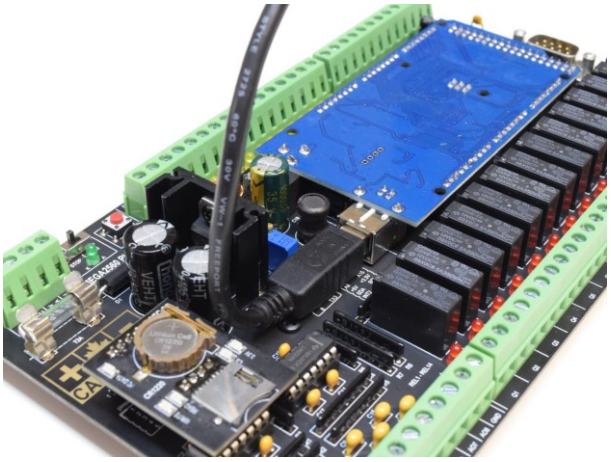
EAN 4260474039951
June 6, 2019
Document version 0.91 preliminary

CANADUINO MEGA2560 300-24 DIY PLC Kit V1.3



This Kit offers a very affordable opportunity to add a programmable logic controller to many kinds of projects and machines like lighting, HVAC, greenhouses, water treatment or smoke houses. It can help you control your Halloween decoration or your manufacturing equipment.

CANADUINO MEGA2560 300-24 PLC is based on an Arduino MEGA2560 module and can be programmed using Arduino IDE or other tools like visual programming with block diagrams or "ladder". We recommend Mitov's "Visuino" visual programming tool.

CANADUINO MEGA2560 300-24 PLC fits a very small budget but delivers power and versatility equal to 10x more expensive professional control devices.

MEGA2560 300-24 PLC basic features:

- ✓ 8 analog 0-10V inputs (10mV res.)
- ✓ 8 analog inputs or GPIO (TTL level)
- ✓ 8 analog 0-10V outputs (2.5mV res.)
- ✓ 2 interrupt inputs
- ✓ 16 digital 3.3-24V inputs
- ✓ 14 digital 250V/5A relay outputs
- ✓ I2C and SPI bus for extensions

INTRODUCTION

MEGA2560 300-24 PLC is a Do-It-Yourself kit comprising only through-hole parts with a pin pitch of typically 2.5mm or more and is easy to build using basic electronic tools.

There are 16 opto-isolated digital inputs, typically recognizing any voltage 3.3V to 24V DC as HIGH level. This of course depends on the CTR of the opto-isolators and can be differ. The ones we ship with the kit have a typical CTR of 50-200 but can be replaced by a different type, for example with CTR of 400-800, to make the inputs work already with a voltage as low as about 2.5V.

The 14 digital outputs are fast acting relays OMRON G5NB-1A-E with about 10ms operate and release time, and high-capacity contacts. The maximum load can be 5A @ 250VAC or 30VDC.

Analog inputs and outputs are designed for 0-10V operation, typically used for light dimmers or motor drivers, for example.

Several 10V output terminals are available to deliver 10V level for example to a potentiometer, to generate the analog input signal. The 10V level is adjustable in a range of about 9-11V and is also used to drive the output relays. The 10V supply outputs in the analog input section are over current protected (trip point 200mA) by a self-resetting fuse.

Analog inputs and outputs are not electrically isolated. The output impedance of the ports in the analog input section is about 1k which limits the short circuit current to 10mA, while the inputs are protected against voltage of up to about 28V. Due to the filtered PWM outputs of the ATmega2560, the analog outputs show a ripple of up to 50mV, depending on the output voltage. This can be ignored when controlling lighting dimmers or electric motors. The 8 additional analog inputs on the AUX connector (2x8 pin header) are straight connected to the ATmega2560 MCU and do not have any kind of additional protection. These pins can also be defined as standard GPIO ports, if auxiliary TTL level digital ports are needed.

I2C and SPI bus are exposed to take the optional RTC and micro-SD module, or to connect other devices. There are no pull-up resistors for the I2C bus on board; please make sure your external device has these resistors assembled. The signal used for I2C and SPI are direct connections to the controller board, and do not have additional protection.

Optional are 2 serial ports RS232 available, to connect with machines, frequency motor drives, computers or HMI devices, for example. This option features a MAX233 IC and a 9-pin male D-Sub port. Port COM2 is available on pins 2 and 3, while COM3 is available on pins 7 and 8.

The auxiliary connector right beside the RS232 ports with its 8 additional analog inputs, 5V and 3.3V supply voltage and I2C bus, can perfectly be used to connect any kind of graphic or character display, like for example UNIVERSAL-SOLDER's 1602 (2x16) or 2004 (4x20) character displays, or 128x64 graphic display, due to the fact that these 8 ports can become GPIO by declaration in your Arduino sketch.

The PLC board can operate in supply voltage limits of 9-24VAC or 12V-35VDC, but we recommend a voltage of 12-24V (AC or DC) to guarantee flawless operation. The first step of the on-board power supply is a switching step-down regulator to provide a voltage of about 12V with an output current capacity of 3A to operate the relays, to generate the 10V level for the analog section, and to provide the input voltage for the second stage, a STM L7805CV 5V / 1.5A linear voltage regulator. The decision to use a linear voltage converter instead of a switching type was based on the much lower cost for the 7805. A fuse with a breaking capacity of 2A(T) is an additional protection for the voltage regulators, besides their short circuit, over current and/or over voltage protections.

The kit comes with sturdy screw terminals with rising cage clamp contacts, to insure best connectivity to solid and flex wires 22-12AWG. Holes in all 4 corners and 2 more in the middle of the board can take 3mm standoffs or spacers for mounting the PLC on any surface you want.

A DIN rail mount (tray) with outer dimensions of 212 x 128mm is available as option and snaps on standard 35mm DIN rails.

ASSEMBLING

Assembling this kit is no challenge. We expect you have some soldering experience, before you start a project in this size, and of course basic knowledge in analog and digital electronics, to proceed with commissioning and troubleshooting after assembling. To support your work and to make some steps easier to understand, please see the pictures on UNIVERSAL-SOLDER.com

Please follow these steps for a flawless and easy assembling experience:

1. Start with the lowest profile parts, which are the 3 resistors R9, R10, R18

2. Proceed with the next thicker parts, which are the 100nF capacitors C2, 3, 6, 7, 10, 11, 16, 17 and 2.2µF capacitors C1, 4, 5, 8, 9, 12, 15, 18.

3. Now install all the resistor networks and arrays. There are 19 of them on board. Please refer to the schematic and make sure to install the right part in every position. The dot on the resistor marks pin 1. All pins #1 have a square on the silk screen. Markings:
   R1, R4 = B223
   R2, R5 = B561
   R3, R6 = A223
   R7, R8 = B103
   R19, R20, R22, R23 = B273
   R13, R16 = A102
   B15, B17 = A392
   R14, R21 = A272
   R12 = B223

   Hint: *Attach the resistor arrays only on 1 pin in the middle, then align them nicely with low force, before you solder all the other pins.*

4. The IC sockets have about the same height as the resistor arrays and should be assembled next. There are 2 x DIP14, 6 x DIP16 and 1 x DIP20 to assemble. Make sure lining up the notch in the sockets with the printed notch on the silk screen.

   Hint: *Attach the sockets first on 2 diagonal pins, then make sure they are all flat on the PCB and not "flying", and correct if necessary, before you solder all the other pins.*

5. Now the LEDs. We marked [A] and [K] on one of the LEDs in every group, also on the RUN LED. The long lead on LEDs is anode [A].
   Insert 16 yellow LEDs for the inputs (D4, 5, 7, 8, 10, 11, 13, 14, 16, 17, 19, 20, 22, 23, 25, 26), one green LED for RUN (D2 has no name on the silk screen) and 14 red LEDs for the outputs (D6, 9, 12, 15, 18, 21, 24, 27-33).

   Hint: *First attach only 1 lead of every LED, then make sure they sit all nicely upright and down to the PCB, before you solder all the other pins.*

6. Time for the headers. Please install all headers, for the Arduino, the optional RTC.SD module, and the auxiliary 2x8 connector.

   Hint: *Like above. For the Arduino headers it is a lot easier when you solder them with the Arduino board already attached, to keep the headers perfectly in place.*

7. Proceed with the remaining parts, starting with the smaller parts like the RUN switch, inductivities, diodes, trim pot, fuse clips and the 3 small electrolytic capacitors. Watch the polarity of the capacitors!! [+] is marked on the PCB, but [-] typically on the capacitors.

   Hint: *Solder the fuse clips with a fuse inserted – it's a lot easier.*

8. Next taller parts are the terminal connectors. You will easily find out how to make them all happen by interlocking the available 2 and 3 pole modules. Then assemble the relays.

9. Now you can assemble all remaining parts (3 big capacitors – watch polarity, 2 voltage regulators and the heat sink). It can be necessary to bend the leads of the switching voltage regulator (TO-220 5-pin package) depending on the type in your kit. Please refer to the pictures, how to bend its leads. It is recommended to assemble the heat sink with the 2 ICs before adding these parts to the PCB but tighten the screw only after all soldering on these parts is done.

COMMISSIONING

Without anything connected to the board, without the ICs in the sockets, without RTC.SD module and without Arduino board, apply a current limited (30-40mA) voltage of 12-24VDC to GND and IN 12-24V terminal and if there is no short, check the 5V on the IC sockets and the about 10V on the 10V terminals within the analog input section. If this seems to be okay and you measure the 5V and the about 10V, you can insert the ICs in the sockets. Make sure the notch or dot marking pin1 lines up with the socket and the printed notch on the silk screen.

Check again just as you did before. The current at 12V should be about 30mA, and only about 20mA with 24V. This is a sign that the switching regulator works as expected.

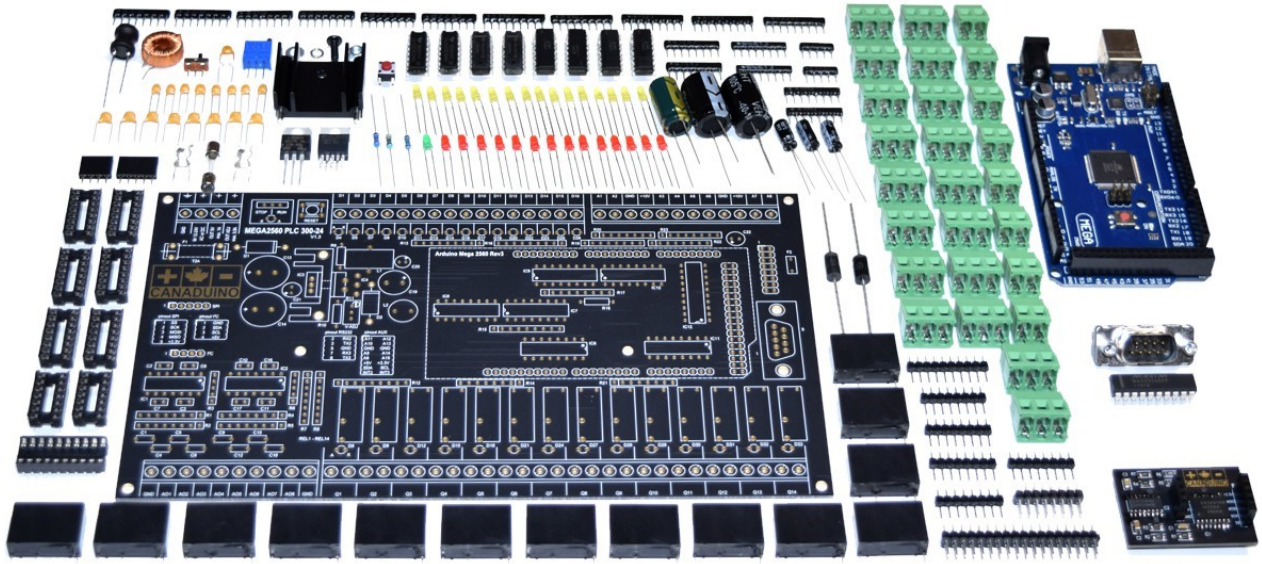
Measure the voltage to GND on every of the Arduino header pins to make sure there is no solder bridge shortening one of the Arduino inputs, outputs or power supply pins to a higher voltage like the 10V rail. The current together with an Arduino MEGA2560 should be about 150mA (24V) to 250mA (12V).

Congratulation! Looks like it works. We recommend you check every input and the analog outputs with a voltmeter, to confirm the expected voltage levels. Connect every input D1 - D16 with a jumper wire to either the 5V or 10V supply output and see if the corresponding input LED will light up.

Any other tests require programming and will not be part of this manual. Please check UNIVERSAL-SOLDER.com website for code samples, tutorials and trouble shooting advice (will be added successively).

ORDER INFORMATION

Basic PLC kit:	EAN 4260474039951
2 x RS232 kit:	EAN 4260474034154
DIN rail kit:	EAN 4260474033997
RTC.SD module:	EAN 4260474034413



DIY Kit with all included parts and the options MEGA2560 module, RTC.SD module and 2 x RS232 ports shown.