AVR 8-bit Microcontrollers

ATtiny104 Xplained Nano

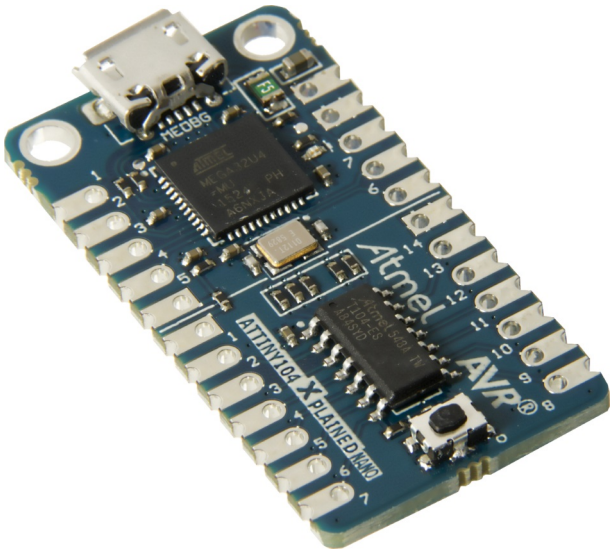
USER GUIDE

Preface

The Atmel® ATtiny104 Xplained Nano evaluation kit is a hardware platform to evaluate the ATtiny104 microcontroller.

Supported by the Atmel Studio integrated development platform, the kit provides easy access to the features of the Atmel ATtiny104 and explains how to integrate the device in a custom design.

The Xplained Nano MCU series evaluation kits include an on-board mini embedded programmer, and no external tools are necessary to program the ATtiny104.



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1. Introduction

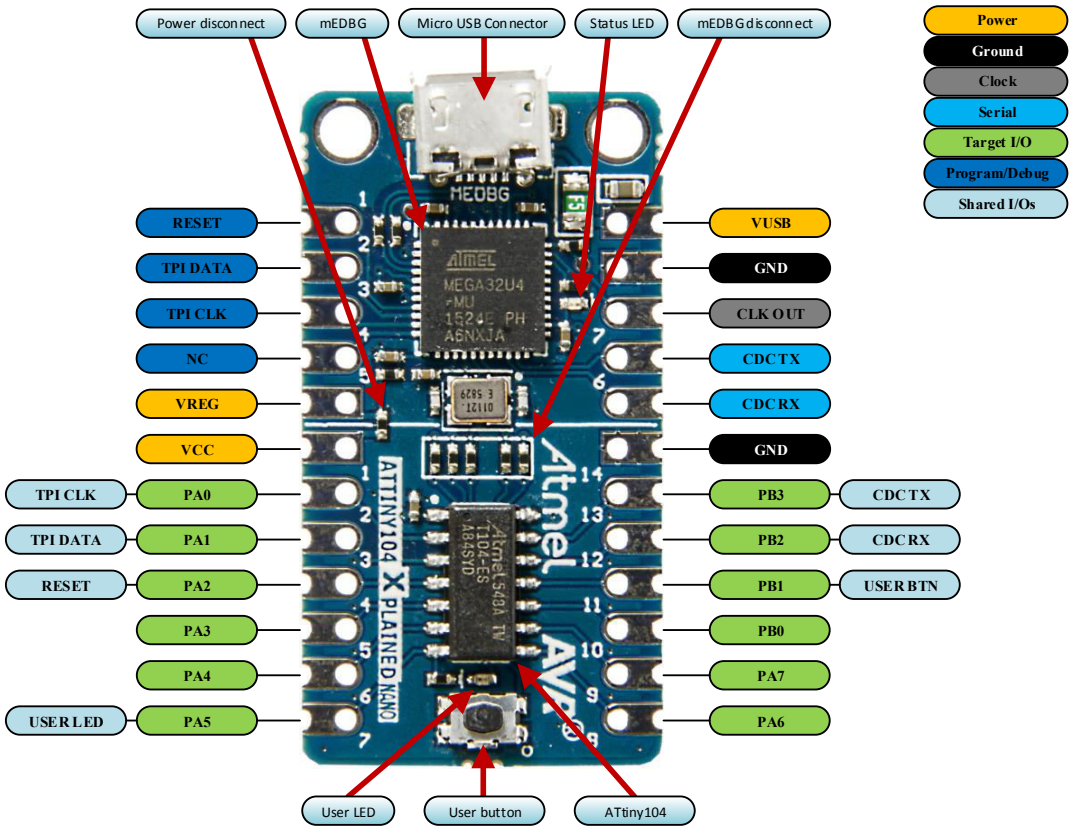
1.1. Features

- ATtiny104 microcontroller
- One yellow user LED
- One mechanical button
- mEDBG
  - Auto-ID for board identification in Atmel Studio
  - One green board status LED
  - Programming
  - Virtual COM port (CDC)
- USB powered

1.2. Kit Overview

The Atmel ATtiny104 Xplained Nano evaluation kit is a hardware platform to evaluate the Atmel ATtiny104.

Figure 1-1. ATtiny104 Xplained Nano Evaluation Kit Overview



2. Getting Started

2.1. Xplained Nano Quick Start

Steps to start exploring the Atmel Xplained Nano platform:

1. Download Atmel Studio.
2. Launch Atmel Studio.
3. Connect a USB cable (Standard-A to Micro-B or Micro-AB) between the PC and the 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.

Once the Xplained Nano board is powered the green status LED will blink and Atmel Studio will auto detect which Xplained Nano board is connected. Atmel Studio will present relevant information like datasheets and kit documentation. The ATtiny104 device is programmed by the on-board Mini Embedded Debugger and therefore no external programmer tool is required.

2.2. Design Documentation and Relevant Links

The following list contains links to the most relevant documents and software for the ATtiny104 Xplained Nano.

- **Xplained products** - Atmel Xplained evaluation kits are a series of easy-to-use evaluation kits for Atmel microcontrollers and other Atmel products. For low pin-count devices the Xplained Nano series provides a minimalistic solution with access to all I/O pins of the target microcontroller. Xplained Mini kits are for medium pin-count devices and adds Arduino Uno compatible header footprint and a prototyping area. Xplained Pro kits are for medium to high pin-count devices, they features advanced debugging and standardized extensions for peripheral functions. All these kits have on board programmers/debuggers which creates a set of low-cost boards for evaluation and demonstration of features and capabilities of different Atmel products.
- **Atmel Studio** - Free Atmel IDE for development of C/C++ and assembler code for Atmel microcontrollers.
- **Atmel sample store** - Atmel sample store where you can order samples of devices.
- **Atmel Data Visualizer** - Atmel 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.
- **Design Documentation** - Package containing CAD source, schematics, BOM, assembly drawings, 3D plots, layer plots etc.
- **Hardware Users Guide in PDF format** - PDF version of this User Guide.

3. Xplained Nano

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

3.1. Mini Embedded Debugger

The ATtiny104 Xplained Nano contains the Atmel Mini Embedded Debugger (mEDBG) for on-board programming. 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 the ATtiny104. On ATtiny104 Xplained Nano, the TPI interface is connected between the mEDBG and the ATtiny104.

The Virtual COM Port is connected to a UART on the ATtiny104 and provides an easy way to communicate with the target application through terminal software. It offers variable baud rate, parity, and stop bit settings.
Note: The settings on the ATtiny104 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 ATtiny104. If the DTR signal is not enabled the UART pins on the mEDBG is kept in high-z (tristate) rendering the COM port unusable. The DTR signal is set automatically by some terminal software, but it may have to be manually enabled in your terminal.

The mEDBG controls one status LED on ATtiny104 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 lit briefly
Normal operation	LED is not lit
Programming	Activity indicator; LED flashes when programming/ debugging with the mEDBG

3.1.1. Xplained Nano Clock Output

The mEDBG output its CPU clock to the *CLK* pin 8 as shown in Xplained Nano Standard Pin-out. 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

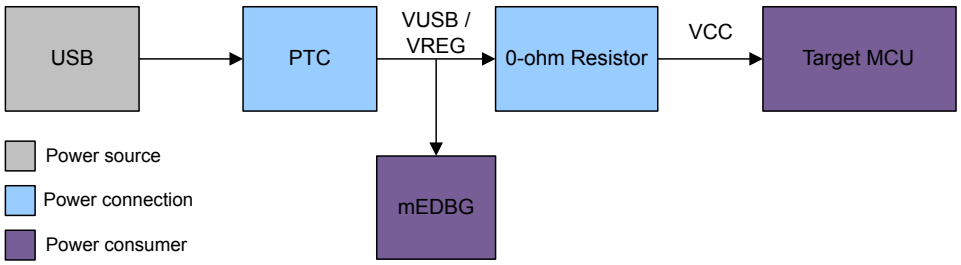
The ATtiny104 Xplained Nano kit can be powered by different sources. By default the kit will have a 5V supply and the voltage is taken directly from the USB port through a 500mA PTC fuse. The voltage from the USB connector can vary between 4.4V to 5.25V (according to USB spec).

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 power 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 Xplained Nano Standard Pin-out.

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 Pin-out

Xplained Nano kits have a standard pin-out 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's located next to the *CDC RX* pin in the standard section. For reference, see figure below.

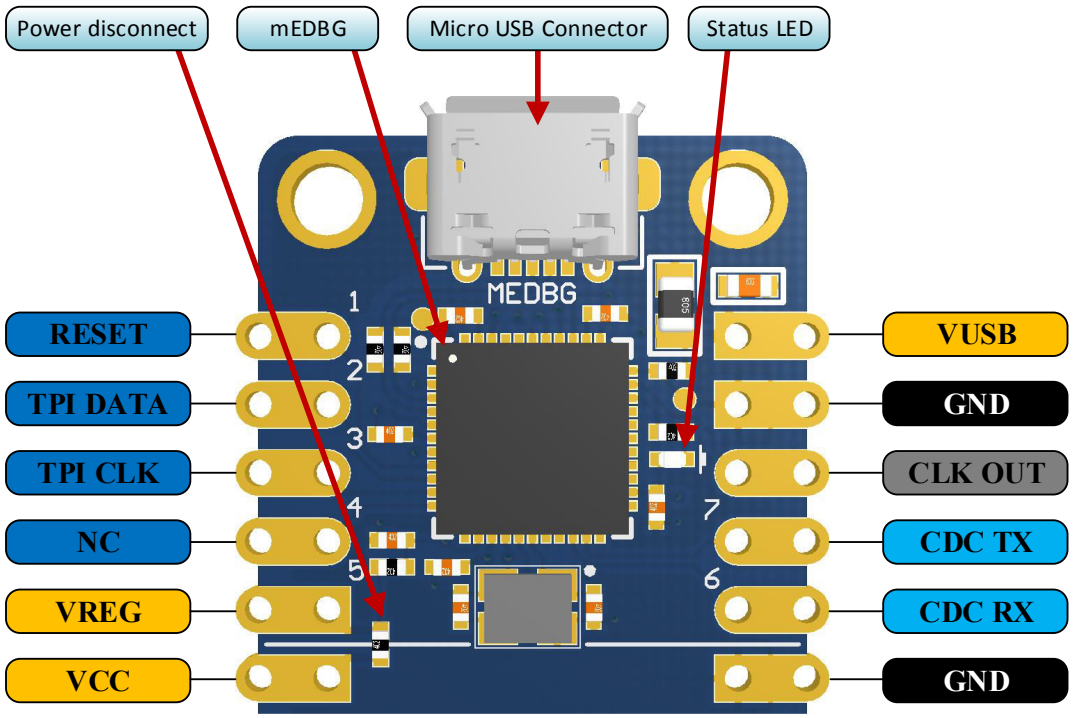
3.3.1. Standard Pin-out for TPI

Table 3-3. Xplained Nano mEDBG Standard Pin-Out

Pin number	Name	Description
1	RST	Reset line
2	TPID	TPI Program data line
3	TPIC	TPI Program clock output

Pin number	Name	Description
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

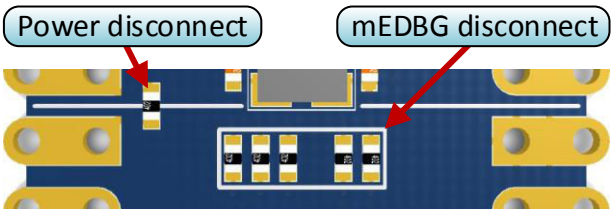
Figure 3-2. Xplained Nano Standard Pin-out for TPI



3.4. Disconnecting mEDBG

The target controller ATtiny104 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. ATtiny104 Xplained Nano Pin-out

The ATtiny104 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	ATtiny104 pin	Functions	Shared functionality
1	V_{CC}	Power supply	
2	PA[0]	PCINT0/ADC0/AIN0/T0/CLKI/TPICLK	mEDBG TPI Clock
3	PA[1]	PCINT1/ADC1/AIN1/OC0B/TPIDATA	mEDBG TPI Data
4	PA[2]	PCINT2/RESET	mEDBG Reset
5	PA[3]	PCINT3/OC0A	
6	PA[4]	PCINT4/ICP0	
7	PA[5]	PCINT5/ADC2/OC0B	User LED
8	PA[6]	PCINT6/ADC3	
9	PA[7]	PCINT7	
10	PB[0]	PCINT8/ADC4	
11	PB[1]	PCINT9/INT0/ADC5/XCK0/OC0A/CLKO	User button
12	PB[2]	PCINT10/ADC6/TxD0/ICP0	mEDBG CDC RX
13	PB[3]	PCINT11/ADC7/ACO/RxD0/T0	mEDBG CDC TX
14	GND	Ground	

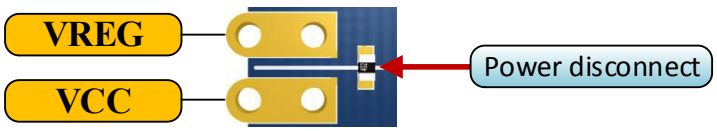
4.2. Current Measurement

The power to the target controller ATtiny104 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 ATtiny104 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 ATtiny104 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

ATtiny104 pin	Function	Shared functionality
PA5	Yellow LED0	Edge connector

4.3.2. Mechanical Buttons

ATtiny104 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 ATtiny104 to use the button.

Table 4-3. Mechanical Button

ATtiny104 pin	Description	Shared functionality
PB1	User button	Edge connector

5. Embedded Debugger Implementation

ATtiny104 Xplained Nano contains a Mini Embedded Debugger (mEDBG) that can be used to program the ATtiny104 using Tiny Program Interface (TPI). The mEDBG also include a Virtual Com port interface over UART. Atmel Studio can be used as a front end for the Mini Embedded Debugger.

5.1. Tiny Program Interface

The Tiny Program Interface (TPI) uses two pins 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. TPI Connections

ATtiny104 pin	Function	Shared functionality
PA0	TPI clock	mEDBG
PA1	TPI data	mEDBG

5.2. Virtual COM Port

The Embedded Debugger acts as a Virtual Com Port gateway by using one of the ATtiny104 UARTs. For further information on how to use the Virtual COM port, see Mini Embedded Debugger.

Table 5-2. Virtual COM Port Connections

ATtiny104 pin	Function	Shared functionality
PB2	UART TXD (ATtiny104 TX line)	mEDBG CDC RX
PB3	UART RXD (ATtiny104 RX line)	mEDBG CDC TX

6. Hardware Revision History and Known Issues

This user guide is written to reflect 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 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 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 ATtiny104 Xplained Nano is A09-2678.

6.2. Revision 2

The target device U200 on revision 2 of the kit has been changed from engineering samples (ATTINY104-SSNRES) to non-engineering samples (ATTINY104-SSNR).

6.3. Revision 1

Revision 1 is the initially released revision.

Engineering samples are mounted on revision 1 for the target device U200 (ATTINY104-SSNRES).

7. Document Revision History

Doc. rev.	Date	Comment
42671B	08/2016	Add revision 2 information.
42671A	02/2016	Initial document release.

8. Evaluation Board/Kit Important Notice

This evaluation board/kit is intended for use for **FURTHER ENGINEERING, DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY.** It is not a finished product and may not (yet) comply with some or any technical or legal requirements that are applicable to finished products, including, without limitation, directives regarding electromagnetic compatibility, recycling (WEEE), FCC, CE or UL (except as may be otherwise noted on the board/kit). Atmel supplied this board/kit "AS IS", without any warranties, with all faults, at the buyer's and further users' sole risk. The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies Atmel from all claims arising from the handling or use of the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge and any other technical or legal concerns.

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