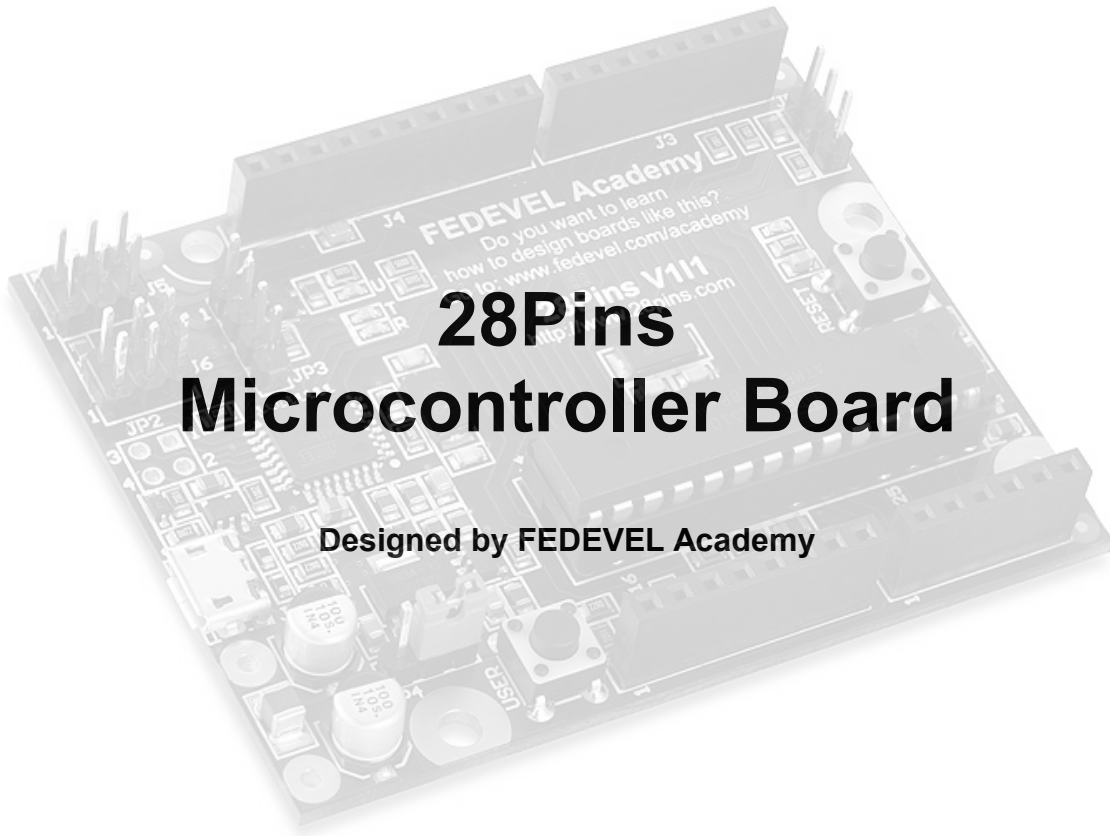

voipac



28Pins Microcontroller Board

Designed by FEDEVEL Academy

Datasheet

| Date | Revision | Changes |
|-------------------|----------|-----------------|
| February 12, 2016 | 1.0 | Initial Release |
| | | |
| | | |

Table of Contents

1. Introduction 2

 1.1 General..... 2

 1.2 Hardware - Block Diagram..... 3

 1.3 Features..... 4

 1.4 Reference Documents..... 4

2. Features Description 4

 2.1 Specification 4

 2.2 Board Layout..... 5

 2.3 Component, Connector and Jumper list 5

3. Component, Connector and Jumper Description 6

3.1 Component Description..... 6

 3.1.1 U1 - ATMEGA328P-PU..... 6

 3.1.2 U2 - ATMEGA16U2..... 7

 3.1.3 U3 - TL1963A-33DCQR..... 8

3.2 Connector Description..... 9

 3.2.1 J1 - POWER..... 9

 3.2.2 J2 - AD..... 9

 3.2.3 J3 - IOL..... 9

 3.2.4 J4 - IOH..... 10

 3.2.5 J5 - ICSP..... 10

 3.2.6 J6 - ICSP1..... 10

 3.2.7 J7 - MicroUSB..... 11

3.3 Jumper Description..... 11

 3.3.1 JP1 - Reset selection..... 11

 3.3.2 JP2 - 16U2 Pins Extension..... 11

 3.3.3 JP3 - Programming Selection..... 12

 3.3.4 JP4 - Power Selection..... 12

4. Technical Specifications 12

 4.1 Input Voltage..... 12

 4.2 Mechanical Drawing..... 13

 4.3 Mechanical..... 13

 4.4 Temperature Range..... 13

 4.5 CE compliance of Voipac products..... 14

 4.6 RoHS and WEEE Compliance..... 14

Warranty:..... 15

Disclaimer:..... 15

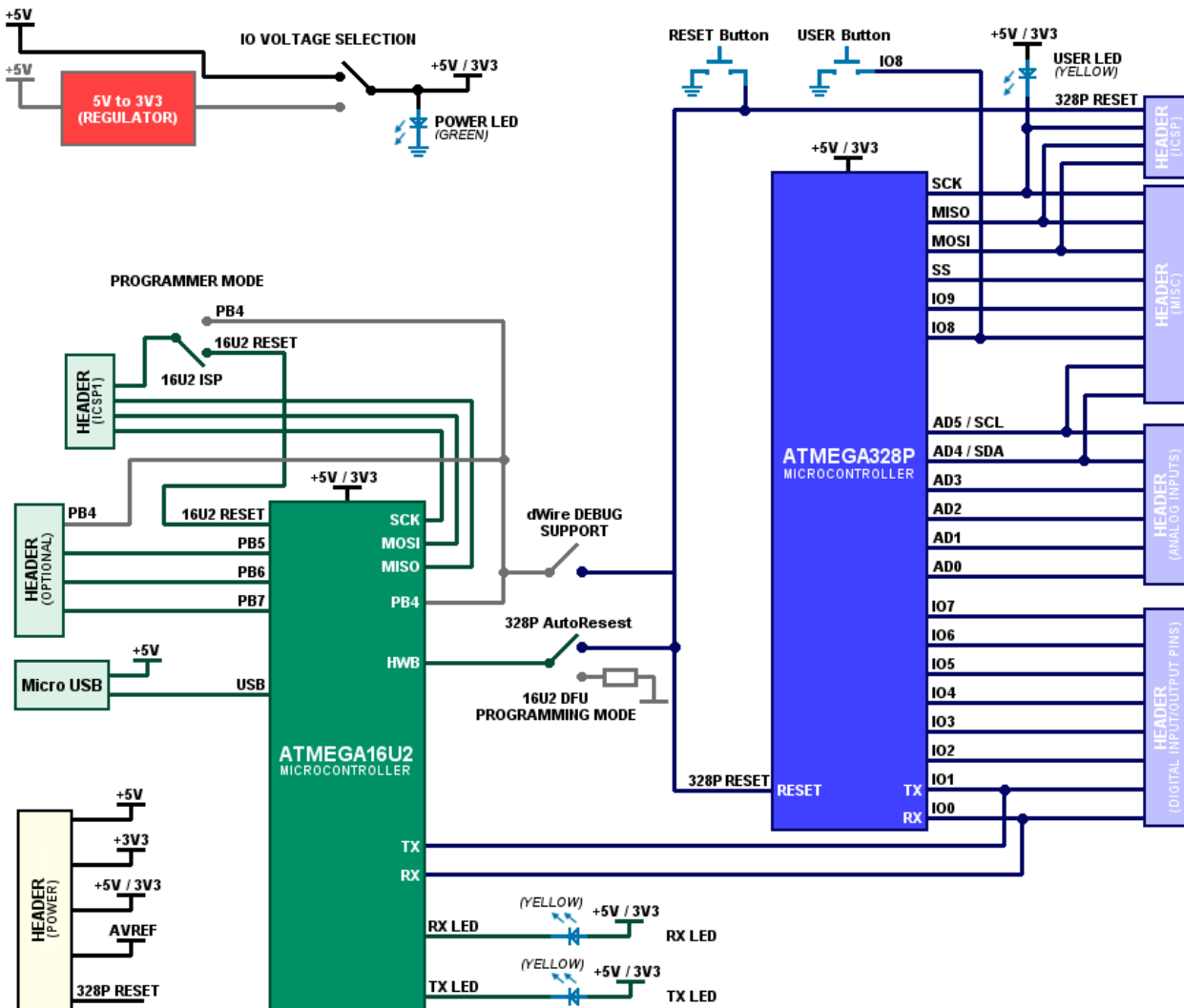
Trademark Acknowledgment:..... 15

1. Introduction

1.1 General

This microcontroller board is an amazing tool for hobbyists and robotics fans allowing building devices that can sense inputs from switches or sensors and then control motors, lights or any other output one can think of. The 28Pins Microcontroller Board is open source board based on Arduino project and was developed by [FEDEVEL Academy](http://FEDEVEL.Academy) to help people learn how to design their own boards. It is compatible with Arduino UNO Rev. 3 microcontroller board, including couple of useful improvements.

1.2 Hardware – Block Diagram



1.3 Features

| Interface | Description |
|-----------------|---|
| POWER SUPPLY | +5V \pm 5% or +3V3/+5V IO voltage configuration |
| POWER INPUT | Micro USB or soldered wires |
| MICROCONTROLLER | ATMEGA16U2 |
| MICROCONTROLLER | ATMEGA328P |
| | SPI programming support |
| | dWire debugging support |
| LDO REGULATOR | On board +3.3V / 1.5A regulator |

1.4 Reference Documents

For more detailed technical information about the 28Pins Microcontroller Board components, please refer to the web resources and documents listed below.

| Component | Description |
|----------------|---|
| ATMEGA16U2 | ATMEGA16U2-AU Datasheet Complete.pdf |
| ATMEGA328P | ATMEGA328P-PU Datasheet Complete.pdf |
| TL1963A-33DCQR | http://www.ti.com/lit/ds/symlink/tl1963a-33.pdf |

| | |
|-----------------------|---|
| DESIGN FILES | http://www.28pins.com/download/ |
| GitHub Project | https://github.com/FEDEVEL/28pins/releases |

2. Features Description

2.1 Specification

The following user interfaces are available on the 28Pins Microcontroller Board.

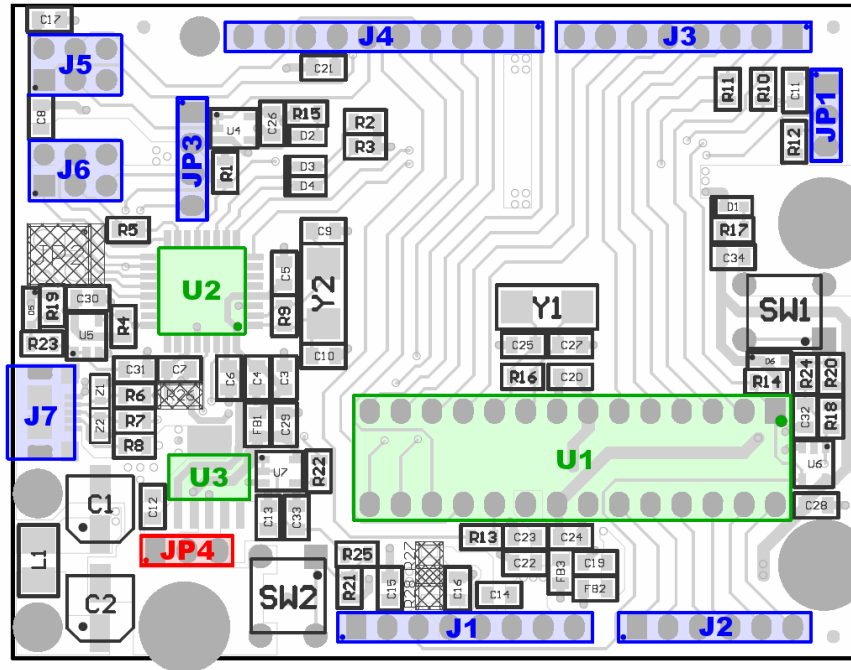
| ATMEGA328P microcontroller: | ATMEGA16U2 microcontroller: |
|--|---|
| FLASH: 32kB / EEPROM: 1kB / RAM: 2kB | FLASH: 16kB / EEPROM: 512B / RAM: 512B |
| Clock: 16MHz (for +5V) / 10MHz (for +3.3V) | Clock: 16MHz (for +5V) / 8MHz (for +3.3V) |
| 20x digital input/output | 4x Digital input / output |
| 6x PWM output | 2x User LED |
| 6x Analog inputs (10bit AD) | 1x USB |
| 1x Serial port, 1x SPI, 1x I2C | 1x SPI |
| 1x User LED | 1x Serial port (shared with 328P) |
| 1x User Buton, 1x Reset Button | DFU programming support |
| | AVRISP MKII firmware available |
| | 1x Reset Button |

28Pins Microcontroller Board Datasheet

2.2 Board Layout

The top component placement shows interfaces layout of the 28Pins Microcontroller Board. Since not all 28Pins Microcontroller Board interfaces have dedicated pins some functions could not be used simultaneously.

TOP SIDE of 3.3V/5V IO voltage 28Pins Microcontroller Board, P/N: ATM-MCB-335



2.3 Component, Connector and Jumper list

| Reference | Type | Description | Page |
|-----------|-----------------|--------------------------------|------|
| U1 | MICROCONTROLLER | ATMEGA328P-PU | 6 |
| U2 | MICROCONTROLLER | ATMEGA16U2-AU | 8 |
| U3 | LDO REGULATOR | TL1963A-33DCQR | 9 |
| J1 | POWER | 1x8 pin, 2,54mm Female Header | 9 |
| J2 | AD | 1x6 pin, 2,54mm Female Header | 10 |
| J3 | IOL | 1x8 pin, 2,54mm Female Header | 10 |
| J4 | IOH | 1x10 pin, 2,54mm Female Header | 10 |
| J5 | ICSP | 2x3 pin, 2,54mm Header | 11 |
| J6 | ICSP1 | 2x3 pin, 2,54mm Header | 11 |
| J7 | Micro USB | 2xUSB-Host stacked | 11 |

| Reference | Type | Description | Page |
|-----------|-----------------------|------------------------|------|
| JP1 | POWER SELECTION | 1x3 pin, 2,54mm Header | 12 |
| JP2 | 16U2 PINS EXTENSION | 2x2 pin, 2,54mm Header | 12 |
| JP3 | RESET SELLECTION | 1x4 pin, 2,54mm Header | 12 |
| JP4 | PROGRAMMING SELECTION | 1x4 pin, 2,54mm Header | 12 |



(Note) Possible switching between 5V or 3.3V pin voltage by simple changing the JP4 jumper is available at 28Pins 3.3V/5V Microcontroller Board. In case of 28Pins 5V Microcontroller Board, JP4 jumper is not fitted.

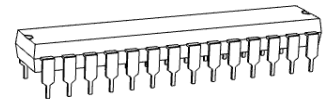
3. Component, Connector and Jumper Description

This chapter describes the components, connectors and jumpers of the 28Pins Microcontroller Board. Connectors have dedicated functionality, however there is possibility to use connector also for other purpose.

3.1 Component Description

3.1.1 U1 - ATMEGA328P-PU (28-DIP 2.54mm lead pitch, 7.62mm body width)

Manufacturer: Atmel Corporation
<http://www.atmel.com>

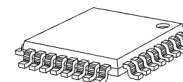


| PIN# | FUNCTION / CONNECTED TO | PIN NAME | DESCRIPTION |
|------|-------------------------|--------------------------|--|
| 1 | 328P_RESETn | PC6 (PCINT14/RESET) | If the RSTDISBL Fuse is programmed, PC6 is used as an I/O pin. If the RSTDISBL Fuse is unprogrammed, PC6 is used as a Reset input. |
| 2 | IO0 | PD0 (PCINT16/RXD) | Port D. Digital I/O 0 (RX) |
| 3 | IO1 | PD1 (PCINT17/TXD) | Port D. Digital I/O 1 (TX) |
| 4 | IO2 | PD2 (PCINT18/INT0) | Port D. Digital I/O 2 |
| 5 | IO3 | PD3 (PCINT19/OC2B/INT1) | Port D. Digital I/O 3 (PWM) |
| 6 | IO4 | PD4 (PCINT20/XCK/T0) | Port D. Digital I/O 4 |
| 7 | +5V5/3V3_328P_VCC | VCC | Digital supply voltage |
| 8 | GND_1 | GND | Ground |
| 9 | 328P_16MHz_XTAL1 | PB6 (PCINT6/XTAL1/TOSC1) | Crystal |
| 10 | 328P_16MHz_XTAL2 | PB7 (PCINT7/XTAL2/TOSC2) | Crystal |
| 11 | IO5 | PD5 (PCINT21/OC0B/T1) | Port D. Digital I/O 5 (PWM) |
| 12 | IO6 | PD6 (PCINT22/OC0A/AIN0) | Port D. Digital I/O 6 (PWM) |
| 13 | IO7 | PD7 (PCINT23/AIN1) | Port D. Digital I/O 7 |
| 14 | IO8 | PB0 (PCINT0/CLKO/ICP1) | Port B. Digital I/O 8 |
| 15 | IO9 | PB1 (OC1A/PCINT1) | Port B. Digital I/O 9 (PWM) |
| 16 | SS | PB2 (SS/OC1B/PCINT2) | Port B. Digital I/O 10 (PWM) |

| PIN# | FUNCTION / CONNECTED TO | PIN NAME | DESCRIPTION |
|------|-------------------------|------------------------|---|
| 17 | MOSI | PB3 (MOSI/OC2A/PCINT3) | Port B. Digital I/O 11 (PWM) |
| 18 | MISO | PB4 (MISO/PCINT4) | Port B. Digital I/O 12 |
| 19 | SCK_R | PB5 (SCK/PCINT5) | Port B. Digital I/O 13 |
| 20 | +5V5/3V3_328P_AVCC | AVCC | AVCC is the supply voltage pin for the A/D Converter, PC3:0, and ADC7:6. It should be externally connected to VCC, even if the ADC is not used. If the ADC is used, it should be connected to VCC through a low-pass filter. Note that PC6...4 use digital supply voltage, VCC. |
| 21 | +AREF | AREF | AREF is the analog reference pin for the A/D Converter. |
| 22 | GND_2 | GND | Ground |
| 23 | AD0 | PC0 (ADC0/PCINT8) | Port C. Analog Input 0 |
| 24 | AD1 | PC1 (ADC1/PCINT9) | Port C. Analog Input 1 |
| 25 | AD2 | PC2 (ADC2/PCINT10) | Port C. Analog Input 2 |
| 26 | AD3 | PC3 (ADC3/PCINT11) | Port C. Analog Input 3 |
| 27 | AD4/SDA | PC4 (ADC4/SDA/PCINT12) | Port C. Analog Input 4 |
| 28 | AD5/SCL | PC5 (ADC5/SCL/PCINT13) | Port C. Analog Input 5 |

3.1.2 U2 - ATMEGA16U2 (32-TQFP)

Manufacturer: Atmel Corporation
<http://www.atmel.com>

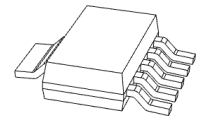


| PIN# | FUNCTION / CONNECTED TO | PIN NAME | DESCRIPTION |
|------|-------------------------|------------------------------------|--|
| 1 | 16U2_16MHz_XTAL1 | XTAL | Input to the inverting Oscillator amplifier and input to the internal clock operating circuit. |
| 2 | 16U2_16MHz_XTAL2 | XTAL2 (PC0) | Output from the inverting Oscillator amplifier if enabled by Fuse. Also serves as a generic I/O. |
| 3 | GND | GND | Ground. |
| 4 | +5V/3V3_16U2 | VCC | Digital supply voltage. |
| 5 | Not Connected | PC2 (PCINT11 / AIN2) | |
| 6 | Not Connected | PD0 (OC.0B / INT0) | |
| 7 | Not Connected | PD1 (AIN0 / INT1) | |
| 8 | 16U2_RXD | PD2 (RXD1 / AIN1 / INT2) | Port D. Analog input 2 |
| 9 | 16U2_TXD | PD3 (TXD1 / INT3) | Port D. Analog input 3 |
| 10 | 16U2_RX_LED | PD4 (INT5/ AIN3) | Port D. Analog input 4 |
| 11 | 16U2_TX_LED | PD5 (XCK AIN4 / PCINT12) | Port D. Analog input 5 |
| 12 | Not Connected | PD6 (RTS / AIN5 / INT6) | |
| 13 | 16U2_PROG_328P_RESETn | PD7 (CTS / HWB / AIN6 / T0 / INT7) | Port D. Analog input 6 |
| 14 | Not Connected | PB0 (SS / PCINT0) | |
| 15 | 16U2_SCLK_R | PB1 (SCLK / PCINT1) | Port B. Digital I/O 1 |
| 16 | 16U2_MOSI | PB2 (PDI / MOSI / PCINT2) | Port B. Digital I/O 2 |

| PIN# | FUNCTION / CONNECTED TO | PIN NAME | DESCRIPTION |
|------|-------------------------|------------------------------|--|
| 17 | 16U2_MISO | PB3 (PDO / MISO / PCINT3) | Port B. Digital I/O 3 |
| 18 | 16U2_PB4 | PB4 (T1 / PCINT4) | Port B. Digital I/O 4 |
| 19 | 16U2_PB5 | PB5 (PCINT5) | Port B. Digital I/O 5 |
| 20 | 16U2_PB7 | PB6 (PCINT6) | Port B. Digital I/O 6 |
| 21 | 16U2_PB8 | PB7 (PCINT7 / OC.0A / OC.1C) | Port B. Digital I/O 7 |
| 22 | Not Connected | PC7 (INT4 / ICP1 / CLKO) | |
| 23 | Not Connected | PC6 (OC.1A / PCINT8) | |
| 24 | 16U2_RESETh | Reset (PC1 / dW) | Reset input. A low level on this pin for longer than the minimum pulse length will generate a reset, even if the clock is not running. The minimum pulse length is given in product datasheet on page 47 . Shorter pulses are not guaranteed to generate a reset. This pin alternatively serves as debugWire channel or as generic I/O. The configuration depends on the fuses RST-DISBL and DWEN. |
| 25 | Not Connected | PC5 (PCINT9/ OC.1B) | |
| 26 | Not Connected | PC4 (PCINT10) | |
| 27 | +3V3_16U2_UCAP | UCAP | |
| 28 | UGND | UGND | USB Ground |
| 29 | USB_P | D+ | USB Full Speed Positive Data Upstream Port |
| 30 | USB_N | D- | USB Full Speed Negative Data Upstream Port |
| 31 | +5V | UVCC | USB Pads Internal Regulator Input supply voltage |
| 32 | +5V/3V3_16U2 | AVCC | AVCC is the supply voltage pin (input) for all analog features (Analog Comparator, PLL). It should be externally connected to VCC through a low-pass filter. |

3.1.3 U3 - TL1963A-33DCQR (SOT-223-6)

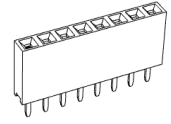
Manufacturer: Texas Instrumets Inc.
<http://www.ti.com>



| PIN# | FUNCTION / CONNECTED TO | PIN NAME | DESCRIPTION |
|------|-------------------------|-------------|--|
| 1 | +5V | SHDN | Shutdown. The SHDN pin is used to put the TL1963A-xx regulators into a low-power shutdown state. |
| 2 | +5V | IN | Power is supplied to the device through the IN pin. |
| 3 | GND | GND | Ground |
| 4 | +3V3 | OUT | The output supplies power to the load. |
| 5 | +3V3 | SENSE / ADJ | SENSE: For fixed voltage versions of the TL1963A-xx, the SENSE pin is the input to the error amplifier. ADJ: Adjust. For the adjustable TL1963A, this is the input to the error amplifier. |
| 6 | GND | GND | Ground |

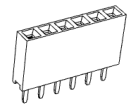
3.2 Connector Description

3.2.1 J1 - POWER (1x8 pin, 2.54mm Female Header)



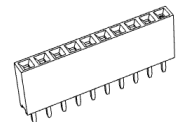
| PIN# | PIN NAME | DESCRIPTION / NOTES |
|------|-------------|------------------------------|
| 1 | NC | Not Connected |
| 2 | +5V/3V3 | I/O Reference voltage |
| 3 | 328P_RESETh | Reset |
| 4 | +3V3 | 3.3V Output |
| 5 | +5V | 5V Output |
| 6 | GND | Ground |
| 7 | GND | Ground |
| 8 | NC | Pin 8 (VIN) is not supported |

3.2.2 J2 - AD (1x6 pin, 2.54mm Female Header)



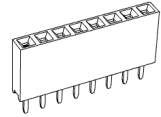
| PIN# | PIN NAME | DESCRIPTION / NOTES |
|------|----------|---------------------|
| 1 | AD0 | Analog PIN 0 |
| 2 | AD1 | Analog PIN 1 |
| 3 | AD2 | Analog PIN 2 |
| 4 | AD3 | Analog PIN 3 |
| 5 | AD4/SDA | (I2C) SDA |
| 6 | AD5/SCL | (I2C) SCL |

3.2.3 J3 - IOL (1x8 pin, 2.54mm Female Header)



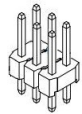
| PIN# | PIN NAME | DESCRIPTION / NOTES |
|------|----------|------------------------------|
| 1 | IO0 | Digital I/O 0 RXD (IN) |
| 2 | IO1 | Digital I/O 1 TXD (OUT) |
| 3 | IO2 | Digital I/O 2 Interrupt |
| 4 | IO3 | Digital I/O 3 (PWM) Interrup |
| 5 | IO4 | Digital I/O 4 |
| 6 | IO5 | Digital I/O 5 (PWM) |
| 7 | IO6 | Digital I/O 6 (PWM) |
| 8 | IO7 | Digital I/O 7 |

3.2.4 J4 - IOH (1x10 pin, 2.54mm Female Header)



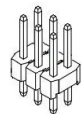
| PIN# | PIN NAME | DESCRIPTION / NOTES |
|------|----------|---|
| 1 | IO8 | Digital I/O 8 |
| 2 | IO9 | Digital I/O 9 (PWM) |
| 3 | SS | Digital I/O 10 (PWM) |
| 4 | MOSI | Digital I/O 11 (PWM) Master-Out, slave-In |
| 5 | MISO | Digital I/O 12 Master-In, Slave-Out |
| 6 | SCK | Digital I/O 13 serial Clock |
| 7 | GND | Ground |
| 8 | +AREF | |
| 9 | AD4/SDA | Serial Data |
| 10 | AD5/SCL | Serial Clock |

3.2.5 J5 - ICSP for ATmega328P (2x3 pin, 2.54mm Header)



| PIN# | PIN NAME | DESCRIPTION / NOTES |
|------|-------------|----------------------|
| 1 | MISO | Master-In, Slave-Out |
| 2 | +5V/3V3 | VCC |
| 3 | SCK | Serial Clock |
| 4 | MOSI | Master-Out, slave-In |
| 5 | 328P_RESETh | RESET |
| 6 | GND | Ground |

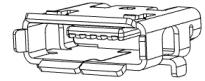
3.2.6 J6 - ICSP1 for ATmega16U2 (2x3 pin, 2.54mm Header)



| PIN# | PIN NAME | NOTES |
|------|-----------------|----------------------|
| 1 | 16U2_MISO | Master-In, Slave-Out |
| 2 | +5V/3V3 | VCC |
| 3 | 16U2_SCLK | Serial Clock |
| 4 | 16U2_MOSI | Master-Out, slave-In |
| 5 | 16U2_HDR_RESETh | RESET |
| 6 | GND | Ground |

3.2.7 J7 - MicroUSB (USB MICRO B RECPT SMT R/A)

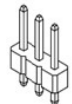
Manufacturer: FCI Electronics
<http://www.fci.com>



| PIN# | PIN NAME | DESCRIPTION |
|------|-----------|---------------|
| 1 | +5V_USB | +5 VDC |
| 2 | CON_USB_N | Negative Data |
| 3 | CON_USB_P | Positive Data |
| 4 | GND | Ground |
| 5 | GND | Ground |

3.3 Jumper Description

3.3.1 JP1 – Reset selection (1x3 pin, 2.54mm Header)

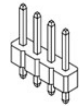


| PIN# | PIN NAME | DESCRIPTION / NOTES |
|------------|---|---|
| 1 } 2 } | 328P_AUTORESETn 16U2PROG_328P_RESETh | Autoreset Enabled - Short 1&2. In this case, 16U2 is used to reset 328P when firmware inside 328P is updated from Arduino IDE. |
| 2 } 3 } | 16U2PROG_328P_RESETh GND | 16U2 DFU mode Enabled - Short 2&3. 16U2 HWB pin is sampled by 16U2 during RESET. If pulled low, then after Reset the 16U2 will go into DFU mode (it's the mode to flash 16U2 firmware through USB and Atmel Flip software: http://www.atmel.com/tools/flip.aspx). |

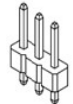
3.3.2 JP2 – 16U2 Pins Extension (2x2 pin, 2.54mm Header) **NOT FITTED**

| PIN# | PIN NAME | NOTES |
|------|----------|-------|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |

3.3.3 JP3 – Programming Selection (1x4 pin, 2.54mm Header)



| PIN # | PIN NAME | DESCRIPTION / NOTES |
|--------|--------------------------------|--|
| 1 2 | 328P_RESETh 16U2_PB4 | DebugWire support - Short 1&2. It supports possible debugWire debugging (programming?) of 328P through 16U2. In this case, the 16U2 needs to have a correct firmware and has to behave as a debugWire tool. |
| 2 3 | 16U2_PB4 16U2_HDR_RESETh | ISP programmer mode - Short 2&3. In this case, take a cable and connect J5 & J6 together. Upload AVRISP MKII firmware into 16U2 and you can program 328P. Example of AVRISP MKII firmware can be found at LUFA projects: http://www.fourwalledcubicle.com/LUFA.php |
| 3 4 | 16U2_HDR_RESETh 16U2_RESETh | ISP header - Short 3 & 4. In this mode, the ICSP1 header is used as a standard ISP header to program 16U2 through ISP interface by an ISP programmer. |



3.3.4 JP4 - Power Selection (1x3 pin, 2.54mm Header)

| PIN# | PIN NAME | DESCRIPTION / NOTES |
|--------|-----------------|--|
| 1 2 | +5V +5V/3V3 | 5V Power Input enabled if pins 1&2 are shorted by jumper |
| 2 3 | +5V/3V3 +3V3 | 3.3V Power Input enabled if pins 2&3 are shorted by jumper |

4. Technical Specifications

4.1 Input Voltage

The 28Pins Microcontroller Board supports 5V or 3V3 voltage level on the IO pins. The board can be powered from micro USB connector (J7) or a single +3.3V power rail (through J1 pin 4).

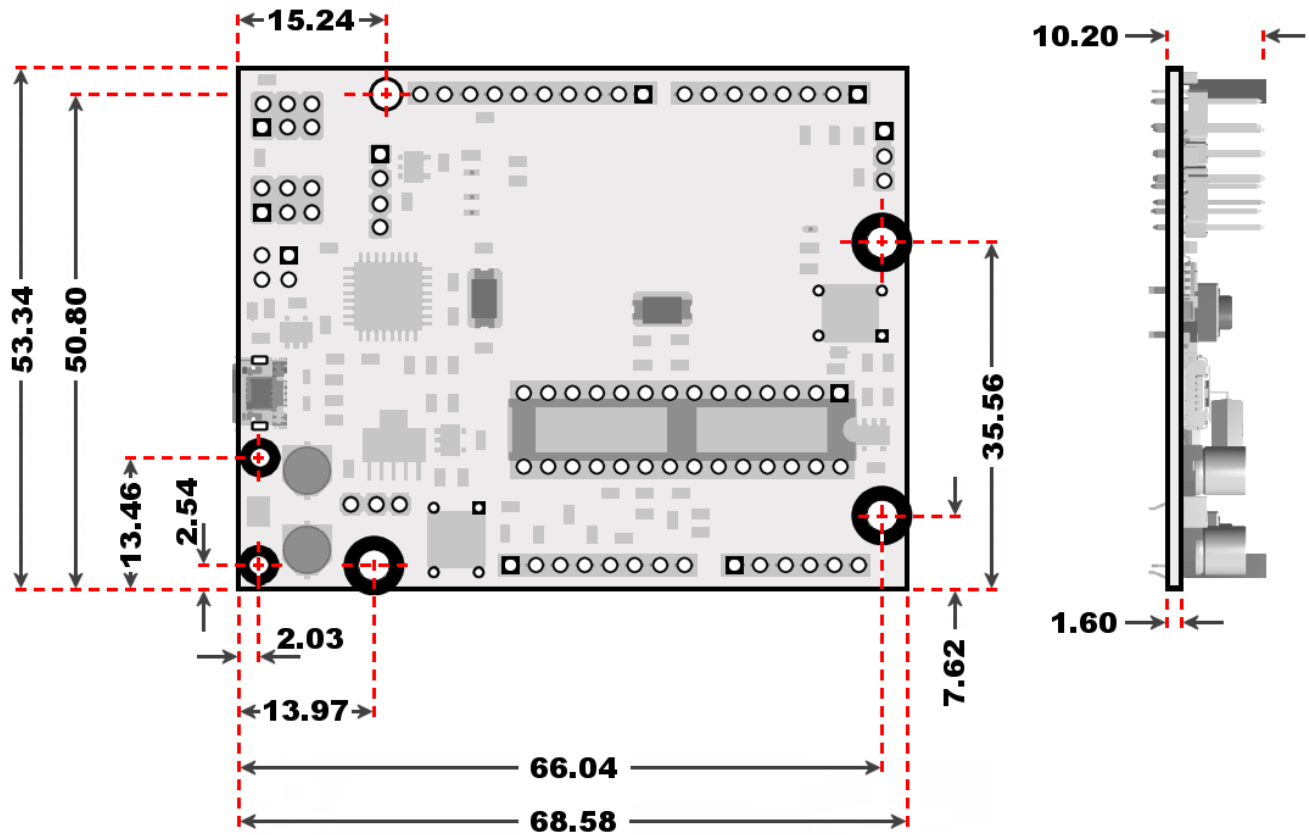
- Power Selection:
- 1) 5V IO
 - 2) 3.3V IO
 - 3) Both 5V and 3V3, selected through JP4 jumper



(Note) More detailed information on Power selection can be found in the 28Pins Microcontroller Board schematic.

Read in detail Design Notes !

4.2 Mechanical Drawing (Units in millimeters)



4.3 Mechanical

| Dimensions | Width | Height | Length | Unit |
|------------|--------------|--------------|--------------|-----------|
| PCB | 53.34 (2100) | 1.60 (62.99) | 68.58 (2700) | mm (mils) |

4.4 Temperature Range

| Symbol | Description | Min | Max | Unit |
|--------|-----------------------------|-----|-----|------|
| T_AMB | Operating temperature range | -20 | +85 | °C |

4.5 CE compliance of Voipac products

The CE label is a mandatory conformity mark for complex electronic devices placed on the market in the European Economic Area and each product sold within the EU needs a CE Certificate of Conformance that ensures that the product conforms to the essential requirements of the applicable EC directives.

However, if such complex electronic devices are produced for further processing by the industry, skilled development teams or system integrators, they do not need to observe the above mentioned CE requirements and consequently do not need any identification either. This applies to the Voipac boards, because these are not used as stand-alone devices by the general public.

To make sure that Voipac boards can be used in CE marked devices, they are designed to obey the EC directives and the standard configuration boards manufactured by Voipac are tested for Electromagnetic Interference and operating temperature ranges.

4.6 RoHS and WEEE Compliance

All of the products designed and manufactured by VOIPAC TECHNOLOGIES s.r.o. are classified as Electrical and Electronic Equipment (EEE) under the Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment 2002/95/EC (RoHS). To comply with the RoHS directive, the restricted use of Lead (Pb), Mercury (Hg), Cadmium (Cd), Hexavalent Chromium (Cr 6+), Polybrominated Biphenyls (PBB) and Polybrominated Diphenyl Ethers (PBDE) must be ensured. VOIPAC TECHNOLOGIES s.r.o. guarantees that products ordered after July 1, 2006 are assembled in full compliance with the RoHS directive from the European Parliament and Counsel. The company procedures also complies with the Waste Electrical and Electronic Equipment Directive 2002/96/EC (WEEE) .

Warranty:

VOIPAC TECHNOLOGIES s.r.o. Does Not Bear Responsibility for the Following:

- Failure of a product resulting from misuse, accident, modification, unsuitable operating environment, or improper maintenance by user
- Unless otherwise agreed in written, a product does not include technical support and the customer may be able to purchase technical support under separate agreement
- Any technical or other support provided under warranty by VOIPAC TECHNOLOGIES s.r.o. such as assistance, set-up and installation is provided WITHOUT WARRANTY OF ANY KIND.

Disclaimer:

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