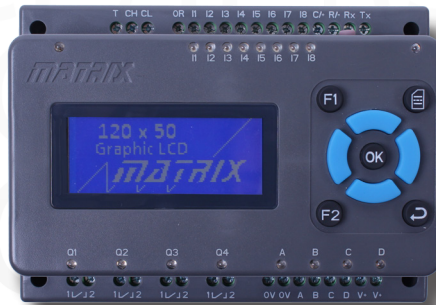







# MIAC



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-  - PIC MIAC
-  - Arduino compatible MIAC
-  - dsPIC MIAC
-  - Raspberry Pi compatible MIAC
-  - AllCode compatible MIAC



# About this document

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This document concerns the various versions of the MIAC (Matrix Industrial Automotive Controller).

## 1. Trademarks and copyright

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## 3. Information and technical support

The latest software updates, FAQs and other information can be found on our **website** and **forums**.

# General information

---

The MIAC is a fully specified industrial electronic controller designed to operate with typical industrial control voltages: 0 -10V inputs, up to 24V motor outputs, 240V switching relays.

The MIAC range has 8 analogue or digital inputs, 4 high current relay outputs and 4 solid state outputs. Other interfaces include a fully operational CAN bus interface so that many MIACs can be networked together to form wide area electronic systems. The CAN bus parameters are adjustable, so as to interface to existing networks. Several of the range also feature RS232 and RS485 serial communication interfaces.

Additionally, a Flowcode "MIAC system" allows users without CAN programming experience to rapidly set up complex CAN networked systems using MIAC plus additional add-on modules.

The MIAC is housed in an attractive rugged, anthracite grey plastic moulding. It has two physical mounting options: it can be mounted onto a 35mm 'top hat' DIN rail, or it can be mounted directly onto any surface using the 4 screw holes provided.

The MIAC unit has screw terminal connectors across the top and bottom of the unit, a keypad and display for user control.

MIAC is available in a range of processor platforms to enable use in differing development environments and toolchains, in addition to Flowcode.

# Versions overview



MI0235 PIC PIC18F4550 processor module

## PIC MIAC



- Keypad (9 keys)
- Eight 10 bit 0-12v Analogue inputs
- Four relay outputs (8A 240V)
- 12 to 16 VDC operating voltage
- 4 line by 16 character LCD display
- Four solid state high current drivers (1.75A total)
- CAN interface
- Application development and simulation with Flowcode IDE
- Application development with C and Assembler



MI5466 AVR ATmega1281 processor module

## Arduino compatible MIAC



- Keypad (9 keys)
- Eight 10 bit 0-12v Analogue inputs
- Four relay outputs (8A 240V)
- 9 to 24 VDC operating voltage
- 5 line by 20 character graphic display with backlight illumination
- Four solid state high current drivers (5.6A total)
- Real Time Clock with super-capacitive backup
- Internal microSD card slot
- Serial communications: RS232, RS485 and CAN
- Application development and simulation with Flowcode V7 IDE
- Application development with Arduino IDE
- Versions with additional internal communication module:
  - MI3449 Bluetooth 2.1
  - MI9335 WiFi



MI5809 dsPIC  
dsPIC33EP256MU806 16 bit  
processor module

## dsPIC MIAC



- Keypad (9 keys)
- Eight 10 bit 0-12v Analogue inputs
- Four relay outputs (8A 240V)
- 9 to 24 VDC operating voltage
- 5 line by 20 character graphic display with backlight illumination
- Four solid state high current drivers (5.6A total)
- Real Time Clock with super-capacitive backup
- Internal microSD card slot
- Serial communications: RS232, RS485 and CAN
- Application development and simulation with Flowcode V7 IDE
- Versions with additional internal communication module:
  - MI8759 Bluetooth 2.1
  - MI8615 WiFi

# Versions overview



MI5769 Raspberry Pi compute processor module

## Raspberry Pi compatible MIAC

- Keypad (9 keys)
- Eight 10 bit 0-12v Analogue inputs
- Four relay outputs (8A 240V)
- 9 to 24 VDC operating voltage
- 5 line by 20 character graphic display with backlight illumination
- Four solid state high current drivers (5.6A total)
- Real Time Clock with super-capacitive backup
- Internal microSD card slot
- Serial communications: RS232, RS485 and CAN
- Raspian/Debian RTOS
- Remote online access development
- Cross-compiler development
- MIAC specific interface Kernel modules
- WiFi fitted internally as standard
- Version with additional internal communication module:
  - MI6693 Bluetooth 2.1



MI5331 AllCode dsPIC33EP256MU806 16 bit processor module

## AllCode compatible MIAC

- Keypad (9 keys)
- Eight 10 bit 0-12v Analogue inputs
- Four relay outputs (8A 240V)
- 9 to 24 VDC operating voltage
- 5 line by 20 character graphic display with backlight illumination
- Four solid state high current drivers (5.6A total)
- Real Time Clock with super-capacitive backup
- Internal microSD card slot
- Serial communications: RS232, RS485 and CAN
- API based operation for control from any host system
- Versions with additional internal communication module:
  - MI5528 Bluetooth
  - MI5331 WiFi

| Processor | Product Code | Arduino Compatible | dsPIC Module | RPi Module | WiFi Module | Bluetooth Module | WiFi USB Dongle |
|-----------|--------------|--------------------|--------------|------------|-------------|------------------|-----------------|
| Arduino   | MI5466       | ✓                  |              |            |             |                  |                 |
|           | MI9335       | ✓                  |              |            | ✓           |                  |                 |
|           | MI3449       | ✓                  |              |            |             | ✓                |                 |
| dsPIC     | MI5809       |                    | ✓            |            |             |                  |                 |
|           | MI8615       |                    | ✓            |            | ✓           |                  |                 |
|           | MI8759       |                    | ✓            |            |             | ✓                |                 |
| RPi       | MI5769       |                    |              | ✓          |             |                  | ✓               |
|           | MI6693       |                    |              | ✓          |             | ✓                | ✓               |
| AllCode   | MI3932       |                    | ✓            |            |             |                  |                 |
|           | MI5331       |                    | ✓            |            | ✓           |                  |                 |
|           | MI5528       |                    | ✓            |            |             | ✓                |                 |

# MIAC add-on modules

MIAC is compatible with a range of add-on expansion modules which bring advanced wired and wireless communications technology to CAN based MIAC systems. The Flowcode design environment takes care of low level CAN bus communications allowing seamless expansion for most modern communication protocols at a chip and system level.

The following is a summary of the functionality of the MIAC Addon range.

## Basic Expansion Module

This module allows users to interface with MIAC technology to conventional TTL level systems. The unit includes a number of I/O lines including PWM outputs for motor control. 12 bit ADC inputs for precision analogue work, 2 x PWM outputs for motor control.

- 18 x TTL level I/O pins
- 2 x PWM outputs
- 5 x ADC inputs



MI1493

## Advanced Expansion Module

This module allows users to interface with MIAC technology to conventional TTL level systems, and also includes other expansion features. The unit includes a number of I/O lines including PWM outputs, 12 bit ADC inputs, 2 x PWM outputs, several TTL level serial buses and 2 x 12 bit DAC outputs. The unit also has interfaces for two external lab sensors and a real time clock.

- 16 x TTL level I/O pins
- Real time clock
- SPI bus, I<sup>2</sup>C bus, TTL level serial bus
- 2 x external sensor inputs
- 2 x DAC outputs, 2 x PWM outputs, 5 x ADC inputs



MI3486

## Serial Expansion Module

This module is designed to allow users to interface MIAC technology to conventional TTL level systems and to allow users access to commonly used serial buses. The unit includes RS232 bus interfaces as well as TTL level serial buses (SPI, I<sup>2</sup>C and USART). The unit also includes a number of TTL level I/O lines and a FAT16/32 compatible SD card for data storage.

- 18 x TTL level I/O pins
- 2 x PWM outputs, 5 x ADC inputs
- SPI bus, I<sup>2</sup>C bus, TTL level serial bus
- RS232 interface
- SD card socket



MI8447

## Industrial Comms. Module

This module includes interfaces for RS485 communications and TCP/IP communications. Connection to RS485 is via screw terminals. TCP/IP connection is available on a standard CAT5 socket. The module is fitted with a CAN bus interface and also allows access to several 5V microcontroller I/O lines.

- 4 x TTL level I/O pins
- 2 x ADC inputs
- RS485 interface
- Ethernet interface



MI4823

## ZigBee Expansion Module

Two versions of the ZigBee Expansion Module are available: ZigBee coordinator and ZigBee router. Each contains a wireless ZigBee control module and access to several TTL level microcontroller I/O lines.

- 6 x TTL level I/O pins
- 4 x ADC inputs
- ZigBee interface (either coordinator or router/end node)
- Built-in antenna



MI3842C/R

## Bluetooth Expansion Module

This module adds Bluetooth functionality to a MIAC system. The class 1 Bluetooth module has a transmit power of 6dBm which should give a 100 yard transmission range at a data transfer rate of 100Kbps. The unit also includes several TTL level I/O lines.

- 6 x TTL level I/O pins
- 4 x ADC inputs
- Bluetooth transceiver
- Built-in antenna



MI4855

## GPS Expansion Module

This module includes a highly sensitive, fast access time Global Positioning System receiver which allows developers to build systems that can identify their own location. A high sensitivity antenna is included in the expansion module. The unit also includes a FAT16 compatible SD card interface and several TTL level I/O lines.

- 6 x TTL level I/O pins
- 4 x ADC inputs
- GPS receiver
- Built-in antenna
- SD card socket



MI8582

## GSM Expansion Module

This module is fitted with a quad band GSM unit which can be used for voice and data transmission. A highly sensitive internal antenna optimises the range of the module. The front of the unit is fitted with 3.5mm jack sockets for a standard hands-free adaptor and a SIM card socket. The unit also includes several TTL level I/O lines.

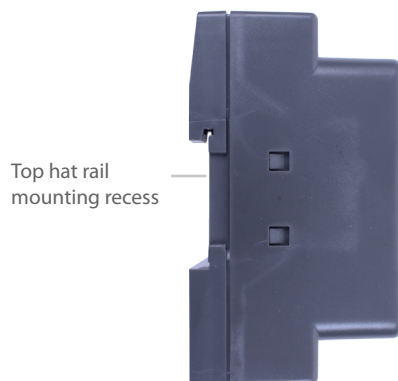
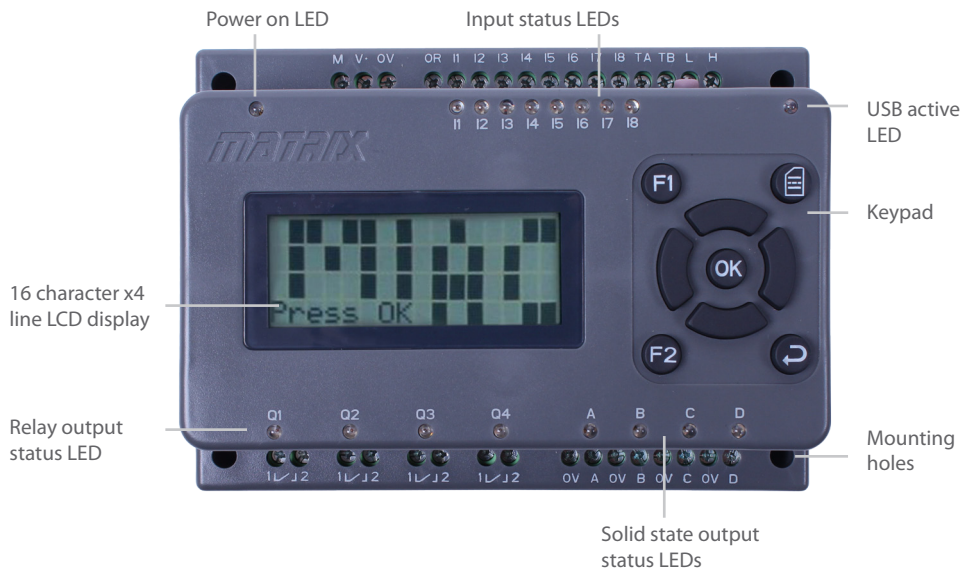
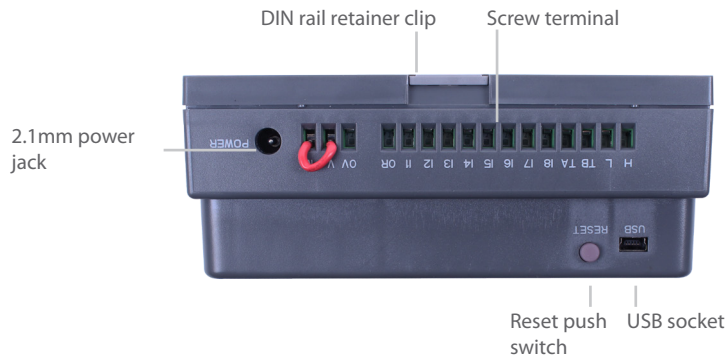
- 6 x TTL level I/O pins
- 4 x ADC inputs
- Quad band GSM transceiver
- SIM card slot
- Built-in antenna



MI4897

# Hardware overview

MI0235 (PIC ) version only.



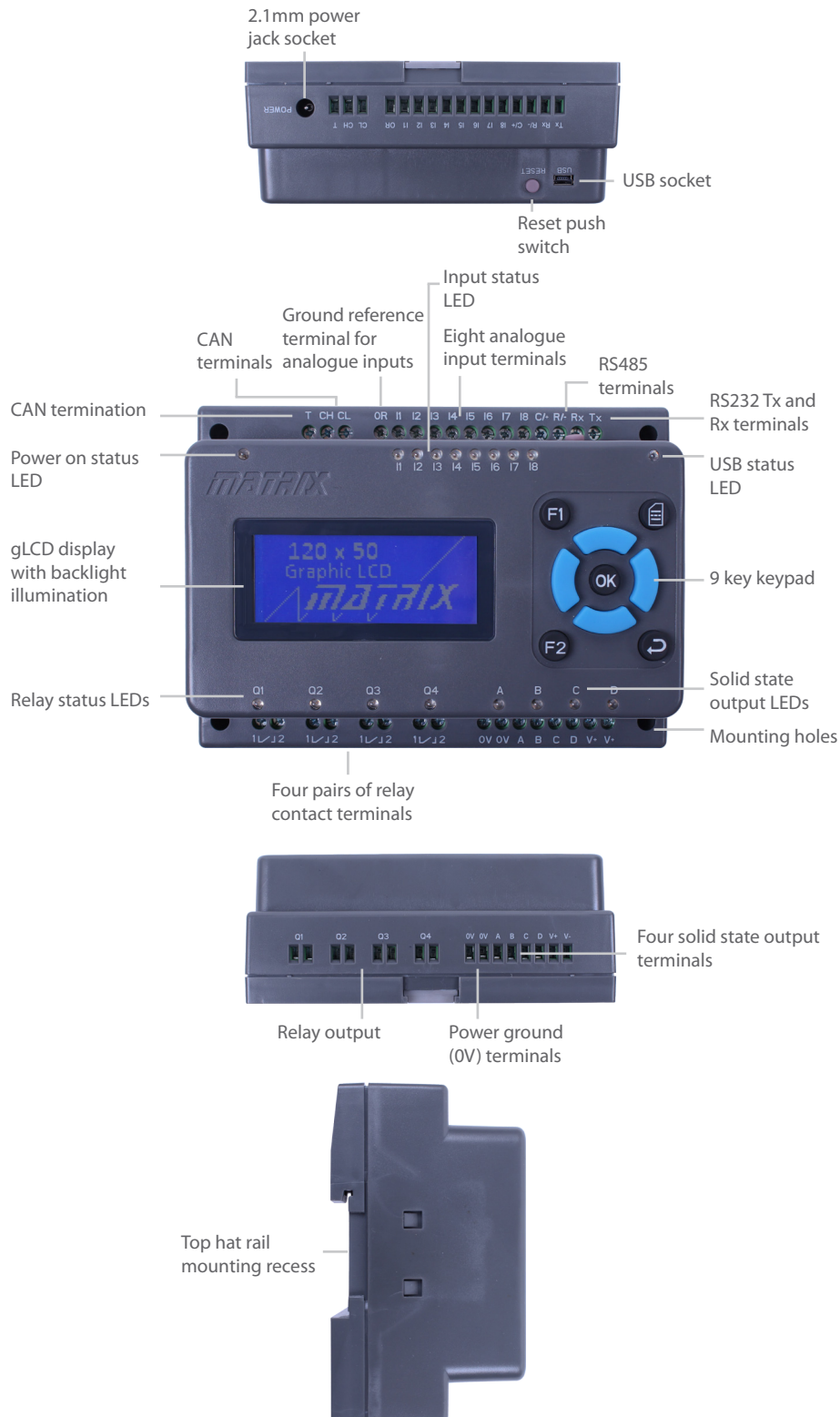
# Hardware overview



This page applies to processor module based MIAC versions:

- MI5466, MI9335, MI3449 (ATmega)
- MI5809, MI8615, MI8759, MI5331 (dsPIC)
- MI5769, MI6693 (Raspberry Pi)

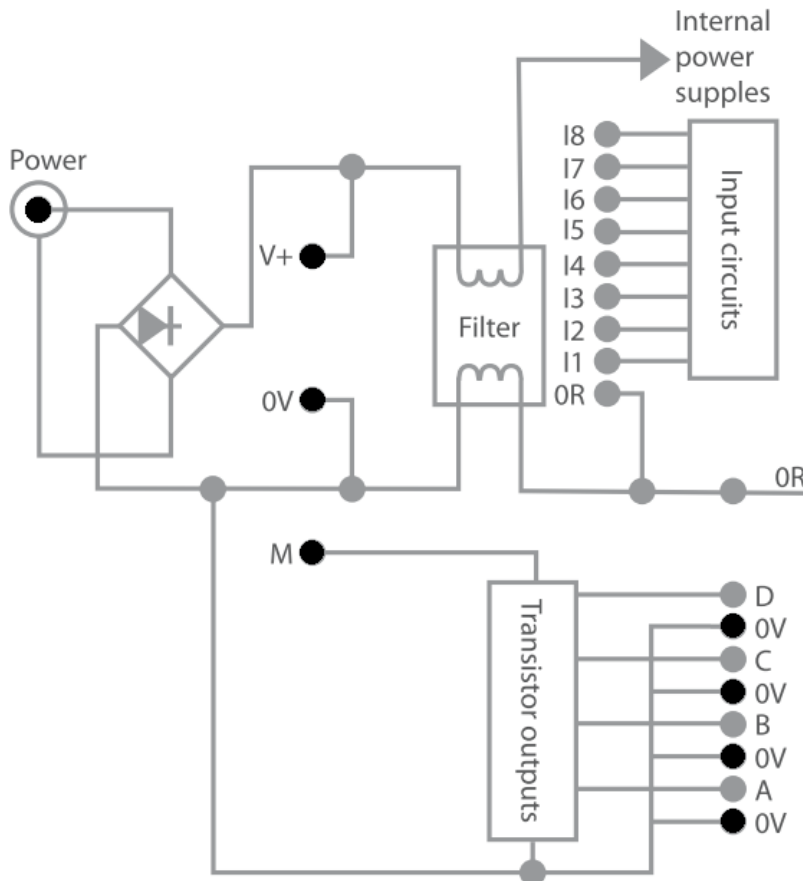
It does not apply to the MI0235 (PIC) version





# Power supply

This page applies only to the MIAC MI0235 (PIC) version.



The MI0235 8 bit PIC MIAC can be powered with a DC supply voltage in the range 12V to 16V DC. The power can be supplied via the 2.1mm power jack (Power), or the power supply terminals (V+, 0V).

The power jack is fed into a bridge circuit and can therefore accept plugs wired with either connection polarity.

The OR terminal is the common voltage for the internal logic circuits and is connected to the 0V terminals via the filter.

The transistor outputs are not powered internally. The M terminal is used to apply power to the transistors which allows a voltage other than the supply voltage to be used on the transistor outputs.

The maximum value of M is nominally 12V DC but up to 28V DC can be used depending on the ambient temperature. The transistor outputs are supplied by a single L298 device and can supply up to 500mA each and 1.75A in total. Transistor outputs can be connected in parallel if more power is needed from an output.

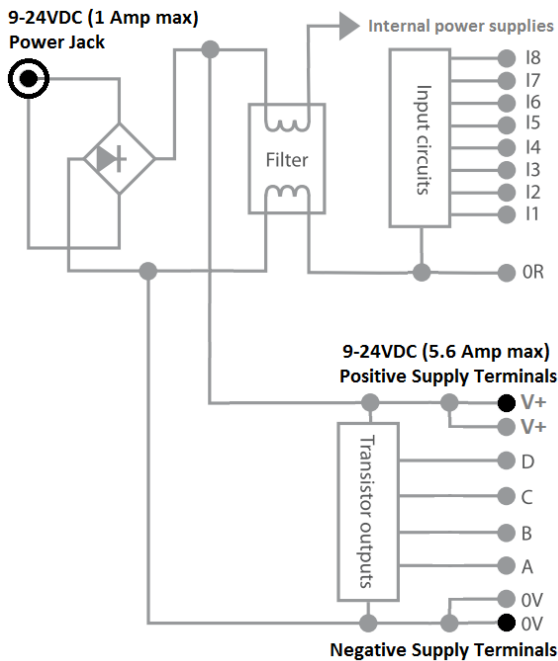
If you wish to power the transistors from the same supply as the supply voltage then simply use a shorting link between the V+ and the M terminals.

# Power supply

This page applies to processor module based MIAC versions:

- MI5466, MI9335, MI3449 (ATmega)
- MI5809, MI8615, MI8759, MI5331 (dsPIC)
- MI5769, MI6693 (Raspberry Pi)

It does not apply to the MI0235 (PIC) version



These MIAC versions can be powered with a DC supply voltage in the range 9V to 24V DC.

The recommended power supply connection is via the terminals marked V+ and 0V.

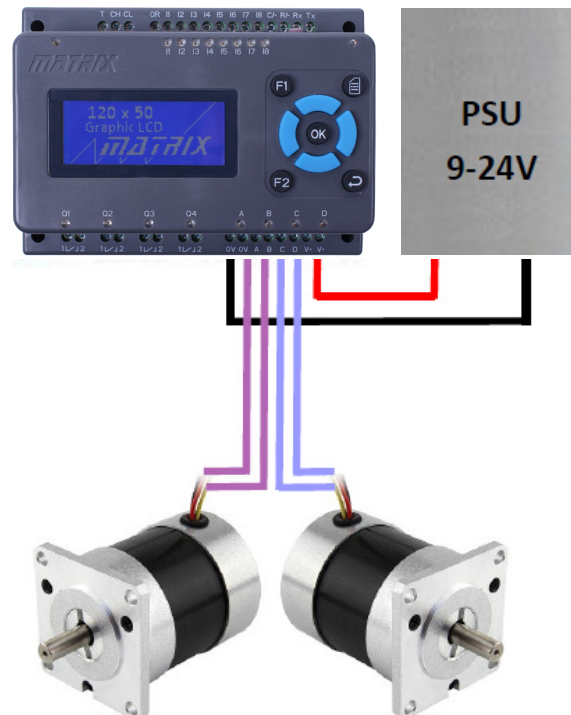
For total power supply current below 1 Amp the power supply can alternatively be provided via the 2.1mm power jack socket. In this case the supply is routed through a bridge rectifier circuit and can therefore accept plugs wired with either connection polarity.

When driving highly inductive loads ensure that transients (such as current through the flyback diodes) do not cause the supply voltage to exceed 30V.

Example of low current usage



Example of high current usage



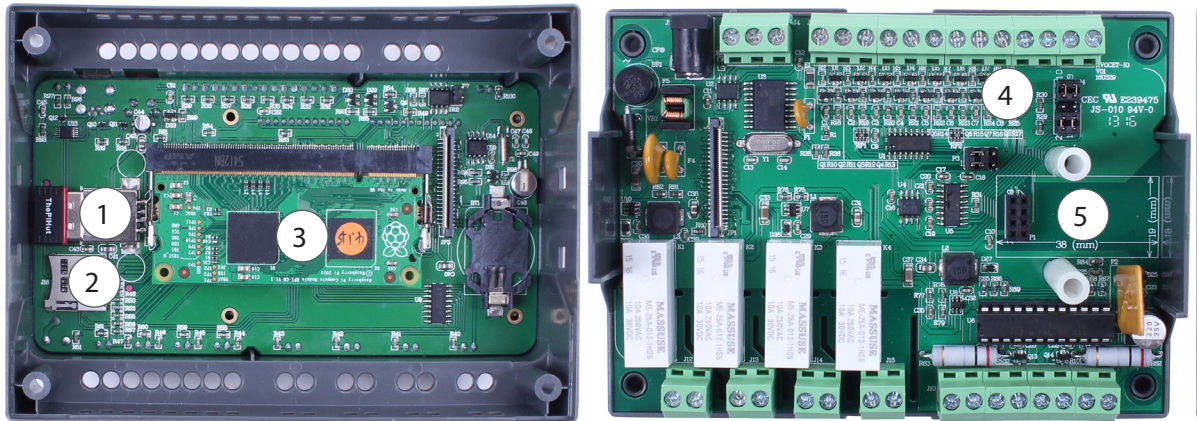
# Internal options

This page applies to processor module based MIAC versions:



- MI5466, MI9335, MI3449 (ATmega)
- MI5809, MI8615, MI8759, MI5331 (dsPIC)
- MI5769, MI6693 (Raspberry Pi)

It does not apply to the MI0235 (PIC) processor version



1. USB WiFi Dongle (Raspberry Pi version only)
2. SD card slot
3. Processor module
4. Serial communication options selectors (see table below)
5. Optional wireless communication module

| C/+                   | R/-                   | Rx                   | Tx                   | Wireless Module | Link Positions |
|-----------------------|-----------------------|----------------------|----------------------|-----------------|----------------|
| UART1<br>RS485<br>A+  | UART1<br>RS485<br>B-  | UART0<br>RS232<br>Rx | UART0<br>RS232<br>Tx |                 |                |
| UART0<br>RS232<br>CTS | UART0<br>RS232<br>RTS | UART0<br>RS232<br>Rx | UART0<br>RS232<br>Tx |                 |                |
| UART0<br>RS232<br>CTS | UART0<br>RS232<br>RTS | UART0<br>RS232<br>Rx | UART0<br>RS232<br>Tx | UART1<br>Rx/Tx  |                |
| UART1<br>RS485<br>A+  | UART1<br>RS485<br>B-  |                      |                      | UART0<br>Rx/Tx  |                |

# Programming with Flowcode

The easiest way to program a user application into a MIAC is to use Flowcode V7.

Using Flowcode V7 also has the added advantage of being able to simulate your application on screen before deployment to the target hardware. This option applies to the PIC, dsPIC and AVR versions.

The Microchip PIC versions of the MIAC require the installation of a USB driver. Download the driver zip from the Matrix resource site and unzip to a temporary location. Connect the MIAC via USB cable to your Windows PC. The new device will be detected, cancel the Windows search and install the driver from the temporary directory.

The AVR ATmega version of MIAC requires the installation of the Windows USB FTDI drivers. Connect the MIAC via USB cable to your Windows PC and power it. The new device will be detected and the FTDI drivers should be installed automatically.



## MI0235 PIC

Create a new project in Flowcode by selecting "New", then choose "PIC" target. Select "Misc" from the drop combo box, then select "MIAC V2" from the displayed list. If you intend to build a MIAC System using Addon modules, then select "MIAC System". Start your project by adding a "MIAC (PIC)", from the "MIAC Module" component menu, onto to the System or Dashboard panel.



## MI5809, MI8615, MI8759 dsPIC

Create a new project in Flowcode by selecting "New", choose "PIC16", then select "Misc" from the drop combo box. Select "MIAC (dsPIC)" from the displayed list. If you intend to build a MIAC System using Addon modules, then select "MIAC (dsPIC) System". Start your project by adding a "MIAC (dsPIC)", from the "MIAC Module" component menu, onto to the System or Dashboard panel.



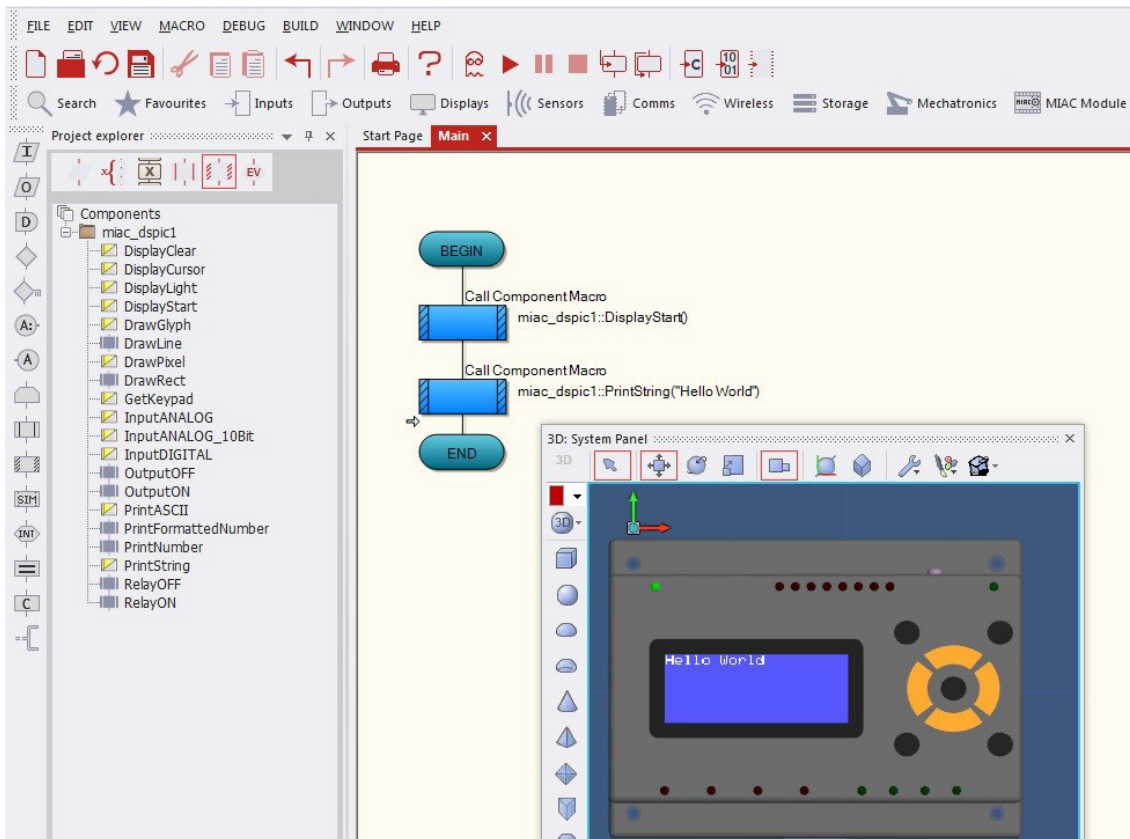
## MI5466, MI9335, MI3449 AVR (Arduino Compatible)

Create a new project in Flowcode by selecting "New", choose "AVR", then select "Misc" from the drop combo box. Select "MIAC (Arduino-Compatible)" from the displayed list. If you intend to build a MIAC System using add-on modules, then select "MIAC (Arduino-Compatible) System". Start your project by adding a "MIAC (Arduino-Compatible)", from the "MIAC Module" component menu, onto to the System or Dashboard panel.

# Programming with Flowcode

The “Project explorer” window will list the macros that are available for use with the MIAC.

For example: drag “DisplayStart” and “PrintString” to the flowchart as shown, click the Play icon to simulate this simple application.



To deploy your project to the PIC and dsPIC versions of MIAC, connect via USB cable and power the MIAC. Click the “Compile to Chip” icon.

Press the Reset button on the MIAC when requested to do so.

To deploy your project to the AVR (Arduino-Compatible) versions of MIAC, connect via USB cable and power the MIAC. The USB communication port will be detected and listed in the Project Options dialog box. Select it as your default connection.

Click the “Compile to Chip” icon.

# Flowcode components

The MIAC Flowcode components contains the API/macros for basic functionality of the MIAC, such as display, keypad, inputs and outputs.

The MIAC versions however have many more internal features and these are easily implemented in a user application by adding additional Flowcode components into the project.

These components can be found under their relevant menu groups, or via the search facility.

Most of the components listed are MIAC-aware in that their properties will be automatically set to values relevant to the MIAC target version being used.

The list below gives an overview of these additional components and their use. Please see additional online and in-component Flowcode help.



The Real Time Clock component can be added to a project to give read and write access the internal RTC device.



The Serial EEPROM component can be added to a project to give read and write access to the internal non-volatile memory device.



The CAN component is used to access the CAN functionality of MIAC. Note: This is not required for MIAC System projects, as these automatically include all the CAN code that is required.



The RS232 component is used to access the RS232 functionality of MIAC. It is a generic UART control component so can also be used to access and control the RS485 UART.

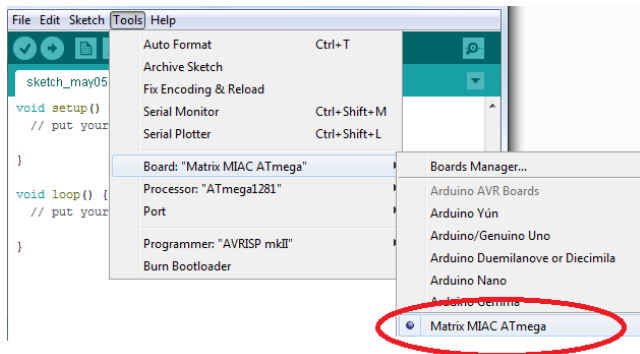


The SD card component can be used to enhance storage capacity of the MIAC when used in conjunction with an optional micro SD card inserted into the internal micro SD card slot.

# Using Arduino IDE

The AVR Arduino-Compatible version of MIAC can be programmed from Flowcode or from the Arduino IDE.

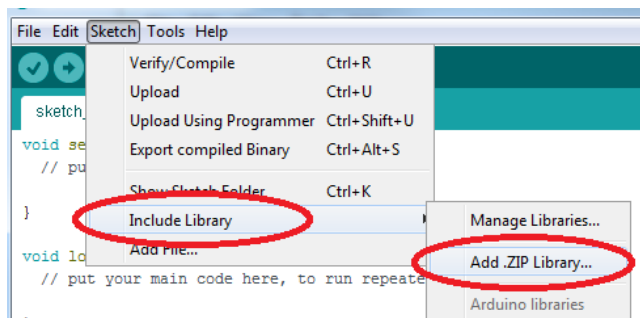
To prepare the Arduino IDE for use with MIAC, first download the MIAC board definition (matrix.zip) and code library (miac.zip) from the matrixtsl resources website.



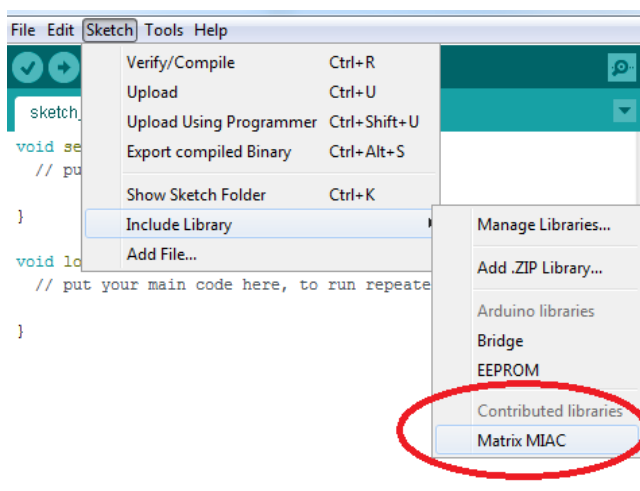
The MIAC board definition needs to be installed by unzipping the matrix.zip contents into the “hardware” installation directory. For example:

“C:\Program Files (x86)\Arduino\hardware\matrix”

The MIAC will now be listed in the “Tools->Board” menu.



The MIAC code library (maic.zip) is installed by using the “Add ZIP Library” feature of the IDE.



The MIAC library can be included in your sketch via the “Sketch->Include Library” menu .

Example MIAC sketches can be seen in the “File->Examples” menu.

# Raspberry Pi version



The MI5769 and MI6693 MIAC versions have a 4Gb Compute module that is pre-loaded with Raspbian Jessie Lite and additionally the light-weight desktop LXDE and remote desktop server XRDP.

It is preconfigured to boot up as an open WiFi Access Point, such that an external PC with WiFi capability can connect to the MIAC on SSID "PiAP" with password "raspberry" and communicate with it at IP address 192.168.1.1 via SSH (putty) or Remote Desktop.

Login credentials are the usual user "pi" and password "raspberry".

Additionally, the compute module file systems can be accessed via the MIAC USB interface, for which the Raspberry Pi Foundation provide the rpiboot tool.

This is best done via another Linux host system, such that both the boot (FAT) partition and the Linux partition can be read and written. For a Linux system, download and compile the rpiboot tool or for Windows use the Windows installer "CM-Boot-Installer".

For detailed instructions see the Raspberry Pi Foundation [website](#).

To access the MIAC file system, connect via USB cable, run "RPi Boot" on the PC and power up the MIAC.

For Windows, tools such as Win32DiskImager can be used to make a complete backup, or restore, of the whole compute file system memory. For a Linux host, dd can be used.

Also to simplify initial use of the MIAC, a start-up script file "startup.sh" and an initial demonstration Python program "demo.py" run at power on from the boot partition. Both of these files are accessible for user editing via USB.

The boot partition also contains the MIAC.py module that simplifies Python code access to the MIAC features, such as display, keypad, inputs and outputs.

This Python module makes use of the pre-installed kernel modules that provide device drivers.

The display (output) and keypad (input) is available via the device node /dev/mdk and hence can also be used by shell script. For example: echo "Hello Word" > /dev/mdk



# Raspberry Pi version

## Connecting the MIAC (Raspberry Pi version) into an existing WiFi network

It's probably a good idea to make a system image backup before you proceed, unless you have Linux PC access to the complete MIAC file system. Otherwise errors implementing these steps could lock you out.

Login to the MIAC via ssh or remote desktop

Disable the hotspot access point:

```
sudo update-rc.d hostapd disable
sudo nano /etc/default/hostapd
```

```
# DAEMON_CONF="/etc/hostapd/hostapd.conf"
```

Add your WiFi Access Point details:

```
sudo nano /etc/wpa_supplicant/wpa_supplicant.conf
```

```
ctrl_interface=DIR=/var/run/wpa_supplicant GROUP=netdev
update_config=1
network={
  ssid="your ssid"
  psk="your psk"
}
```

Change the network interface wlan0 details:

```
sudo nano /etc/network/interfaces
```

```
allow-hotplug wlan0
iface wlan0 inet dhcp
wpa-conf /etc/wpa_supplicant/wpa_supplicant.conf
```

Add to the startup.sh script to display the IP address allocated by your DHCP server on startup:

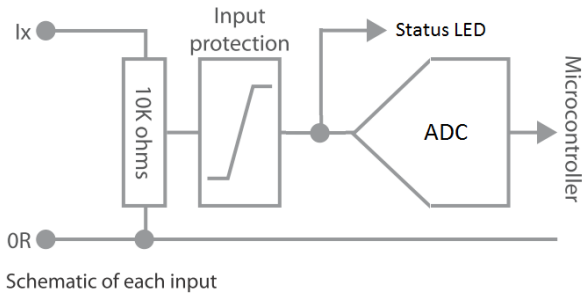
```
sudo nano /boot/startup.sh
```

```
# Wait a while for the network to be established
sleep 3
# Output the allocated IP address to the MIAC gLCD
hostname -I > /dev/mdk
```

All done, re-boot:

```
sudo reboot
```

# Input circuits



MIAC has eight analogue inputs channels (I1 to I8) with an input voltage range of 0V to 24V, and an input resistance of 10K ohms to 0R. Analogue conversion accuracy is maintained between 0V and 12V.

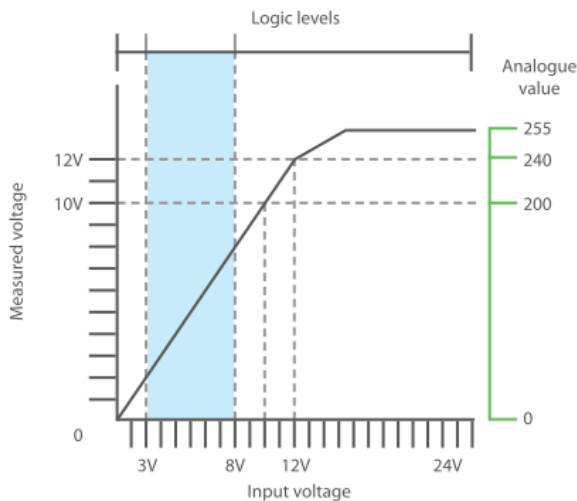
Analogue conversions have a resolution of 50mV (20 counts per Volt). This allows simple calculations to be used to convert the results of an analogue sample into a direct voltage representation - simply divide the input by 20. Analogue conversion of input voltages above 12V will return the value of the clamping voltage (between 241 and 255).

The input resistance allows most industrial PNP output sensors to be used without additional load resistors. It can also be used as part of a potential divider in conjunctions with other sensing devices (thermistors, light dependent resistors etc.).

The input resistance will affect voltages measured from signals with a high output impedance or a low current capacity. Signal sources must be capable of supplying 0.1mA per Volt of signal. Analogue voltage measurements from a source with an output resistance,  $R_s$ , will be reduced by a factor of

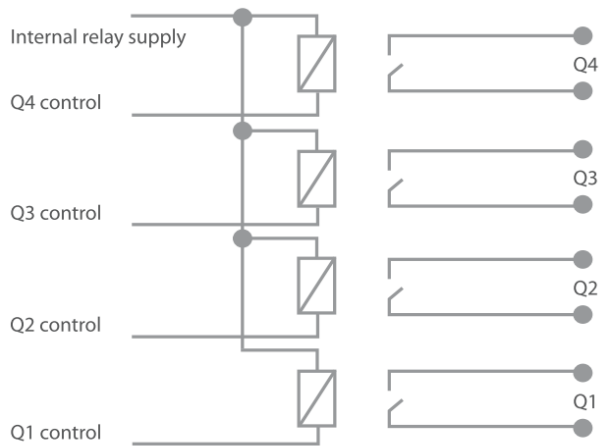
$10K/(10K + R_s)$ . To achieve accurate analogue measurements, signals sources should be obtained from low resistance or buffered sources.

In the case of the MI0235 MIAC PIC version, the internal processor ADC peripheral channels are used, hence these inputs have dual use as digital inputs too. For all other MIAC versions an external ADC convertor is used, hence only inputs 1 and 2 are also connected to logic level inputs for faster input reading of sensors such as quadrature encoders. Logic level switching occurs at input voltages between 3 and 8V DC. The logic levels are undefined for input voltages between the two logic levels: Logic 0: < 3V DC, Logic 1: > 8V DC



Analogue input conversion

# Output circuits



All in the MIAC range have four, single-pole, normally open relays, Q1 to Q4.

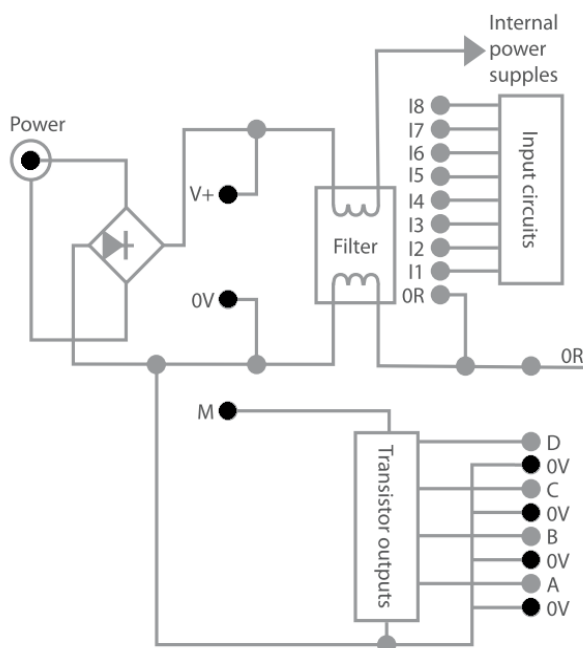
Pairs of terminals provide access to the switch contacts of each relay.

The four pairs of relay contacts are isolated from each other, and from the MIAC control circuitry.

The relays are independently controlled by the MIAC. Each can switch up to 8A at 250VAC or 30VDC.

In order to retain the high isolation and low resistance switching properties of the relays, no protection devices have been added to the contact circuits. Care should be taken when switching loads that could exceed the voltage or current ratings of the contacts.

## Solid state outputs of the MIAC MI0235 (PIC) version only



The MI0235 8 bit PIC MIAC transistor outputs are not powered internally. The M terminal is used to apply power to the transistors which allows a voltage other than the supply voltage to be used on the transistor outputs.

The maximum value of M is nominally 12V DC but up to 28V DC can be used depending on the ambient temperature. The transistor outputs are supplied by a single L298 device and can supply up to 500mA each and 1.75A in total. Transistor outputs can be connected in parallel if more power is needed from an output.

If you wish to power the transistors from the same supply as the supply voltage then simply use a shorting link between the V+ and the M terminals.

# Output circuits

This page applies to processor module based MIAC versions:

- MI5466, MI9335, MI3449 (ATmega)
- MI5809, MI8615, MI8759, MI5331 (dsPIC)
- MI5769, MI6693 (Raspberry Pi)

It does not apply to the MI0235 (PIC) version

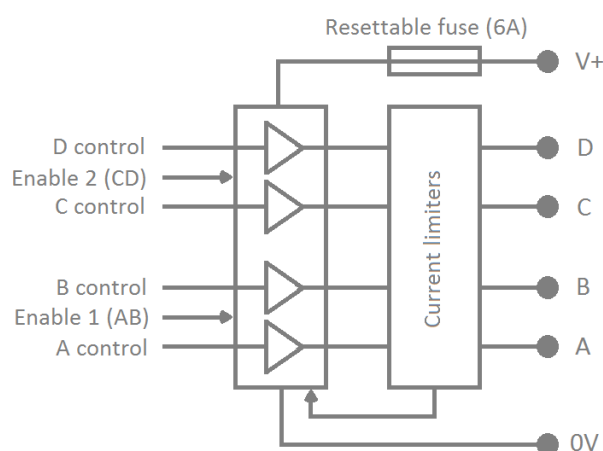


The processor module range of MIAC have four solid state outputs supplied by a DMOS dual full bridge driver (L6206). The operating supply voltage (V+) is from 9V to 24V DC.

Typical output on resistance is 0.5 ohms. The outputs have over-current detection and protection, thermal shutdown and integrated free wheeling diodes.

The four outputs can be used independently or as two full bridge drivers. Outputs A and B form one bridge and outputs C and D form another bridge. Each bridge can be independently enabled, or controlled by PWM, and each output can source or sink current.

All four outputs have a status LED.



## Maximum allowable solid state output currents:

|  |   |          |
|--|---|----------|
| Output driving high, load to 0V        | Maximum A and B combined total source current | 2.8 Amps |
| Output driving high, load to 0V        | Maximum C and D combined total source current | 2.8 Amps |
| Output driving low, load to V+         | Maximum A and B combined total sink current   | 2.5 Amps |
| Output driving low, load to V+         | Maximum C and D combined total sink current   | 2.5 Amps |
| Load between A and B, full bridge mode | Maximum current (A:B)                         | 2.5 Amps |
| Load between C and D, full bridge mode | Maximum current (C:D)                         | 2.5 Amps |

# Processor port and pin map

This page applies to processor module based MIAC versions:



- MI5466, MI9335, MI3449 (ATmega)
- MI5809, MI8615, MI8759, MI5331 (dsPIC)
- MI5769, MI6693 (Raspberry Pi)

It does not apply to the MI0235 (PIC) version

| Name    | Notes   | Raspberry Pi |            |      | dsPIC          | ATmega   |
|---------|---|--------------|------------|------|----------------|----------|
| SDA0    | EEPROM  | GPIO0        | SDA0       | ALT0 | 31 (SDA2)      | 26 (D1)  |
| SCL0    |   | GPIO1        | SCL0       | ALT0 | 32 (SCL2)      | 25 (D0)  |
| SDA1    | RTC   | GPIO2        | SDA1       | ALT0 | 31 (SDA2)      | 26 (D1)  |
| SCL1    |   | GPIO3        | SCL1       | ALT0 | 32 (SCL2)      | 25 (D0)  |
| I1_INT  | Input 1 logic                                   | GPIO4        |            | I    | 16 (RB0)       | 33 (G0)  |
| I2_INT  | Input 2 logic                                   | GPIO5        |            | I    | 15 (RB1)       | 34 (G1)  |
| GD_LED  | gLCD backlight                                  | GPIO6        |            | O    | 33 (RP99) (F3) | 43 (G2)  |
| CS_ADC  | ADC/CAN   | GPIO7        | SPIO_CE1_N | ALT0 | 14 (RB2)       | 7 (E5)   |
| CS_CAN  |   | GPIO8        | SPIO_CE0_N | ALT0 | 13 (RB3)       | 8 (E6)   |
| MISO0   |   | GPIO9        | SPIO_MISO  | ALT0 | 5 (SDI2)       | 13 (B3)  |
| MOSI0   |   | GPIO10       | SPIO_MOSI  | ALT0 | 6 (SDO2)       | 12 (B2)  |
| SCLK0   |   | GPIO11       | SPIO_SCLK  | ALT0 | 4 (SCK2)       | 11 (B1)  |
| MOTOR_1 | MOTORS  | GPIO12       | PWM0       | ALT0 | 58 (RP96) (F0) | 17 (PB7) |
| MOTOR_2 |   | GPIO13       | PWM1       | ALT0 | 58 (RP96) (F0) | 14 (PB4) |
| TXD0    | UART0<br>RS232<br>Optional WiFi<br>or Bluetooth | GPIO14       | TXD0       | ALT0 | 60 (RP80) (E0) | 3 (E1)   |
| RXD0    |   | GPIO15       | RXD0       | ALT0 | 61 (RP81) (E1) | 2 (E0)   |
| CTS0    |   | GPIO16       | CTS0       | ALT3 | 47 (RC13)      | 61 (F0)  |
| RTS0    |   | GPIO17       | RTS0       | ALT3 | 48 (RC14)      | 60 (F1)  |
| CS_SD   | microSD card                                    | GPIO18       | SPI1_CE0_N | ALT4 | 12 (RB4)       | 9 (E7)   |
| MISO1   |   | GPIO19       | SPI1_MISO  | ALT4 | 2 (RP186)      | 13 (B3)  |
| MOSI1   |   | GPIO20       | SPI1_MOSI  | ALT4 | 3 (RP87)       | 12 (B2)  |
| SCLK1   |   | GPIO21       | SPI1_SCLK  | ALT4 | 1 (RP85)       | 11 (B1)  |
| DB0     | gLCD/Keypad                                     | GPIO22       |            | I/O  | 21 (RB8)       | 35 (C0)  |
| DB1     |   | GPIO23       |            | I/O  | 22 (RB9)       | 36 (C1)  |
| DB2     |   | GPIO24       |            | I/O  | 23 (RB10)      | 37 (C2)  |
| DB3     |   | GPIO25       |            | I/O  | 24 (RB11)      | 38 (C3)  |
| DB4     |   | GPIO26       |            | I/O  | 27 (RB12)      | 39 (C4)  |
| DB5     |   | GPIO27       |            | I/O  | 28 (RB13)      | 40 (C5)  |
| DB6     |   | GPIO28       |            | I/O  | 29 (RB14)      | 41 (C6)  |
| DB7     |   | GPIO29       |            | I/O  | 30 (RB15)      | 42 (C7)  |
|         | UART1<br>RS485<br>Optional WiFi<br>or Bluetooth | GPIO30       | n/c        |      |                |          |
| RTS1    |   | GPIO31       | RTS1       | ALT5 | 8 (RG9)        | 19 (G4)  |
| TXD1    |   | GPIO32       | TXD1       | ALT5 | 64 (RP84) (E4) | 28 (D3)  |
| RXD1    |   | GPIO33       | RXD1       | ALT5 | 63 (RP83) (E3) | 27 (D2)  |
| GD_RS   | gLCD  | GPIO34       |            | O    | 42 (RD8)       | 27 (D2)  |
| GD_RW   |   | GPIO35       |            | O    | 43 (RD9)       | 30 (D5)  |
| GD_EN   |   | GPIO36       |            | O    | 44 (RD10)      | 31 (D6)  |
| GD_RT   |   | GPIO37       |            | O    | 45 (RD11)      | 32 (D7)  |
| RELAY_1 | RELAYS  | GPIO38       |            | O    | 46 (RD0)       | 51 (A0)  |
| RELAY_2 |   | GPIO39       |            | O    | 49 (RD1)       | 50 (A1)  |
| RELAY_3 |   | GPIO40       |            | O    | 50 (RD2)       | 49 (A2)  |
| RELAY_4 |   | GPIO41       |            | O    | 51 (RD3)       | 48 (A3)  |
| MOTOR_A | MOTORS  | GPIO42       |            | O    | 52 (RD4)       | 15 (PB5) |
| MOTOR_B |   | GPIO43       |            | O    | 53 (RD5)       | 16 (PB6) |
| MOTOR_C |   | GPIO44       |            | O    | 54 (RD6)       | 5 (PE3)  |
| MOTOR_D |   | GPIO45       |            | O    | 55 (RD7)       | 6 (PE4)  |

# Technical specifications

|  | MI0235 (PIC)  | MI5466, MI9335, MI3449 (AVR),<br>MI5809, MI8615, MI8759 (dsPIC),<br>MI5769, MI6693(RPi),<br>MI5331 (Allcode)   |
|--|---|--|
| Power supply voltage range                 | 12V-16V DC  | 9V-24V DC  |
| Power supply internal current consumption  | 100mA-200mA   | 50mA-250mA   |
| Inputs                                     | 8   | 8  |
| Inputs working voltage range               | 0V-12V DC   | 0V-12V DC  |
| Inputs maximum voltage range               | -30V, +45V  | -30V, +35V   |
| Input impedance                            | 10K   | 10K  |
| Relay outputs                              | 4   | 4  |
| Relay contact rating (resistive load)      | 8A @ 240VAC, 30VDC  | 8A @ 240VAC, 30VDC   |
| Solid state outputs                        | 4   | 4  |
| Solid state o/p source current (max)       | 500 mA  | 2.8 A  |
| Solid state o/p sink current (max)         | 500 mA  | 2.5 A  |
| Solid state o/p total source current (max) | 1.75 A  | 5.6 A  |
| Solid state o/p total sink current (max)   | 1.75 A  | 5 A  |
| Operating temperature range                | -5 to 50C   | -5 to 50C  |
| Storage temperature range                  | -40 to +70C   | -40 to +70C  |
| IP rating                                  | 20  | 20   |
| Programming interface                      | USB   | USB (WiFi, Bluetooth, depending on model)  |
| Communication                              | CAN   | CAN, RS232, RS485 (WiFi, Bluetooth, depending on model)  |
| Certification                              | CE certification:<br>EN 60950-1: 2001+A11: 2004<br>EN 55022: 2006 Class B<br>EN 55024: 1998+A1: 2001+A2: 2003<br><br>FCC certification:<br>ANSI C63.4 (2003)<br>CISPR 22: 1997+A1: 2000<br>ICES-003: 2004 | CE certification:<br>EN 60950-1: 2006+A2: 2013<br>EN 55032: 2015<br>EN 55024: 2010+A1: 2015<br>EN 300 328 v1.9.1<br>EN 301 489-1 v1.9.2<br>EN 301 489-17 v2.2.1<br>EN 62479: 2010<br><br>FCC certification:<br>ANSI C63.4 : 2014<br>47 CFR PART 15 Subpart B: 2016<br>ICES-003: 2016 |

## Warnings

The MIAC unit can operate with hazardous voltages which can result in electric shock or other potentially fatal injuries. Disconnect all power sources before working on equipment.

Do not operate the equipment with case open. Avoid all contact with the connector terminals when any power sources are connected.

Ensure all wiring is in good condition and correctly terminated.

Do not use in safety-critical applications.

# Regulatory Compliance and Safety Information for MIAC



**NOTE:** This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

**WARNING:** Changes or modifications not expressly approved by Matrix TSL could void the user's authority to operate the equipment.

## RF Exposure

The equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This device should be installed and operated with minimum distance 20cm between the radiator & your body.

The following products contain transmitter module FCC ID: 2AHMR-ESP12S

- MI9335 – Arduino-compatible MIAC with WiFi
- MI8615 – dsPIC MIAC with WiFi
- MI5331 – AllCode MIAC with WiFi

The following products contain transmitter module FCC ID: 2AHRD-EPN8531

- MI5769 – Raspberry Pi MIAC with WiFi
- MI6693 – Raspberry Pi MIAC with WiFi and Bluetooth

The following products contain transmitter module FCC ID: A8TBM77SPPSYC2A

- MI3449 – Arduino-compatible MIAC with Bluetooth
- MI8759 – dsPIC MIAC with Bluetooth
- MI6693 – Raspberry Pi MIAC with WiFi and Bluetooth



## CE Conformity

The products covered by this guide are intended to be used in all EU member countries, Norway, and Switzerland. Products been tested and found to comply with the requirements for a Class B device pursuant to European Council Directive 2014/30/EU (EMC) and 1999/5/EC (R&TTE), thereby satisfying the requirements for CE Marking and sale within the European Economic Area (EEA).



## Restriction of Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS)

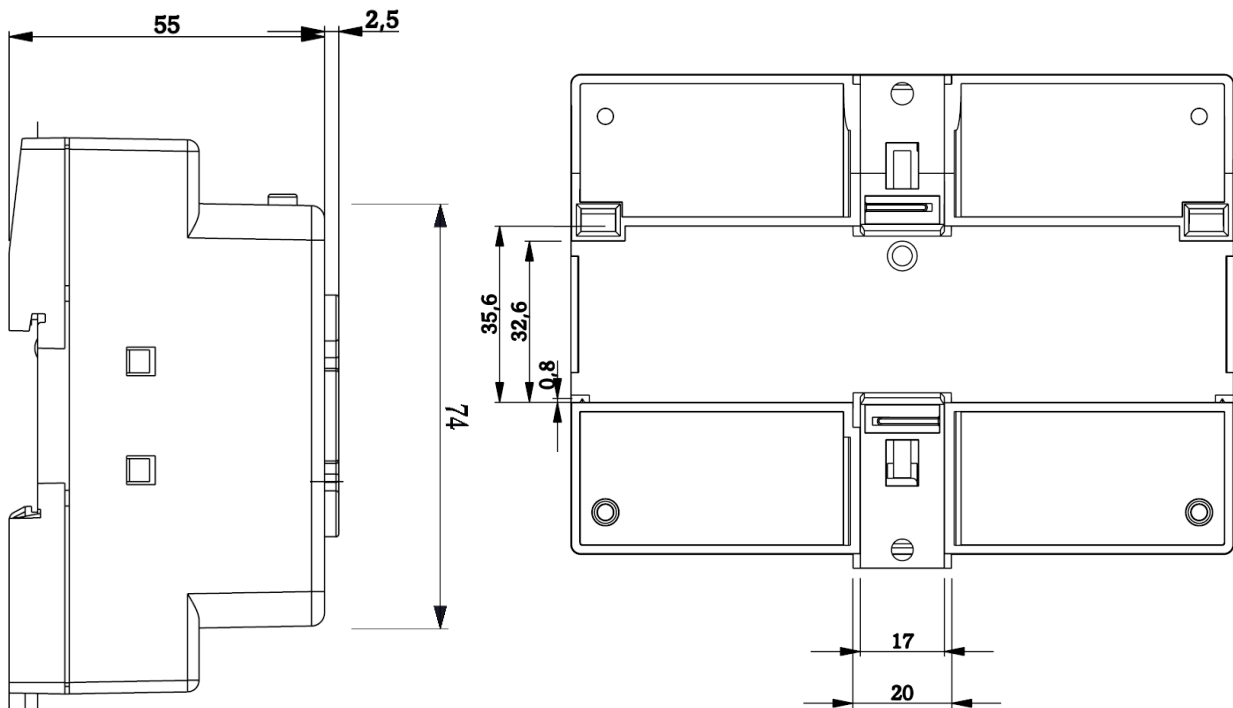
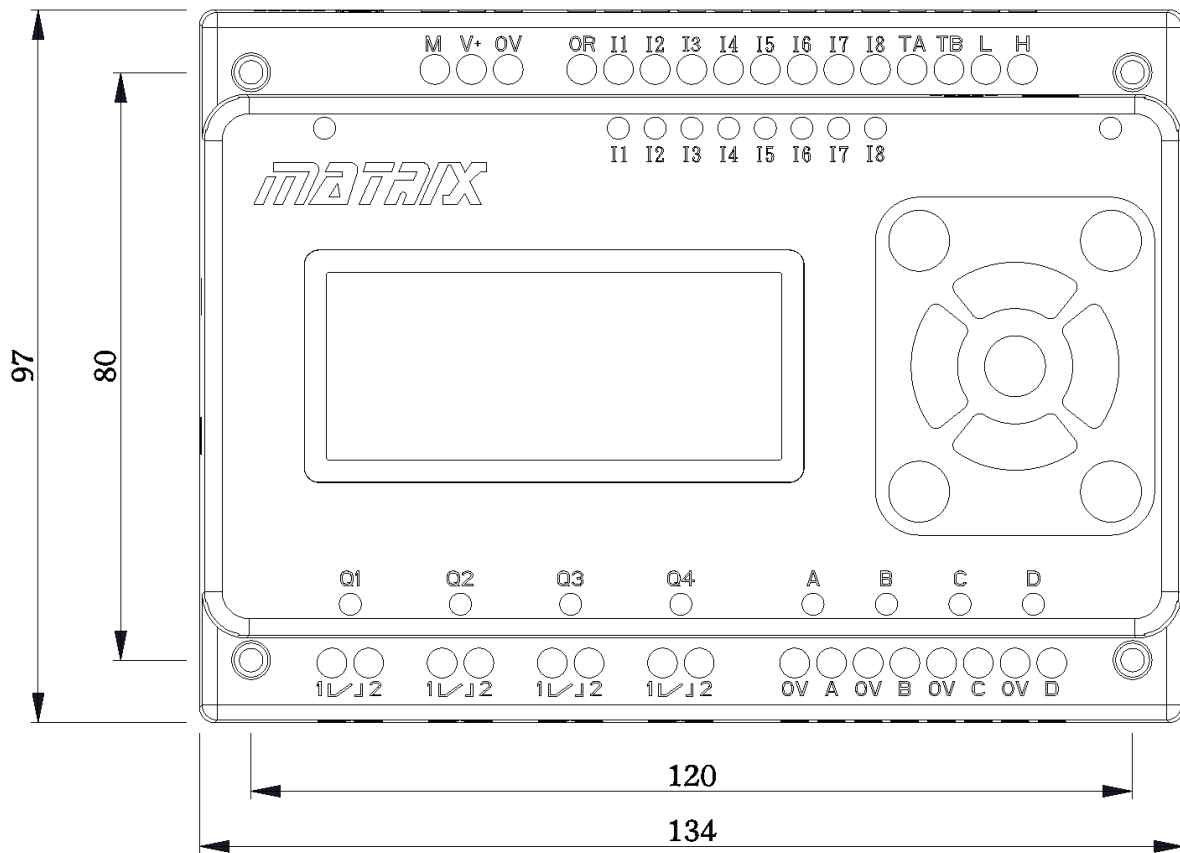
MIAC complies in all material respects with DIRECTIVE 2011/65/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 January 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS Directive) and Amendment 2005/618/EC filed under C(2005) 3143.



## Waste Electrical and Electronic Equipment (WEEE)

For product recycling instructions and more information, please go to [www.matrixtsl.com](http://www.matrixtsl.com)

# Case dimensions





# Version control

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| Version | Author | Date       | Changes                   |
|---------|--------|------------|---------------------------|
| 1.0     | LN     | 20/07/2016 | Document creation         |
| 1.1     |        | 12/07/2017 | Page 5 information update |



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MIAC-60-3.1