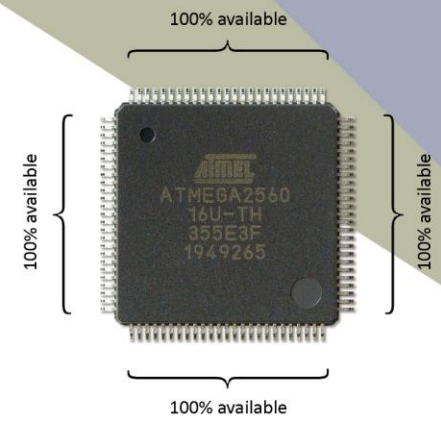
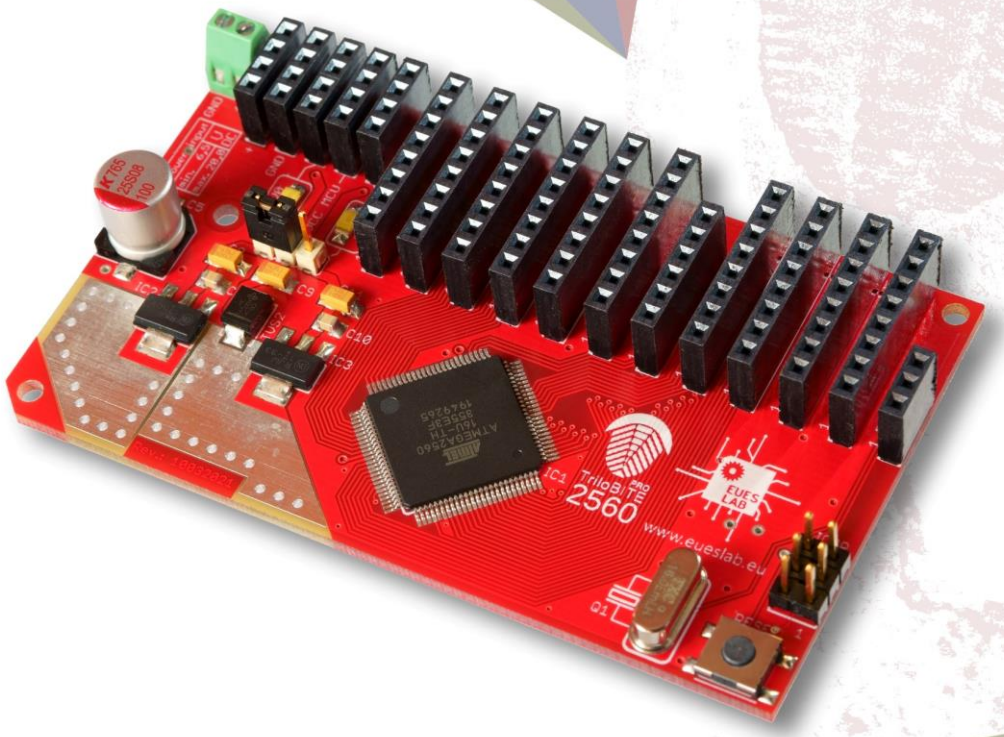
https://eueslab.eu

PRO
TriloBITE
2560

Microcontroller with 100% ATmega2560





DATASHEET

EN

CONTENTS

1. TriloBITE 2560 PROFESSIONAL MICROCONTROLLER WITH ATmega2560.

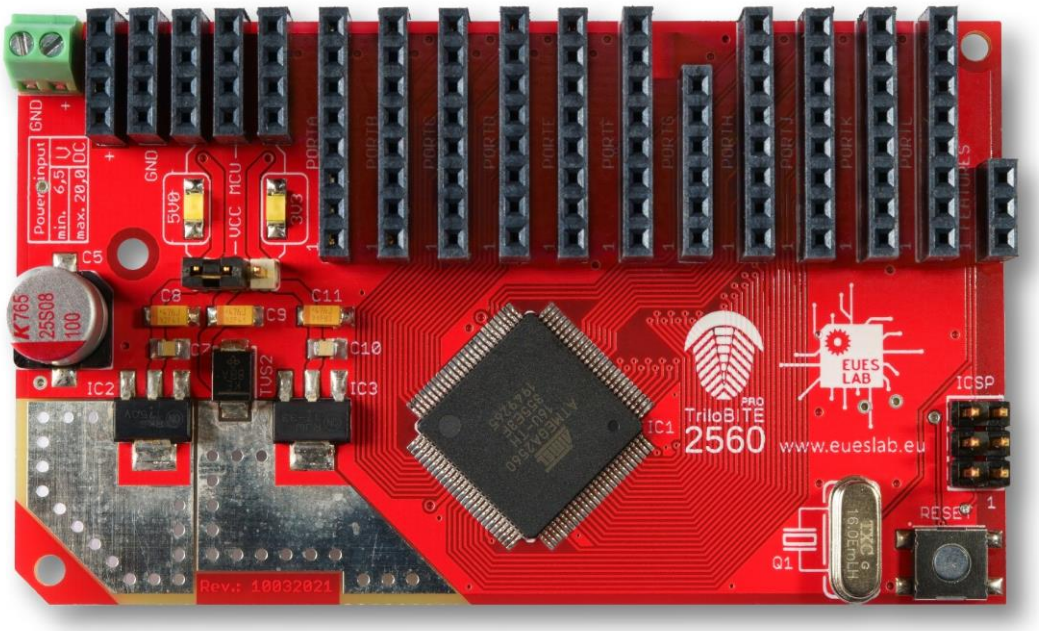
1.1 FEATURES

- Microcontroller ATmega2560.
  - 100% available all ports and features.
- Two LDO power supplies 5V0 and 3V3.
- The voltages of the internal power supplies are permanently available on the multi-pin connectors.
- Ability to power MCUs from multiple locations. Power supply from 1.8VDC to 5.5VDC and from 6,5VDC to 20VDC.
- Possibility to permanently power the microcontroller via ICSP.
- Interchangeable crystal in the cavities.
- Possibility to completely disconnect the crystal circuit using SMD jumpers and use an external clock.
- Low-pass filter with the possibility to easily exclude it from the function.
- Programming with ICSP.
- 11 logically arranged ports.
- Connector FEATURES with functions:
  - External RESET.
  - External clock.
  - AREF MCU.
- Integrated fuses and TVS protections.
- GND on multipins connector.
- RESET button.

1.2 APPLICATIONS

- Control units
- Data loggers
- Robots
- Regulators
- PLC
- Displays
- Battery powered systems
- Mobile applications

Figure 1.3 Top view TriloBITE 2560 PRO



2. PCB ARRANGEMENT

Figure 2.1 Top side layout of the TriloBITE 2560 PRO

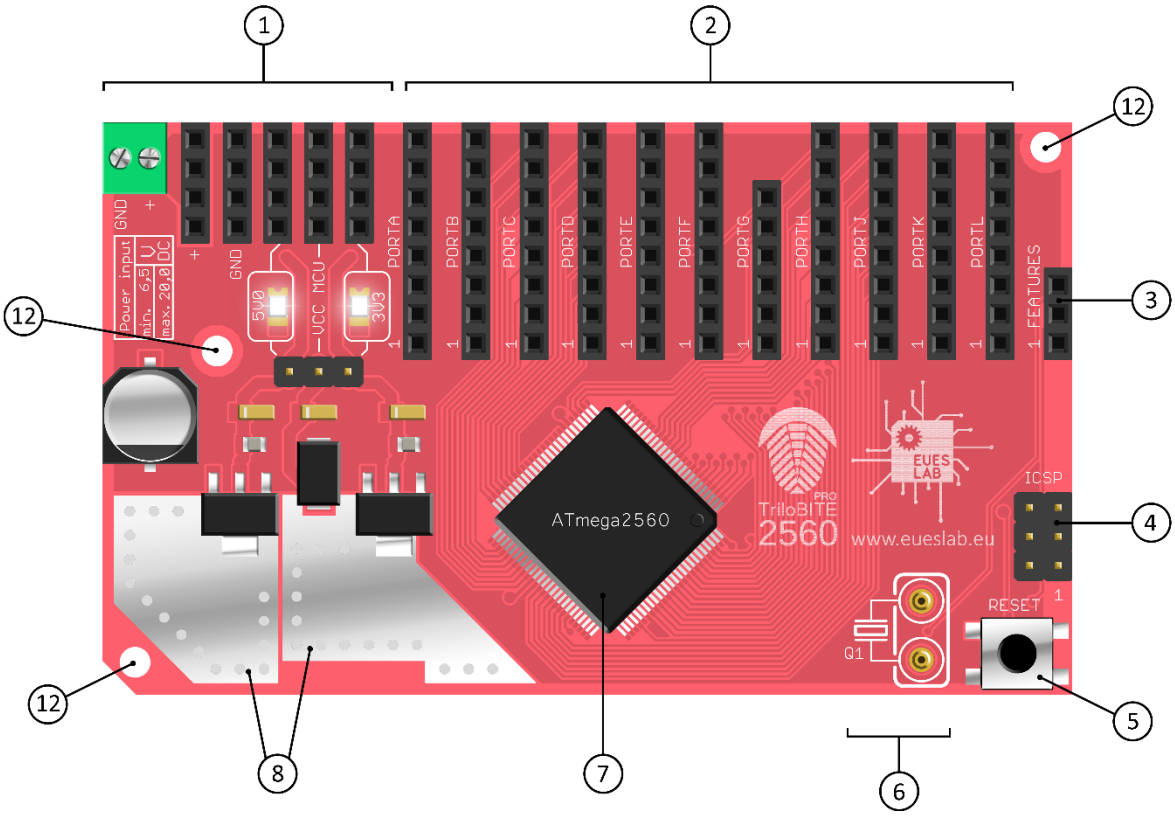
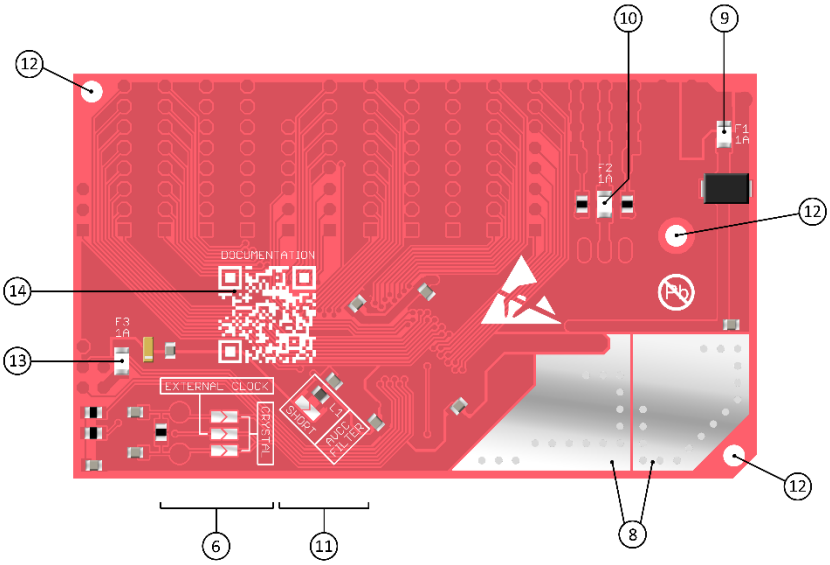


Figure 2.2 Bottom side layout of the TriloBITE 2560 PRO

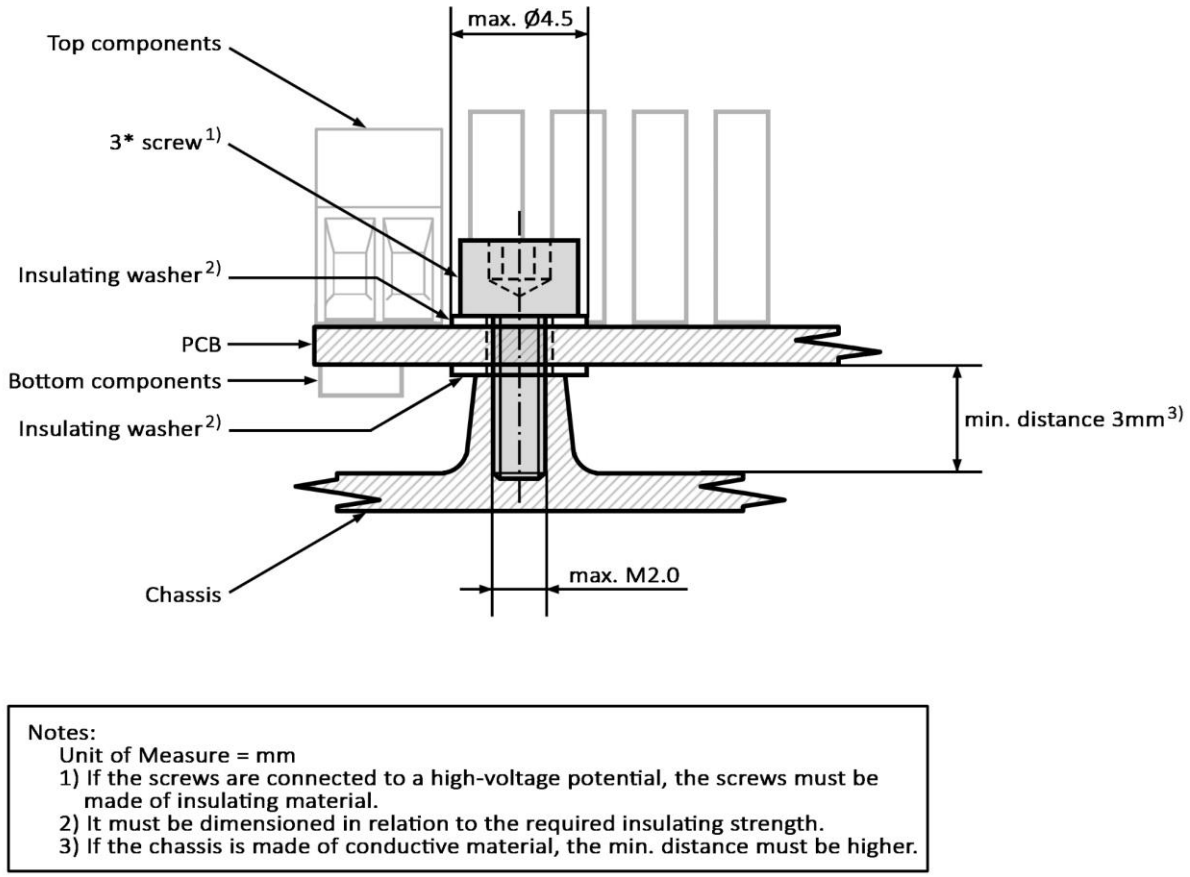


1. Internal and external power supplies (page 12)
2. Ports (page 15)
3. FEATURES connector (page 16)
4. ICSP connector (page 18)
5. RESET button (page 18)
6. Internal and external clocks (page 17)
7. ATmega2560 microcontroller (page 19)
8. Cooling LDO power supplies (page 19)
9. Fuse F1 (page 20)
10. Fuse F2 (page 20)
11. AVCC filter (low-pass filter) (page 18)
12. Mounting holes (page 8)
13. Fuse F3 (page 20)
14. QR code – website and documentation

3. MOUNTING HOLES

Three mounting holes are used to hold the PCB. The dimensions of the mounting holes are given in section **Drawing 20.1** mechanical dimensions on page 21. A metal fastener may be used to mount the PCB, but the insulating strength between the PCB and the fastener must be maintained.

Drawing 3.1 Recommended mounting method



Notes:
Unit of Measure = mm
1) If the screws are connected to a high-voltage potential, the screws must be made of insulating material.
2) It must be dimensioned in relation to the required insulating strength.
3) If the chassis is made of conductive material, the min. distance must be higher.

4. POWER INPUT CONNECTOR

Drawing 4.1 Maximum and minimum conductor cross-section

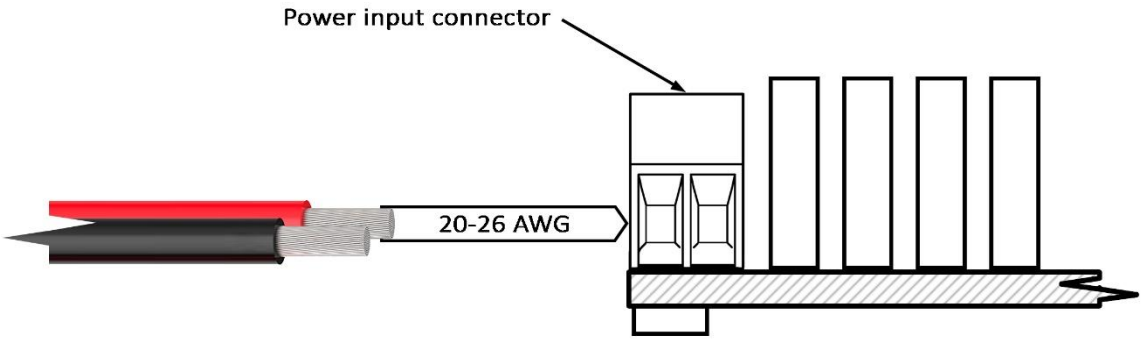


Table 4.2 Connection data

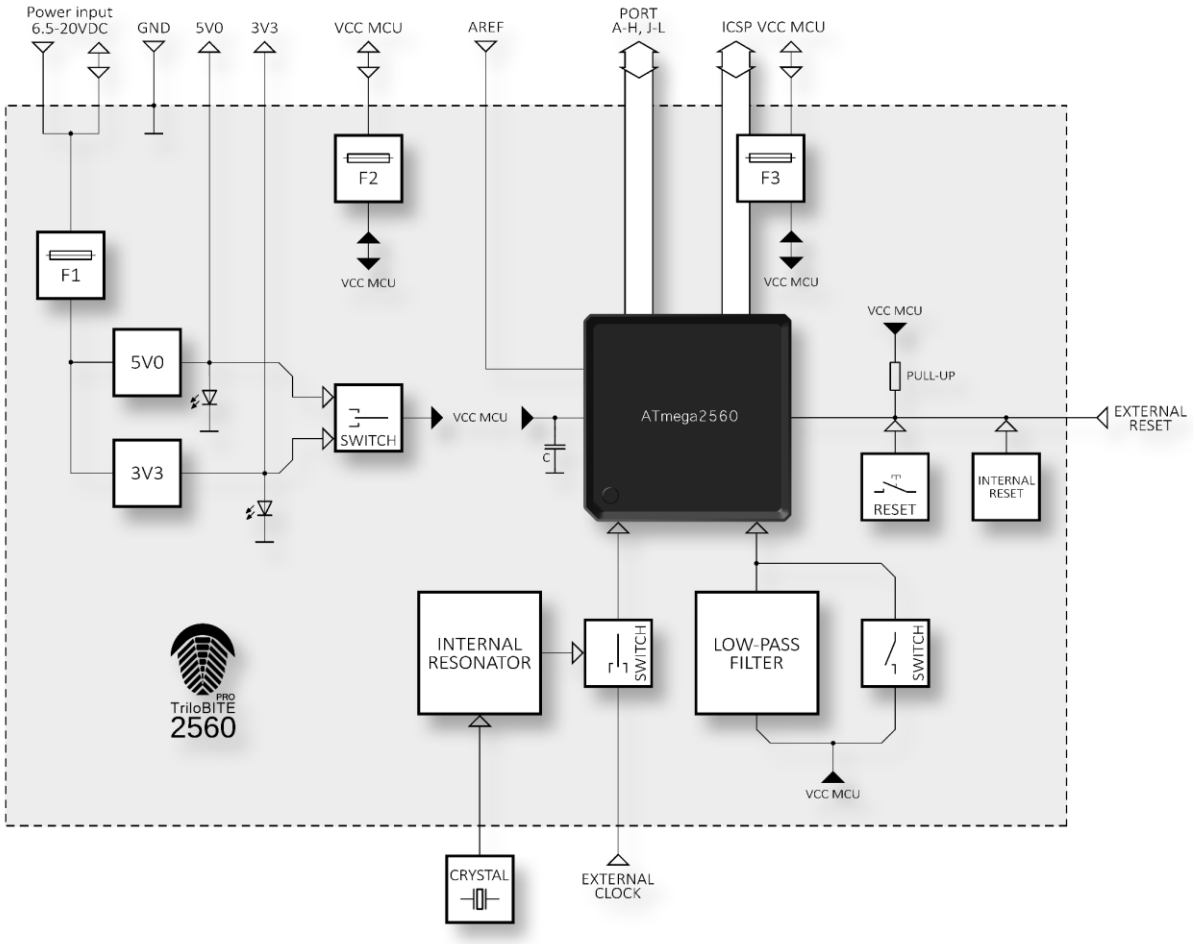
Conductor cross section solid min.	0.14 mm²
Conductor cross section solid max.	0.5 mm²
Conductor cross section flexible min.	0.14 mm²
Conductor cross section flexible max.	0.5 mm²
Conductor cross section flexible, with ferrule without plastic sleeve min.	0.25 mm²
Conductor cross section flexible, with ferrule without plastic sleeve max.	0.34 mm²
Conductor cross section flexible, with ferrule with plastic sleeve min.	0.25 mm²
Conductor cross section flexible, with ferrule with plastic sleeve max.	0.34 mm²
Conductor cross section AWG min.	26
Conductor cross section AWG max.	20
2 conductors with same cross section, solid min.	0.14 mm²
2 conductors with same cross section, solid max.	0.34 mm²
2 conductors with same cross section, stranded min.	0.14 mm²
2 conductors with same cross section, stranded max.	0.34 mm²

Figure 4.3 Recommended screwdriving tools

Micro screwdriver SZS 0.4x2.0 – 1205202 bladed.
Size: 0.4 * 2.0 * 60mm, 2-component grip, with non-slip grip and twist cap.

5. BLOCK DIAGRAM

Figure 5.1 Block diagram



TriloBITE 2560 PRO is designed with an emphasis on the availability of 100% ports and all the features that ATmega2560 dispose. The circuit architecture is designed to simplify the recovery of the MCU using internal peripherals directly on the PCB. All of these internal peripherals can be excluded from the function so that they do not affect the MCU connection. Excluding all internal peripherals from the function allows you to use your own customized peripheral designs (power supply, variable crystal, external clock and reset) and work with free ATmega2560, for example when researching and using low power modes or sleep modes.

TriloBITE 2560 PRO allows you to use an internal low-pass filter to power the A/D converter, or simply disable it.

6. IDE AND PROGRAMMING HARDWARE

Ability to program through all programming IDEs and hardware that support ATmega2560 programming.

Examples:
Interface: ICSP connector; Others (after adding the necessary external hardware).
IDE: AVR studio, Atmel studio, Eclipse and more...
Programming hw: USB ASP and more...

7. GENERAL DATA

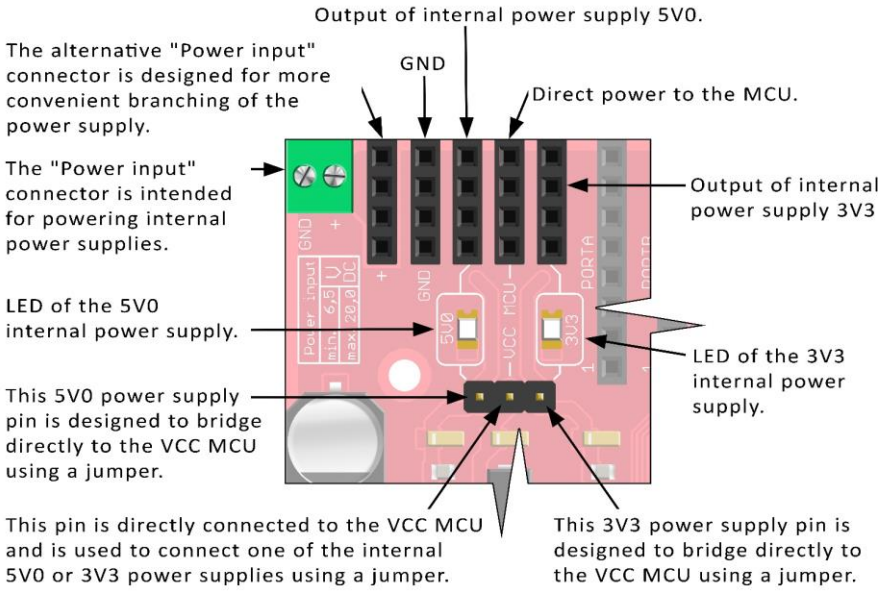
Table 7.1 General data

PARAMETER (TA = 25°C unless otherwise noted)	SYMBOL	MIN	TYP	MAX	UNIT
Power supply via "Power input" connector					
Input voltage	Vin	6.5	-	20.0	V
Input current (If LDO are not loaded)	Iin	0.01	0.01	0.01	A
Input load current	Iload	-	-	1.0	A
Power supply via "VCC MCU" connector					
Input voltage	Vin	1.8	-	5.5	V
Input load current	Iload	Limited by ATmega2560	-	1.0	A
Power supply via ICSP connector					
Input voltage	Vin	1.8	-	5.5	V
Input load current	Iload	Limited by ATmega2560	-	1.0	A
LDO 3V3					
Output voltage	Vout	-	3.3	-	V
Output load current	Iout	-	-	1.0	A
Total power dissipation @ Tc = +70°C	Pmax	-	-	2.0	W
LDO 5V0					
Output voltage	Vout	-	5.0	-	V
Output load current	Iout	-	-	1.0	A
Total power dissipation @ Tc = +70°C	Pmax	-	-	2.0	W
MCU ATmega2560					
Operating frequency	f	-	-	16.0	MHz
General TriloBITE 2560 PRO					
Operating junction and storage temperature range	Tj TSTG	-20	-	+70	°C
Unit size height	H.	13.5	14.0	15.0	mm
Unit size width	W.	-	50.0	-	mm
Unit size long	L.	-	84.5	-	mm
Unit weight	m	270	300	330	g

Note:
Table 7.1 is in some cases based on third party data and does not serve as a comprehensive or reference table. To use the ATmega2560 microcontroller, it is necessary to use the data provided by the microcontroller manufacturer. For example, ATmega2560 datasheet.

8. INTERNAL AND EXTERNAL POWER SUPPLIES

Figure 8.1 Interface of internal and external power supplies



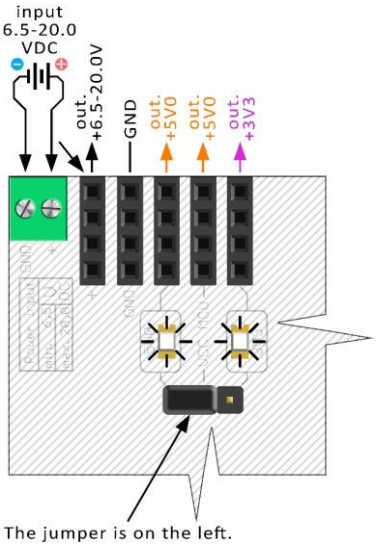
The interface of internal and external power supply allows various combinations of power supply for MCUs or external peripherals (see **Table 8.2** Configuration internal and external power supplies).

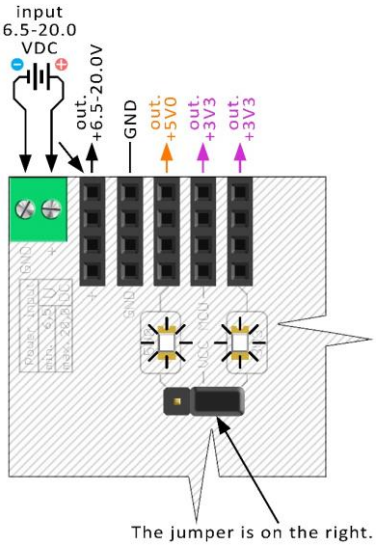
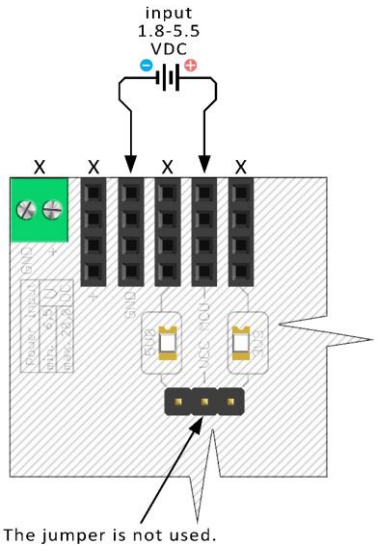
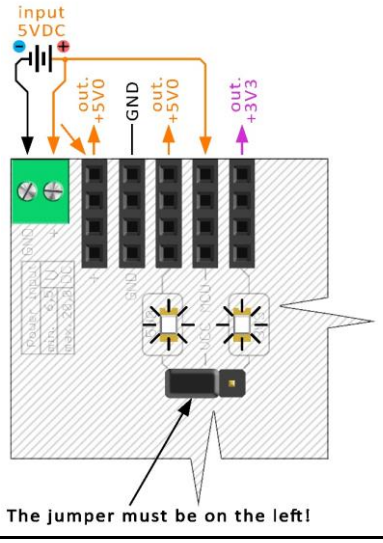
There are two LDO power supplies 5V0 and 3V3 available with a maximum allowed load of up to 1A (see **Graph 8.4** Characteristics of the maximum current load of internal LDO power supplies 3V3 and 5V0 on page 14). The supply of 6,5VDC to 20,0VDC must not exceed current 1A (see section **17. FUSE F1** on page 20).

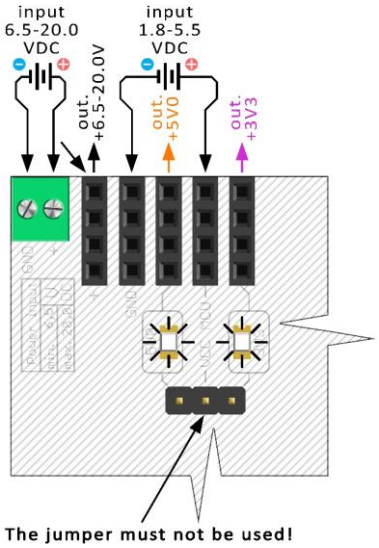
The power supply interface allows you to disconnect internal power supplies from the MCU and power the MCU with its own external power supply. This power supply method is advantageous if it is desired to use an MCU without circuits on the power supply branch and to use its power supply properties (for example, low-power modes of the ATmega2560 microcontroller, see the ATmega2560 datasheet).

For specialized applications, a common GND for all internal and external power supplies must be considered.

Table 8.2 Internal and external power supplies configurations

CONFIGURATION	DESCRIPTION	SCHEMATIC
1	**Figure 8.2.1** Powering the MCU from the internal 5V0 power supply To use internal power supplies, it is necessary to connect the power supply from an external 6.5-20.0VDC power supply to the "Power input" connector. By bridging the internal 5V0 power supply with a jumper to the position on the left, the MCU is powered by the 5V0 power supply and voltage is available on two connectors for any use. An internal 3V3 power supply is available on one connector for connecting alternative peripherals. Both LEDs are lit.	

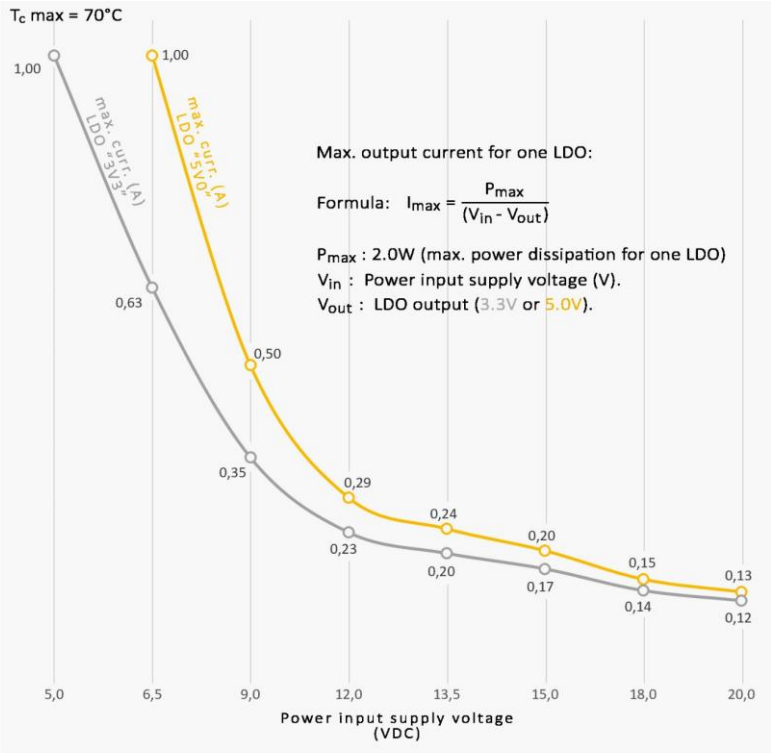
CONFIGURATION	DESCRIPTION	SCHEMATIC
2	**Figure 8.2.2** Powering the MCU from the internal 3V3 power supply To use internal power supplies, it is necessary to connect the power supply from an external 6.5-20.0VDC power supply to the "Power input" connector. By bridging the internal 3V3 power supply with a jumper to the position on the left, the MCU is powered by the 3V3 power supply and voltage is available on two connectors for any use. An internal 5V0 power supply is available on one connector for connecting alternative peripherals. Both LEDs are lit.	
3	**Figure 8.2.3** Powering the MCU with an external 1.8-5.5VDC power supply By connecting an external power supply to the "GND" connectors on "-" and "MCU VCC" to "+", the MCU can be powered by an external power supply 1.8-5.5VDC. The jumper is not used and the LEDs are off. This power supply method is advantageous if it is desired to use an MCU without circuits on the power supply branch and to use its power supply properties (for example, low-power modes of the ATmega2560 microcontroller, see the ATmega2560 datasheet).	
4	**Figure 8.2.4** Powering the MCU with an external 5VDC source and starting the internal 3V3 power supply By connecting an external 5VDC power supply to the "Power input" connector and to the "VCC MCU", the MCU is powered by an external 5VDC power supply and the internal 3V3 power supply is started for alternative use. **The jumper must be in the left position. In this configuration, the jumper must not be used on the right to avoid collisions of power supplies with different voltages.** Both LEDs are lit. This configuration is advantageous if only a 5VDC external power supply is available. In this configuration, the current of each power supplies is max. 1A.	

CONFIGURATION	DESCRIPTION	SCHEMATIC
5	**Figure 8.2.5** Powering the MCU with an external power supply and starting internal power supplies for alternative use To use internal power supplies, it is necessary to connect an external 6.5-20.0 VDC power supply to the "Power input" connector. By connecting a second external power supply to the "GND" connectors on - and "VCC MCU" to +, the MCU can be powered by an external 1.8-5.5VDC power supply independently of the internal power supplies. The advantage of this configuration is the power supply of the MCU to 1.8VDC, for example, and the internal power supplies 5V0 and 3V3 can be used to supply alternative peripherals. It is necessary to take into account the common GND for all power supplies. **The jumper must not be used in this configuration to avoid collisions of power supplies with different voltages.**	

Warning 8.3 Other types of configuration of internal and external power supplies
Typical power supplies configurations options are show in **Table 8.2** Internal and external power supplies configuration. Other types of configurations are not recommended. It is necessary to take into account the principle of internal and external sources, and the function of the jumper. Otherwise, internal and external power supplies may collide, resulting in the destruction of the TriloBITE 2560 PRO or external peripherals. The power inputs are equipped with protection circuits, but this does not guarantee 100% safety in case of incorrect use.

Graph 8.4 Characteristics of maximum current load of internal LDO power supplies 3V3 a 5V0

The maximum output current of one LDO source depends on the maximum allowed power dissipation of the source (2.0W) at case temperature not exceeding 70°C. The sum of the output currents of both LDO power supplies must not exceed the value of the input fuse element (see section **17. FUSE F1** on page 20).



9. PORTS

The PORTA to PORTL connectors are connected to the microcontroller ports analogously according to the scale of the individual bits as shown in **Figure 9.1** Numbering of connectors the PORT-A to PORT-L and FEATURES connectors.

The comprehensive function of the FEATURES connector is specified in section **10. FEATURES CONNECTOR** on page 16.

Figure 9.1 Numbering of connectors PORT-A to PORT-L and FEATURES

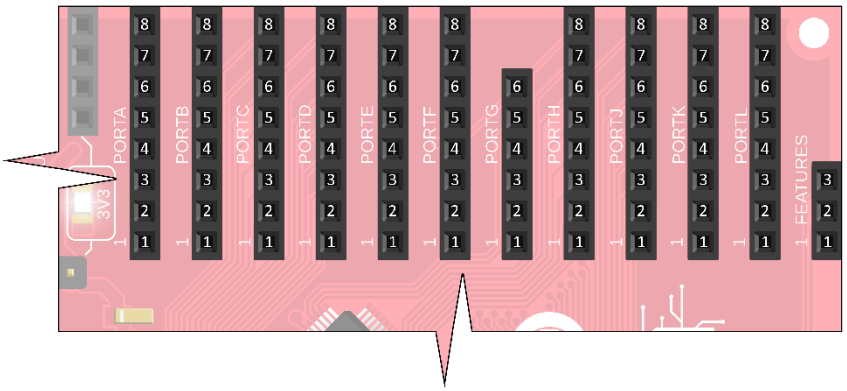
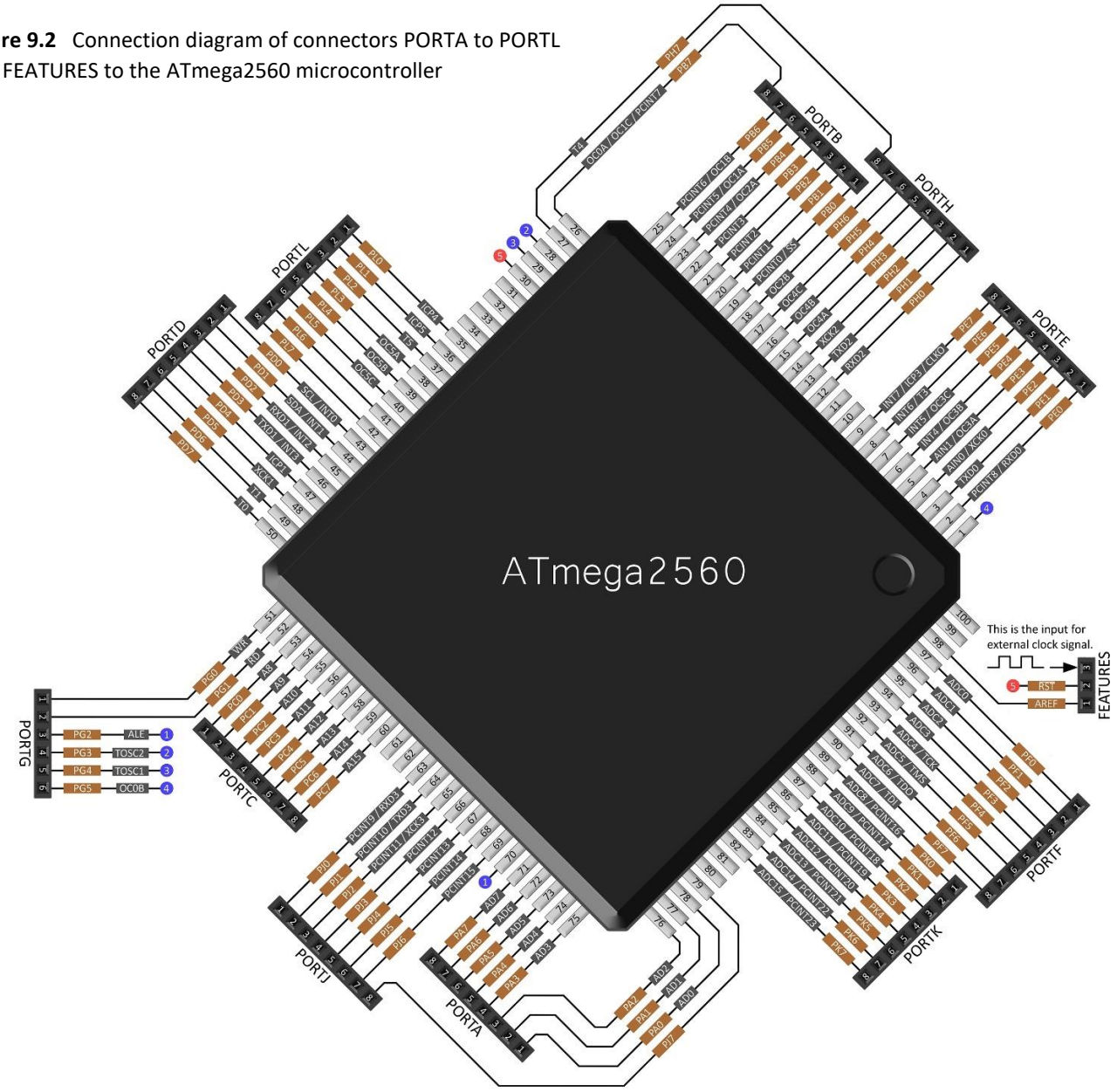


Figure 9.2 Connection diagram of connectors PORTA to PORTL and FEATURES to the ATmega2560 microcontroller

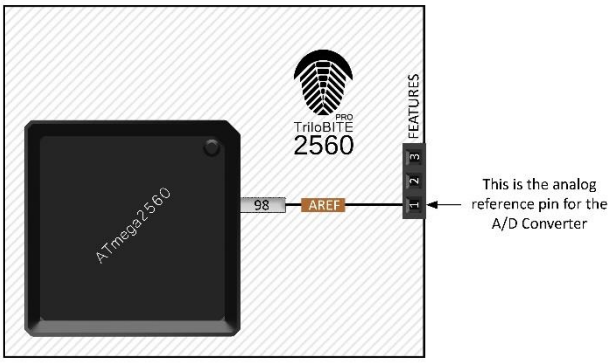


10. FEATURES CONNECTOR

10.1 AREF CONNECTION

This is the analog reference pin for the microcontroller A/D converter. Details of how AREF and A/D workare described in the ATmega2560 datasheet.

Figure 10.1.1 AREF connection

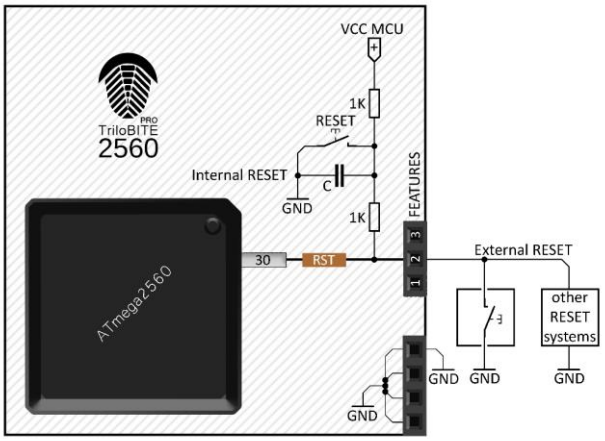


10.2 INTERNAL AND EXTERNAL RESET

After connecting the TriloBITE 2560 PRO to the power supply, the MCU is automatically restarted using the internal RESET system.

Pin 2 of the FEATURES connector is used to connect an external RESET system. The pin is connected to the built-in RESET button and the internal RESET system via a pull-up resistor to maintain a higher priority for the external RESET. The integrated RESET button and the internal RESET system are disabled if GND or VCC MCU is connected to the external RESET pin. This pin allows the connection of a power supervisor, for example.

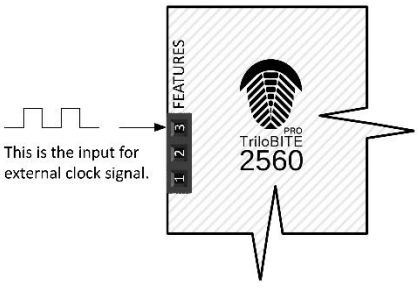
Figure 10.2.1 External RESET connection



10.3 EXTERNAL CLOCK SIGNAL CONNECTION

This pin allows the connection of an external clock signal to control the ATmega2560 microcontroller. Jumper configuration on the PCB is required for control by an external clock signal.
For more information, see section **11. INTERNAL AND EXTERNAL CLOCK** on page 17.

Figure 10.3.1 Connecting an external clock signal



11. INTERNAL AND EXTERNAL CLOCKS

Before using the microcontroller, an internal replaceable crystal or an external clock must be configured as the clock signal source.

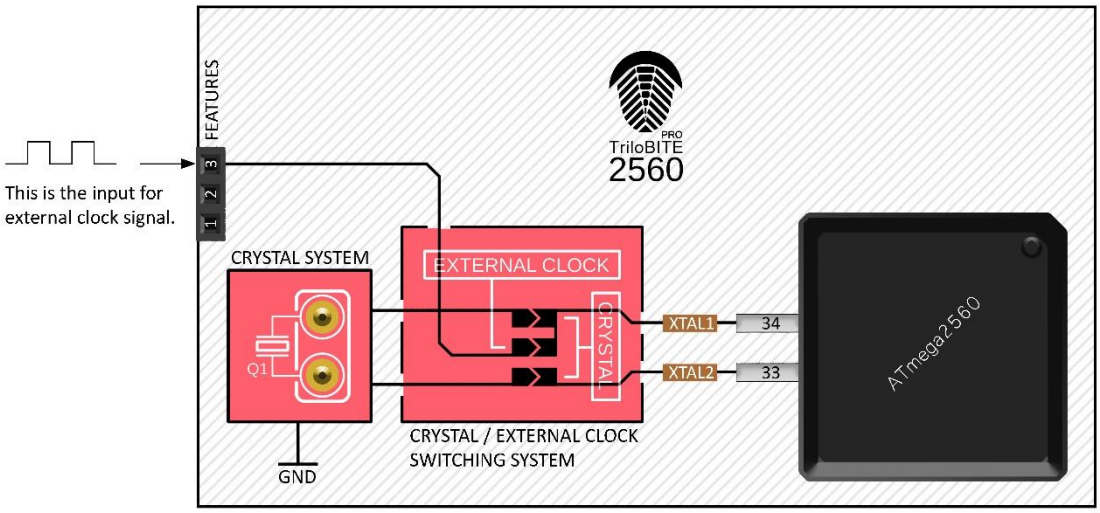
11.1 INTERNAL CLOCK

To use the internal clock[1)], select the crystal value, set the microcontroller fuses as show in datasheet ATmega2560, and connect the „CRYSTAL“ jumpers. In this mode, the „EXTERNAL CLOCK“ jumper should be disconnected.

11.2 EXTERNAL CLOCK

To use an external clock signal, it is necessary to connect the "EXTERNAL CLOCK" jumper and configure the microcontroller fuses as specified in the datasheet ATmega2560. The external clock signal is fed to the "FEATURES" connector pin 3. Before using the external clock signal, the internal crystal[1)] must be disconnected from the microcontroller by disconnecting the "CRYSTAL" jumpers.

Figure 11.3 Internal and external interface

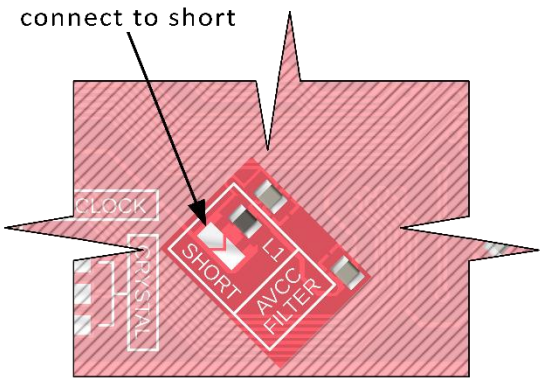


Note:
1) The internal clock (crystal) is to be understood as a crystal connected to a resonant circuit. When using an external clock, it is not enough to pull the crystal out of the cavities, as this will not disconnect the entire resonant circuit from the microcontroller. The resonant circuit must be disconnected from the microcontroller by disconnecting the "CRYSTAL" jumpers.

12. AVCC FILTER (LOW-PASS FILTER)

AVCC FILTER is a low-pass filter intended for powering an A/D converter. In the case of PORT-F power supply without an A/D converter, it is recommended to exclude the AVCC FILTER from the function by connecting the "SHORT" jumper. The details of the use of the "low-pass filter" are specified datasheet ATmega2560.

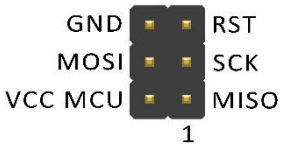
Figure 12.1 AVCC FILTER



13. ICSP CONNECTOR

The ICSP connector interface (In Circuit Serial Programming) allows programming of the ATmega2560 microcontroller. The ICSP connector has improved power and protection circuits. Thanks to this, the TriloBITE 2560 PRO can be permanently powered via the ICSP as well as via the "VCC MCU" connector (1.8-5.5VDC).

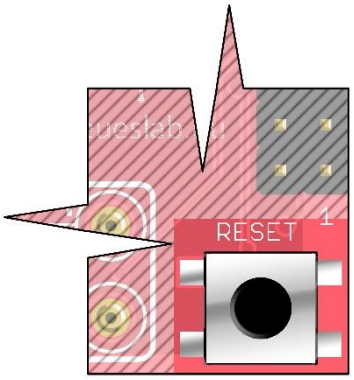
Figure 13.1 Connecting the ICSP connector



14. RESET BUTTON

Pressing the RESET button restarts the microcontroller. If an external RESET system is connected via the FEATURES connector, the external reset has a higher priority (see section **10.2 INTERNAL AND EXTERNAL RESET** on page 16).

Figure 14.1 RESET button

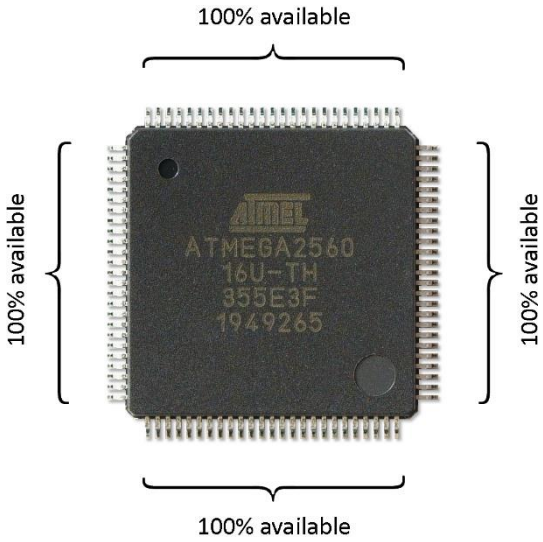


15. ATmega2560 MICROCONTROLLER

The TriloBITE 2560 PRO development board is equipped with an ATmega2560 microcontroller. The placed ATmega2560 microcontroller can be used without restrictions, as defined by the datasheet ATmega2560.

15.1 Some advantages and possibilities of use

- Power supply from 1.8VDC to 5.5VDC and from 6.5VDC to 20VDC.
- Speed 0-16MHz.
- 100% availability of all ports.
- All MCU functions and features available.
- The microcontroller can be disconnected from internal sources and work with energy možné odpojiť od interných zdrojov a pracovať s režimami úspory energie (Ultra-Low Power Consumption).
- Using all sleep modes, without affecting the surrounding systems for total energy consumption (in case of disconnection of internal power supplies).
- Possibility to use a built-in low-pass filter or simply exclude it from the function.
- Full use of the RESET input.



16. COOLING OF LDO POWER SUPPLIES

Cooling of LDO sources is provided by two cooling surfaces - FIGURES **16.1** and **16.2**. The cooling of LDO power supplies can be improved by adding two galvanically separated cooling profiles in places of cooling surfaces. The cooling surfaces are electrically connected to LDO power supplies, therefore it is necessary to ensure their sufficient isolation from the environment (for example from metal chassis, or from electronics).

Figure 16.1 Cooling LDO power supplies - top view

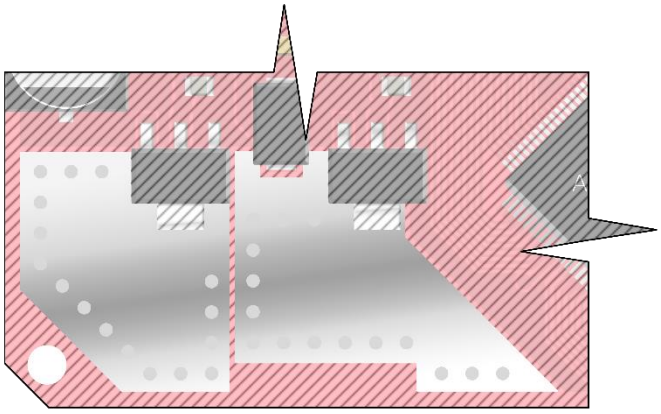
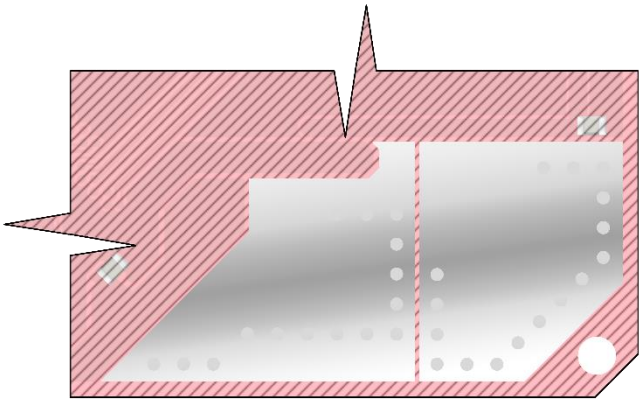


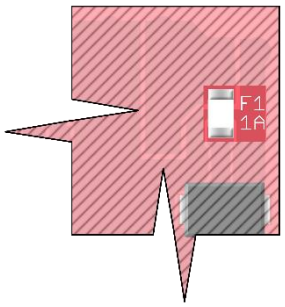
Figure 16.2 Cooling LDO power supplies - bottom view



Note:
In order to guarantee the long life of the PCB, it is necessary not to exceed the maximum allowed temperature of 70°C.

17. FUSE F1

Figure 17.1 Fuse F1



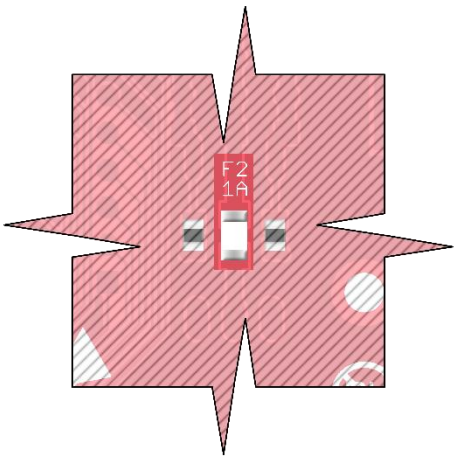
Fuse F1 serves as protection of the "Power input 6.5-20.0VDC" input. Remelting occurs in the event of overload, short circuit, overvoltage, or polarity reversal of the input terminals.

Table 17.2 Fuse parameters F1

PARAMETER	VALUE	UNIT
Permanent load	1	A
Maximum input voltage	20.0	VDC
Remelting speed	slow	

18. FUSE F2

Figure 18.1 Fuse F2



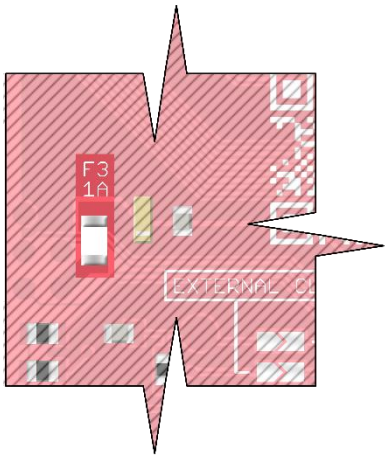
Fuse F2 serves to protect the MCU power input from an external 1.8-5.5VDC power supply via the "VCC MCU" connector. Remelting occurs in the event of overload, short circuit, overvoltage, or polarity reversal of the input terminals.

Table 18.2 Fuse parameters F2

PARAMETER	VALUE	UNIT
Permanent load	1	A
Maximum input voltage	5.5	VDC
Remelting speed	slow	

19. FUSE F3

Figure 19.1 Fuse F3



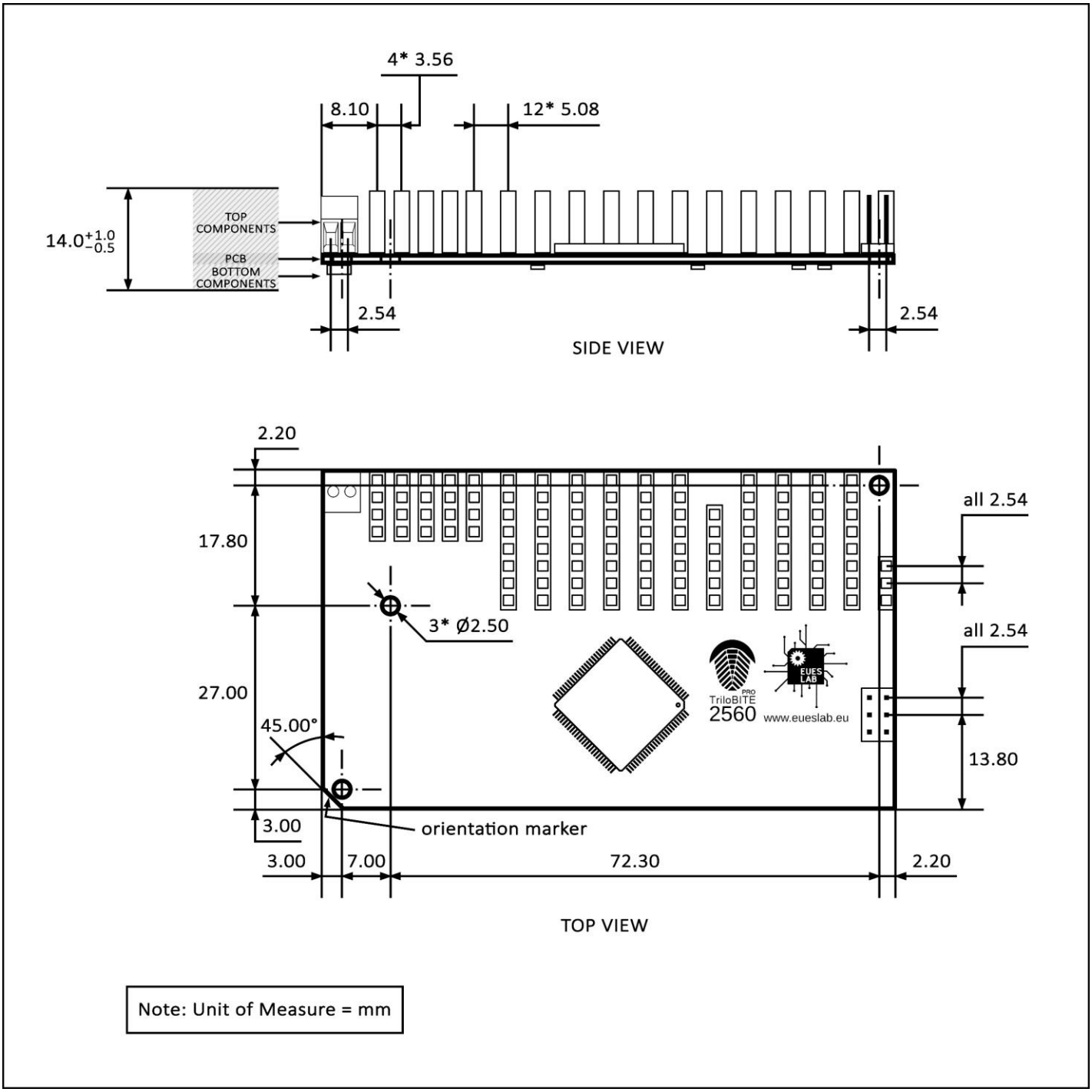
Fuse F3 serves to protect the MCU power input from an external 1.8-5.5VDC power supply via the ICSP connector. Remelting occurs in the event of overload, short circuit, overvoltage, or polarity reversal of the input terminals.

Table 19.2 Fuse parameters F3

PARAMETER	VALUE	UNIT
Permanent load	1	A
Maximum input voltage	5.5	VDC
Remelting speed	slow	

20. MECHANICAL DIMENSION

Drawing 20.1 Mechanical dimension



21. ABOUT THIS DOCUMENT

This document describes the TriloBITE 2560 PRO microcomputer data, but in some cases is based on third party data. To use the ATmega2560 microcontroller, it is necessary to use the data provided by the microcontroller manufacturer.
- for example, datasheet ATmega2560.

22. ERRATA

26032024 - Page 18 - 12. AVCC FILTER (LOW-PASS FILTER) - The translation of the entire section into English was missing.
27032024 - Page 6 - 1.1 FEATURES – The translation of the entire section into English was missing.

23. DATASHEET REVISION HISTORY

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24. PRODUCT SAFETY

Failure to follow the application recommendations in this manual may result in a safety hazard.

24.1 WARNING

If this device is used for potentially dangerous voltage, for example a life-threatening potential is applied to its terminals, it is recommended to use a warning label.

24.2 Safety Precautions

The device contains various components such as electrolytic capacitors, semiconductors, plastic and metal components, solder, and other types of materials. Improper use and non-compliance with the application recommendations in this manual may result in gas release or fire. It is therefore necessary to take precautionary measures under the EHS.

24.3 Non - operational

The device should not be used in an environment of high cold, or high temperatures, high pressure, high mechanical stress, or high gravitational acceleration - such as torque.

24.4 Dangerous use

Most failures are passive in nature and do not pose a safety risk. However, if this fault occurs, a dangerous fault may occur in the equipment in which the equipment is used. Therefore, circuits should be designed to prevent possible failure, or to avoid risks in the event of equipment failure - such as redundancy.

24.5 Assembly

Installation should be done to ensure adequate ventilation and cooling. The device should be used in an environment with sufficient insulation strength to prevent electrical leakage, short circuits and high voltage jumps.

24.6 Fumigation

In many countries around the world, it is common practice to fumigate shipments to control insect infestation, especially if wooden and cardboard packaging is used. Some fumigants can penetrate the packaging through seals and contaminate the product or its components. In this case, corrosion of components or some of their internal parts may occur. The level of damage depends on the magnitude of exposure to such a substance, the operating temperature, or the magnitude of the voltage during operation. It can take months or years for the failure to occur.

24.7 Contact of the device with a chemical substance

The device may only be used in a clean environment to prevent unwanted or hazardous chemical reactions that could cause corrosion, electrical leakage, electrical short circuit, temperature rise, fire, explosion, or other type of destructive reaction.

25. RoHS AND SPECIFICATIONS OF MATERIALS USED

The device is constructed of components that meet RoHS specifications.
A list of all materials used in the product is available on request from EUES LAB.

26. DISCLAIMER

All product specifications, statements, information and data (collectively, the "Information") in this datasheet are subject to change. The customer is responsible for checking and verifying the extent to which the Information contained in this publication is applicable to an order at the time the order is placed.

Statements of suitability for certain applications are based on EUES LAB knowledge of typical operating conditions for such applications, but are not intended to constitute – and EUES LAB specifically disclaims – any warranty concerning suitability for a specific customer application or use. The Information is intended for use only by customers who have the requisite experience and capability to determine the correct products for their application. Any technical advice inferred from this Information or otherwise provided by EUES LAB with reference to the use of EUES LAB's products is given gratis, and EUES LAB assumes no obligation or liability for the advice given or results obtained.

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Although all product–related warnings, cautions and notes must be observed, the customer should not assume that all safety measures are indicted or that other measures may not be required.

27. SAFETY-CRITICAL, MILITARY, AND AUTOMOTIVE APPLICATIONS DISCLAIMER

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28. COPYRIGHT

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29. CONTACT

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