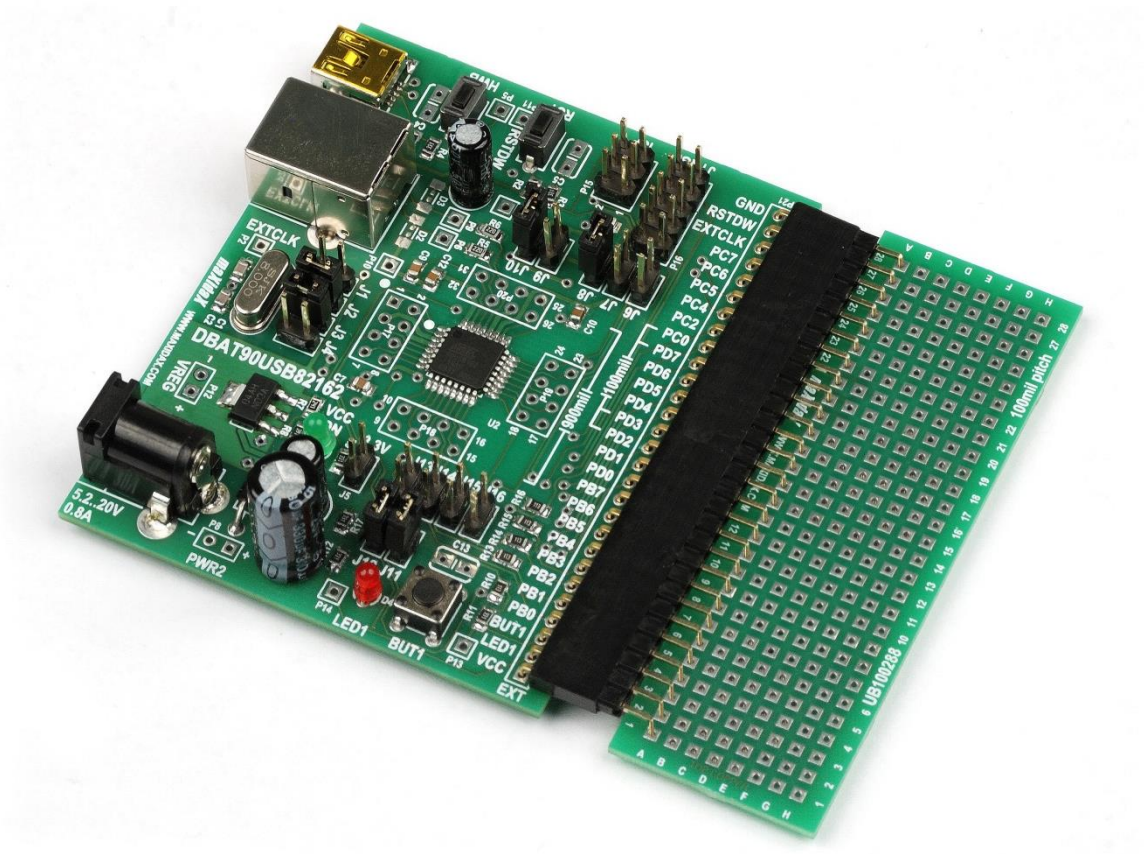
DBAT90USB162

Atmel®

AT90USB162

Enhanced Development Board

User's manual



1. INTRODUCTION

Thank you for choosing the DBAT90USB162 – Atmel® AT90USB162 enhanced development board. This board is designed to give both professionals and hobbyists a quick start to develop code and for hardware prototyping and testing.

1.1. OVERVIEW

This document describes the DBAT90USB162 development board – a simple yet feature rich, flexible and easily configurable development tool, designed to allow easy coding and prototyping.

The DBAT90USB162 is an enhanced Atmel® AT90USB162 development board which also accepts AT90USB82. Offering modular design, this board is a cost-effective yet feature rich, highly compatible, flexible and easily configurable development tool, designed to give a quick start to develop code and for hardware prototyping and testing. Its design provides configurability and flexibility not available with other products. The board provides all the basic circuitry needed to work with AT90USB162: USB connector and circuit, crystal and clock configuration circuitry, Reset and HWB buttons, status LED, user button and LED, power source/voltage configuration circuitry, configurable voltage regulator, isolation resistors to combine ISP lines with other functions. The board either accepts a MCU directly, or uses additional header boards for MCU installation giving the developer the freedom of using one development board with several MCUs, eventually programmed with different code.

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An extension header is available allowing connection of various size universal boards such as the usually included UB100288 or breadboards holding the rest of the circuitry, and eventually using different hardware, or direct interfacing with other devices.

Furthermore most board components are detachable or configurable via jumpers.

The board offers flexible power: both 3.3 V and 5 V USB-powered or from external supply. The board also features a built-in voltage regulator, configurable to 3.3 V and 5 V with overcurrent and thermal protection.

Board design makes it compatible with virtually all design/development software and libraries, including open source.

1.2. FEATURES

- Flexible power – 3.3 V or 5 V from built-in voltage regulator, USB bus or external 3.0 V to 5.5 V;
- All MCU I/O pins are accessible;
- Headers for MCU header board – allows use of several MCUs (holding different firmware) with one development board;
- 100-mil extension header for connection to universal or breadboards, or direct interfacing with other devices, providing access to all I/O pins and virtually all signals;
- Dedicated headers for some signals: USB D-, D+, VBUS; RST/DW; HWB; EXTCLK, LED1, BUT1;
- Flexible I/O connections – virtually any 100 mil universal or breadboard can be attached using various connectors – allows using the board for more than one project;
- USB full speed (12 Mbps) Device mode supported;
- Type B and Mini USB connectors;
- Built-in 0.9..16 MHz crystal (default 8 MHz);
- Internal or external clock;
- Optional transient voltage suppression for USB data lines;
- Reset (RST) button;
- Hardware boot (HWB) button – allows forcing bootloader (stock Atmel® or third-party) execution at reset (see AT90USB82/AT90USB162 datasheet) – allows MCU programming via USB without external programmer. I/O pin is still useable for other purposes;
- Detachable user button (BUT1) – general use button and/or used for debugging purposes. Can be disconnected to free I/O pin;
- Detachable user LED (LED1) – general use LED and/or used for debugging purposes. Can be disconnected to free I/O pin;
- FR-4 1.5 mm PCB with all terminals and components clearly marked, accepting TQFP-32, 7x7 mm body size, 0.8 mm lead pitch, and QFN-32, 5x5 mm body size, 0.5 mm lead pitch;
- ISP (6-pin) and JTAG (10-pin) connectors, both supporting in-circuit programming and debugging via debugWIRE;
- Switchable insulation resistors for all ISP pins (SCK, MOSI, MISO) and for HWB pin.

1.3. SPECIFICATIONS

Processor	AT90USB162
Flash memory	16 kBytes (10,000 write cycles)
Max. frequency	8 MHz at 2.7 V, 16 MHz at 4.5 V
RAM	512 Bytes (static)
EEPROM	512 Bytes (100,000 write cycles)
USB	USB 2.0 full speed (12 Mbps) Device mode
USB DPRAM	176 Bytes
I/O lines	22
Timers	1 8-bit, 1 16-bit
PWM channels	5
USART	1
SPI port	1
Programming	Via USB and hardware-initiated bootloader or ISP connector
Debugging	Via debugWIRE interface (ISP connector)
Operating voltage	2.7 V to 5.5 V
Operating temperature	Industrial -40°C to +85°C
Dimensions	61 x 76 x 19 mm (2.4 x 3.0 in), 95 x 76 mm (3.7 x 3.0 x 0.75 in) with UB100288 universal board
Weight	31.4 g bare 39.25 g with UB100288

1.4. COMPATIBILITY

As all MCU I/O pins are accessible and all MCU powering and clocking options are available the SBAT90USB162a is compatible with virtually every project and development tool designed for AT90USB162 and particularly for AVR MCUs.

1.5. MCU OVERVIEW

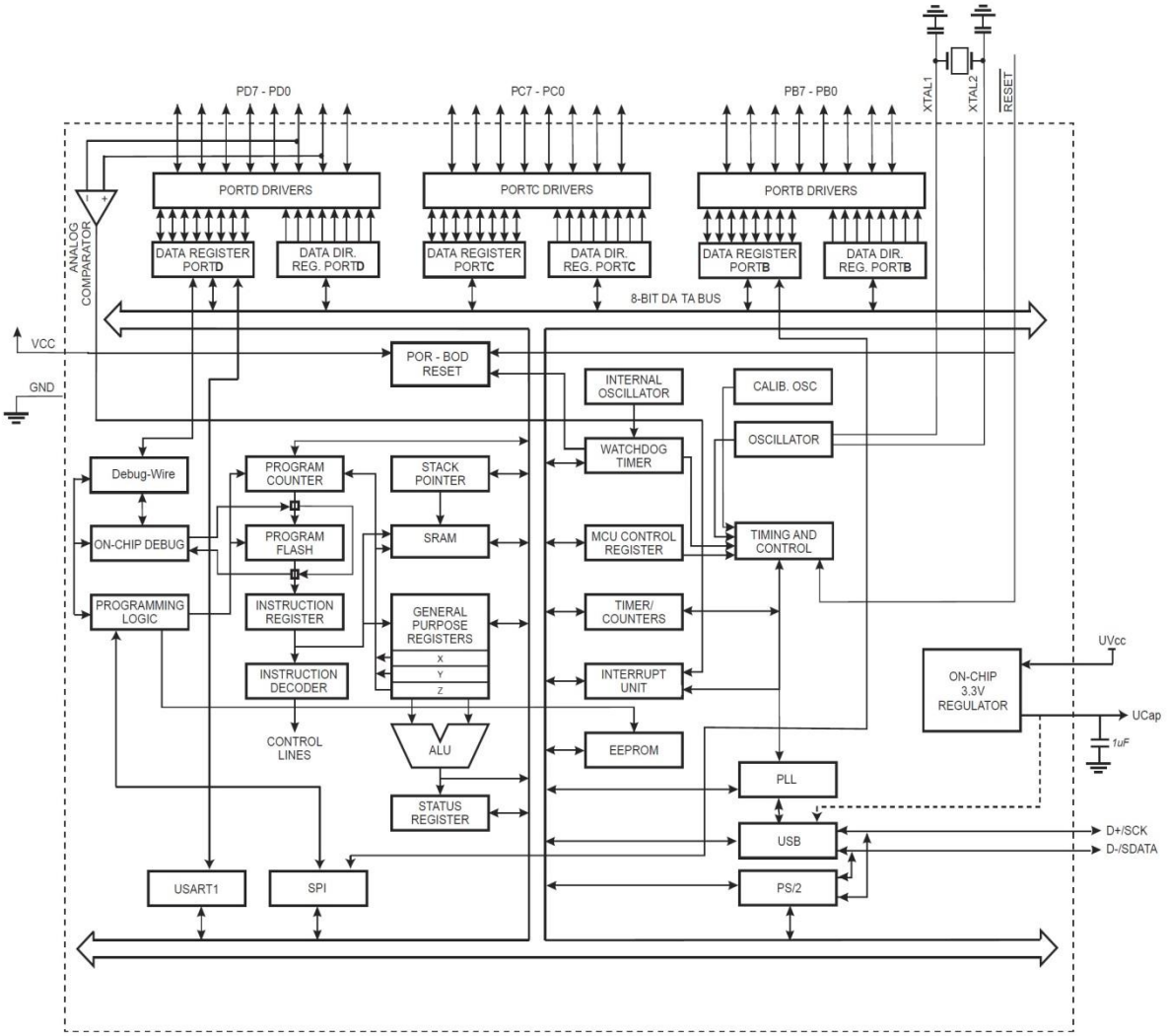
The AT90USB162 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the AT90USB162 achieves throughputs approaching 1 MIPS per MHz allowing optimization of power consumption versus processing speed.

1.5.1. Features

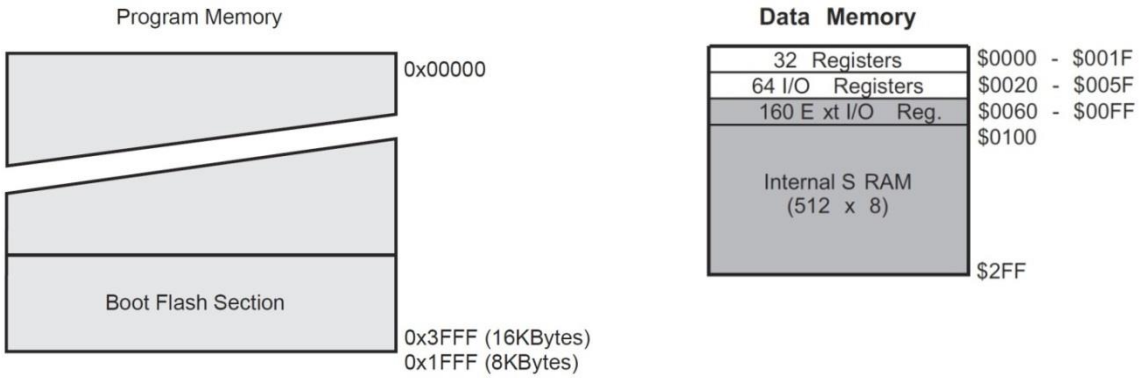
- High Performance, Low Power AVR® 8-Bit Microcontroller
- Advanced RISC Architecture
  - 125 Powerful Instructions
  - Most Single Clock Cycle Execution
  - 32 x 8 General Purpose Working Registers
  - Fully Static Operation
  - Up to 16 MIPS Throughput at 16 MHz
- Non-volatile Program and Data Memories
  - 8K/16K Bytes of In-System Self-Programmable Flash
    - Endurance: 10,000 Write/Erase Cycles
  - Optional Boot Code Section with Independent Lock Bits
    - USB boot-loader programmed by default in the factory
    - In-System Programming by on-chip Boot Program hardware-activated after reset
    - True Read-While-Write Operation
  - 512 Bytes EEPROM
    - Endurance: 100,000 Write/Erase Cycle
  - 512 Bytes Internal SRAM
  - Programming Lock for Software Security
- USB 2.0 Full-speed Device Module with Interrupt on Transfer Completion
  - Complies fully with Universal Serial Bus Specification REV 2.0
  - 48 MHz PLL for Full-speed Bus Operation: data transfer rates at 12 Mbit/s
  - Fully independent 176 bytes USB DPRAM for endpoint memory allocation
  - Endpoint 0 for Control Transfers: from 8 up to 64-bytes
  - 4 Programmable Endpoints:
    - IN or Out Directions
    - Bulk, Interrupt and Isochronous Transfers
    - Programmable maximum packet size from 8 to 64 bytes
    - Programmable single or double buffer
  - Suspend/Resume Interrupts
  - Microcontroller reset on USB Bus Reset without detach
  - USB Bus Disconnection on Microcontroller Request
  - USB pad multiplexed with PS/2 peripheral for single cable capability
- Peripheral Features
  - PS/2 compliant pad
  - One 8-bit Timer/Counters with Separate Prescaler and Compare Mode (two 8-bit PWM channels)
  - One 16-bit Timer/Counter with Separate Prescaler, Compare and Capture Mode (three 8-bit PWM channels)
  - USART with SPI master only mode and hardware flow control (RTS/CTS)

  - Master/Slave SPI Serial Interface
  - Programmable Watchdog Timer with Separate On-chip Oscillator
  - On-chip Analog Comparator
  - Interrupt and Wake-up on Pin Change
- On Chip Debug Interface (debugWIRE)
- Special Microcontroller Features
  - Power-On Reset and Programmable Brown-out Detection
  - Internal Calibrated Oscillator
  - External and Internal Interrupt Sources
  - Five Sleep Modes: Idle, Power-save, Power-down, Standby, and Extended Standby
- I/O and Packages
  - 22 Programmable I/O Lines
  - QFN32 (5x5 mm) / TQFP32 packages
- Operating Voltages
  - 2.7 - 5.5 V
- Operating temperature
  - Industrial (-40 °C to +85 °C)
- Maximum Frequency
  - 8 MHz at 2.7 V - Industrial range
  - 16 MHz at 4.5 V - Industrial range

1.5.2. Block diagram



1.5.3. Memory map



1.6. DEMO PROGRAM

The DBAT90USB162 comes with a simple demo program installed. It makes LED1 blink, while pressing BUT1 changes the blinking rate. This program doesn't provide USB compatibility.

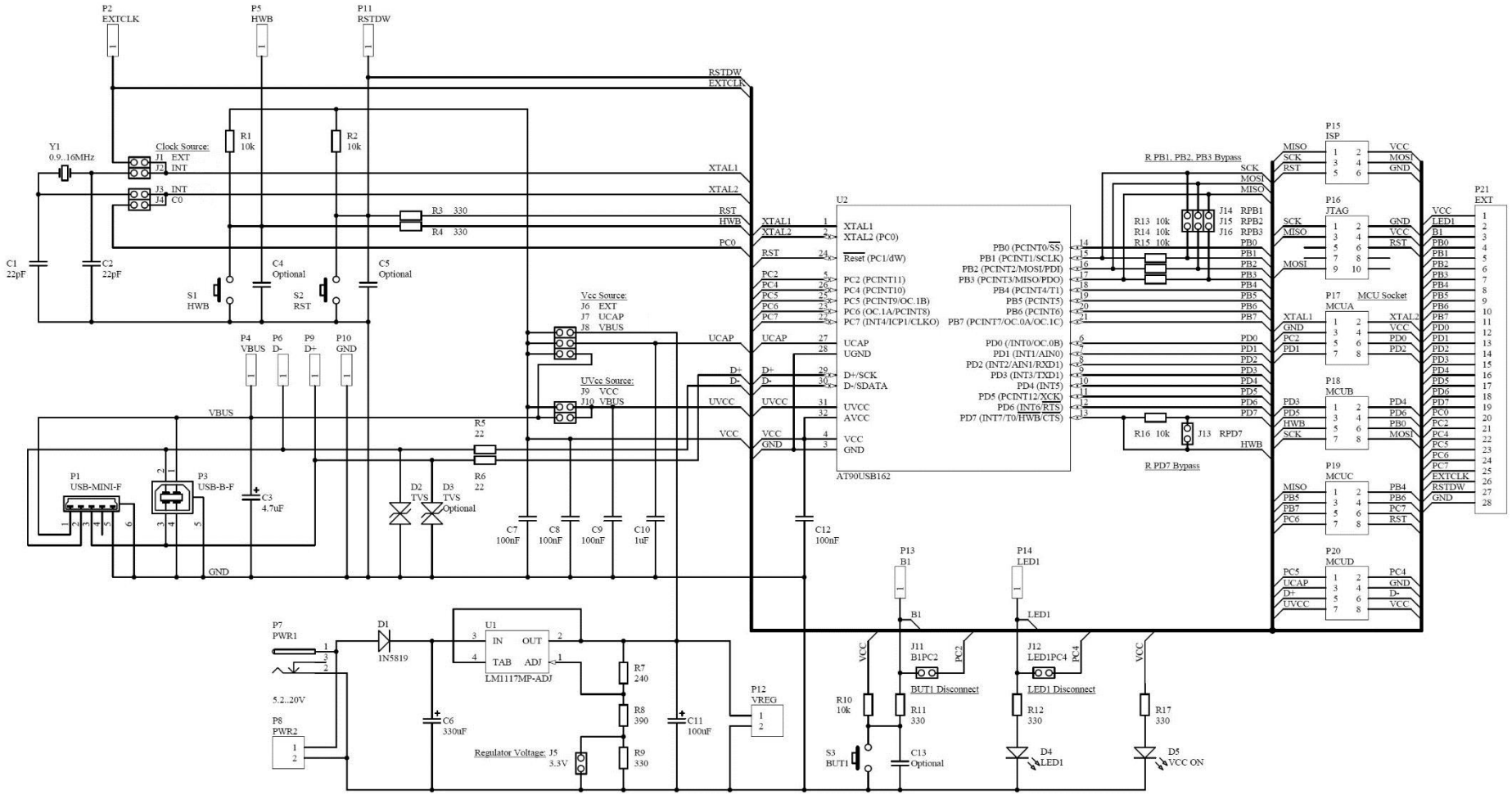
AVR-GCC source file is available for download at
http://embeddedglow.com/products/DBAT90USB162/DBAT90USB162_Demo.c.

HEX file is available for download at
http://embeddedglow.com/products/DBAT90USB162/DBAT90USB162_Demo.hex.

2. USING THE DBAT90USB162

This section describes the board and all its features

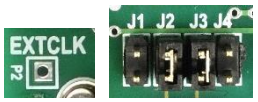
2.1. SCHEMATIC



2.2. SCHEMATIC DESCRIPTION AND CONFIGURATION

2.2.1. Clock

Depending on jumper configuration clock source is either internal from 0.9..16 MHz[1] crystal oscillator, or internal calibrated RC oscillator, or external[2] via EXTCLK (P2). For using external clock CKSEL fuses must be programmed (see AT90USB162 datasheet).



Clock	J1	J2	J3	J4
Internal crystal	open	**short**	**short**	open
External	**short**	open	open	**short**

Note:
1. Default is 8 MHz crystal, other is possible by request.
2. XTAL2 (PC0) can be used as generic I/O depending on MCU configuration.

2.2.2. Reset button (S2)

Cold reset is done either manually by RST button (S2) or externally via RSTDW (P11, P21-27).

Optionally a parallel capacitor (C5) can be installed to the RST button (S2). The PCB accepts thru-hole and 0805 SMD.

2.2.3. HWB button (S1)

The hardware boot button allows forcing bootloader execution after reset (see AT90USB162 datasheet) thus allowing MCU programming via USB without external programmer. The HWB mode is active only when the HWBE fuse is enabled. In that case PD7/HWB pin is configured as input during reset and sampled during reset rising edge.

Optionally a parallel capacitor (C4) can be installed. The PCB accepts thru-hole and 0805 SMD.

Programming via USB is based on pre-programmed USB bootloader, located in the on-chip boot section of the AT90USB162. This is the easiest and fastest way to reprogram the device directly over the USB interface, but with certain limitations. To force bootloader execution, operate as follows:

- Press both “RST” and “HWB” buttons;
- Release the “RST” button;
- Release the “HWB” button.

FLIP (Flexible In-system Programmer) is the software provided by Atmel® to do in-system programming of Flash devices through RS232, USB or CAN. For further details regarding programming via USB, please refer to FLIP documentation.

Note: In order to use FLIP, driver installation is required. USB drivers come with FLIP and can be found in its install folder. If Windows® operating system is used, depending on its version digitally signed drivers might be required. As they may not be supplied by Atmel®, third-party signed drivers can be downloaded from the net.

Tip: After programming is complete press the “RST” button.

LUFA bootloader is also supported.

2.2.4. USB connector

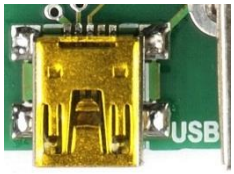
Use either Type B USB (P3) or Mini-B USB (P1)(1).

USB Type B connector pinout:

Pin	Signal	Description
1	VCC	+5 V
2	D-	Data -
3	D+	Data +
4	GND	Ground

USB Mini connector pinout:

Pin	Signal	Description
1	VCC	+5 V
2	D-	Data -
3	D+	Data +
4	ID	NC for type B
5	GND	Ground



USB signals are available via headers as follows:

Pin	Signal	Header
1	VCC	
2	D-	
3	D+	
4	GND	

Note: 1. Type B and Mini USB connectors cannot be used simultaneously.
2. New, unprogrammed AT90USB162 device is seen via USB as "AT90USB162 DFU". To use USB driver installation is required. USB drivers can be downloaded from Atmel's site: http://atmel.com/*. Third-party drivers are also available on the net.

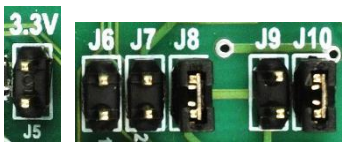
2.2.5. USB data lines transient voltage suppression

Data lines protection is available by using optional transils D2 and D3.

2.2.6. Power supply

Both 3.3 V and 5 V VCC power can be used, supplied from USB, built-in regulator, or other source via VREG (P12).

I/O voltage / VCC source	J5	J6	J7	J8	J9	J10
3 V I/O USB-powered	-	open	**short**	open	open	**short**
5 V I/O USB-powered	-	open	open	**short**	open	**short**
3.0 to 3.6 V I/O self-powered(1)	**short**	**short**	**short**	open	open	open
3.4 to 5.5 V I/O self-powered(2)	open	**short**	open	open	**short**	open



Note: 1. 3.0 V to 3.6 V can be supplied via VREG (P12) instead of using the built in voltage regulator;
2. 3.4 V to 5.5 V can be supplied via VREG (P12) instead of using the built in voltage regulator.

VCC presence, no matter what the power source is, is indicated by the green VCC ON LED (D5).

2.2.7. Built-in voltage regulator

The built-in voltage regulator depending on J5 produces 3.3 V or 5 V from a source, connected to PWR1 (P7) or PWR2 (P8). Based on LM1117, the voltage regulator can deliver up to 0.8 A from 5.2 V to 20 V input. **Please obey maximum power dissipation, which is around 1.2 W, otherwise thermal shutdown may occur!**

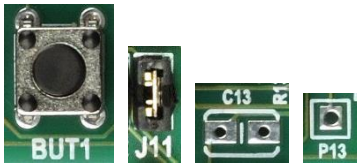
VREG	J5
3.3 V	**short**
5 V	open

Power jack (PWR1, P7) pinout: 

Shottky diode D1 serves as a reverse polarity protection.

2.2.8. User button BUT1

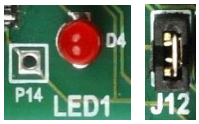
BUT1 can be used as a general use button or for debugging purposes. It can be detached from PC2 by leaving J11 open. To use PC2 I/O pin for other purposes leave J11 open. BUT1 signal is available via header P13. Optionally capacitor C13 can be used. The PCB accepts thru-hole and 0805 SMD.



BUT1	J11
In use	**short**
Not in use	open

2.2.9.User LED LED1

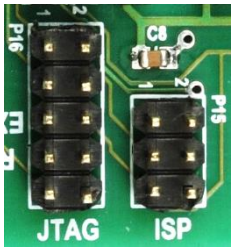
LED1 can be used as a general use LED or for debugging purposes. It can be detached from PC4 by leaving J12 open. To use PC4 I/O pin for other purposes leave J11 open. LED1 signal is available via header P14.



LED1	J12
In use	**short**
Not in use	open

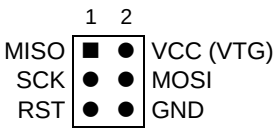
2.2.10. ISP and JTAG connectors

Both ISP (6-pin) (P15) and JTAG (10-pin) (P16) connectors offer **identical functionality** for in-circuit programming and debugging via debugWIRE (RST pin). If these connectors are in use, it is not recommended (although is possible) to use corresponding MCU pins as generic I/Os. **ISP and JTAG connectors are pin-to-pin connected** as follows:

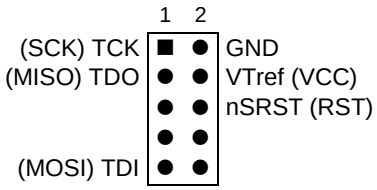


ISP (6-pin)	JTAG (10-pin)	In-circuit programming	Debugging via debugWIRE
Pin 3 SCK	Pin 1 TCK	X	
Pin 6 GND	Pin 2 GND	X	X
Pin 1 MISO	Pin 3 TDO	X	
Pin 2 VCC	Pin 4 VTref	X	X
Pin 5 RST	Pin 6 nSRST	X	X
Pin 4 MOSI	Pin 9 TDI	X	

ISP connector pinout:



JTAG connector pinout:



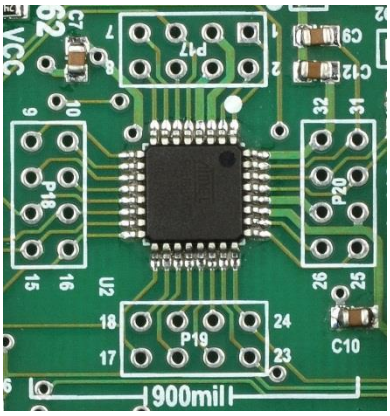
The JTAG connector is intended for use with devices like JTAGICE mkII and AVR ONE!, but only offers in-circuit programming and debugging via debugWIRE as the full JTAG interface is not supported by AT90USB162. The JTAG 10-pin connector pinout is different from ISP 10-pin connector pinout, which is not implemented here! DO NOT CONNECT ISP 10-WIRE CABLES TO THE JTAG CONNECTOR!

The debugWIRE interface uses only one pin, the RST pin, for communication with the target device. To enable the debugWIRE interface on an AVR device, the DWEN fuse must be programmed (DWEN = 0). AVR devices featuring debugWIRE are shipped with the DWEN fuse unprogrammed. ISP or High-Voltage Programming is required to enable debugWIRE.

In order to use the ISP interface the SPIEN fuse must be programmed.

2.2.11. MCU headers (P17..P20)

Provide support for optional header boards for MCU allowing the use of several (differently programmed) MCUs.



2.2.12. R13..R16 isolation resistors

Provide isolation for SCK, MISO, MOSI, and HWB pins, if they have to be used for other purposes (not recommended). Isolation resistors can be shorted by jumpers J13..J16.

PB1 (SCLK)	J13
ISP	open
Generic I/O	**short**

PB3 (MISO)	J15
ISP	open
Generic I/O	**short**

PB2 (MOSI)	J14
ISP	open
Generic I/O	**short**

PD7 (HWB)	J16
HWB	open
Generic I/O	**short**

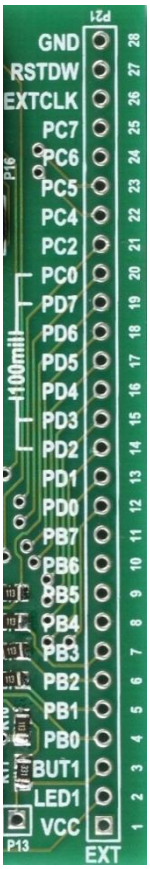
2.2.13. Extension header (P21)

Provides connection to other devices and circuitry allowing access to all MCU I/O pins, power supply, and most other signals. Fits any 100mil/2.54mm linear connector, thus providing connectivity with virtually any 100mil/2.54mm universal or breadboard.

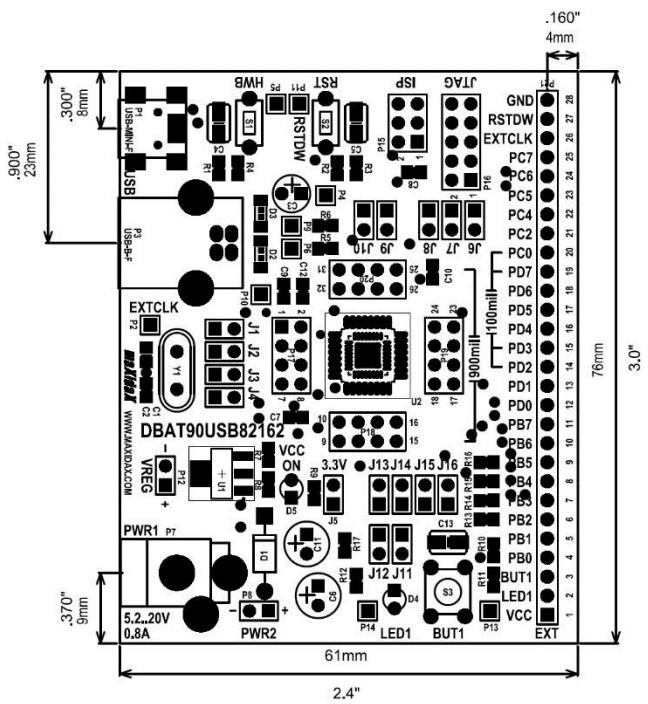
Example 1: Use male/female headers and connect universal board like UB100288 or any third-party universal or breadboard.
Example 2: Use a 100 mil / 2.54 mm terminal header to connect wires directly.
Example 3: Use a 100 mil SIP socket to connect single parts like sensors directly.

EXT header pinout:

1	■	VCC
2	●	LED1
3	●	BUT1
4	●	PB0
5	●	PB1
6	●	PB2
7	●	PB3
8	●	PB4
9	●	PB5
10	●	PB6
11	●	PB7
12	●	PD0
13	●	PD1
14	●	PD2
15	●	PD3
16	●	PD4
17	●	PD5
18	●	PD6
19	●	PD7
20	●	PC0
21	●	PC2
22	●	PC4
23	●	PC5
24	●	PC6
25	●	PC7
26	●	EXTCLK
27	●	RSTDW
28	●	GND



3. BOARD LAYOUT AND DIMENSIONS



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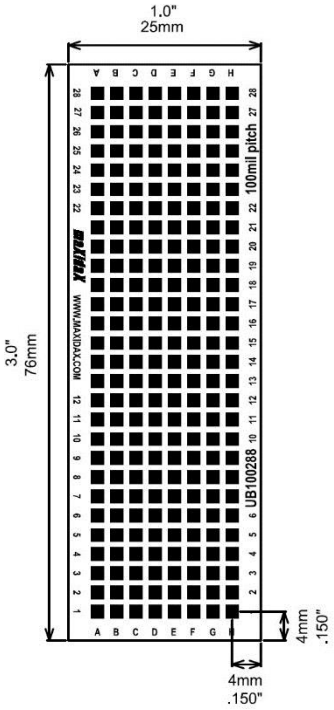

Optional UB100288

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