ATtiny416 Xplained Nano

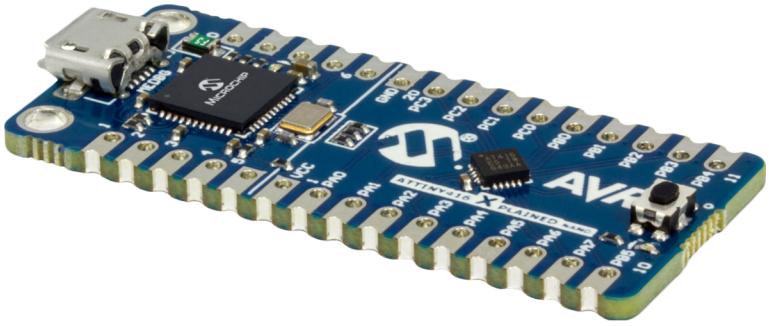
ATtiny416 Xplained Nano Evaluation Kit User's Guide

Preface

The ATtiny416 Xplained Nano Evaluation Kit is a hardware platform to evaluate the ATtiny416 microcontroller.

Supported by the Atmel Studio and MPLAB® X integrated development platform, the kit provides easy access to the features of the ATtiny416 and explains how to integrate the device into a custom design.

The Xplained Nano series of evaluation kits include an on-board mini embedded programmer, and no external tools are necessary to program the ATtiny416.



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1. Introduction

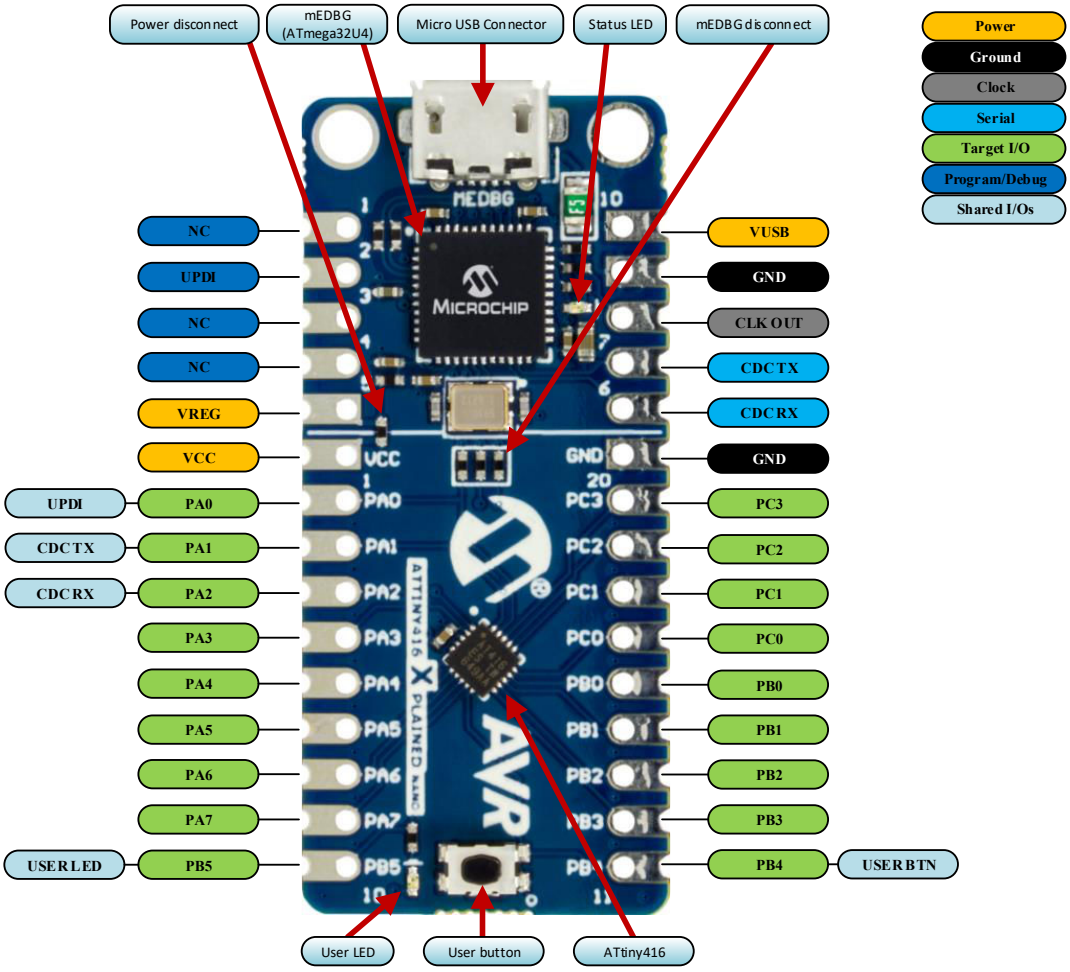
1.1 Features

- ATtiny416 Microcontroller
- One Yellow User LED
- One Mechanical Button
- mEDBG
  - Auto-ID for board identification in Atmel Studio/Microchip MPLAB® X IDE
  - One green board status LED
  - Programming
  - Virtual COM port (CDC)
- USB Powered

1.2 Kit Overview

The Microchip ATtiny416 Xplained Nano Evaluation Kit is a hardware platform to evaluate the ATtiny416.

Figure 1-1. ATtiny416 Xplained Nano Evaluation Kit Overview



2. Getting Started

2.1 Xplained Nano Quick Start

Steps to start exploring the Microchip Xplained Nano platform:

1. Download Atmel Studio/Microchip MPLAB® X IDE.
2. Launch Atmel Studio/Microchip MPLAB® X IDE.
3. Optional: Use MPLAB® Code Configurator or Atmel START to generate drivers and examples.
4. Write your application code.
5. Connect a USB cable (Standard-A to Micro-B or Micro-AB) between the PC and the debug USB port on the kit.

When the Xplained Nano kit is connected to your computer for the first time, the operating system will perform a driver software installation. The driver file supports both 32- and 64-bit versions of Microsoft® Windows® XP, Windows Vista®, Windows 7, Windows 8, and Windows 10. The drivers for the kit are included with Atmel Studio/ Microchip MPLAB® X IDE.

Once the Xplained Nano board is powered, the green status LED will blink and Atmel Studio/Microchip MPLAB® X IDE will auto-detect which Xplained Nano board is connected. Atmel Studio/Microchip MPLAB® X IDE will present relevant information like data sheets and kit documentation. The ATtiny416 device is programmed and debugged by the on-board Mini Embedded Debugger and therefore, no external programmer or debugger tool is required.

2.2 Design Documentation and Relevant Links

The following list contains links to the most relevant documents and software for the ATtiny416 Xplained Nano.

- **Xplained Products** - Xplained Evaluation Kits are a series of easy-to-use evaluation kits for Microchip microcontrollers and other Microchip products.
  - Xplained Nano - used for low pin count devices and provides a minimalistic solution with access to all I/O pins of the target microcontroller.
  - Xplained Mini - used for medium pin count devices and adds Arduino Uno compatible header footprint and a prototyping area.
  - Xplained Pro - used for medium-to-high pin count devices that features advanced debugging and standardized extensions for peripheral functions.

  Note: All the above kits have on-board programmers/debuggers, which creates a set of low-cost boards for evaluation and demonstration of features and capabilities of different Microchip products.
- **Atmel Studio** - Free IDE for the development of C/C++ and assembler code for microcontrollers.
- **MPLAB® X IDE** - MPLAB® X IDE is a software program that runs on a PC (Windows®, Mac OS®, Linux®) to develop applications for Microchip microcontrollers and digital signal controllers. It is called an Integrated Development Environment (IDE) because it provides a single integrated “environment” to develop code for embedded microcontrollers.
- **MPLAB® Code Configurator** - MPLAB® Code Configurator (MCC) is a free software plug-in that provides a graphical interface to configure peripherals and functions specific to your application.
- **IAR Embedded Workbench® for AVR®** - This is a commercial C/C++ compiler that is available for 8-bit AVR. There is a 30-day evaluation version as well as a 4 KB code-size-limited kick-start version available from their website.
- **Atmel START** - Atmel START is an online tool that helps the user to select and configure software components and tailor your embedded application in a usable and optimized manner.
- **Microchip Sample Store** - Microchip sample store where you can order samples of devices.
- **Data Visualizer** - Data Visualizer is a program used for processing and visualizing data. The Data Visualizer can receive data from various sources such as the EDBG Data Gateway Interface found on Curiosity Nano and Xplained Pro boards and COM Ports.
- **ATtiny416 Xplained Nano website** - Kit information, latest user guide and design documentation.

- **ATtiny416 Xplained Nano on Microchip Direct** - Purchase this kit on microchipDirect.

3. Xplained Nano

Xplained Nano is an evaluation platform that provides a set of small boards with access to all microcontroller I/O's. The platform consists of a series of low pin count Microcontroller (MCU) boards, which are integrated with Atmel Studio/Microchip MPLAB® X IDE to present relevant user guides, application notes, data sheets, and example code through Atmel Studio/Microchip MPLAB® X IDE. The platform also features a Virtual COM port for serial communication to a host PC.

3.1 Mini Embedded Debugger

The ATtiny416 Xplained Nano contains the Mini Embedded Debugger (mEDBG) for on-board programming and debugging. The mEDBG is a composite USB device of two interfaces: a debugger and a virtual COM port.

Together with Atmel Studio, the mEDBG debugger interface can program and debug the ATtiny416. On ATtiny416 Xplained Nano, the UPDI interface is connected between the mEDBG and the ATtiny416.

The virtual COM port is connected to a UART on the ATtiny416 and provides an easy way to communicate with the target application through the terminal software. It offers variable baud rate, parity, and Stop bit settings.
Note: The settings on the ATtiny416 must match the settings given in the terminal software.

Info: The virtual COM port in the mEDBG requires the terminal software to set the Data Terminal Ready (DTR) signal to enable the UART pins connected to the ATtiny416. If the DTR signal is not enabled the UART pins on the mEDBG are kept in high-z (tri-state), rendering the COM port unusable. The DTR signal is automatically set by some terminal software, but it may have to be manually enabled in the target terminal.

The mEDBG controls one status LED on the ATtiny416 Xplained Nano. The table below shows how the LED is controlled in different operation modes.

Table 3-1. mEDBG LED Control

Operation Mode	Status LED
Power-up	LED is briefly lit
Normal operation	LED is not lit
Programming	Activity indicator; the LED flashes when programming/ debugging with the mEDBG

3.1.1 Xplained Nano Clock Output

The mEDBG outputs its CPU clock to the *CLK* pin 8, as shown in 3.3 Xplained Nano Standard Pinout. The clock output can be used to feed the target device with a more accurate clock if this is needed for the application.

3.2 Power Sources

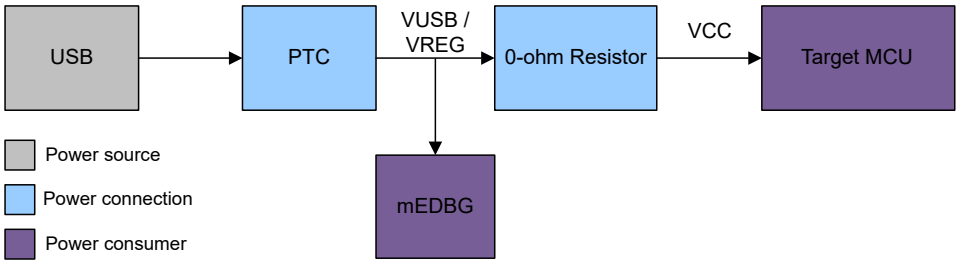
The kit can be powered by different sources. By default the kit will have a 5V supply and the voltage is taken directly from the USB port through a 500 mA PTC fuse. The voltage from the USB connector can vary between 4.4V to 5.25V (according to USB spec).

If other voltages are required, the kit must be disconnected from the USB to avoid damage or contention to the USB power. The mEDBG must also be disconnected from the target section of the board. The board can be powered by applying a voltage to one of the power connections on the board, according to the table below. To avoid any power leakage through the mEDBG, this should also be disconnected by removing the resistors shown in Figure 3-3. For placement of power connections, see 3.3 Xplained Nano Standard Pinout.

Table 3-2. Power Connections

Power Connection	Description
VUSB	USB Voltage output when USB is connected (behind a PTC fuse). Can be used as power input when USB is not used.
VREG	Regulated voltage from VUSB. If the kit does not have a regulator, this is directly connected to VUSB.
VCC	Target voltage supply. By default, connected to VREG through a 0Ω resistor. Apply external voltage here if the resistor is removed.

Figure 3-1. Power Supply Block Diagram



3.3 Xplained Nano Standard Pinout

Xplained Nano kits have a standard pinout in the mEDBG section, as shown in the tables and figure below. The program/debug pins will change depending on the target interface but will remain at the same locations.

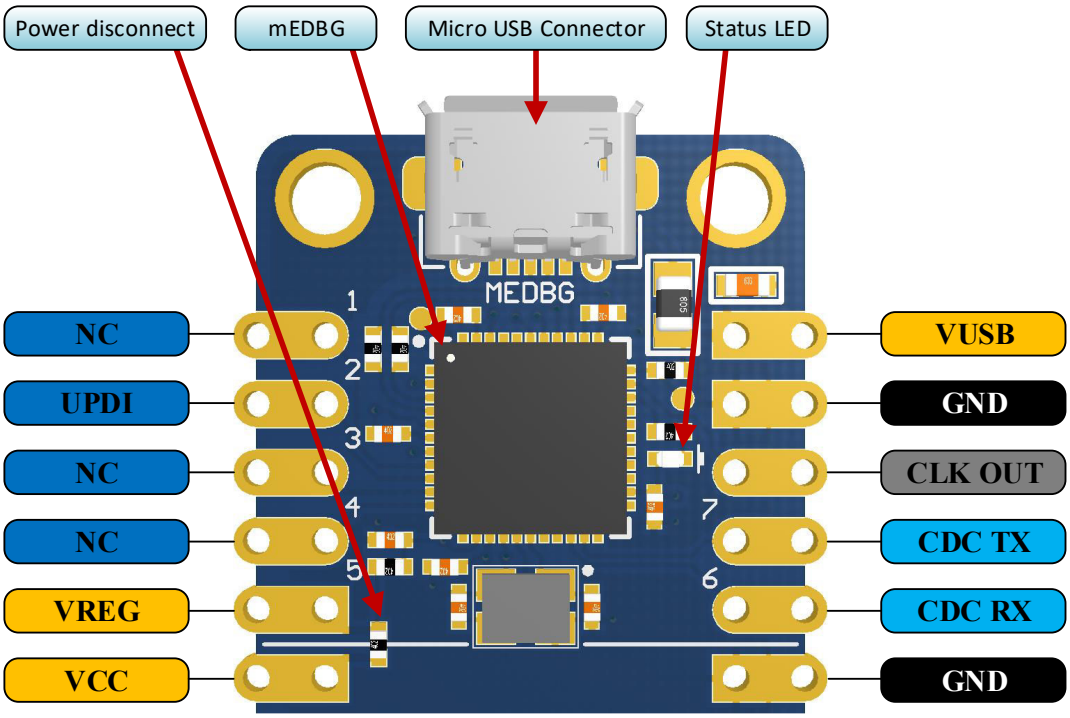
Xplained Nano kits have a target section where all I/O pins will be available and fanned out. Except for the *VCC* and *GND* pins with fixed positions, there are no defined pin functions in this area. The first pin in the target area is the *VCC* pin, located right next to the *VREG* pin of the standard section. The last pin is *GND*, and it is located next to the *CDC RX* pin in the standard section. For reference, see the figure below.

3.3.1 Standard Pinout for UPDI

Table 3-3. Xplained Nano Standard Pinout for UPDI

Pin Number	Name	Description
1	NC	No Connect
2	UPDI	UPDI program/debug line
3	NC	No Connect
4	NC	No Connect
5	VREG	Regulated voltage or VUSB if no regulator present
6	UART RX	mEDBG UART RX line
7	UART TX	mEDBG UART TX line
8	CLK	mEDBG clock output
9	GND	Ground
10	VUSB	USB voltage

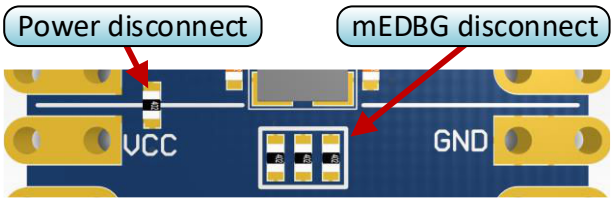
Figure 3-2. Xplained Nano Standard Pinout for UPDI



3.4 Disconnecting mEDBG

The target device can be completely separated from the mEDBG, but this requires some small modifications to the board using a soldering iron. By removing the resistors in the sections shown in the figure below, the mEDBG is completely disconnected from the target controller. If desired to connect the mEDBG again, solder in 0Ω resistors or solder in 100-mil headers on the header footprints and use wire-straps to connect the interfaces.

Figure 3-3. Kit Modifications



4. Hardware User Guide

4.1 Connectors

4.1.1 ATtiny416 Xplained Nano Pinout

The ATtiny416 Xplained Nano has a direct fan-out of the I/O pins of the device and all I/O's are accessible at the edge connectors.

Table 4-1. Edge Connector

Edge Connector	ATtiny416 Pin	Functions	Shared Functionality
1	V_{CC}	Power supply	
2	PA[0]	ADC0_0/UPDI/RESET	mEDBG UPDI
3	PA[1]	ADC0_1/MOSI0/*TxD0/SDA0*	mEDBG CDC TX
4	PA[2]	ADC0_2/MISO0/EVOUT0/*RxD0/SCL0*	mEDBG CDC RX
5	PA[3]	ADC0_3/SCK0/WO3/CLKIN/*XCK0*	
6	PA[4]	ADC0_4/ADC1_0/XY0/SS0/WOA/*XDIR*	
7	PA[5]	ADC0_5/ADC1_1/XY1/ACOUT/WO4/WOB	
8	PA[6]	ADC0_6/ADC1_2/XY2/ACN0/DACOUT/WO5	
9	PA[7]	ADC0_7/ADC1_3/XY3/ACP0/	
10	PB[5]	ADC0_8/ACN1/CLKOUT/*WO2*	User LED
11	PB[4]	ADC0_9/ACP1/*WO1*	User button
12	PB[3]	TOSC1/EVOUT1/RxD0/*WO0*	
13	PB[2]	TOSC2/TxD0/WO2	
14	PB[1]	ADC0_10/XY4/XCK0/SDA0/WO1	
15	PB[0]	ADC0_11/XY5/XDIR0/SCL0/WO0	
16	PC[0]	ADC1_6/WOC/*SCK0*	
17	PC[1]	ADC1_7/WOD/*MISO0*	
18	PC[2]	ADC1_8/EVOUT2/*MOSI0*	
19	PC[3]	ADC1_9/*SS0/WO3*	
20	GND	Ground	

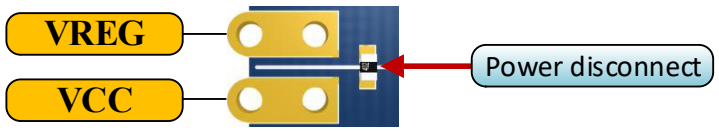
4.2 Current Measurement

The power to the target controller ATtiny416 is connected from the *VREG* supply to the targets *VCC* supply with a 0Ω resistor, as shown in the figure below. To measure the power consumption of the device, remove the 0Ω resistor and replace it with an ammeter. The ammeter can be connected between the *VREG* and *VCC* pads for easy measurement.

Tip: To connect the two power domains again, solder in a 0Ω resistor on the footprint or a 100-mil header on the header footprint at the edge of the board and place a jumper between *VREG* and *VCC*.

⚠ CAUTION Removing the resistor while the kit is powered without an ammeter or jumper may cause the ATtiny416 to be powered through its I/O pins. This may cause permanent damage to the device.

Figure 4-1. Current Measurement



4.3 Peripherals

4.3.1 LED

There is one yellow LED available on the ATtiny416 Xplained Nano board that can be turned ON and OFF. The LED can be activated by driving the connected I/O line to GND.

Table 4-2. LED Connection

ATtiny416 Pin	Function	Shared Functionality
PB5	Yellow LED0	Edge connector

4.3.2 Mechanical Buttons

ATtiny416 Xplained Nano contains one mechanical button. This is a generic user configurable button and when a button is pressed it will drive the I/O line to GND.

Info: There is no pull-up resistor connected to the generic user button. Remember to enable the internal pull-up in the ATtiny416 to use the button.

Table 4-3. Mechanical Button

ATtiny416 Pin	Description	Shared Functionality
PB4	User button	Edge connector

5. Embedded Debugger Implementation

ATtiny416 Xplained Nano contains a Mini Embedded Debugger (mEDBG) that can be used to program the ATtiny416 using Tiny Program Interface (TPI). The mEDBG also include a Virtual Com port interface over UART. Atmel Studio/ Microchip MPLAB® X IDE can be used as a front end for the Mini Embedded Debugger.

5.1 UPDI

The Unified Program Debug Interface (UPDI) uses one pin to communicate with the target. For further information on how to use the programming capabilities of the mEDBG, see Mini Embedded Debugger.

Table 5-1. UPDI Connections

ATtiny416 Pin	Function	Shared Functionality
PA0	UPDI	mEDBG

5.2 Virtual COM Port

The Embedded Debugger acts as a Virtual Com Port gateway by using one of the ATtiny416 UARTs. For further information on how to use the Virtual COM port, see Mini Embedded Debugger.

Table 5-2. Virtual COM Port Connections

ATtiny416 Pin	Function	Shared Functionality
PA1	UART0 TXD (ATtiny416 TX line)	mEDBG CDC RX
PA2	UART0 RXD (ATtiny416 RX line)	mEDBG CDC TX

6. Hardware Revision History and Known Issues

This user guide provides the latest available revision of the kit. This chapter contains information about known issues, a revision history of older revisions, and how older revisions differ from the latest revision.

6.1 Identifying Product ID and Revision

The revision and product identifier of Xplained Nano boards can be found in two ways; either through Atmel Studio/ Microchip MPLAB® X IDE or by looking at the sticker on the bottom side of the PCB.

By connecting an Xplained Nano board to a computer with Atmel Studio/Microchip MPLAB® X IDE running, an information window will pop up. The first six digits of the serial number, which is listed under kit details, contain the product identifier and revision.

The same information can be found on the sticker on the bottom side of the PCB. Most kits will print the identifier and revision in plain text as A09-nnnn\rr, where nnnn is the identifier and rr is the revision. Boards with limited space have a sticker with only a QR-code, which contains a serial number string.

The serial number string has the following format:

"nnnnrrssssssssss"

n = product identifier

r = revision

s = serial number

The product identifier for ATtiny416 Xplained Nano is A09-2795.

6.2 Fuse masking

The ATtiny416 RSTPINCFG fuse is masked in the mEDBG firmware. The user is not allowed to disable UPDI (use pin as GPIO or RESET), as it will lock the debugger out of the device.

6.3 Revision 4

Revision 4 is the initially released revision.

7. Document Revision History

Doc. Rev.	Date	Comment
B	12/2019	Added description of fuse masking, section 6.2.
A	10/2017	Initial document release.

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