
Getting started with AT32F490RCT7

Introduction

AT-START-F490 is designed to help you explore the high performance of the 32-bit microcontroller AT32F490 that embeds ARM Cortex[®]-M4F core, and expedite application development.

AT-START-F490 is an evaluation board based on AT32F490RCT7 microcontroller. The device contains such peripherals as LEDs, buttons, USB type-C and USB type-A connectors, Arduino[™] Uno R3 extension connectors. 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-F490 has the following characteristics:

- AT-START-F490 has an on-board AT32F490RCT7 microcontroller that embeds ARM Cortex®-M4F 32-bit core, 256 KB Flash memory and 96+6 KB SRAM, 2 MB QSPI PSRAM accessible via internal QSPI interface, in LQFP64 10x10 mm package.
- 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)
 - AT-Link-EZ can be disassembled from the board by bending it along the joint and connected to an independent AT-Link for programming and debugging purposes
- Various power supply methods:
 - USB bus for AT-Link-EZ
 - OTGFS bus (VBUS_FS) for AT-START-F490
 - 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) indicating operation status
- User button and Reset button
- 12 MHz HEXT crystal oscillator
- 32.768 kHz LEXT crystal oscillator
- USB type-A (host) and type-C connectors (device) for OTGFS functions
- Rich extension interfaces
 - Arduino™ Uno R3 extension connectors
 - LQFP64 I/O extension connectors

1.2 Definition of terms

- **Jumper JPx ON**
Jumper fitted.
- **Jumper JPx OFF**
Jumped not fitted.
- **Resistor Rx ON**
Short by solder or 0Ω resistor.
- **Resistor Rx OFF**
Connections left open.

2 Quick start

2.1 Get started

Configure the AT-START-F490 board in the following sequence:

1. Check the Jumper's position on board:
JP1 OFF (BOOT0 = 0, and BOOT0 has an pull-down resistor in the AT32F490RCT7);
2. Connect AT_Link_EZ to PC via a USB cable (Type A to type-C), 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 User button (B2), the blinking frequency of three LEDs are changed.

2.2 AT-START-F490 development toolchains

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

3 Hardware and configuration

AT-START-F490 board is designed around an AT32F490RCT7 microcontroller in LQFP64 10x10 mm package.

[Figure 1](#) shows the connections between AT-Link-EZ, AT32F490RCT7 and their peripherals (buttons, LEDs, OTGFS and extension connectors)

[Figure 2](#) and [Figure 3](#) shows their respective locations on the AT-Link-EZ and AT-START-F490 board.

Figure 1. Hardware block diagram

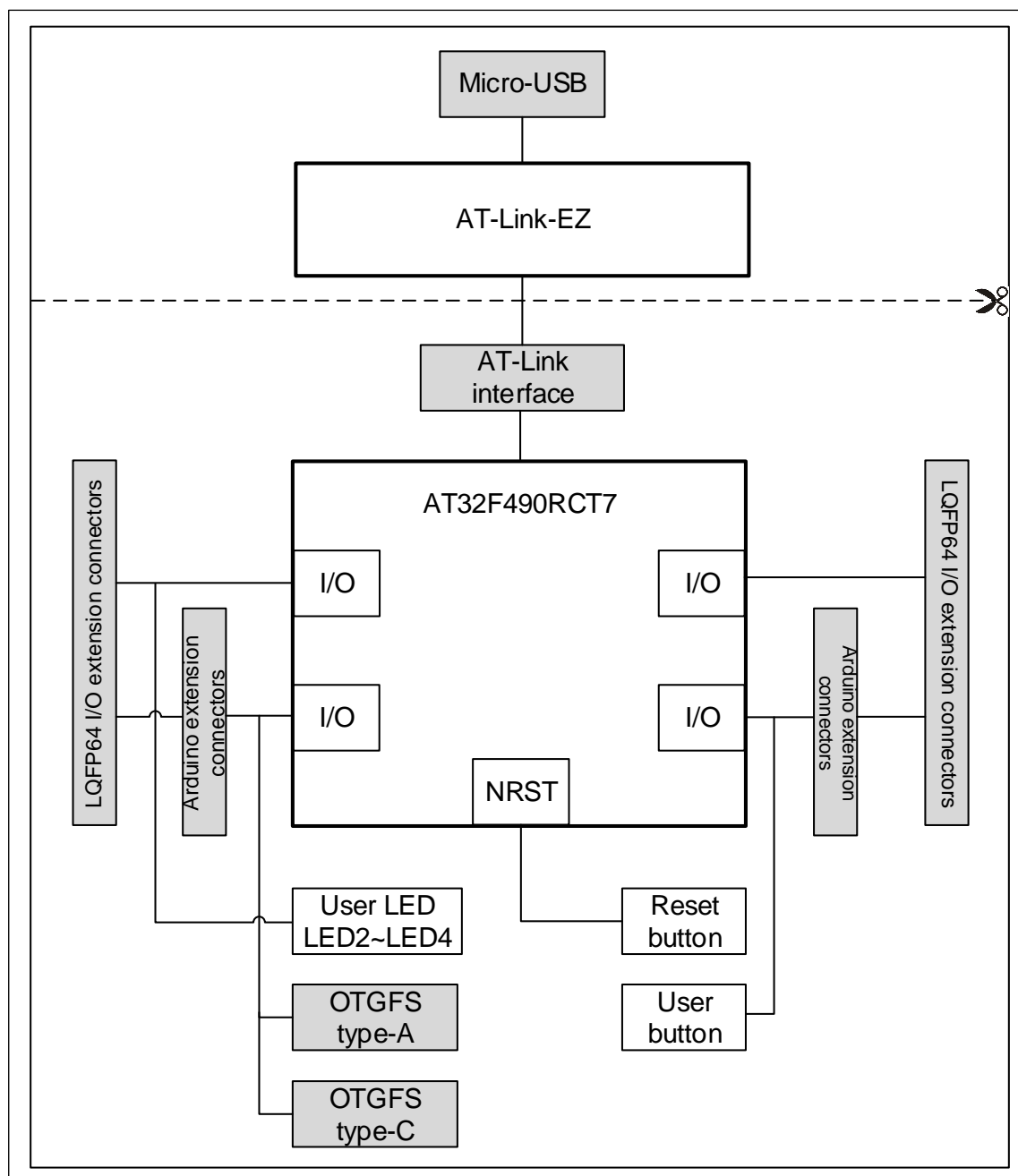


Figure 2. Top layer

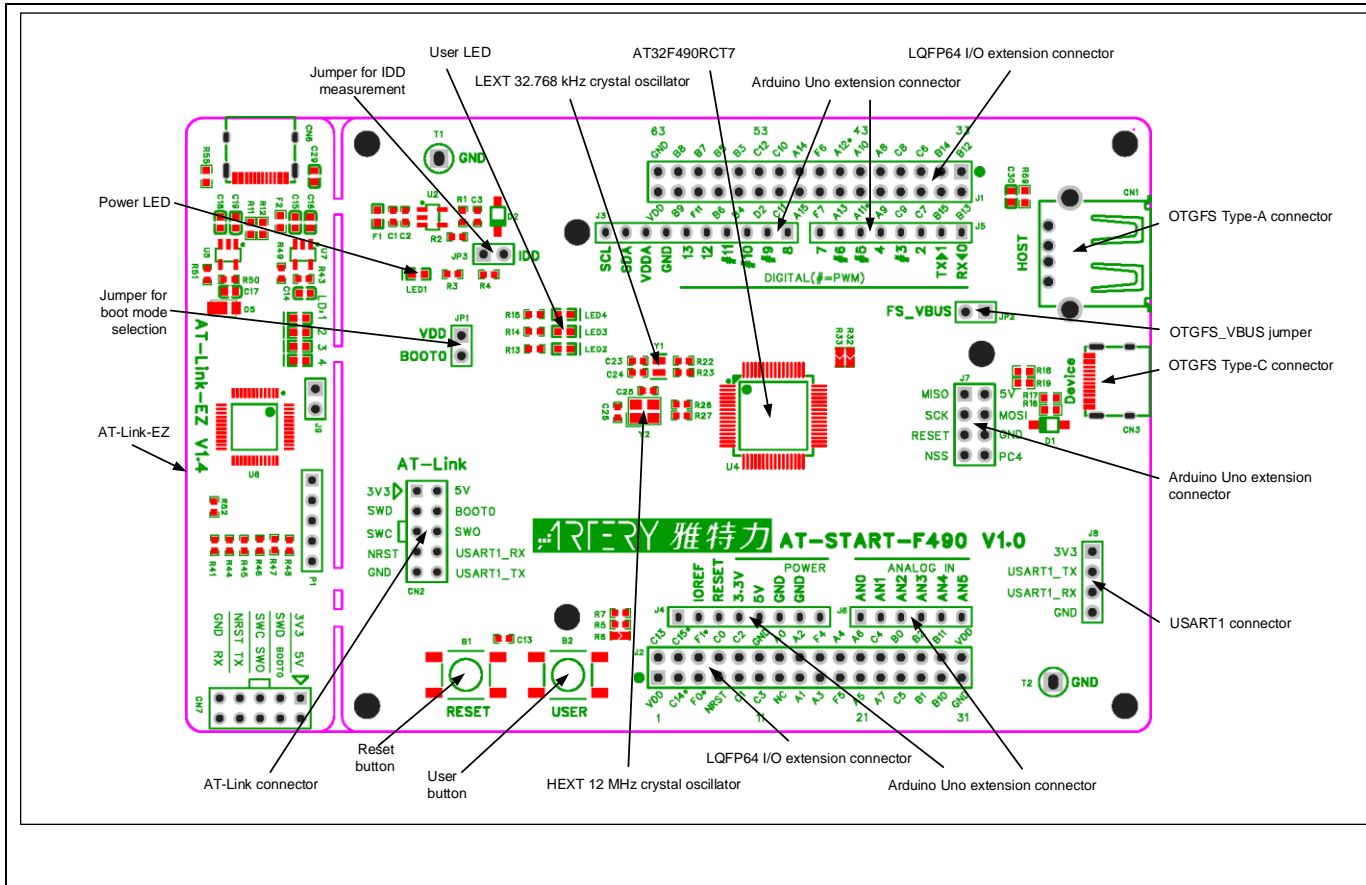
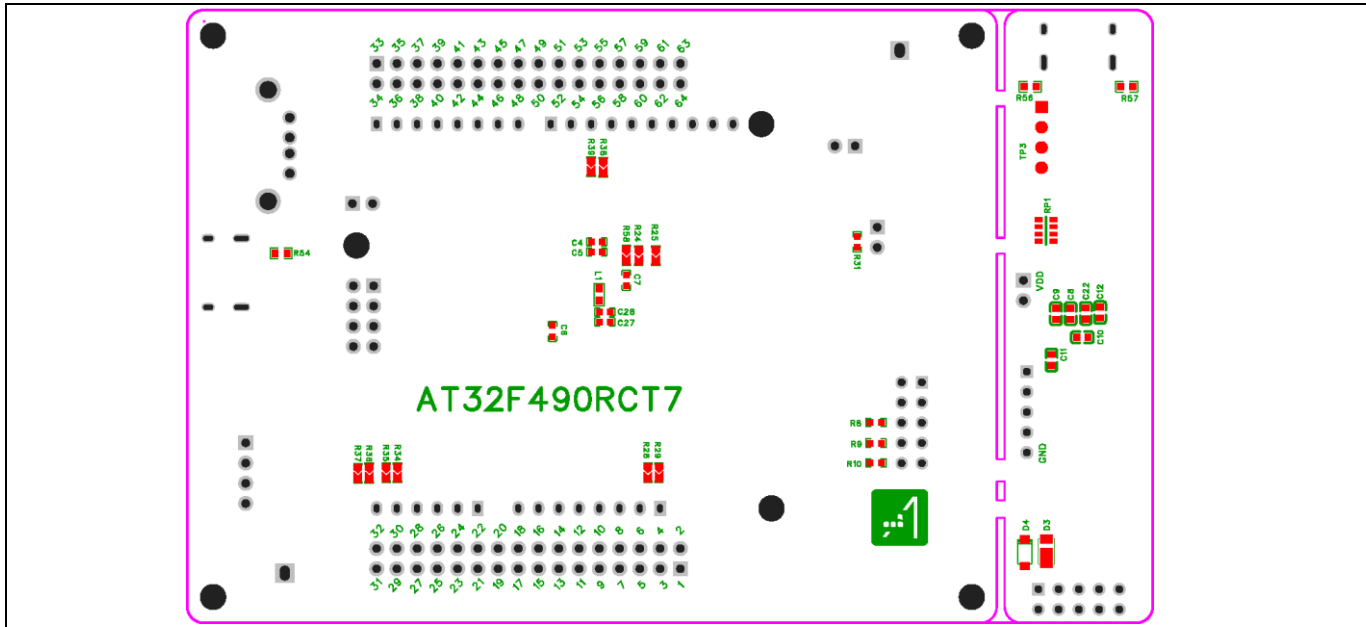


Figure 3. Bottom layer



3.1 Power supply sources

The 5 V power supply source required for the AT-START-F490 can be provided through a USB cable (either via USB connector CN6 of the AT-Link-EZ or via OTGFS connector CN3 on AT-START-F490). It can also be provided through an external 5 V power supply (E5V). Then the 3.3 V required by the microcontroller and its peripherals is provided via a 5 V-to-3.3 V voltage regulator (U2).

Additionally, the 5 V pin of J4 or J7 can be used as an input power source so that the AT-START-F490 board can be supplied with a 5 V power unit.

The 3.3 V pin of J4, or VDD pin of J1 and J2 can also be used as 3.3 V input power supply of the, AT-START-F490 board.

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

When another board is connected to J4, the 5 V and 3.3 V can be used as output power supply, 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 AT32F490RCT7.

- **JP3 OFF, R4 ON**

AT32F490RCT7 is being powered. (Default setting and JP3 connector is not mounted before shipping)

- **JP3 ON, R4 OFF**

AT32F490RCT7 is being powered.

- **JP3 OFF, R4 OFF**

An ammeter must be connected to measure the power consumption of AT32F490RCT7 (If no ammeter, the AT32F490RCT7 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 AT32F490RCT7 on the AT-START-F490 board. AT-Link-EZ supports SWD interface mode and SWO for debugging purposes. It also offers a virtual COM port (VCP) to be connected to the USART1_TX/USART1_RX (PA9/PA10) of AT32F490RCT7.

Please refer to [AT-Link User Manual](#) for complete details on AT-Link-EZ.

The AT-Link-EZ can be disassembled or separated from the AT-START-F490 board. In this case, the CN2 connector (not mounted before shipping) of the AT-START-F490 board can still be connected to the CN7 connector (not mounted before shipping) of the AT-Link-EZ, or connected to another AT-Link to reestablish connection, so as to continue programing and debugging the AT32F490RCT7.

3.4 Boot mode selection

At startup, the board boots from the following memory locations according to the BOOT configuration. JP1 connector is not mounted before shipping. After startup, BOOT0 pin is used as PF11.

Table 1. Boot mode selection

Jumper	PF11/BOOT0 configuration	Boot mode
JP1 OFF	0	Boot from internal Flash memory (factory default setting)
JP1 connected to VDD	1	Boot from boot memory or internal SRAM ⁽¹⁾

(1) Depending on the nBOOT1 bit of the User System Data area.

3.5 External clock sources

3.5.1 HEXT clock source

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

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

The 12 MHz crystal oscillator on board is used as HEXT clock source. Hardware settings: R26 and R27 must be ON, R28 and R29 OFF.

- **External oscillator from PF0**

External oscillator is injected from the pin_5 of J2. Hardware settings: R28 must be ON, R26 and R27 OFF. If PF1 is to be used as GPIO, R29 ON can be connected to the pin_6 of J2.

- **HEXT not used**

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

3.5.2 LEXT clock sources

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

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

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

- **External oscillator from PC14**

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

- **LEXT not used**

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

3.6 LEDs

- **Power LED1**
Red LED, indicates that the AT-START-F490 is being powered by 3.3 V.
- **User LED2**
Red LED, connected to the PF4 pin of the AT32F490RCT7.
- **User LED3**
Yellow LED, connected to the PF5 pin of the AT32F490RCT7.
- **User LED4**
Green LED, connected to the PF6 pin of the AT32F490RCT7.

3.7 Buttons

- **Reset button B1**
Connected to NRST to reset AT32F490RCT7 microcontroller.
- **User button B2**
By default, it is connected to the PA0 of AT32F490RCT7 and used as a wakeup button (R5 ON and R6 OFF), or it is connected to the PC13 and used as TAMPER-RTC button (R5 OFF and R6 ON).

3.8 OTGFS

AT-START-F490 board implements USB full-speed device mode via a USB type-C connector (CN3). In device mode, AT-START-F490 can be directly connected to the host via USB type-C connector. The VBUS_FS can be used as 5 V input power source of the AT-START-F490 board.

AT-START-F490 board also offers a USB type-A extension connector (CN1) which is used as USB full-speed/low-speed host interface to be connected to other devices like U-disk or mouse.

If the PA9 of the AT32F490RCT7 is to be used as OTGFS_VBUS, JP2 must turn on so that PA9 is connected to USB type-C connector.

3.9 0Ω resistors

Table 2. 0 Ω resistor settings

Resistors	State ⁽¹⁾	Description
R4 (MCU power consumption measurement)	ON	When JP3 OFF, the AT32F490RCT7 is supplied by 3.3 V.
	OFF	When JP3 OFF, an ammeter can be connected to 3.3 V to measure the power consumption of the AT32F490RCT7. (AT32F490RCT7 cannot be powered without ammeter)
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: external oscillator from PF0, or when PF0 and PF1 are used as GPIOs.
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: external oscillator from PC14, or when PC14 and PC15 are used as GPIOs.

Resistors	State ⁽¹⁾	Description
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	When used as USB, PA11 and PA12 are disconnected from the pin_12 and pin_13 of J1.
	ON, ON	When 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_CS
	ON, OFF	Arduino™ D10 is connected to PWM (TMR4_CH1)

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

3.10 Extension connectors

3.10.1 Arduino™ Uno R3 extension connectors

Female connectors J3~J6 and male J7 support standard Arduino™ Uno R3 connectors. Most of the daughter boards built on Arduino™ Uno R3 are applicable to AT-START-F490 board.

Note 1: AT32F490RCT7 I/O ports are 3.3 V-compatible with Arduino™ Uno R3, but 5 V not.

Note 2: 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	AT32F490 pin name	Description
J4 (Power supply)	1	NC	-	-
	2	IOREF	-	3.3 V reference voltage
	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

Connector	Pin number	Arduino pin name	AT32F490 pin name	Description
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_CS 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	PC2	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	NSS	PB12	SPI2_CS
	8	GPIO	PC4	-

(1) Refer to [Table 2](#) for details on 0Ω resistors.

3.10.2 LQFP64 I/O extension connectors

The extension connectors J1 and J2 are used to connect the I/O ports of AT32F490RCT7 microcontroller to external devices. All I/O ports on the AT32F490RCT7 are accessible. J1 and J2 can be measured with oscilloscope, logic analyzer or voltmeter probe.

4 Revision history

Table 4. Document revision history

Date	Revision	Changes
2024.11.26	1.00	Initial release

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