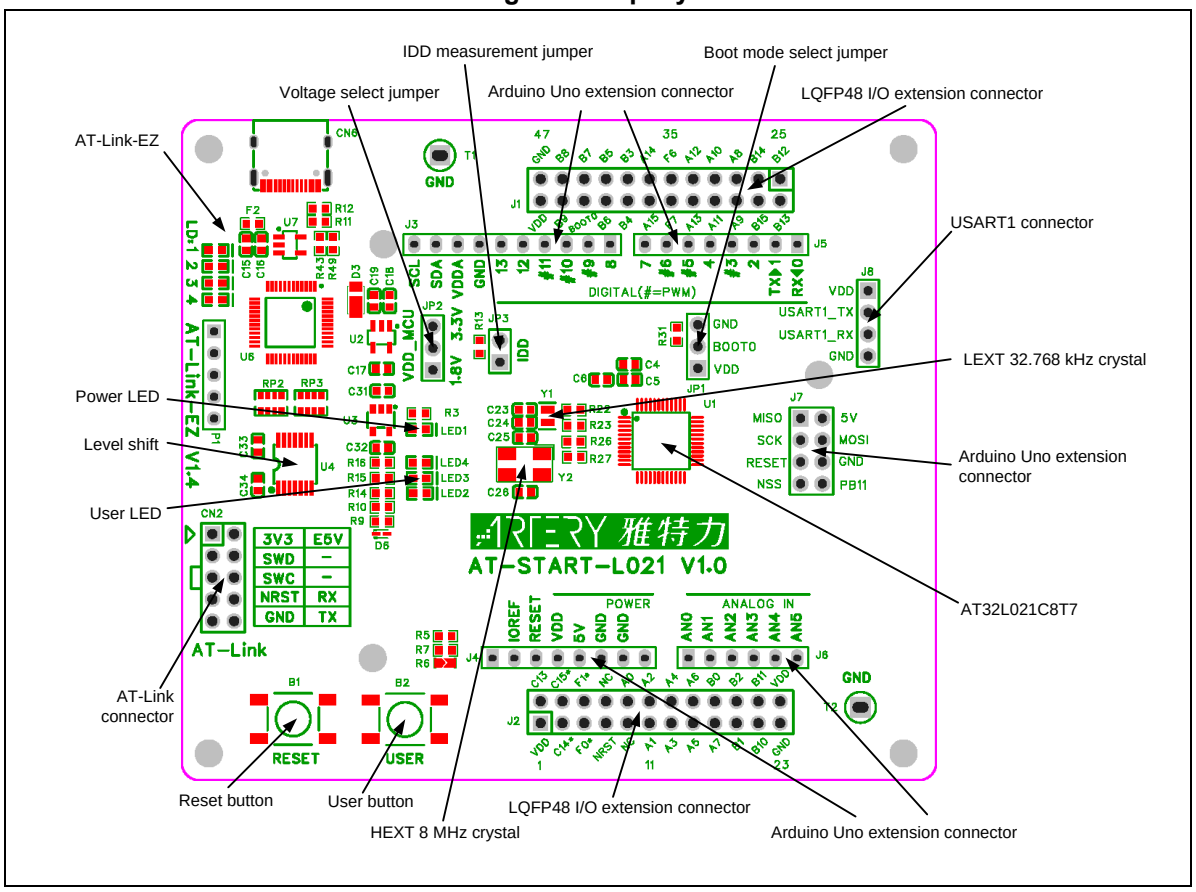
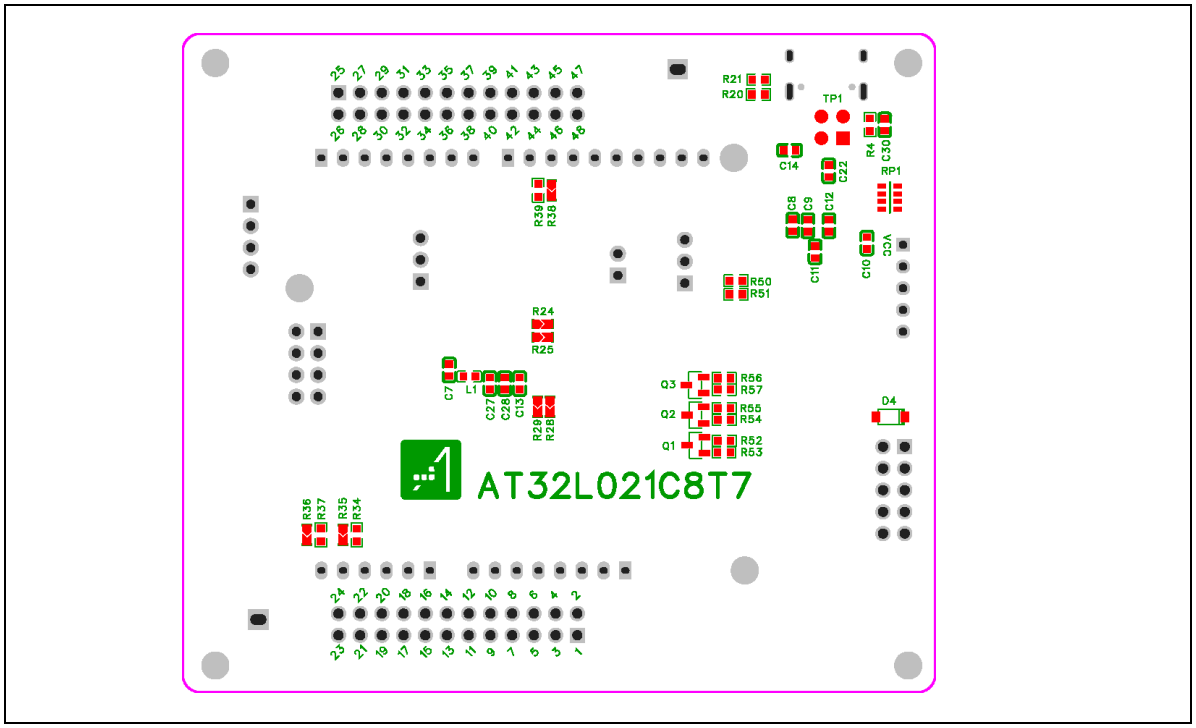


Figure 3. Bottom layer



3.1 Power supply sources

The 5 V power supply source required for AT-START-L021 can be provided from USB connector (CN6) of the AT-Link-EZ via USB cable, or from an external 5 V power source (E5V). Then the 3.3 V or 1.8 V power required by the microcontroller and its peripherals is via 5 V to 3.3 V voltage regulator (U2) or via 3.3 V to 1.8 V voltage regulator (U3) on board. The JP2 is used to select the desired 3.3 V or 1.8 V.

Additionally, the E5V pin of J4 or J7 can be used as an input power source. Then the AT-START-L021 board must be powered by a 5 V power supply unit.

The VDD_MCU pin of J4, or the VDD pin of J1 and J2, can also be used as input power source of the AT32L021C8T7 and its peripherals.

Note: Unless 5 V is provided through the USB connector (CN6) on the AT-Link-EZ, the AT-Link-EZ will not be powered by other power supply methods.

When another application board is connected to J4, the E5V and VDD_MCU can be used as output power supply, the E5V pin of J7 as 5 V output power supply, the VDD pin of J1 and J2 as 3.3 V or 1.8 V output power supply.

3.2 IDD

When JP3 OFF (symbol IDD) and R13 OFF, an ammeter can be connected to measure the power consumption of AT32L021C8T7. As a low-power product series, the AT32L021C8T7 is designed to better meet the demand of low power application market.

- **JP3 OFF, R13 ON**

  AT32L021C8T7 is being powered. (Default setting, and JP3 plug is not mounted before shipping)

- **JP3 ON, R13 OFF**

  AT32L021C8T7 is being powered.

- **JP3 OFF, R13 OFF**

  An ammeter must be connected to measure the power consumption of AT32L021C8T7 (if no ammeter, the AT32L021C8T7 cannot be powered).

3.3 Embedded AT-Link-EZ for programming and debugging

The evaluation board integrates Artery AT-Link-EZ for users to program/debug the AT32L021C8T7 on the AT-START-L021 board. AT-Link-EZ supports SWD interface mode. It offers a virtual COM port (VCP) to be connected to the USART1_TX/USART1_RX (PA9/PA10) of the AT32L021C8T7. Thanks to the level shift chip (U4) available on board, it is possible to achieve level shift between the 3.3 V signal level of the AT-Link-EZ and the 3.3 V or 1.8 V signal level of the microcontroller.

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

The AT-Link-EZ on board can be disconnected from AT-START-L021 by RP2 and RP3 OFF. In this case, AT-START-L021 can still be connected to other Link through CN2 (not mounted before shipping) to continue programming and debugging the AT32L021C8T7.

3.4 Boot mode selection

At startup, the board boots from the following memory locations.

Table 1. Boot mode selection

Jumper	BOOT0 pin configuration	Description
JP1 connected to GND or OFF	0	Boot from the internal Flash memory (Factory default settings)
JP1 connected to VDD	1	Boot from the system memory or SRAM(1)

(1) It depends on the nBOOT1 bit in the User System Data.

3.5 External clock source

3.5.1 HEXT clock source

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

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

  The 8 MHz crystal on board is used as HEXT clock source.Hardware settings: R26 and R27 must be ON, and R28, R29 OFF

- **External oscillator from PF0**

  External oscillator is from the pin 5 of J2. Hardware settings: R28 and R29 must be ON, and R26, R27 OFF.

- **HEXT not used**

  PF0 and PF1 are used as GPIOs. Hardware settings: R28 and R29 must be ON, and R26, R27 OFF.

3.5.2 LEXT clock source

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

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

  The 32.768 kHz crystal on board is used as LEXT clock source. Hardware settings: R22 and R23 must be ON, and R24, R25 OFF

- **External oscillator from PC14**

  External oscillator is from the pin 3 of J2. Hardware settings: R24 and R25 must be ON, and R22, R23 OFF.

- **LEXT not used**

  PC14 and PC15 are used as GPIOs. Hardware settings: R24 and R25 must be ON, and R22, R23 OFF.

3.6 LEDs

- **Power LED1**

  Red color, indicates that the board is being powered.

- **User LED2**

  Red color, controlled with the PF6 pin of AT32L021C8T7. The User LED lights on when PF6 outputs high.

- **User LED3**

  Yellow color, controlled with the PF7 pin of AT32L021C8T7. The User LED lights on when PF7 outputs high.

- **User LED4**

  Green color, controlled with the PB11 pin of AT32L021C8T7. The User LED lights on when PB11 outputs high.

3.7 Buttons

- **Reset button B1**

  Connected to NRST to reset AT32L021C8T7.

- **User button B2**

  By default, it is connected to the PA0 of AT32L021C8T7 and used as a wake-up button (R5 ON, R6 OFF) as alternate function; it can also be connected to PC13 and used as TAMPER-RTC button (R5 OFF, R6 ON) as alternate function.

3.8 0 Ω resistors

Table 2. 0 Ω resistor settings

Resistors	State(1)	Description
R13 (Microcontroller power consumption measurement)	**ON**	When JP3 OFF, the AT32L021C8T7 is powered by 3.3 V or 1.8 V.
	OFF	When JP3 OFF, an ammeter can be connected to 3.3 V or 1.8 V to measure the power consumption of AT32L021C8T7 (if no ammeter, AT32L021C8T7 cannot be powered)
R26, R27, R28, R29 (HEXT)	**ON, ON, OFF, OFF**	The crystal Y2 on board is used as HEXT clock source
	OFF, OFF, ON, ON	HEXT clock source is from external PF0 or PF0, and PF1 is used as GPIO
R22, R23, R24, R25 (LEXT)	**ON, ON, OFF, OFF**	The crystal Y1 on board is used as LEXT clock source
	OFF, OFF, ON, ON	LEXT clock source is from external PC14 or PC14, and PC15 is used as GPIO
R5, R6 (User button B2)	**ON, OFF**	User button B2 is connected to PA0
	OFF, ON	User button B2 is connected to PC13

Resistors	State(1)	Description
R34, R35, R36, R37 (Arduino™ AN4, AN5)	**ON, OFF, OFF, ON**	Arduino™ A4 and A5 are connected to ADC1_IN6 and ADC1_IN9
	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 (TMR16_CH1N)

(1) The factory default Rx state is shown in **BOLD** font.

3.9 Extension connectors

3.9.1 Arduino™ Uno R3 extension connectors

Female plug J3~J6 and male J7 support standard Arduino™ Uno R3 connectors. Most of the daughter boards designed around Arduino™ Uno R3 are fit to AT-START-L021.

Note 1: The I/O ports of AT32L021C8T7 are 3.3 V compatible with Arduino™ Uno R3, but 5V not.

Note 2: The pin 8 of J3 is VDDA, the same level as VDD, and has no AFEF function of Arduino™ Uno R3.

Table 3. Arduino™ Uno R3 extension connectors

Connectors	Pin No.	Arduino pin name	AT32L021 pin name	Function
J4 (Power)	1	NC	-	-
	2	IOREF	-	3.3 V or 1.8 V reference voltage
	3	RESET	NRST	External reset
	4	VDD_MCU	-	3.3 V or 1.8 V input/output
	5	5V	-	5 V input/output
	6	GND	-	Ground
	7	GND	-	Ground
	8	NC	-	-
J6 (Analog input)	1	AN0	PA0	ADC1_IN0
	2	AN1	PA1	ADC1_IN1
	3	AN2	PA4	ADC1_IN4
	4	AN3	PB0	ADC1_IN8
	5	AN4	PA6 or PB9(1)	ADC1_IN6 or I2C1_SDA
	6	AN5	PB1 or PB8(1)	ADC1_IN9 or I2C1_SCL
J5 (Logic input/output low byte)	1	D0	PA3	USART2_RX
	2	D1	PA2	USART2_TX
	3	D2	PA10	-
	4	D3	PB5	TMR3_CH2
	5	D4	PB3	-
	6	D5	PB4	TMR3_CH1
	7	D6	PA8	TMR1_CH1
	8	D7	PB10	-

Connectors	Pin No.	Arduino pin name	AT32L021 pin name	Function
J3 (Logic input/output high byte)	1	D8	PA9	-
	2	D9	PB7	TMR17_CH1C
	3	D10	PA15 or PB6(1)	SPI1_CS or TMR16_CH1C
	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
	3	SCK	PB13	SPI2_SCK
	4	MOSI	PB15	SPI2_MOSI
	5	RESET	NRST	External reset
	6	GND	-	Ground
	7	CS	PB12	SPI2_CS
	8	PB11	PB11	-

(1) 0 Ω resistor settings are shown in *Table 2*.

3.9.2 LQFP48 I/O extension connectors

The extension connectors J1 and J2 are used to connect the IO ports of the AT-START-L021 to external devices. All the I/O ports of AT32L021C8T7 are accessible. J1 and J2 can also be measured with oscilloscope, logic analyzer or voltmeter probe.

4 Revision history

Table 4. Document revision history

Date	Revision	Changes
2024.2.29	1.00	Initial release

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