



INDUSTRIAL SHIELDS

## USER GUIDE

### PLC Arduino ARDBOX 20 I/Os Analog HF Modbus





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# PLC Arduino ARDBOX 20 I/Os Relay HF User Guide

**Revised March 2018**

This user guide is for version PLC Arduino ARDBOX 20 I/Os Analog HF, with Reference name Ref.IS.AB20AN-HF only. For older versions refer to user guide with Cat. No. ABOX-003-001-70



## Preface

This User Guide is been implemented by Boot & Work, S.L. working under the name Industrial Shields.

### Purpose of the manual

The information contained in this manual can be used as a reference to operating, to functions, and to the technical data of the signal modules, power supply modules and interface modules.

### Intended Audience

This User Guide is intended for the following audience:

- Persons in charge of introducing automation devices.
- Persons who design automation systems.
- Persons who install or connect automation devices.
- Persons who manage working automation installation.



#### Warnings:

- Unused pins should not be connected. Ignoring the directive may damage the controller.
- Improper use of this product may severely damage the controller.
- Refer to the controller's User Guide regarding wiring considerations.
- Before using this product, it is the responsibility of the user to read the product's User Guide and all accompanying documentation.



## Application Considerations and Warranty

### Read and Understand this Manual

Please read and understand this manual before using the product. Please consult your comments or questions to Industrial Shields before using the product.

### Application Consideration

THE PRODUCTS CONTAINED IN THIS DOCUMENT ARE NOT SAFETY RATED. THEY SHOULD NOT BE RELIED UPON AS A SAFETY COMPONENT OR PROTECTIVE DEVICE FOR ENSURING SAFETY OF PERSONS, AS THEY ARE NOT RATED OR DESIGNED FOR SUCH PURPOSES.

Please know and observe all prohibitions of use applicable to the products.

FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, NEVER USE THE INDUSTRIAL SHIELDS PRODUCTS.

NEVER USE THE INDUSTRIAL SHIELDS PRODUCTS BEFORE THEY ARE PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

Industrial Shields shall not be responsible for conformity with any codes, regulations or standards that apply to the combination of products in the customer's application or use of the product.

The following are some examples of applications for which particular attention must be given. This is not intended to be an exhaustive list of all possible uses of the products, nor is it intended to imply that the uses may be suitable for the products:

- Systems, machines, and equipment that could present a risk to life or property.
- Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machine, vehicles, safety equipment, and installation subject to separate industry or government regulations.
- Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this document.

At the customer's request, INDUSTRIAL SHIELDS will provide applicable third party certification documents identifying ratings and limitations of use that apply to the products. This information by itself is not sufficient for a complete determination of the suitability of the products in combination with the system, machine, end product, or other application or use.



## Disclaimers

### Weights and Dimensions

Dimensions and weights are nominal and they are not used for manufacturing purposes, even when tolerances are shown.

### Performance Data

Performance data given in this manual is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of INDUSTRIAL SHIELDS's test conditions, and the users must correlate it to actual application requirements. Actual performance is subject to the INDUSTRIAL SHIELDS Warranty and Limitations of Liability.

### Change in Specifications

Product specifications and accessories may be changed at any time based on improvements and other reasons.

It is our practice to change model numbers when features are changed, or published ratings or when significant construction changes are made. However, some specifications of the products may be changed without any notice. When in doubt, special numbers may be assigned to fix or establish key specifications for your application on your request. Please consult with your INDUSTRIAL SHIELDS representative at any time to confirm actual specifications of purchased products.

### Errors and Omissions

The information in this document has been carefully checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical, or proofreading errors, or omissions.



## Warranty and Limitations of Liability

### Warranty

Industrial Shields's exclusive warranty is that the products are free from defects in materials and workmanship for a period of one year (or other period if specified) from date of sale by Industrial Shields.

INDUSTRIAL SHIELDS MAKES NO REPRESENTATION OR WARRANTY, EXPRESS OR IMPLIED, REGARDING MERCHANTABILITY, NON-INFRINGEMENT, OR FITNESS FOR PARTICULAR PURPOSE OF THE PRODUCTS. ANY BUYER OR USER ACKNOWLEDGES THAT THE BUYER OR USER ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE. INDUSTRIAL SHIELDS DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED

### Limitations of Liability

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If no event shall the responsibility of INDUSTRIAL SHIELDS for any act exceed the individual price of the product on which liability is asserted.

IN NO EVENT SHALL INDUSTRIAL SHIELDS BE RESPONSIBLE FOR WARRANTY, REPAIR OR OTHER CLAIMS REGARDING THE PRODUCTS UNLESS INDUSTRIAL SHIELDS'S ANALYSIS CONFIRMS THAT THE PRODUCTS WERE PROPERLY HANDLED, STORED, INSTALLED, AND MAINTAINED AND NOT SUBJECT TO CONTAMINATION, ABUSE, MISUSE, OR INAPPROPRIATE MODIFICATION OR REPAIR.

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## 1. ARDBOX

A compact PLC based in Open Source Hardware technology. With different Input/Outputs Units.



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<div>Supply Voltage</div> <div>24 Vcc</div>	<b>COMPACT PLC ARDUINO 12-24Vdc ARDBOX ANALOG HF</b>	
	<b>Supply Voltage</b>	12-24Vdc Fuse protection (2.5A) Polarity protection
	<b>Max. current consumption</b>	1,5A
	<b>Size</b>	100x45x115
	<b>Clock Speed</b>	16MHz
	<b>Flash Memory</b>	32KB of which 4KB are used by bootloader
	<b>SRAM</b>	2.5KB
	<b>EEPROM</b>	1KB
	<b>Communications</b>	I2C 1 – USB -- RS485 Half/Full Duplex(Modbus) –SPI
	<b>TOTAL Input points</b>	10
<div>Compact</div> <div>DIN rail mounting</div>	<b>TOTAL Output points</b>	10
	<b>INPUTS</b>	Digital range: 12 to 24 Vdc (7.6 to 25.4 Vdc) Analog range: 0 to 10 Vdc
	<b>Digital</b>	10 12 to 24Vdc I min: 3/6 mA Separated PCB ground
	<b>Analog 10 bits</b>	9 of 10 Digital input 0 to 10V Input Impedance: 78K Separated PCB ground
	<b>* Interrupt HS</b>	1 of 10 Digital input 12 to 24Vdc I min: 5/10 mA Separated PCB ground
	*The same input is not simultaneously compatible as InterruptHS and Digital. IMPORTANT	



**Safety**Industrial  
communications**I/Os**Digital  
Analog  
Relay

<b>OUTPUTS</b>	Digital Isolated range: 5 to 24 Vdc (4.6 to 25.4 Vdc)  Analog range: 0 to 10 Vdc	
<b>Digital Isolated</b>	<b>10</b>	5 to 24 Vdc I max: 0.3 A Galvanic INSULATION Diode Protected for Relay
<b>Analog 8 bits</b>	<b>7</b>	0 to 10 Vdc I max: 40 mA Separated PCB ground
<b>PWM Isolated 8bit</b>	<b>6 of 10 Digital isolated Output</b>	5 to 24 Vdc I max: 0.3 A Galvanic INSULATION Diode Protected for Relay
<b>Expandability</b>	I2C - RS485 Half/Full Duplex (Modbus) - SPI	
<b>Reference</b>	IS_AB20ANA.HF	

## 2. Precautions

Read this manual before attempting to use the Ardbox and follow its descriptions for reference during operation.

### 2.1 Arduino Board

All Ardbox family PLCs include Arduino LEONARDO Board as controller.

### 2.2 Intended Audience

This manual is intended for technicians, which must have knowledge on electrical systems.

### 2.3 General Precautions

The user must operate Ardbox according to the performance specifications described in this manual.

Before using Ardbox under different conditions from what has been specified in this manual or integrating Ardbox to nuclear control systems, railroad systems, aviation systems, vehicles, combustion systems, medical equipment, amusement machines, safety equipment and other systems, machines, and equipment that may have a serious influence on lives and property if used improperly, consult your INDUSTRIAL SHIELDS representative. Ensure that the rating and performance characteristics of Ardbox are sufficient for the systems, machines, and equipment, and be sure to provide the systems, machines, and equipment double safety mechanisms. This manual provides information for programming and operating the Ardbox.



### 3. Technical Specifications

#### 3.1 General Specifications:

<b>Power supply voltage</b>	<b>DC power supply</b>	12 to 24Vdc
<b>Operating voltage range</b>	<b>DC power supply</b>	11.4 to 25.4Vdc
<b>Power consumption</b>	<b>DC power supply</b>	30VAC max.
<b>External power supply</b>	<b>Power supply voltage</b>	12 to 24Vdc
	<b>Power supply output capacity</b>	700Ma
<b>Insulation resistance</b>		20MΩ min.at 500Vdc between the AC terminals and the protective earth terminal.
<b>Dielectric strength</b>		2.300 VAC at 50 to 60 HZ for one minute with a leakage current of 10mA max. Between all the external AC terminals and the protective earth terminal.
<b>Shock resistance</b>		80m/s <sup>2</sup> in the X, Y and Z direction 2 times each.
<b>Ambient temperature (operating)</b>		0° to 45°C
<b>Ambient humidity (operating)</b>		10% to 90% (no condensation)
<b>Ambient environment (operating)</b>		With no corrosive gas
<b>Ambient temperature (storage)</b>		-20° to 60°C
<b>Power supply holding time</b>		2ms min.
<b>Weight</b>		340g max.

#### 3.2 Performance Specification:

<b>Arduino Board</b>	<b>ARDUINO LEONARDO</b>
<b>Control method</b>	Stored program method
<b>I/O control method</b>	Combination of the cyclic scan and immediate refresh processing methods.
<b>Programming language</b>	Arduino IDE. Based on wiring (Wiring is an Open Source electronics platform composed of a programming language. "similar to the C". <a href="http://arduino.cc/en/Tutorial/HomePage">http://arduino.cc/en/Tutorial/HomePage</a>
<b>Microcontroller</b>	ATmega32u4
<b>Flash Memory</b>	32kb of which 4Kb are used by bootloader



<b>Program capacity (SRAM)</b>	2.5kb
<b>EEPROM</b>	1kb
<b>Clock Speed</b>	16MHz

## 4. Software interface

Industrial Shields PLC are programmed using Arduino IDE, which is a software based on the C language. They can also be programmed using directly C but it is much easier working with Arduino IDE as it provides lots of libraries that helps in the programming.

Furthermore Industrial Shields provides boards for programming the PLCs much easier. Basically it is no needed to define the pins and if that pins are inputs or outputs. Everything is set up automatically if using the boards.

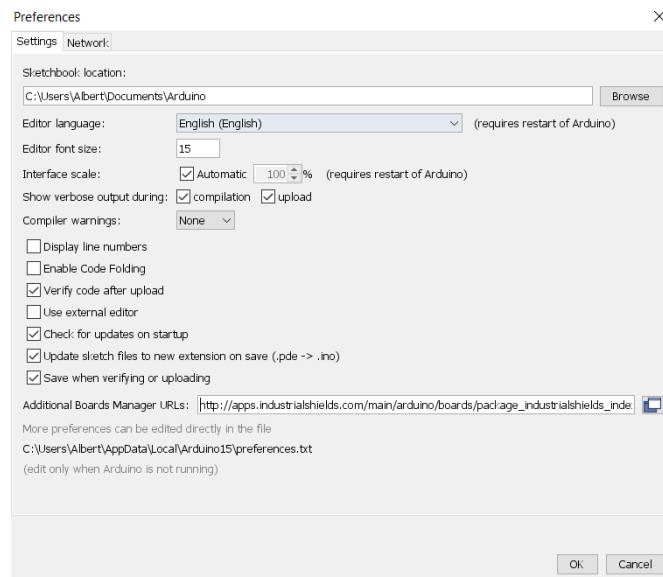
In order to install Industrial Shields boards, these are the steps that must be followed.

### Requirements:

Arduino IDE 1.8.0 or above (better to have always the latest version).

### Steps:

1. Open Arduino IDE and go to: "File -> Preferences" located in the top left corner.

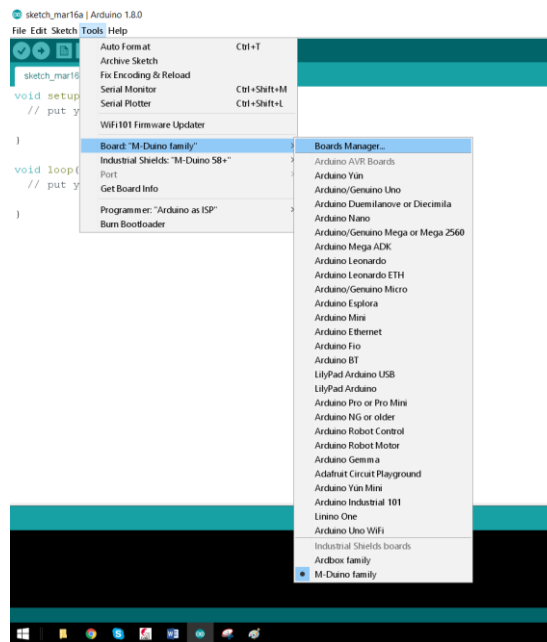


2. In Additional Boards URLs write the following:

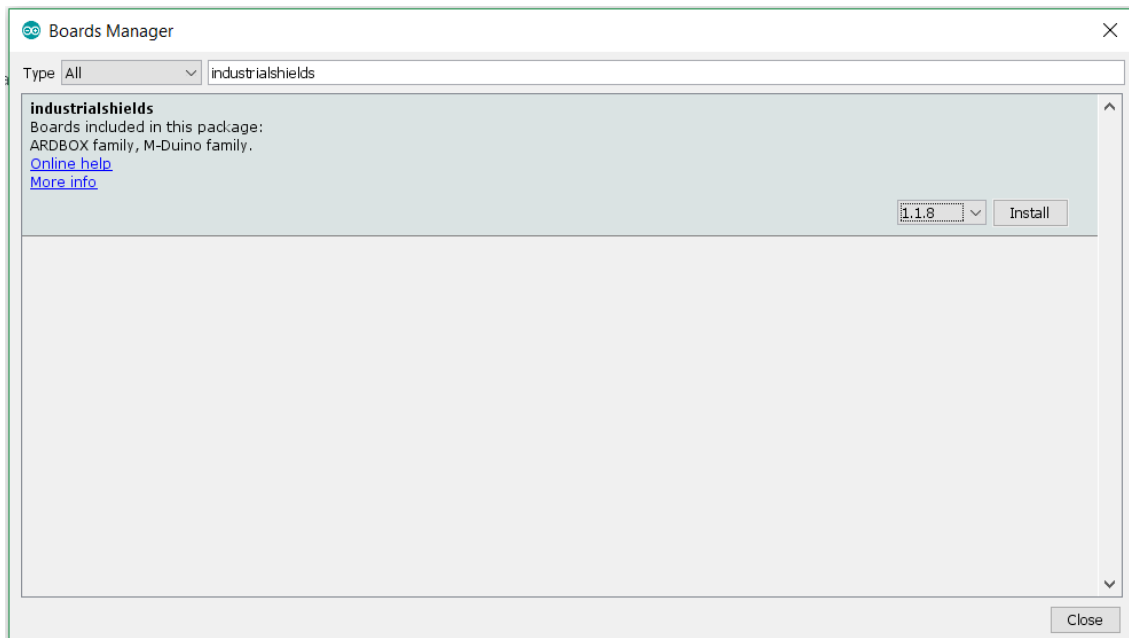
[http://apps.industrialshields.com/main/arduino/boards/package\\_industrialshields\\_index.json](http://apps.industrialshields.com/main/arduino/boards/package_industrialshields_index.json)



3. Press OK to save the changes.
4. Go to: Tools -> Board: ... -> Boards Manager

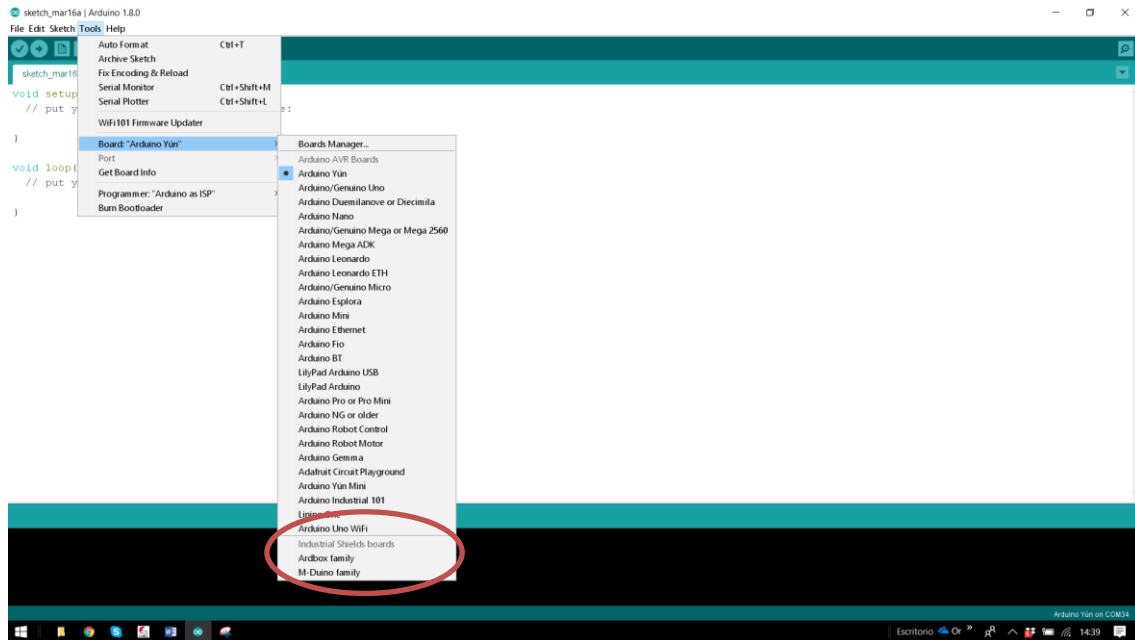


5. Search for industrialshields on the searcher.



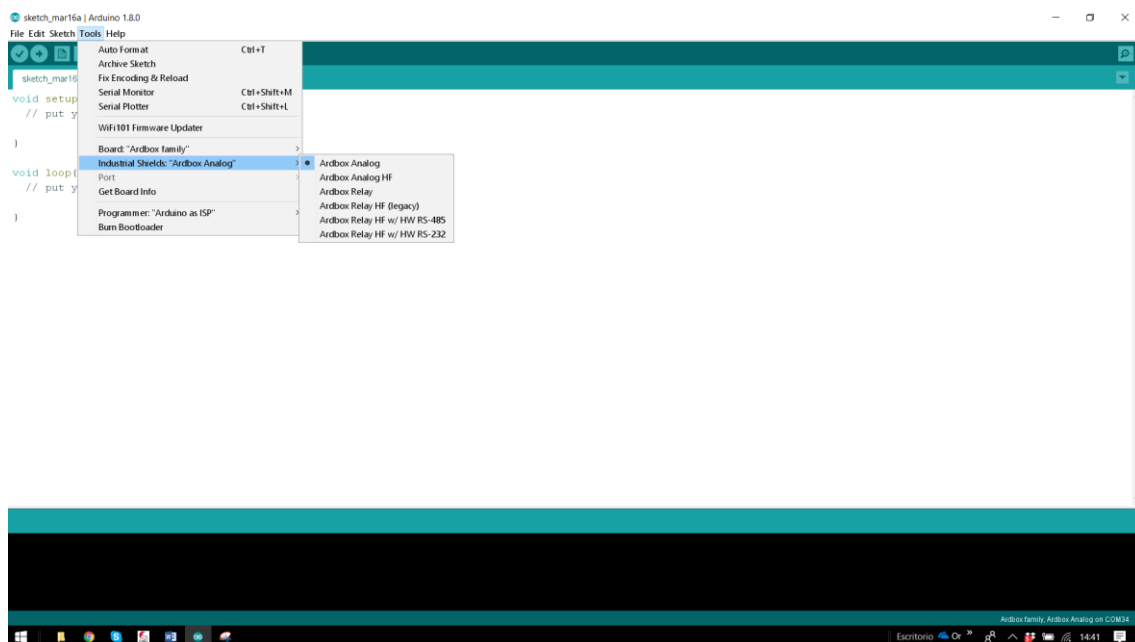
6. Click install (selecting the latest version).

Following this steps you will be able to use now the Industrial Shields Boards:



Once it is selected the Ardbox Family or M-Duino family an extra option will appear on Tools:

There, it can be selected the exact model for every family.



Also there are some examples of programming in File -> Examples -> Ardbox Family.

Furthermore there are some extra libraries that can be found in Industrial Shields github.

<https://github.com/IndustrialShields/>



## 5. How to connect PLC Arduino to PC

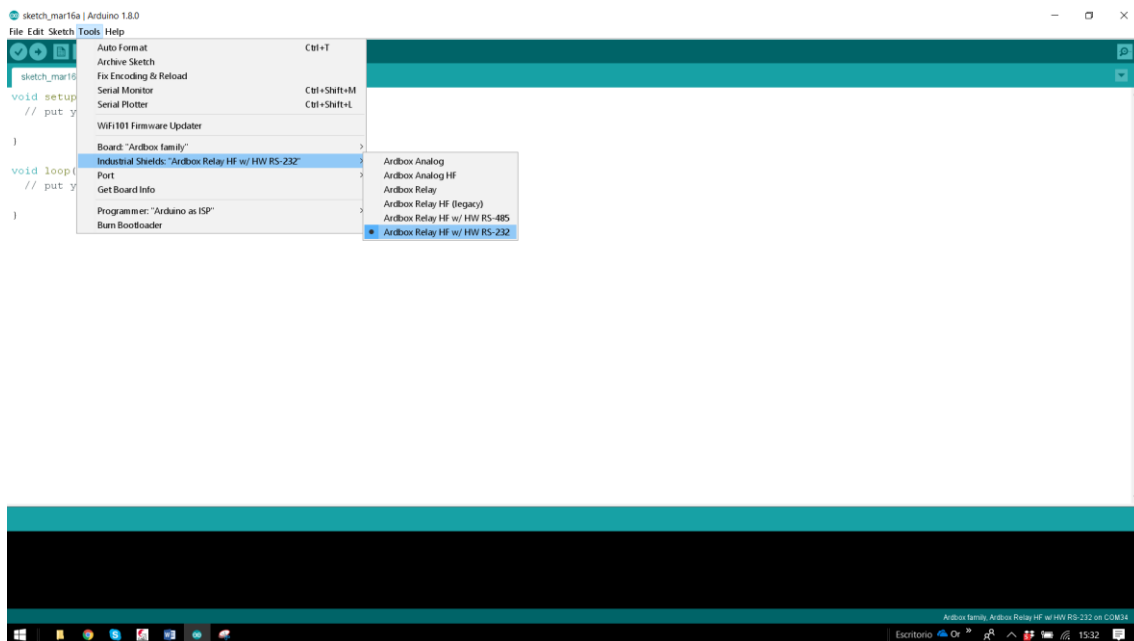
- Connect USB port from PLC to PC.

**NOTE:**

Ardbox Family use micro USB cable.



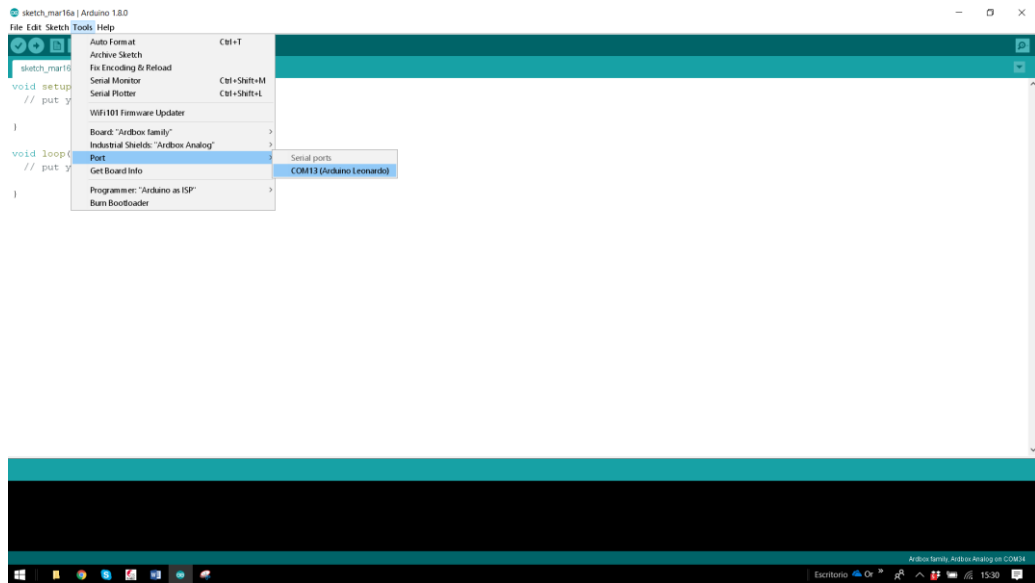
- Open Arduino IDE interface:
- Select Industrial Shields boards -> Ardbox Family
- Select the correct Ardbox Relay Board.



In order to use the correct board, Ardbox Analog HF is the option that must be selected.



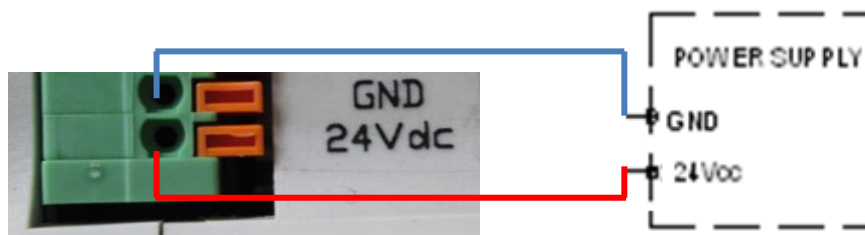
- Select correct port.



Now everything is set up to upload a sketch to Ardbox Relay HF

## 6. How to connect PLC to power supply

- Ardbox Family PLCs are 12-24Vdc supplied. **IMPORTANT: The polarity IS NOT REVERSAL!**
- Make sure that the live and GND connector of the power supply match the PLC.
- Make sure that the power supply mains output is not higher than 24Vdc.







## - Suggested power suppliers



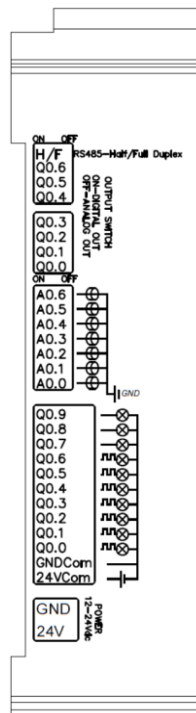
\* Not recommended for industrial applications. The *Jack* connector needs to be removed and use the live and GND connectors.



## 7. Ardbox Analog I/O Pinout:

### 7.1 Zone Connections

RIGHT Zone		
Ardbox Connector	Arduino Pin	Function
A0.6	3	Analog Out
A0.5	5	Analog Out
A0.4	6	Analog Out
A0.3	9	Analog Out
A0.2	10	Analog Out
A0.1	11	Analog Out
A0.0	13	Analog Out Digital
Q0.9	0	Output
Q0.8	1	Digital Output
Q0.7	7	Digital Output
Q0.6	3	PWM/digital Output
Q0.5	5	PWM/digital Output
Q0.4	6	PWM/digital Output
Q0.3	9	PWM/digital Output
Q0.2	10	PWM/digital Output
Q0.1	11	PWM/digital Output
Q0.0	13	PWM/digital Output
GNDCOM	-	Isolated GND
24VCOM	-	Isolated VIN



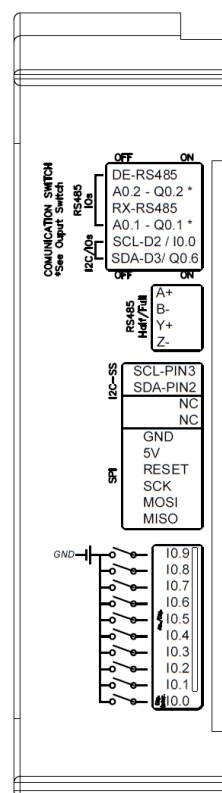
RIGHT Zone

Switch config\*  
(see section 9 for Analog/Digital  
Outputs configuration)

Analog Outputs pinout



LEFT Zone		
Ardbox Connector	Arduino Pin	Function
A+	-	RS485(A)
B-	-	RS485(B)
Y+	-	RS485(Y)
Z-	-	RS485(Z)
SCL-PIN3	3	SCL(I2C)
SDA-PIN2	2	SDA(I2C)
NC	-	-
NC	-	-
5V	-	5Vout DC
RESET	-	RESET
SCK	-	SPI
MOSI	-	SPI
MISO	-	SPI
I0.9	A0	Analog/Digital Input
I0.8	A1	Analog/Digital Input
I0.7	A2	Analog/Digital Input
I0.6	A3	Analog/Digital Input
I0.5	A4	Analog/Digital Input
I0.4	A5	Analog/Digital Input
I0.3	4 / A6*	Analog/Digital Input
I0.2	8 / A8*	Analog/Digital Input
I0.1	12 / A11*	Analog/Digital Input
I0.0	2	Digital interrupt

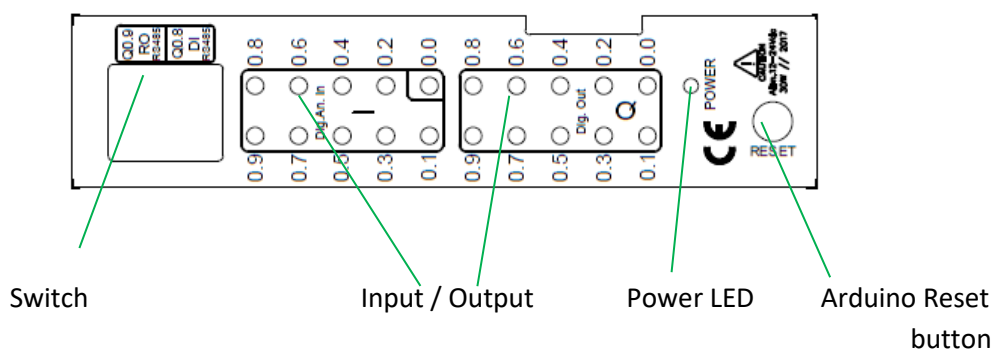


LEFT Zone

Switch config\*  
(see section 9 for Switch configuration.  
Enabling Communications disables  
some I/Os)

Communications pinout  
(SPI, I2C, RS485, RS232)

\*Use A6, A8 and A11 for analog values



Configuration switch\* (see section 9 for communications configuration)



## 8. Switch configuration

### General Switches Configurations

LEFT ZONE		
SWITCH CONFIGURATION		
ARDUINO PIN	OFF*	ON
10	A0.2-Q0.2	DE-RS485
10	DE-RS485	A0.2-Q0.2
11	A0.1-Q0.1*	RE-RS485
11	RE-RS485	A0.1-Q0.1*
2	SCL-D2	I0.0
3	SDA-D3	Q0.6

RIGHT ZONE			
SWITCH CONFIGURATION			
ARDUINO PIN	PLC PIN	OFF	ON
-	H/F	Full Duplex	Half Duplex
3	Q0.6	ANALOG	DIGITAL
5	Q0.5	ANALOG	DIGITAL
6	Q0.4	ANALOG	DIGITAL
9	Q0.3	ANALOG	DIGITAL
10	Q0.2	ANALOG	DIGITAL
11	Q0.1	ANALOG	DIGITAL
13	Q0.0	ANALOG	DIGITAL

TOP ZONE		
ENABLED CONNECTION	ON	OFF
Q0.9	Q0.9	RO
RO	RO	Q0.9
Q0.8	Q0.8	DI
DI	DI	Q0.8

#### \*IMPORTANT:

**LEFT ZONE.** To enable I2C communication connections the switches of the I2C (SCL, SDA) must be set to "OFF". Set to "ON" position to enable I/Os PLC connection (I0.0, Q0.6). To enable RS485 communication connections the switch of (DE-RS485) must be set to "ON" and the switch of A0.2-Q0.2 must be "OFF". The contrary configuration will enable A0.2-Q0.2 and it will disable RE-RS485. Communications and I/Os on the chart can not work simultaneously. For example if DE is enabled (ON), Q0.2 will not work.

**RIGHT ZONE.** The right zone configures the outputs. If the switch is set to "ON" the Q0.X will have the behaviour of a digital output. If it is set to "OFF" it will be digital. There is also a switch for switching between Half and Full Duplex. It is "ON" for HD and "OFF" for FD.

**TOP ZONE.** Communications and outputs can not work simultaneously. If Q0.9 is enabled RO must be disabled and vice versa. It is also the same implementation for the Q0.8 – DI.

### 8.1 RS- 485 Switch configuration

RS-485 CONFIGURATION			
TOP ZONE		LEFT ZONE	
Q0.9	OFF	DE-RS485	ON
RO	ON	A0.2-Q0.2	OFF
Q0.8	OFF	RE-RS485	ON
DI	ON	A0.1-Q0.1	OFF
		SDA	ON/OFF
		SCL	ON/OFF

**RS485:** Enable RE/DE/DI and RO internal pins with configuration switches. A0.2, A0.1, Q0.2, Q0.1, Q0.8 and Q0.9 will not be available. The defined Arduino Mega pins for RS485 are showed in the chart below.



## 8.2 I2C Switch configuration

I2C CONFIGURATION			
TOP ZONE		LEFT ZONE	
Q0.9	ON/OFF	DE-RS485	ON/OFF
RO	ON/OFF	A0.2-Q0.2	ON/OFF
Q0.8	ON/OFF	RE-RS485	ON/OFF
DI	ON/OFF	A0.1-Q0.1	ON/OFF
		SDA	OFF
		SCL	OFF

**I2C:** Enable SCL and SDA connections (direct Arduino pins) with configuration switches. IO.0 and Q0.6 will not be available. In order to implement this communication a 4.7k $\Omega$  pull-up resistor ([IS.AC12C-4.7K](#)) is required.

## 8.3 Analog/Digital Output Switch Configuration

RIGHT SIDE		
SWITCH CONFIG		
Output	ON	OFF
H/F	Half Duplex	Full Duplex
Q0.6	DIGITAL	ANALOG
Q0.5	DIGITAL	ANALOG
Q0.4	DIGITAL	ANALOG
Q0.3	DIGITAL	ANALOG
Q0.2	DIGITAL	ANALOG
Q0.1	DIGITAL	ANALOG
Q0.0	DIGITAL	ANALOG

## 9. Communications

### 9.1 SPI

The Ardbox pins used for the SPI bus are summarized in the table below. For SPI bus MISO, MOSI and CLOCK pins are common to all the connected devices to the M-Duino, conversely, each of the connected devices will have a single and dedicated SS pin.

Function	Ardbox connection	Mega board pin
MISO	MISO	MISO
MOSI	MOSI	MOSI
CLOCK	SCK	SCK
Reset	RESET	Reset
SS	SCL (pin 3)/SDA (pin 2)/DE (pin 7)/ RE(pin 4)	pin 3 /pin 2 /pin 7/pin 1

Check the switch configuration at section 8 to enable SS pins.



Check the link to see an example: <http://blog.industrialshields.com/en/how-to-upload-a-bootloader-on-a-ardboxm-duino-plc/>

## 9.2 RS-485

For RS485 communication protocol the defined Arduino Mega pins are showed in the chart below.

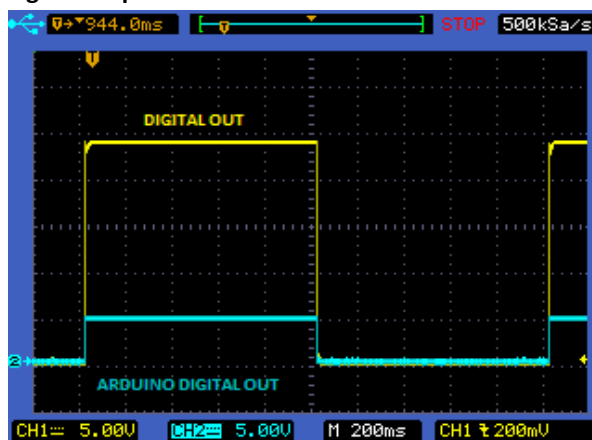
RS485 pinout	
Function	Arduino Pin
DI	10
RO	11
RE	1
DE	0

Check the switch configuration at section 9 to enable RS485 pins

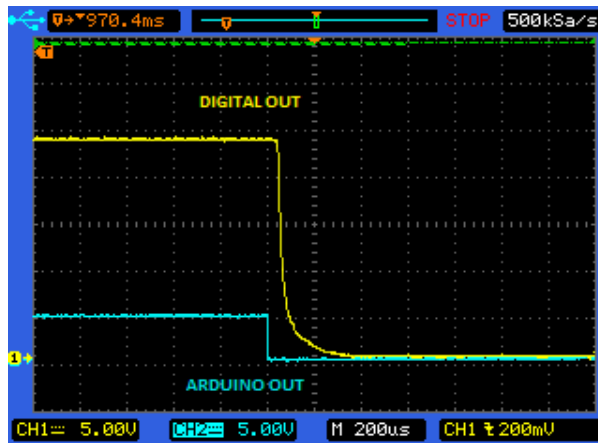
Check the link to see an example: <http://blog.industrialshields.com/en/rs485-communication/>

## 10. I/O technical details

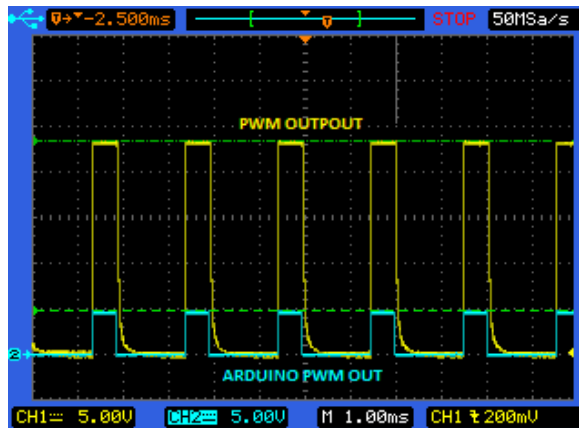
Digital Output Waveform



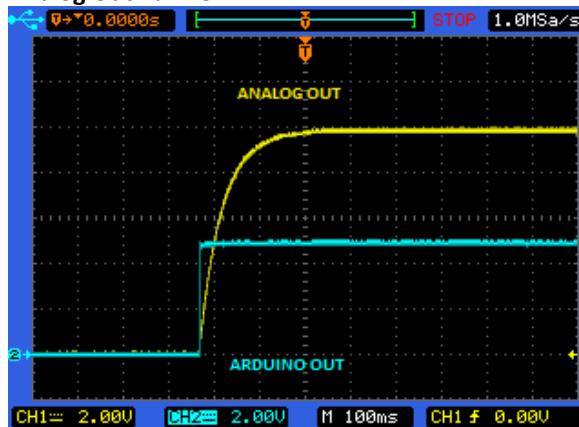
Digital Output Turn-off



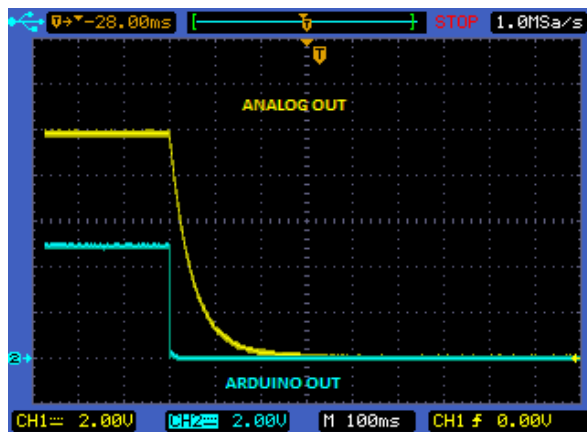
PWM Waveform



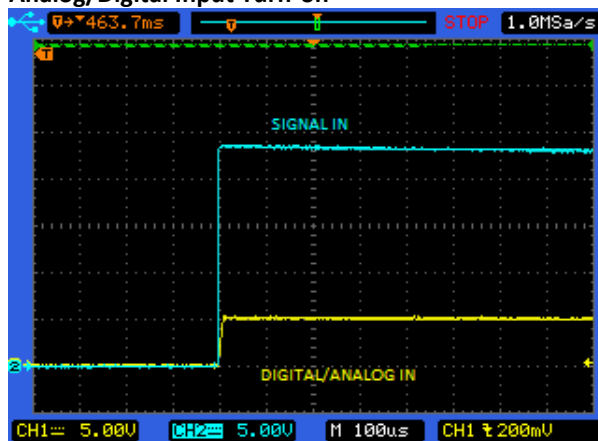
Analog Out Turn-on



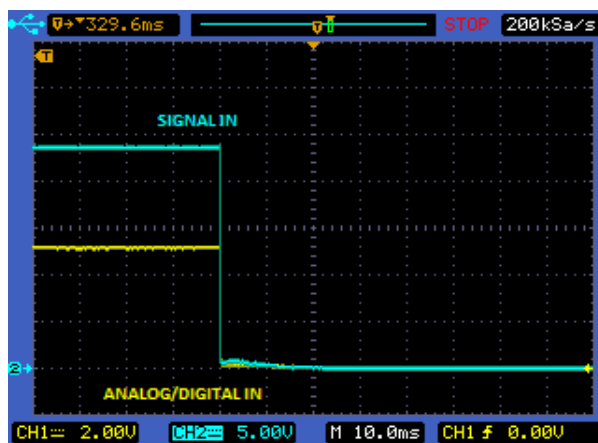
Analog Out Turn-off



Analog/Digital Input Turn-on

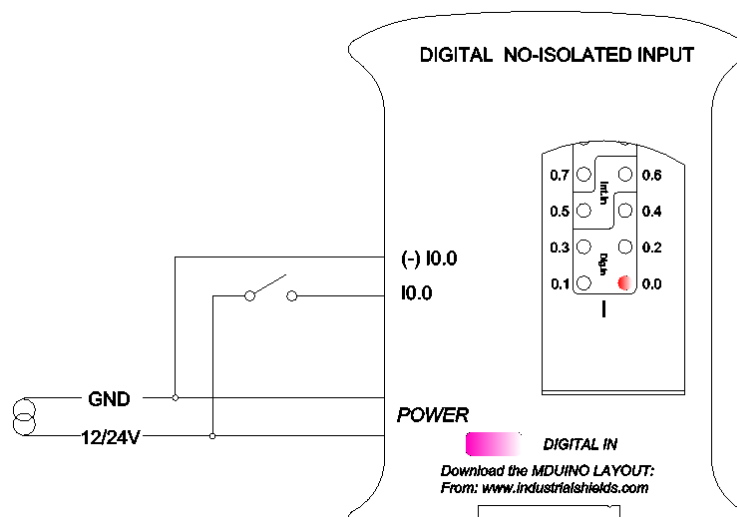
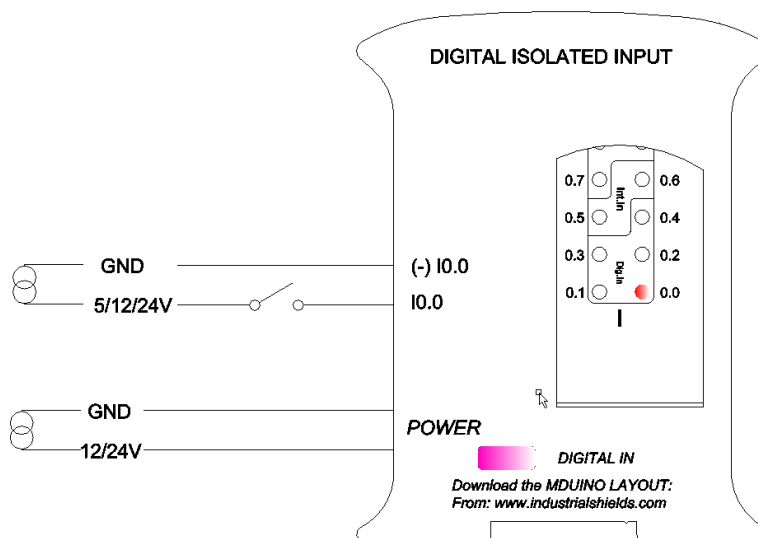


Analog/Digital Input Turn-off

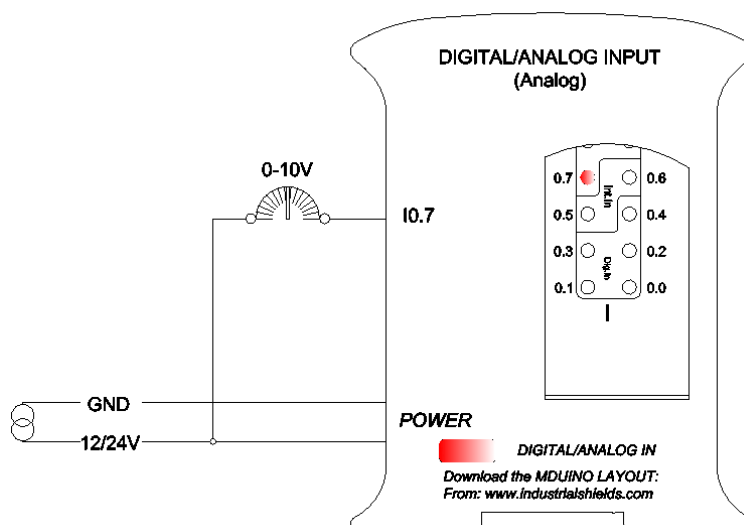
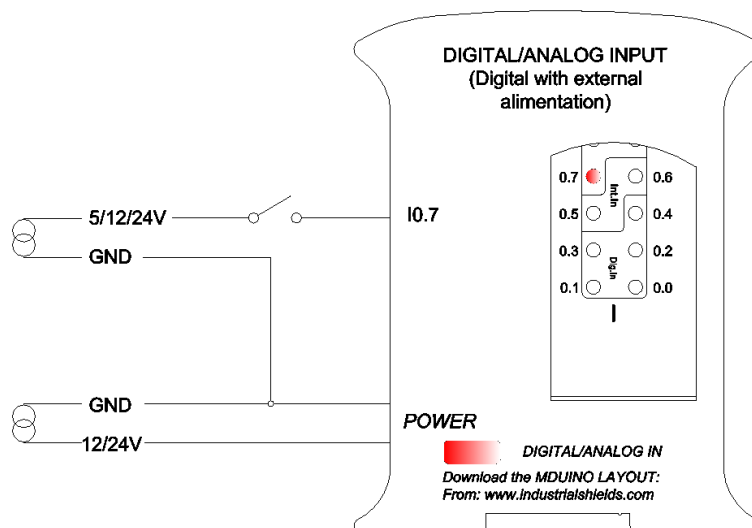
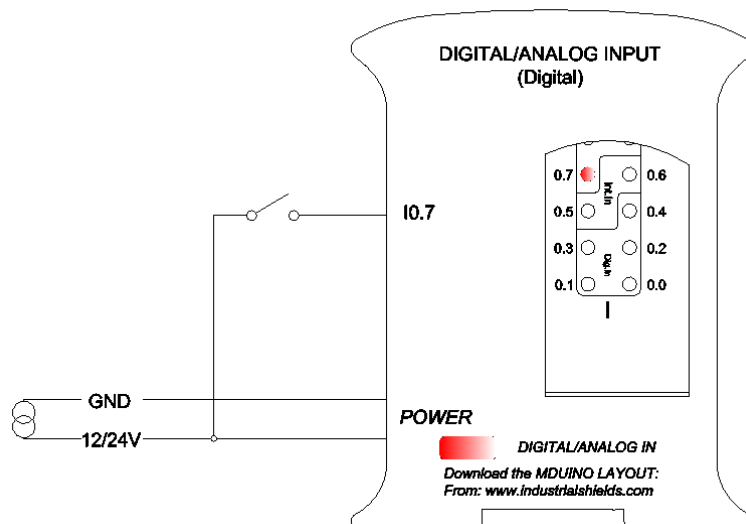


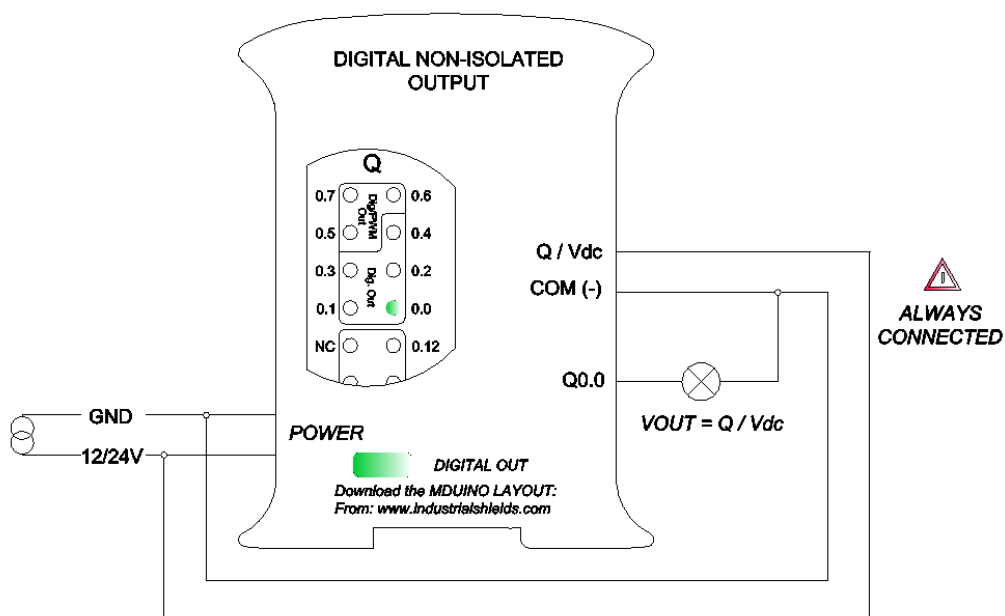
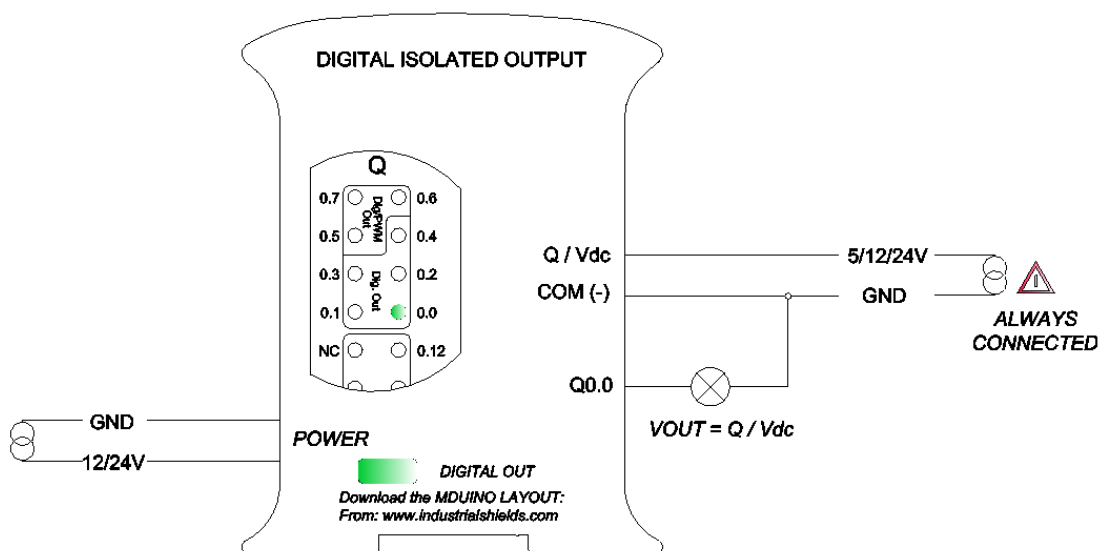
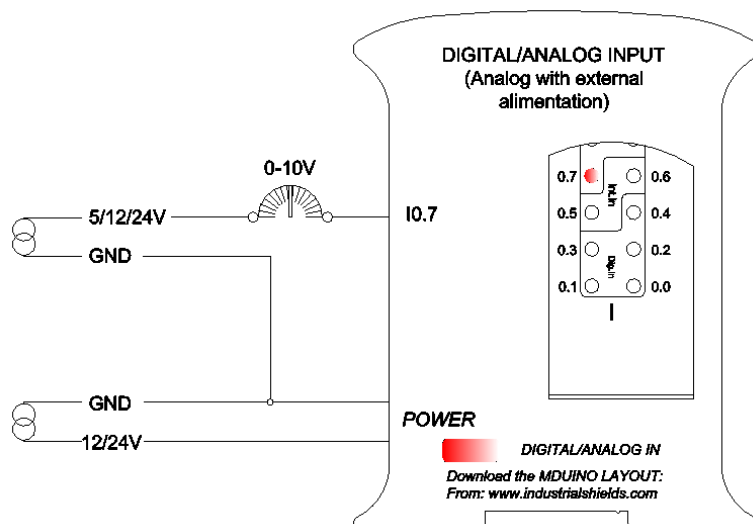


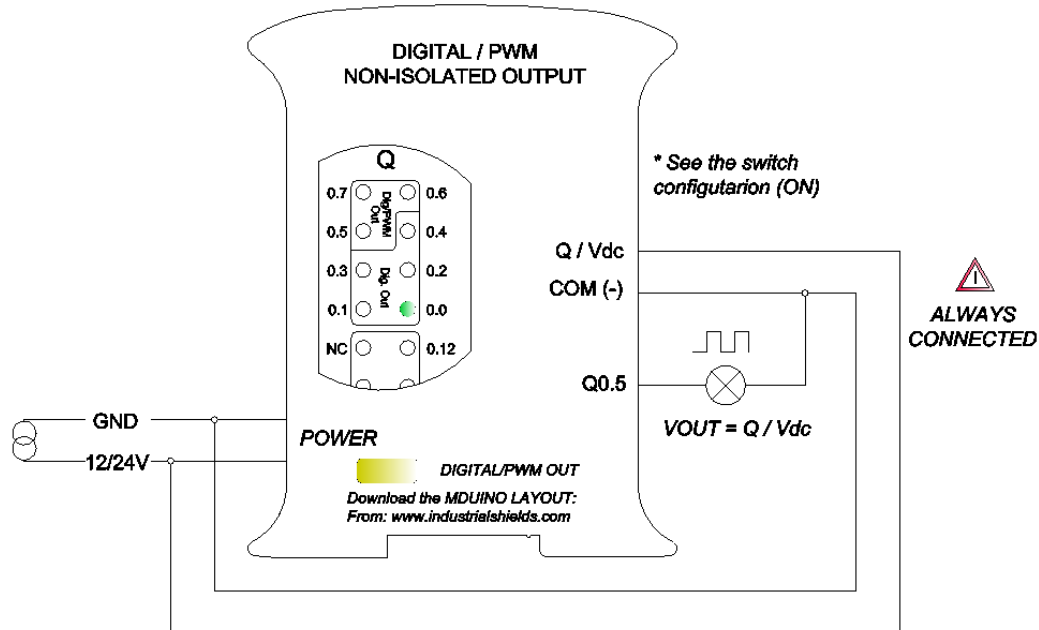
## 11. Typical Connections











## 12. Connector details

The connector inside the PLCs that mounts on the PCB is MC 0,5/10-G-2,5 THT – 1963502 from Phoenix contact. MC0,5/10-G-2,5THT

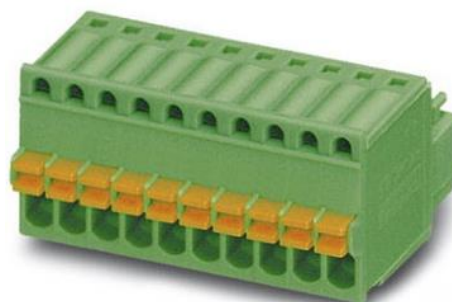
For I/O and power supply there is a FK-MC 0,5/10-ST-2,5 - 1881406 connector from Phoenix contact. FK-MC 0,5/10-ST-2,5

Connection details:

Article reference	MC 0,5/10-G-2,5 THT
Height	8,1mm
Pitch	2,5mm
Dimension	22,5mm
Pin dimensions	0,8x0,8mm
Pin spacing	2,50mm



Article reference	FK-MC 0,5/10-ST-2,5
Rigid conduit section min.	0,14 mm <sup>2</sup>
Rigid conduit section max.	0,5 mm <sup>2</sup>
Flexible conduit section min.	0,14 mm <sup>2</sup>
Flexible conduit section max.	0,5 mm <sup>2</sup>
Conduit section AWG/kcmil min.	26
Conduit section AWG/kcmil max.	20

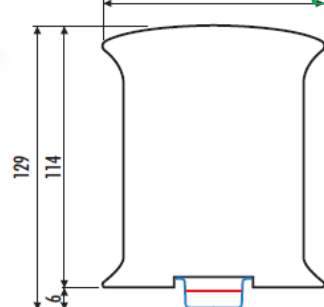




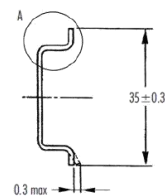
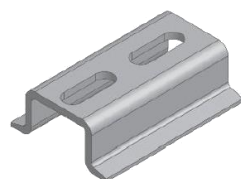
### 13. ARDBOX Family Dimensions:

### 14. DIN rail mounting:

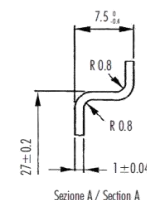
### 15.



45mm width

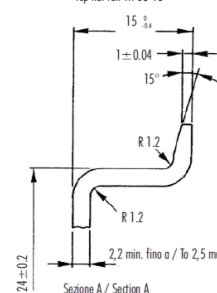


Profilato a cappello TH 35-7,5  
Top hat rail TH 35-7,5



Sezione A / Section A

Profilato a cappello TH 35-15  
Top hat rail TH 35-15



Sezione A / Section A



CARATTERISTICHE	METODO	UNITA' DI MISURA	BLENDE PC/ABS
<b>Meccaniche</b>			
Resistenza a trazione allo snervamento	ASTM D638	MPa	68
Resistenza a trazione a rottura	ASTM D638	MPa	48
Allungamento a rottura	ASTM D638	%	59
Modulo in flessione	ASTM D790	MPa	2894
Prova di carico con intaglio	ISO 180/14	XJ/in	5.5
<b>Termiche</b>			
Temperatura di ammolimento Visc. metodo B	ASTM D1525	°C	114
Temperatura Ricotta	ASTM D648	°C	97
<b>Fisiche</b>			
Peso specifico	ASTM D792	g/cm3	1.21
Ritiro nella stampa	ASTM D955	%	0.4/0.6
Melt Flow Index 260°C - 98N	ASTM D1238	g/10'	11.1
<b>Comportamento alla fiamma</b>			
Autosostegno (mm di spessore)	UL94	-	V-0 (0.8)
Filo fuoriuscente 32 mm	IEC 695.2.1	°C	960

Italtronic si riserva il diritto di modificare il materiale con cui realizza i propri prodotti senza obbligo di preavviso.

FEATURES	TEST METHOD	UNITS	BLENDE PC/ABS
<b>Mechanical test</b>			
Resistance to tensile stress at yield	ASTM D638	MPa	68
Tensile strength	ASTM D638	MPa	48
Ultimate elongation	ASTM D638	%	59
Flexing modulus	ASTM D790	MPa	2894
Load test method	ISO 180/14	XJ/in	5.5
<b>Thermal test</b>			
Heat softening temperature method B	ASTM D1525	°C	114
Reheating temperature	ASTM D648	°C	97
<b>Physical test</b>			
Specific gravity	ASTM D792	g/cm3	1.21
Mold shrinkage	ASTM D955	%	0.4/0.6
Melt Flow Index 260°C - 98N	ASTM D1238	g/10'	11.1
<b>Flame test</b>			
Self extinguisher (thickness in mm)	UL94	-	V-0 (0.8)
Incandescence thread 32 mm	IEC 695.2.1	°C	960

Italtronic can operate any change of the materials without being obliged to forewarn.



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