
WLR089 Xplained Pro User's Guide

Introduction

Microchip's WLR089 Xplained Pro (XPro) (EV23M25A) is a hardware platform used to evaluate the low power LoRa[®] Sub-GHz WLR089U0 module. This kit provides easy access to the features of the WLR089U0 LoRa module and explains how to integrate the device in a custom design. The WLR089 Xplained Pro Evaluation kit includes an on-board embedded debugger, thus an external programmer or debugger is not required to program or debug the WLR089U0 module. This kit offers additional peripherals to extend the features of the board and ease the development of custom designs.

Figure 1. WLR089 Xplained Pro Evaluation Kit



Features

- WLR089U0 LoRa Module, Based on the ATSAMR34J18B LoRa device
- Supports both 868 MHz and 915 MHz Operation
- On-Board Embedded Debugger and Atmel ICE Support
- Two Standard Xplained Pro Extension Headers for Signal Breakout and Extension Boards
- On-Board Power Management System with Current Monitoring and USB Power Conditioning

WLR089 Xplained Pro (EV23M25A)

- Xplained Pro Current Measurement System with Data Visualizer Support
- USB Power Inlet (EDBG USB or Target USB) with ESD Protection and Low-Dropout Regulator
- Up to +18.59 dBm Maximum Output Power
- U.FL Connector for External Antenna
- External U.FL Dipole Antenna (RFA-S1-C55H1-150D034)
- On-Board Serial Flash
- Manual Reset Button
- User Push Button
- Indicator LEDs for Status, Power and User Defined Application
- Auxiliary 10-Pin Cortex Debug Connector
- Target USB Connection to WLR089U0 module with ESD Protection
- Qtouch[®] Button
- CR1220 Backup Battery Holder
- Studio 7 Integrated Development Platform Support
- Support for Software Examples in Advanced Software Framework (ASF)

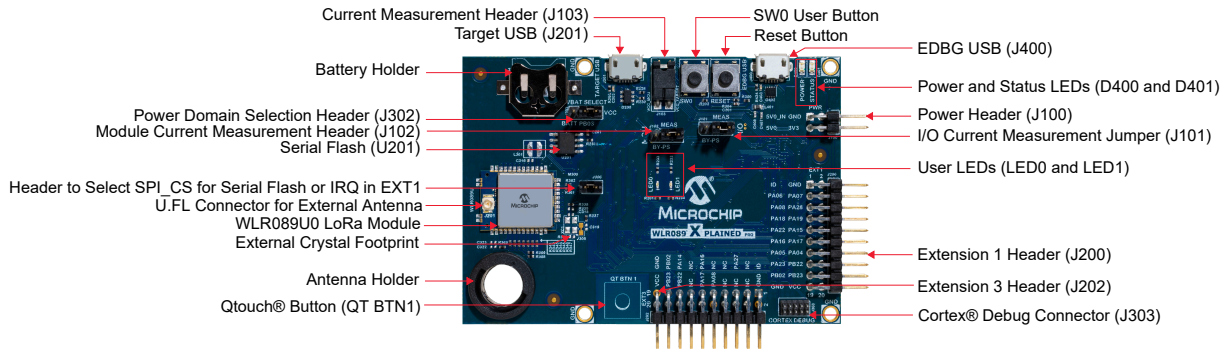
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1. Kit Overview

The WLR089 Xplained Pro Evaluation kit offers a set of features that enable the users to get started with the WLR089U0 peripherals and to integrate the device in their own design.

Figure 1-1. WLR089 Xplained Pro Evaluation Board



1.1 Kit Contents

The WLR089 Xplained Pro Evaluation kit contains the following:

- One WLR089 Xplained Pro Evaluation board
- One external U.FL dipole antenna (RFA-S1-C55H1-150D034)
- One micro-USB cable
- One antenna holder (BPC2J5)
- Four nylon standoffs and screws

2. Xplained Pro

Xplained Pro is an evaluation platform containing a series of microcontroller boards (evaluation kits) and extension boards. Atmel Studio is used to program and debug the microcontrollers on these boards. Atmel Studio includes Advanced Software Framework (ASF) and Atmel START, which has drivers and demo code, and Data Visualizer, which supports data streaming and advanced debugging. Xplained Pro evaluation kits can be connected to a wide range of Xplained Pro extension boards through standardized headers and receptacles. Xplained Pro extension boards have identification (ID) chips to uniquely identify which boards are connected to the Xplained Pro evaluation kits.

2.1 Xplained Pro Quick Start

The steps to start exploring the Xplained Pro platform are the following:

1. Download and install Atmel Studio.
2. Launch Atmel Studio.

Note: For more details, refer to the *WLR089 Xplained Pro Evaluation Kit (EV23M25A) Quick Start Guide* ([DS00003487A](#)).

When the WLR089 Xplained Pro Evaluation kit is connected to the host PC for the first time, the operating system installs the driver software automatically. This driver supports 32-bit and 64-bit versions of Microsoft® Windows® XP, Windows Vista®, Windows 7, Windows 8, Windows 10 and Windows Server 2012.

Observe the following changes after powering on the WLR089 Xplained Pro Evaluation board:

- The green power LED D400 turns on.
- Atmel Studio automatically detects the connected Xplained Pro and extension board(s).
- In Atmel Studio, the landing page of the kit presents an option to launch the associated ASF.

Notes:

- Ensure that only the on-board embedded debugger is used for debugging, not another debugger like Atmel-ICE or SAM-ICE.
- For more details, refer to the *SAM R34 MLS Getting Started Guide* ([DS50002812](#)).

2.2 Design Documentation and Relevant Links

The following list contains links to the most relevant documents for the WLR089 Xplained Pro Evaluation kit:

- [WLR089 Xplained Pro Product Page](#)
- Ordering Code – The WLR089 Xplained Pro Evaluation Kit can be ordered from www.microchipdirect.com using the Ordering Code “EV23M25A”.
- [Atmel Studio 7](#) – Atmel Studio presents Free Atmel IDE for development of C/C++ and assembler code for microcontrollers and relevant documentation.
- [Microchip sample store](#) – Microchip sample store where samples of devices can be ordered.
- [EDBG User Guide](#) – User guide containing more information about the on-board Embedded Debugger.
- [Data Visualizer](#) – Data Visualizer is a program used for processing and visualizing data. Data Visualizer can receive data from various sources such as the Embedded Debugger Data Gateway Interface found on Xplained Pro boards and COM ports.
- *WLR089 Low Power LoRa® Sub-GHz Module Data Sheet* ([DS70005435](#))
- *SAM R34/R35 Low Power LoRa® Sub-GHz SiP Datasheet* ([DS70005356](#))
- *SAM R34 MLS Getting Started Guide* ([DS50002812](#))
- WLR089 Xplained Pro design documentation – This manufacturing document package includes schematics, layout artwork, assembly diagrams and Bill of Materials (www.microchip.com/DevelopmentTools/ProductDetails/PartNO/EV23M25A).

2.3 Embedded Debugger

The WLR089 Xplained Pro contains an Embedded Debugger (EDBG) for on-board debugging. The EDBG is a USB-composite device with the following interfaces:

- Debugger
- Virtual COM port
- Data Gateway Interface (DGI)

The EDBG can program and debug the WLR089U0 module with the help of Atmel Studio. The Serial Wire Debug (SWD) interface is connected between the EDBG and the WLR089U0 module on the WLR089 Xplained Pro Evaluation board.

The Virtual COM Port is connected to a UART on the WLR089U0 module and provides an easy way to communicate with the target application through terminal software. It offers variable baud rate, parity and stop bit settings. The settings on the WLR089U0 module must match the settings given in the terminal software.



Info: The Virtual COM Port in the EDBG requires the terminal software to set the Data Terminal Ready (DTR) signal to enable the UART pins connected to the WLR089U0 module. If the DTR signal is not enabled, the UART pins on the EDBG are kept in tri-state (high-Z) to render the COM Port not usable. The DTR signal is automatically set by the terminal software, but it may have to be manually enabled in your terminal.

The DGI consists of several physical interfaces for bidirectional communication with the host computer. Communication over the interfaces is bidirectional. It can be used to send event values and data from the WLR089U0 module. Traffic over the interfaces can be timestamped by the EDBG for more accurate tracking of events, but timestamping reduces the maximal data throughput. The [Data Visualizer](#) is used to send and receive data through DGI.

The EDBG controls two LEDs on the WLR089 Xplained Pro Evaluation board: a power LED and a status LED. The following table provides details on how the LEDs are controlled in different operating modes.

Table 2-1. EDBG LED Control

Mode	Power LED	Status LED
Normal mode	The power LED is ON when power is applied to the board.	Activity indicator, the LED flashes when any communication happens to the EDBG.
Bootloader mode (idle)	The power LED and the status LED blink simultaneously.	
Bootloader mode (firmware upgrade)	The power LED and the status LED blink in an alternating pattern.	

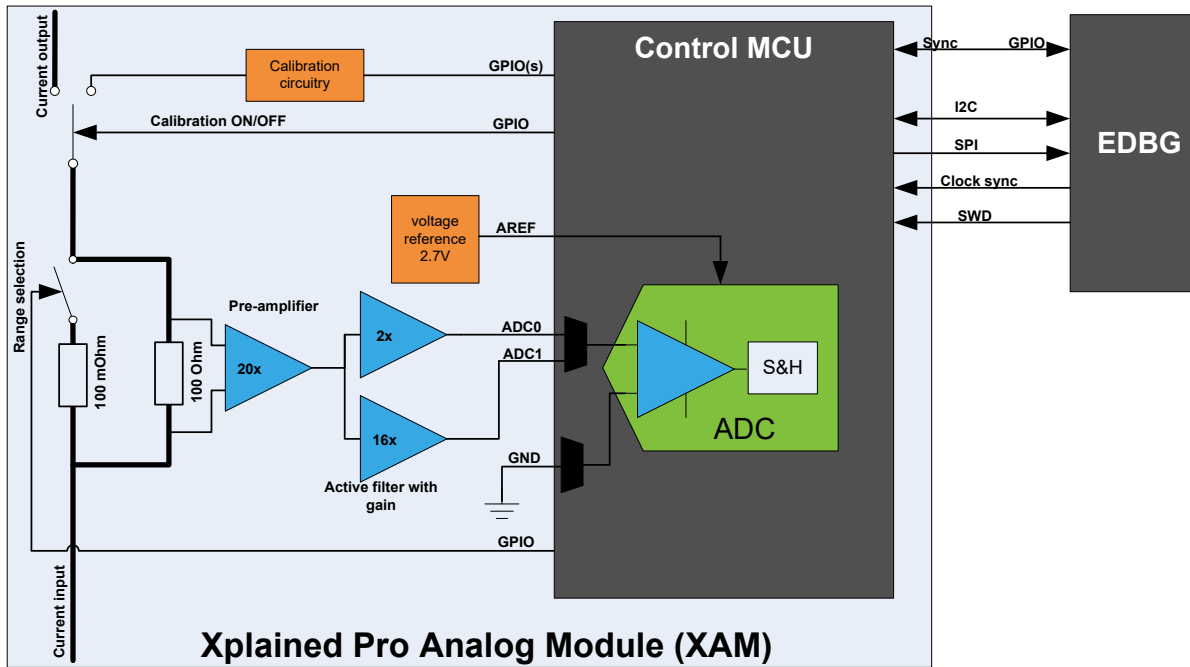
For additional information on the EDBG, see the [EDBG User Guide](#).

2.4 Xplained Pro Analog Module

2.4.1 Overview

The Xplained Pro Analog Module (XAM) extends the embedded debugger with a high dynamic range current measurement. This enables power profiling of the target system.

Figure 2-1. XAM Block Diagram



The XAM consists of:

- Calibration Circuitry
- Voltage Reference Circuitry
- Analog Front-End:
 - Shunt resistors with a range selection switch
 - Pre-amplifier
 - Two active filters with gain
- Control MCU
 - Analog-to-Digital converter
 - Signal processing
 - Control/communication interface to the EDBG

The current measurement front-end is a high side shunt measurement with a pre-amplifier and a second active filter stage with gain, as shown in [Figure 2-1](#). The wide dynamic range is achieved by four measurement ranges, which are defined by two shunt resistors and the two parallel second stage active filters with gain.

2.4.2 EDBG Interface

The XAM is connected to the EDBG with the following interfaces:

- **I²C**: This is used to control and configure the XAM.
- **SPI**: Current measurement data is streamed to the EDBG via this interface. This is a unidirectional channel from the XAM to the EDBG.
- **SWD**: The MCU in the XAM is programmed via SWD from the EDBG.
- **Clock sync**: Signal used to synchronize ADC measurements with the EDBG.
- **Reference clock**: Reference clock for the XAM.

2.4.3 Sample Rate

The raw sampling rate of the XAM is up to 250 kHz, and with the default averaging configuration (average of 16 samples), the actual output of the XAM is 16.67 ksp/s.



Info: The XAM output sample rate is not an integer fraction of the raw sampling.

2.4.4 Measurement Ranges and Accuracy

The XAM has four measurement ranges. These are defined by two shunt resistors and two gain stages.

Table 2-2. XAM Measurement Ranges and Accuracy

Measurement Range	Hardware	Resolution	Accuracy	Comments
Range 1	Low current shunt and high gain stage	20 nA	1 LSB \pm 1%	Accuracy will decrease below 1 μ A. The typical accuracy for 300 nA is 1 LSB \pm 10%.
Range 2	Low current shunt and low gain stage	150 nA	1 LSB \pm 1%	
Range 3	High current shunt and high gain stage	10 μ A	1 LSB \pm 1%	
Range 4	High current shunt and low gain stage	100 μ A	1 LSB \pm 1%	Accuracy will decrease above 100 mA. Typical accuracy is 1 LSB \pm 5% at 400 mA. The maximum current is 400 mA.

The ranges are automatically switched by the XAM to achieve the best measurement results, and the currently active range is visualized in the [Data Visualizer](#) front-end tool. The maximum voltage drop over the shunt resistor is 100 mV, and the XAM switches the range automatically before reaching this limit.

2.5 Hardware Identification System

All Xplained Pro extension boards come with an identification chip (ATSHA204A CryptoAuthentication™ chip) to uniquely identify the boards that are connected to the WLR089 Xplained Pro Evaluation board. This chip contains information that identifies the extension with its name and some extra data. When an Xplained Pro extension is connected to the WLR089 Xplained Pro Evaluation board, the information is read and sent to the Atmel Studio. The following table shows the data fields stored in the ID chip with example content.

Table 2-3. Xplained Pro ID Chip Content

Data Field	Data Type	Example Content
Manufacturer	ASCII string	Microchip\0'
Product name	ASCII string	Segment LCD1 Xplained Pro\0'
Product revision	ASCII string	02\0'
Product serial number	ASCII string	1774020200000010\0'
Minimum voltage [mV]	uint16_t	3000
Maximum voltage [mV]	uint16_t	3600
Maximum current [mA]	uint16_t	30

2.6 Power Supply

The WLR089 Xplained Pro Evaluation kit automatically detects the availability of power sources based on the following priority:

- External power
- Embedded debugger USB
- Target USB

The following table lists the details of the available power supply sources.

Table 2-4. Power Sources for WLR089 Xplained Pro Evaluation Board

Power Input	Voltage Requirements	Current Requirements	Pin Name
External power	<ul style="list-style-type: none"> • 5V \pm2% (\pm100 mV) for the USB host operation • 4.3V to 5.5V, if the USB host operation is not required 	Recommendation: <ul style="list-style-type: none"> • Requires a minimum current of 1A, which provides enough current for the connected USB devices and the board • The maximum current can go up to 2A due to the input protection maximum current specification 	PWR
Embedded debugger USB	4.4V to 5.25V (according to the USB spec.)	500 mA (according to the USB 2.0 spec.)	EDBG USB
Target USB	4.4V to 5.25V (according to the USB spec.)	500 mA (according to the USB 2.0 spec.)	TARGET USB



Info: Use an external power supply when 500 mA from a USB connector is not enough to power the board with possible extension boards. A connected USB device in a USB host application may easily exceed this limit.

2.7 Xplained Pro Headers and Connectors

2.7.1 Xplained Pro Standard Extension Header

All Xplained Pro kits have many dual-row, 20-pin, 100 mil extension headers. The Xplained Pro MCU boards have male headers, while the Xplained Pro extensions have their female counterparts. The following table provides the pin description of all the connected pins.



Info: Not all pins are always connected to all extension headers.

The extension headers can be used to connect a variety of Xplained Pro extensions to module Xplained Pro boards or to access the pins of the target module on the Xplained Pro boards.

Table 2-5. Xplained Pro Standard Extension Header

Pin Number	Pin Name	Description
1	ID	Pin to communicate with the ID chip on an extension board
2	GND	Ground.
3	ADC(+)	Analog-to-Digital Converter; alternatively, a pin for the positive terminal of a differential ADC
4	ADC(-)	Analog-to-Digital Converter; alternatively, a pin for the negative terminal of a differential ADC
5	GPIO1	General purpose I/O pin
6	GPIO2	General purpose I/O pin
7	PWM(+)	Pulse-Width Modulation; alternatively, a pin for the positive part of a differential PWM
8	PWM(-)	Pulse-Width Modulation; alternatively, a pin for the negative part of a differential PWM
9	IRQ/GPIO	Interrupt request pin and/or general purpose I/O pin
10	SPI_SS_B/GPIO	Slave select pin for Serial Peripheral Interface (SPI) and/or general purpose I/O pin
11	I ² C_SDA	Data pin for I ² C interface. Always connected, bus type
12	I ² C_SCL	Clock pin for I ² C interface. Always connected, bus type
13	UART_RX	Receiver pin of target device UART
14	UART_TX	Transmitter pin of target device UART
15	SPI_SS_A	Slave select for SPI
16	SPI_MOSI	SPI master out slave in pin. Always connected, bus type
17	SPI_MISO	SPI master in slave out pin. Always connected, bus type
18	SPI_SCK	SPI clock pin. Always connected, bus type
19	GND	Ground pin for extension boards
20	VCC	Power pin for extension boards

2.7.2 Xplained Pro Power Header

The power header can be used to connect external power to the WLR089 Xplained Pro Evaluation board. The kit automatically detects and switches to an external power source, if supplied. The power header can also be used to supply power to external peripherals or extension boards. Ensure that the total current does not exceed the recommended current limit of the on-board regulator when using the 3.3V pin.

Table 2-6. Xplained Pro Power Header

Pin Number	Pin Name	Description
1	VEXT_P5V0	External 5V input pin
2	GND	Ground pin
3	VCC_P5V0	Unregulated 5V pin (an output, derived from one of the input sources)
4	VCC_P3V3	Regulated 3.3V pin (an output, used as the main power supply for the kit)

3. Hardware User Guide

3.1 Power Distribution

The WLR089 Xplained Pro Evaluation board can be powered by:

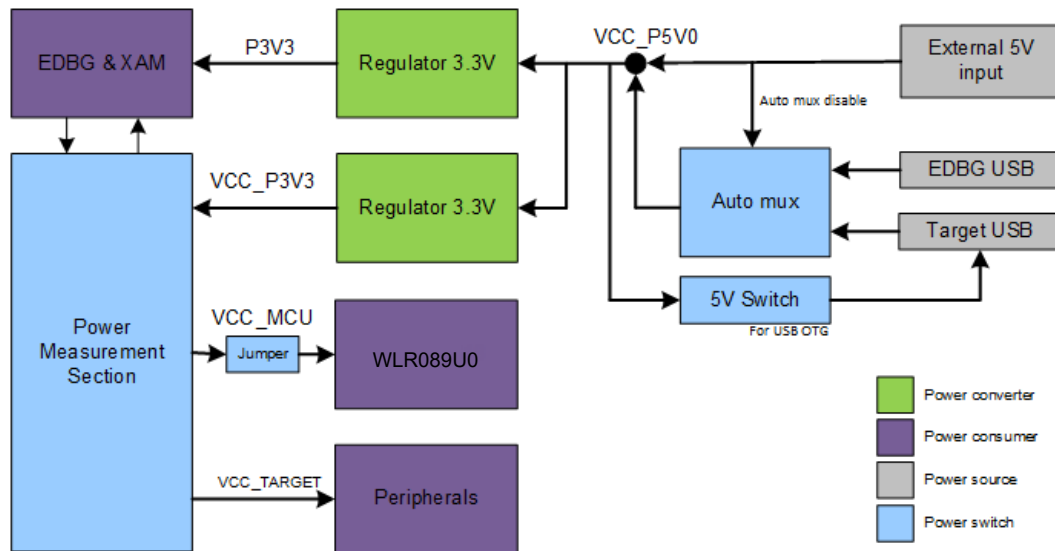
- EDBG USB
- TARGET USB
- External (5V)

The kit has a power MUX which automatically chooses the power source if two or all three of the power sources are available to the kit at the same time.

The kit contains:

- Two on-board voltage regulators (3.3V) for:
 - EDBG and XAM section
 - WLR089U0 module
- IO peripherals
- Power Measurement Section (XAM)

Figure 3-1. Power Supply Block Diagram



3.2 Connectors

The following sections describe the implementation of the relevant connectors and headers on the WLR089 Xplained Pro Evaluation board and their connection to the WLR089U0 module. The tables of connections in the sections also describe which signals are shared between the headers and on-board functionality.

3.2.1 Xplained Pro Extension Headers

The headers (EXT1 and EXT3) on the WLR089 Xplained Pro Evaluation board offer access to the I/O of the module in order to expand the board by connecting extensions to the board. These headers are based on the standard extension header specified in [2.7.1 Xplained Pro Standard Extension Header](#). The headers have a pitch of 2.54 mm.

Table 3-1. EXT1 Extension Header

EXT1		Pins on WLR089U0 Module	Shared Functionality
Pin	Signal		
1	ID	—	—
2	GND	GND	—
3	ADC(+)	PA06	QTouch Button
4	ADC(-)	PA07	Target USB
5	GPIO1	PA08	EDBG, EXT3
6	GPIO2	PA28	Mechanical Button
7	PWM(+)	PA18	LED1
8	PWM(-)	PA19	LED0
9	IRQ	PA22 ⁽¹⁾	EDBG, Serial Flash
10	SPI_SS	PA15	Target USB, EDBG, optional 12 MHz external crystal
11	TWI_SDA	PA16	EXT3, EDBG
12	TWI_SCL	PA17	EXT3, EDBG
13	UART_RX	PA05	EDBG
14	UART_TX	PA04	EDBG
15	SPI_SS	PA23	—
16	SPI_MOSI	PB22	EXT3, EDBG, Serial Flash
17	SPI_MISO	PB02	EXT3, EDBG, Serial Flash
18	SPI_SCK	PB23	EXT3, EDBG, Serial Flash
19	GND	GND	—
20	VCC	—	Supply to peripherals

Note:

1. Disconnect the jumper cap on J306 to use the IRQ line at pin 9 in the EXT1 header.

Table 3-2. EXT3 Extension Header

EXT3		Pins on WLR089U0 Module	Shared Functionality
Pin	Signal		
1	ID	—	—
2	GND	GND	—
3	ADC(+)	—	—
4	ADC(-)	—	—
5	GPIO1	PA27	EDBG
6	GPIO2	—	—
7	PWM(+)	—	—
8	PWM(-)	—	—

.....continued

EXT3		Pins on WLR089U0 Module	Shared Functionality
Pin	Signal		
9	IRQ	—	—
10	SPI_SS	PA08	EXT1, EDBG
11	TWI_SDA	PA16	EXT1, EDBG
12	TWI_SCL	PA17	EXT1, EDBG
13	UART_RX	—	—
14	UART_TX	—	—
15	SPI_SS	PA14	EDBG, optional 12 MHz external crystal
16	SPI_MOSI	PB22	EXT1, EDBG, Serial Flash
17	SPI_MISO	PB02	EXT1, EDBG, Serial Flash
18	SPI_SCK	PB23	EXT1, EDBG, Serial Flash
19	GND	GND	—
20	VCC	—	Supply to peripherals

3.2.2 Target USB Connection

For USB applications on the WLR089U0 module, there is a directly connected USB port designated as TARGET_USB, which is exposed as a Micro-AB jack (J201). The TARGET_USB port includes required ESD suppression and power management circuitry. A General Purpose I/O (GPIO) pin is used to detect the VBUS voltage on the connector, to detect when a TARGET USB cable is connected in Self-Powered mode. In the USB Host mode, the VBUS voltage is provided by the kit and cannot identify the connected device; therefore, another GPIO is used to detect the USB ID of the device.

Note: The EDBG USB port is not directly connected to the WLR089U0 module USB PHY.

Table 3-3. USB Connections

Pin on WLR089U0 Module	USB Function	Shared Functionality
PA07	VBUS Detection	EXT1
PA15	USB ID	EXT1, EDBG, optional 12 MHz external crystal
PA24	USB D-	—
PA25	USB D+	—

3.2.3 Current Measurement Header

The WLR089 Xplained Pro Evaluation board provides a right-angled 1x2, 100-mil pin header (J103) for the MCU current measurement. Powering the WLR089U0 module is exclusively routed through this header (excluding power to extension headers and peripherals). To measure the power consumption of the device, remove the jumper and replace it with an ammeter.



Removing the jumper from the pin header while the kit is powered on may cause the WLR089U0 module to be powered through its I/O pins. This may cause permanent damage to the device.

3.2.4 Power Supply Domain Selection Header

The WLR089 Xplained Pro Evaluation board has a power supply domain selection header (J302). Place a jumper cap between pins 1 and 2 of the header (J302) to connect with the battery to test the Battery Backup mode using the PB03 supply controller pin (SUPC/VBAT). Place the jumper cap between pins 2 and 3 to connect PB03 with the 3.3V module supply (VCC_MCU).

3.2.5 Cortex Debug Connector

The WLR089 Xplained Pro Evaluation board has a 10-pin 50 mil cortex debug connector that can be used to attach external debuggers to the WLR089U0 module.

Table 3-4. Cortex Debug Connector Details

Pin Number	Pin Name	Function	Shared functionality
1	VCC_TARGET	Peripheral supply	—
2	PA31	SWD data signal	EDBG
3	GND	Ground	—
4	PA30	SWD clock signal	EDBG
5	GND	Ground	—
6	—	—	—
7	—	—	—
8	—	—	—
9	GND	Ground	—
10	TARGET_RESET	Target reset signal	Reset button, EDBG

3.3 Peripherals

3.3.1 Mechanical Buttons

The WLR089 Xplained Pro Evaluation board consists of two mechanical buttons:

- RESET button connected to the WLR089U0 module Reset line
 - When the RESET button is pressed, it drives the I/O line to ground
- Generic user-configurable button
 - When the user button is pressed, it drives the I/O line to ground

Note: There is no pull-up resistor connected to the generic user button; enable the internal pull-up in the WLR089U0 module to use the button.

Table 3-5. Mechanical Buttons

Pin on WLR089U Module	Silkscreen Text	Shared functionality
RESET_N	RESET	EDBG, Cortex® Debug Connector (J303)
PA28	SW0	EXT1

3.3.2 LEDs

The WLR089 Xplained Pro Evaluation board has the user LEDs (yellow and green) that can be turned on and off based on user application. To activate the LED, drive the connected I/O line to GND.

Table 3-6. LED Functions

Pin on WLR089U0 Module	Function	Shared Functionality
PA19	Yellow LED0 (D201)	EXT1
PA18	Green LED1 (D202)	EXT1

3.3.3 UART Connection

The WLR089U0 module exposes the UART on EXT1. This is useful for command line interfaces, debugging and application layer code.

The following table provides the UART signals pin description.

Table 3-7. UART Signals Pin Description

Pin on WLR089U0 Module	Function	Shared Functionality
PA04	UART_TX	EDBG
PA05	UART_RX	EDBG

3.3.4 QTouch Button

The WLR089 Xplained Pro Evaluation board contains a self-capacitance button, which can be used as an I/O. This QTouch button is intended to be driven by the built-in Peripheral Touch Controller (PTC) of the device. A 10 kΩ series resistor on the I/O line to the QTouch button can be used to disconnect the QTouch button from the extension header 1 because the QTouch button and extension header 1 (EXT1) share the I/O line.

Note: To get started with QTouch, refer to the [QTouch® Library](#) and [QTouch® Composer](#).

Table 3-8. QTouch Connection

Pin on WLR089U0 Module	Silkscreen Text	Shared Functionality
PA06	QT BTN1	EXT1

3.3.5 Backup Battery

The WLR089 Xplained Pro Evaluation board is equipped with a CR1220 backup battery holder. This provides 35 mAH of power for SRAM backup.

Note: A battery is not included in this package.

3.3.6 Serial Flash

WLR089 Xplained Pro Evaluation board contains a 4-Mb serial Flash (AT25DF041B-SSHN-T) for Firmware Update Over-The-Air (FUOTA) and other applications. The SPI signals are connected to SERCOM 5. SPI signals are also available on EXT1, EXT3 and the embedded debugger.

Table 3-9. Signals Pin Description

Pin on WLR089U0 Module	Function	Shared Functionality
PB22	MOSI	EXT1, EXT3, EDBG
PA22 ⁽¹⁾	CS	EXT1, EDBG
PB23	SCK	EXT1, EXT3, EDBG
PB02	MISO	EXT1, EXT3, EDBG

Note:

1. Ensure that a jumper cap is placed on the J306 header. Do not use the IRQ line at pin 9 in the EXT1 header while using serial Flash.

3.3.7 External Crystal Oscillator

Footprint provision is available on-board for an external 12 MHz crystal oscillator. The external oscillator (XOSC) acts as a clock source for generic clock generators. Configure the XOSC using the generic clock controller.

At Reset, disable the XOSC and use the XIN (PA14)/XOUT (PA15) pins as GPIO pins with other peripherals in the system. The operating mode determines the GPIO usage after enabling the XOSC. In the Crystal Oscillator mode, OSCCTRL controls the XIN and XOUT pins and overrides the GPIO functions on both of the pins.

3.4 Embedded Debugger Implementation

The WLR089 Xplained Pro Evaluation board contains an Embedded Debugger (EDBG) that can be used to program and debug the WLR089U0 module using Serial Wire Debug (SWD). The embedded debugger also includes a Virtual Com port interface over UART, a Data Gateway Interface (DGI) over SPI and I²C, and also includes four of the WLR089U0 module GPIOs. The kit also includes a XAM extension processor to the embedded debugger for on-board current measurement. Atmel Studio can be used as a front-end for the embedded debugger.

3.4.1 Serial Wire Debug

The Serial Wire Debug (SWD) uses two pins to communicate with the target. For further information on how to use the programming and debugging capabilities of the EDBG, see [2.3 Embedded Debugger](#).

Table 3-10. SWD Connections

Pin on WLR089U0 Module	Function	Shared Functionality
PA30	SWD clock	Cortex® Debug Connector
PA31	SWD data	Cortex® Debug Connector

3.4.2 Virtual COM Port

The embedded debugger acts as a virtual COM port gateway by using one of the WLR089U0 module UARTs. For further information on how to use the virtual COM port, refer to [2.3 Embedded Debugger](#).

Table 3-11. Virtual COM Port Connections

Pin on WLR089U0 Module	Function	Shared Functionality
PA05	UART RX line	EXT1
PA04	UART TX line	EXT1

3.4.3 Data Gateway Interface

The embedded debugger features a Data Gateway Interface (DGI) by using either an SPI or I²C. The DGI can send data from the WLR089U0 module to the host PC. For further information on how to use the DGI interface, refer to the [Data Visualizer](#) and the [EDBG User Guide](#).

Table 3-12. DGI Interface Connections using SPI

Pin on WLR089U0 Module	Function	Shared Functionality
PA27	GPIO/SPI SS (Slave Select) (WLR089U0 is Master)	EXT3
PB02	SERCOM5 PAD[0] SPI MISO (Master In, Slave Out)	EXT1, EXT3, Serial Flash
PB22	SERCOM5 PAD[2] SPI MOSI (Master Out, Slave In)	EXT1, EXT3, Serial Flash
PB23	SERCOM5 PAD[3] SPI SCK (Clock Out)	EXT1, EXT3, Serial Flash

Table 3-13. DGI Interface Connections using I²C

Pin on WLR089U0 Module	Function	Shared Functionality
PA16	SERCOM1 PAD[0] SDA (Data line)	EXT1, EXT3
PA17	SERCOM1 PAD[1] SCL (Clock line)	EXT1, EXT3

Four GPIO lines are connected to the embedded debugger. The EDBG can monitor these lines and timestamp pin value changes. This makes it possible to accurately timestamp events in the WLR089U0 application code. For further information on how to configure and use the GPIO monitoring features, refer to the [Data Visualizer](#) and the [EDBG User Guide](#).

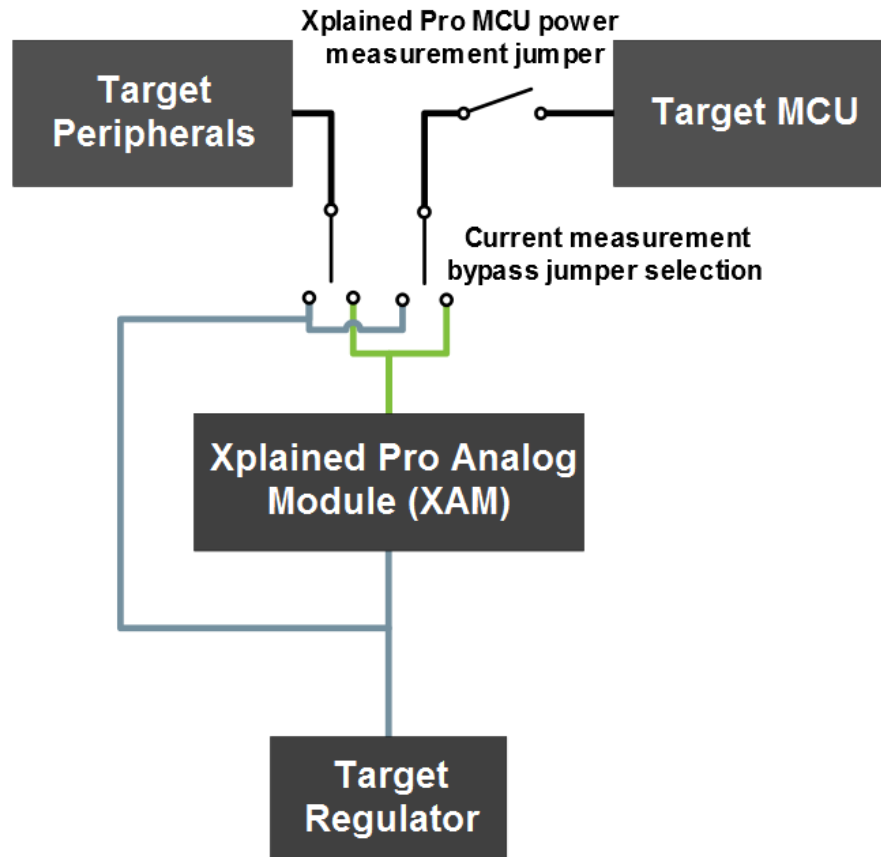
Table 3-14. GPIO Lines Connected to the EDBG

Pin on WLR089U0 Module	Function	Shared Functionality
PA08	GPIO0	EXT1, EXT3
PA14	GPIO1	EXT3, optional 12 MHz external crystal
PA15	GPIO2	EXT1, target USB ID, optional 12 MHz external crystal
PA22	GPIO3	EXT1 and serial Flash

3.4.4 WLR089 Xplained Pro XAM Configuration

On the WLR089 Xplained Pro, the MCU and the MCU peripherals (for example, extensions) are powered by their own regulator, as shown in the following figure. All other parts of the board, mainly the embedded debugger and accompanying Xplained Pro Analog Module (XAM), are powered from a separate regulator. The current to the MCU and peripherals can be measured by connecting them to the XAM output through jumper settings.

Figure 3-2. WLR089 XAM Implementation Block Diagram



XAM can be used in four configurations on the WLR089 Xplained Pro Evaluation board:

1. **No current measurement or external MCU current measurement:** The XAM is bypassed and thus the module and peripherals are supplied directly by the regulator. Set both jumpers in the "BYPASS" position. In this configuration, it is also possible to connect external measurement tools on the module Xplained Pro power measurement header to measure the module current directly instead of using the XAM.
2. **Module current measurement:** The XAM measures only the module current while the peripherals are supplied directly by the regulator. For this configuration, place the jumper for "I/O" (peripherals) into the "BYPASS" position and the jumper for "MCU" into the "MEASURE" position.
3. **Peripherals measurement:** The XAM measures only the peripherals current while the module is directly supplied by the regulator. For this configuration, place the jumper for "MCU" into the "BYPASS" position and the "I/O" jumper into the "MEASURE" position.
4. **Module and peripherals measurement:** In this configuration, both the module and peripherals are measured by the XAM. Place both jumpers on "I/O" and "MCU" headers in the "MEASURE" position.

3.5 Kit Modifications

The WLR089 Xplained Pro Evaluation board contains several resistors that can be used to disconnect I/O pins of the WLR089U0 module from connectors and on-board ICs, and to disconnect power signals.

Table 3-15. Disconnect Resistors for Multiplexed IO Functionality

Designator	Value	From	To	Comment
R322	0R	EDBG SWDIO	PA31 SWDIO	Debug interface from the EDBG to the WLR089U0 module
R323	0R	EDBG SWDCLK	PA30 SWDCLK	
R324	0R	EDBG TARGET RESET	TARGET MCU RESET	
R310	0R	EDBG SPI SS	PA27 GPIO	
R311	0R	EDBG SPI SCK	PB23 SPI SCK	EDBG CDC and DGI interfaces to the WLR089U0 module
R312	0R	EDBG SPI MOSI	PB22 SPI MOSI	
R313	0R	EDBG SPI MISO	PB02 SPI MISO	
R314	0R	EDBG DGI SDA	PA16 I2C SDA	
R315	0R	EDBG DGI SCL	PA17 I2C SCL	
R316	0R	EDBG CDC RX	PA04 UART TX	
R317	0R	EDBG CDC TX	PA05 UART RX	
R318	0R	EDBG DGI_GPIO0	PA08 GPIO	
R319	0R	EDBG DGI_GPIO1	PA14 GPIO	
R320	0R	EDBG DGI_GPIO2	PA15 GPIO	
R321	0R	EDBG DGI_GPIO3	PA22 GPIO	
R229	0R	TARGET VUSB DETECT	PA07 ADC7	To detect if a USB cable is connected to the TARGET USB connector
R109	47K	VCC_P3V3_CM_IN	TARGET VOLTAGE	To detect the target voltage of 3.3V in the voltage divider network
R325	0R	RESET	TARGET RESET SENSE	Reset sense signal to EDBG, to detect external Resets
R364	0R	PB23_S5_SPI_SCK_EXT3	PB23_S5_SPI_SCK	To disconnect the SPI clock line to EXT3
R365	0R	PB23_S5_SPI_SCK_EXT1	PB23_S5_SPI_SCK	To disconnect the SPI clock line to EXT1
R366	0R	PB23_S5_SPI_SCK_EDBG	PB23_S5_SPI_SCK	To disconnect the SPI clock line to EDBG
R367	0R	PB23_S5_SPI_SCK_FLASH	PB23_S5_SPI_SCK	To disconnect the SPI clock line to serial Flash
R337	0R	PA15_XOUT	PA15_GPIO	To use the optional 12 MHz external crystal output
R338	0R	PA14_XIN	PA14_GPIO	To use the optional 12 MHz external crystal input
R202	39R	Pin6_GPIO of EXT1 (PA28_GPIO)	User Button (SW0)	To disconnect the user button

.....continued				
Designator	Value	From	To	Comment
R235	10K	PIN3_ADC(+) of EXT1 (PA06_ADC6_PTCY4)	QTouch [®] Button	To disconnect the QTouch [®] button
R201	0R	Pin8 of EXT1 (PA19_PWM_T0_W3)	LED_YELLOW (LED0)	To disconnect the yellow user LED
R234	0R	Pin7 of EXT1 (PA18_PWM_T0_W2)	LED_GREEN (LED1)	To disconnect the green user LED
R231	330R	PA15_GPIO	ID pin of Target MCU USB	To disconnect the ID pin of target MCU USB

3.5.1 Operating at Other Voltages

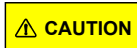
The WLR089 Xplained Pro Evaluation board operates at 3.3V by default, but it is also possible to run the board at lower voltages from an external supply. The EDBG is designed to run from a 3.3V supply and will not work on other voltages; therefore, all connections from the EDBG and from the on-board 3.3V regulator to the WLR089U0 module must be removed.

To completely disconnect the EDBG and the on-board power supply from the WLR089U0 module, perform the following steps:

- Remove the two jumpers from the on-board 3-pin current measurement headers (J101 and J102) and connect the two center pins (pin 2) together with a wire or an ammeter as shown in [Figure 3-3](#).
- Remove all the EDBG disconnect resistors (refer to [Table 3-15](#)).
- Power ON the WLR089 Xplained Pro Evaluation board via pin 4 (3V3) and pin 2 (GND) of the Power Header J100.
- Program the WLR089U0 module using an industry standard 2x5-50 mil cortex debug connector and an external programmer such as Atmel ICE.

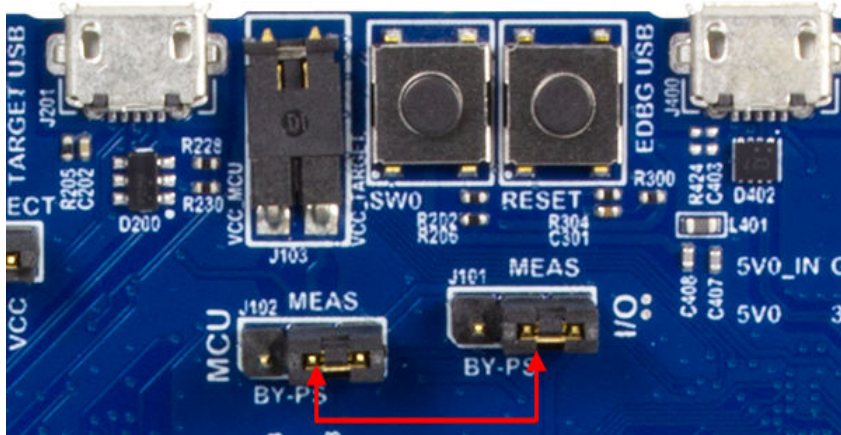


Info: Operating the WLR089U0 module at voltages other than 3.3V requires physical modifications on the kit using a soldering iron and an external debugger for programming the WLR089U0 module. The on-board current measurement only works at 3.3V. The on-board LED is selected for 3.3V operation; the LED brightness at 1.8V operation is dull. To increase the emitted light level, the value of the series resistor can be lowered. EDBG functionality can be restored by re-soldering the removed components.



CAUTION The voltage supplied through the power header is applied directly to the WLR089U0 module and the extension headers. Applying a voltage greater than 3.5V may damage the board permanently.

Figure 3-3. WLR089 Xplained Pro Evaluation kit Current Measurement Headers



Related Links

[2.7.2 Xplained Pro Power Header](#)

[3.2.5 Cortex Debug Connector](#)

4. Regulatory Approval

This equipment (WLR089 Xplained Pro/A09-3355) is an evaluation kit and not a finished product. It is intended for laboratory evaluation purpose only. It is not directly marketed or sold to general public through retail; it is only sold through authorized distributors or through Microchip. Using this requires a significant engineering expertise towards understanding of the tools and relevant technology, which can be expected only from a person who is professionally trained in the technology.

When this module is used in USA/Canada, the user must restrict the operating frequency band within 902-928 MHz. For Europe, the user must ensure that the module must be operated only within the 868-868.6 MHz frequency band. Regulatory compliance settings have to follow the WLR089U0 module certifications.

The following regulatory notices are to cover the requirements under the regulatory approval.

4.1 United States

The WLR089 Xplained Pro (A09-3355) contains WLR089U0 module, which has received Federal Communications Commission (FCC) CFR47 Telecommunications, Part 15 Subpart C “Intentional Radiators” single-modular approval in accordance with Part 15.212 Modular Transmitter approval.

Contains Transmitter Module FCC ID: 2ADHKR34M

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.



Important: FCC Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for uncontrolled environment. The antenna (s) used for this transmitter must be installed to provide a separation distance of at least 20 mm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter. This transmitter is restricted for use with the specific antenna (s) tested in this application for certification.



Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

FCC Notice

This kit is designed to allow:

- Product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product.
- Software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.
- The kit is for evaluation only; not FCC approved for resale; and any radio frequency transmitter employed as part of an evaluation kit shall be designed to comply with all applicable FCC technical rules, including frequency use, spurious and out-of-band emission limits, and maximum power or field strength ratings applicable to final products that would employ the components or circuitry to be evaluated.

- Under 47 CFR 2.805(d)(2) in order to operate the evaluation kit, the user must ultimately render the device inoperable or return it to Microchip.
- Evaluation kit is defined by FCC as “[a]n assembly of components, subassemblies, or circuitry, including software, created by or for a component maker, system integrator, or product developer for the sole purpose of facilitating: End product developer evaluation of all or some of such components, subassemblies, or circuitry, or (ii) the development of software to be used in an end product.” (see 47 CFR 2.1)

4.2 Canada

The WLR089 Xplained Pro (A09-3355) contains WLR089U0 module, which has been certified for use in Canada under Innovation, Science, and Economic Development Canada (ISED, formerly Industry Canada) Radio Standards Procedure (RSP) RSP-100, Radio Standards Specification (RSS) RSS-Gen and RSS-247.

Contains IC: 20266-R34M

This device contains license-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada’s license-exempt RSS(s). Operation is subject to the following two conditions:

1. This device may not cause interference;
2. This device must accept any interference, including interference that may cause undesired operation of the device.

L’émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d’Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L’exploitation est autorisée aux deux conditions suivantes:

1. L’appareil ne doit pas produire de brouillage;
2. L’appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d’en compromettre le fonctionnement.



This equipment complies with radio frequency exposure limits set forth by Innovation, Science and Economic Development Canada for an uncontrolled environment. This equipment must be installed and operated with minimum distance 35 mm between the device and the user or bystanders.

Cet équipement est conforme aux limites d'exposition aux radiofréquences définies par d’Innovation, Sciences et Développement économique Canada pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 35 mm de distance entre le dispositif et l'utilisateur ou des tiers.

4.3 Europe

This equipment (A09-3355) has been assessed under the Radio Equipment Directive (RED) for use in European Union countries. The product does not exceed the specified power ratings, antenna specifications, and/or installation requirements as specified in the user manual. A Declaration of Conformity is issued for each of the standards and kept on file as described in RED.

Simplified EU Declaration of Conformity

Hereby, Microchip Technology Inc. declares that the radio equipment type [A09-3355] is in compliance with Directive 2014/53/EU.

The full text of the EU declaration of conformity is available at (refer product specific pages): www.microchip.com/design-centers/wireless-connectivity/.

4.4 Antenna Considerations

For the list of antennas approved by the regulatory bodies, refer to Section 11.4 in the *WLR089U0 Low Power LoRa® Sub-GHz Module Data Sheet* ([DS70005435](#)).



All RF transmission or reception should be performed with the antenna connected.

5. Hardware Revision History

5.1 Identifying Product ID and Revision

There are two ways to find the revision and product identifier of the Xplained Pro boards: either through Atmel Studio or by looking at the sticker on the bottom side of the PCB.

When a module Xplained Pro board is connected to a computer with Atmel Studio running, an information window with the serial number displays. The first six digits of the serial number contain the product identifier and revision. Information about connected Xplained Pro extension boards also displays in the window.

The same information can be found on the sticker on the bottom side of the PCB. Most kits have stickers that have the identifier and revision printed in plain text as A09-nnnn/rr. Boards with limited space have a sticker with only a data matrix code, which contains a serial number string.

The serial number string has the following format:

```
"nnnnrrssssssssss"
```

n = product identifier

r = revision

s = serial number

6. Document Revision History

Revision	Date	Section	Description
A	09/2020	Document	Initial revision

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