



INDUSTRIAL SHIELDS

USER GUIDE

ARDBOX ANALOG



Version:
15-07-15_Ardbox_Analog



Ardbox User Guide:

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INDUSTRIAL SHIELDS

COMPACT PLC.



INDUSTRIAL SHIELDS

2 ARDBOX FAMILY GUIDE



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

Supply Voltage

24 Vcc

Compact

DIN rail mounting

I2C

Safety

Industrial communications

I/Os

Digital
Analog
Relay

COMPACT PLC ARDUINO 24Vdc ARDBOX ANALOG	
Input Voltage	12-24Vdc
Max. current	0,5A
Size	100x45x115
Clock Speed	16MHz
Flash Memory	32KB of which 0,5KB are used by bootlader
SRAM	2KB
EEPROM	1KB
Communications	I2C ¹ – USB -- RS232 -- RS485 –SPI
TOTAL Input points	9
TOTAL Output points	10
Type of signals	
* An/Dig Input 10bit (0-10Vdc / 0-24Vdc)	8
* Digital Input (24Vdc)	1
* Interrupt Input HS (24Vdc)	1 (the Digital Input can work as Interrupt)
* An/Dig Output 8bits (0-10Vdc /0-24Vdc)	6
* Analog Output 8bits (0-10Vdc)	1
* Digital Output (24Vdc)	3
* PWM Output 8bit (24Vdc)	7
Expandability	I2C ¹ - 127 elements – RS232 - RS485 - SPI
Reference	IS.AB20AN.base
* By using this type of signal you can no longer use Digital signal (24Vdc) You must read product Datasheet. (1) With previous request. IMPORTANT	

¹ 10k pull-up resistance required (IS.ACI2C-4.7K)



3 Precautions

1.1. Arduino Board

All Ardbox family products use Arduino LEONARDO Board.

1.2. Intended Audience

This manual is intended for the following personal, which must also have knowledge of electrical systems.

1.3. General Precautions

The user must operate the product according to the performance specifications described in the operation manuals.

Before using the product under conditions, which are not described in the manual or applying the product 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.

Make sure that the rating and performance characteristics of the product are sufficient for the systems, machines, and equipment, and be sure to provide the systems, machines, and equipment with double safety mechanisms.

This manual provides information for programming and operating the Unit. Be sure to read this manual before attempting to use the Unit keep this manual close at hand for reference during operation.



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.



4 Technical Specifications

4.1 General Specifications:

Power supply voltage	DC power supply	24Vdc
Operating voltage range	DC power supply	20.4 to 25.4Vdc
Power consumption	DC power supply	30VAC max.
External power supply	Power supply voltage	24Vdc
	Power supply output capacity	700Ma
Insulation resistance		20MΩ min.at 500Vdc between the AC terminals and the protective earth terminal.
Dielectric strength		2.300 VAC at 50/60 HZ for one minute with a leakage current of 10mA max. Between all the external AC terminals and the protective earth terminal.
Shock resistance		80m/s ² in the X, Y and Z direction 2 times each.
Ambient temperature (operating)		0° to 45°C
Ambient humidity (operating)		10% to 90% (no condensation)
Ambient environment (operating)		With no corrosive gas
Ambient temperature (storage)		-20° to 60°C
Power supply holding time		2ms min.
Weight		340g max.

4.2 Performance Specification:

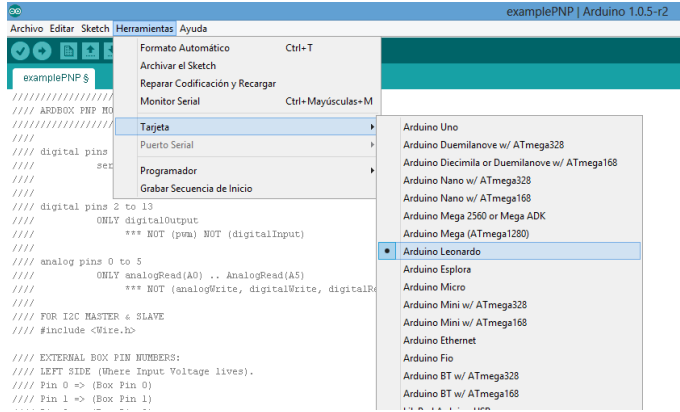
Arduino Board	ARDUINO LEONARDO
Control method	Stored program method
I/O control method	Combination of the cyclic scan and immediate refresh processing methods.
Programming language	Arduino IDE. Based on wiring (Wiring is an Open Source electronics platform composed of a programming language. "similar to the C". http://arduino.cc/en/Tutorial/HomePage
Microcontroller	ATmega32u4
Flash Memory	32kb of which 4 kb are used by bootloader
Program capacity (SRAM)	2.5kb
EEPROM	1kb
Clock Speed	16MHz



5 Software interface

Arduino IDE is compatible for programming these PLCs. You must to download a start code in www.industrialshields.com at product page in “document files” section and then It is necessary open it with Arduino IDE.

Configuration about Arduino IDE:



6 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:

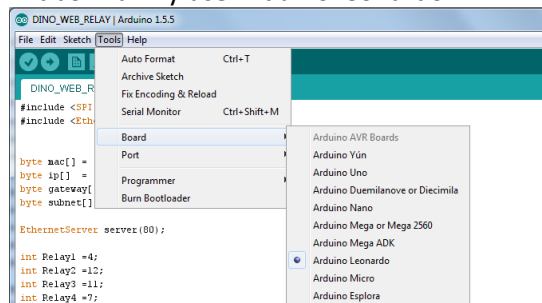
You can install with this link:

<http://arduino.cc/download.php?f=/arduino-1.0.6-windows.exe>

- Select Arduino Board

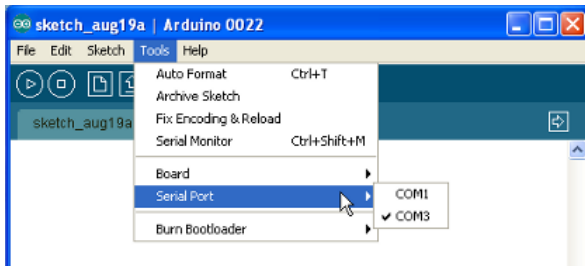
NOTE:

Ardbox Family use Arduino leonardo.



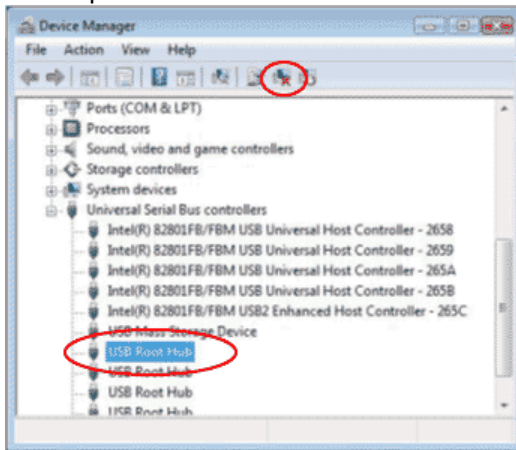


- Select correct port.



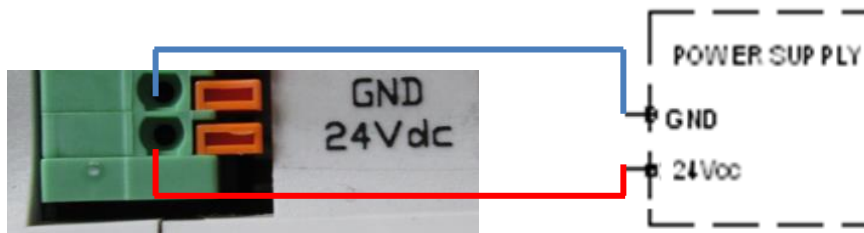
IMPORTANT:

Verify the USB port is detected:



7 How to connect PLC to power supply

- Ardbox Family PLCs are 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



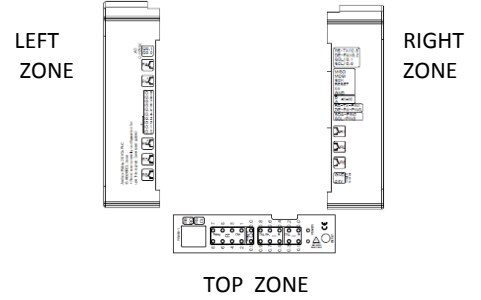
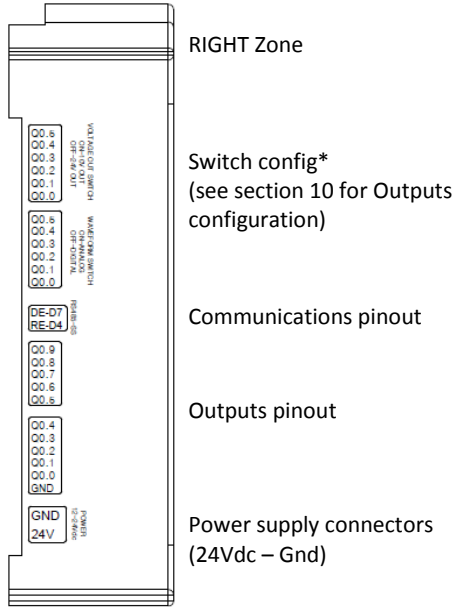
* Not recommended for industrial applications. The *Jack* connector needs to be removed and use the live and GND connectors.





8 Ardbox Analog I/O Pinout:

8.1 Zone Connections



Base (common unit)		
LEFT Zone		
Ardbox Connector	Arduino Pin	Function
MISO	-	SPI
MOSI	-	SPI
SCK	-	SPI
RESET	-	SPI
5V	-	SPI
GND	-	SPI
B	-	RS485
A	-	RS485
TX	-	RS232
RX	-	RS232
SDA-PIN2	2	I2C/ SPI (SS)
SCL-PIN3	3	I2C/ SPI (SS)
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 ²	A4/ A5	Analog/Digital Input
I0.4 ²	A4/ A5	Analog/Digital Input
I0.3 ³	4	Analog/Digital Input
I0.2	8	Analog/Digital Input
I0.1	12	Analog/Digital Input
GND	-	Gnd
(-)I0.0	-	-
I0.0 ³	2	Digital Input/Interrupt

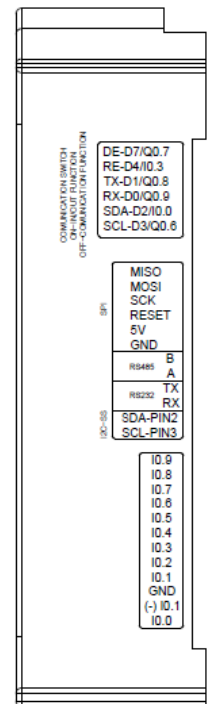
Base (common unit)		
RIGHT Zone		
Ardbox Connector	Arduino Pin	Function
DE	7	RS485/ SPI SS
RE	4	RS485/ SPI SS
Q0.9 ³	0	Digital Output
Q0.8 ³	1	Digital Output
Q0.7 ³	7	Digital Output
Q0.6 ³	3	Analog/PWM
Q0.5	5	Analog/PWM/ digital Output
Q0.4	6	Analog/PWM/ digital Output
Q0.3	9	Analog/PWM/ digital Output
Q0.2	10	Analog/PWM/ digital Output
Q0.1	11	Analog/PWM/ digital Output
Q0.0	13	Analog/PWM/ digital Output
GND	-	Gnd
GND 24Vdc	-	Gnd

LEFT Zone

Switch config* (see section 14 for Communications configuration).
Enabling Communications disables some I/Os)

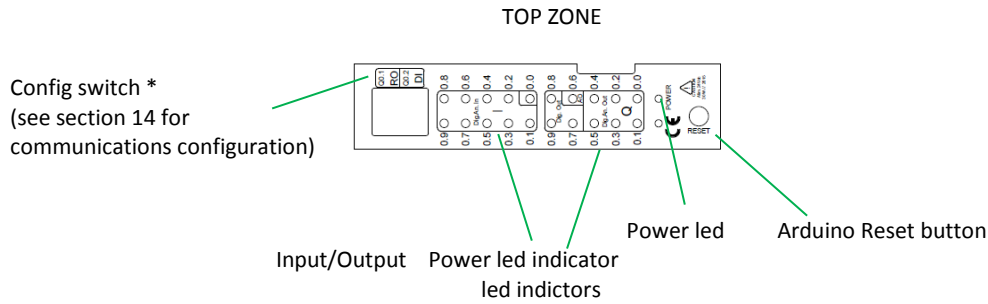
Communications pinout

Inputs pinout



² I0.5 and I0.4 are the same inputs, they are physically binded.

³ See section 10 to enable these connections.



9 I/O Pinout (summary pinout/Arduino PIN)

LEFT Zone			RIGHT Zone			TOP Zone	
Ardbox Connector	Arduino Pin	Function	Ardbox Connector	Arduino Pin	Function	Ardbox LED	SIGNAL
MISO	-	SPI	DE	7	RS485/	Q0.9	Q0.9
MOSI	-	SPI			SPI SS	Q0.8	Q0.8
SCK	-	SPI	RE	4	RS485/	Q0.7	Q0.7
RESET	-	SPI			SPI SS	Q0.6	Q0.6
5V	-	SPI	Q0.9*	0	Digital Output	Q0.5	Q0.5
GND	-	SPI	Q0.8*	1	Digital Output	Q0.4	Q0.4
B	-	RS485	Q0.7*	7	Digital Output	Q0.3	Q0.3
A	-	RS485	Q0.6*	3	Analog/PWM	Q0.2	Q0.2
TX	-	RS232	Q0.5	5	Analog/PWM/	Q0.1	Q0.1
RX	-	RS232			digital Output	Q0.0	Q0.0
SDA-PIN2	2	I2C/ SPI (SS)	Q0.4	6	Analog/PWM/	I0.9	I0.9
SCL-PIN3	3	I2C/ SPI (SS)			digital Output	I0.8	I0.8
I0.9	A0	Analog/Digital	Q0.3	9	Analog/PWM/	I0.7	I0.7
		Input			digital Output	I0.6	I0.6
I0.8	A1	Analog/Digital	Q0.2	10	Analog/PWM/	I0.5	I0.5
		Input			digital Output	I0.4	I0.4
I0.7	A2	Analog/Digital	Q0.1	11	Analog/PWM/	I0.3	I0.3
		Input			digital Output	I0.2	I0.2
I0.6	A3	Analog/Digital	Q0.0	13	Analog/PWM/	I0.1	I0.1
		Input			digital Output	I0.0	I0.0
I0.5 ⁴	A4/	Analog/Digital	GND	-	Gnd		
	A5	Input					
I0.4 ⁴	A4/	Analog/Digital	GND	-	Gnd		
	A5	Input	24Vdc				
I0.3*		Analog/Digital					
	4	Input					
I0.2		Analog/Digital					
	8	Input					
I0.1		Analog/Digital					
	12	Input					
GND		Gnd					
(-) I0.0	-						
I0.0*	2	Digital Input/					
		Interrupt					

*NOTE: To enable these connections see section 10.

⁴ I0.5 and I0.4 are the same inputs, they are physically binded.



10 Switch configuration

LEFT Zone		
SWITCH CONFIG		
Arduino Pin	OFF*	ON
7	DE	Q0.7
4	RE	I0.3
1	TX	Q0.8
0	RX	Q0.9
2	SDA	I0.0
3	SCL	Q0.6

TOP Zone		
ENABLED CONNECTION	ON	OFF
Q0.1	Q0.1	RO
RO	RO	Q0.1
Q0.2	Q0.2	DI
DI	DI	Q0.2

***IMPORTANT:**

LEFT ZONE. To enable communication connections the switches must be set to “OFF”. Set to “ON” position to enable I/Os PLC connection. Communications and I/Os on the chart can not work simultaneously. For example if DE is enabled (OFF), Q0.7 will not work. OFF position provides direct connection to Arduino Pin (NOT for TX and RX), so they can be programmed according to Arduino pin features.

TOP ZONE. Communications and outputs can not work simultaneously. If Q0.1 is enabled RO must be disabled and conversely.

LEFT SIDE		
SWITCH CONFIG		
Input	ON	OFF
Q0.6 Q0.5 Q0.4 Q0.3 Q0.2 Q0.1 Q0.0	10 Vdc	24 Vdc
SWITCH CONFIG		
Q0.6 Q0.5 Q0.4 Q0.3 Q0.2 Q0.1 Q0.0	Analog	Digital

Some Outputs can be configured as Analg/Digital and 10Vdc/24Vdc, the chart above summarizes the positions for each type of configurable I/O.



11 I/O technical details

Ardbox family products		
Signal	Vdc	Maxim current consumption
Digital Input	24 Vdc	60mA
Analog/Digital Input configurable		
Analog	0-10Vdc	60mA
Digital	24Vdc	60mA
Digital Output	24Vdc ⁵	200mA
Analog/Digital/PWM Output configurable		
Analog	0-10Vdc	80mA
Digital	24 Vdc	80mA
PWM	24Vdc	80mA
Cumulative outputs	All outputs can be working simultaneously at its max current value	

⁵ You can select 24Vdc or 10Vdc (with correctly switch configuration). Digital output will be 12Vdc If you connect PLC to 12Vdc power supply



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](#)

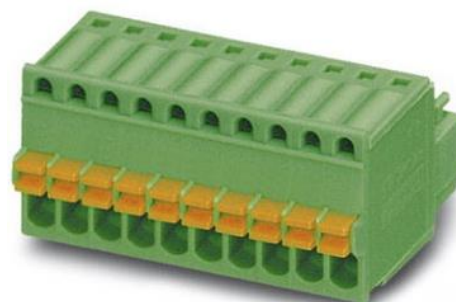
For I/O and power supply there is a FK-MC 0,5/10-ST-2,5 - 1881406 connector from Phoenix contact. [FK-MC 0,5/10-ST-2,5](#)

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



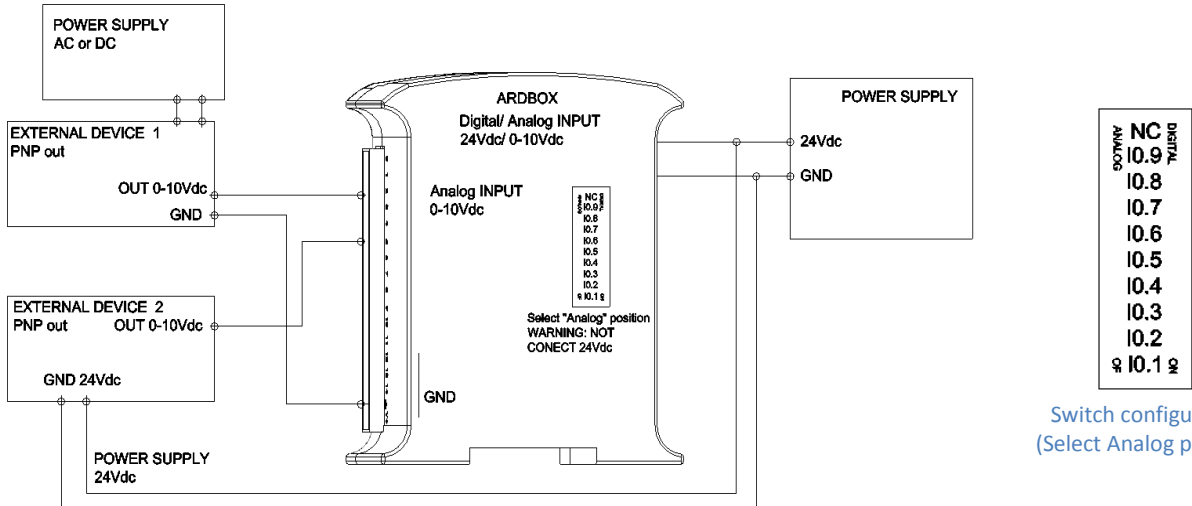


13 Connection type

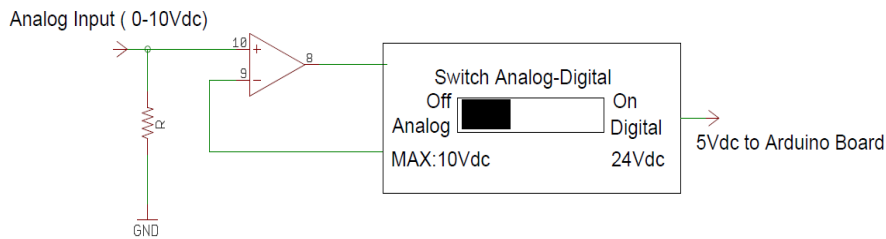
13.1 Analog (0-10Vdc) / Digital Inputs “configurable”

13.1.1 Analog configuration mode:

Connection analog Inputs (0-10Vdc)



Switch configuration
(Select Analog position)



- Programation Code (example):

```

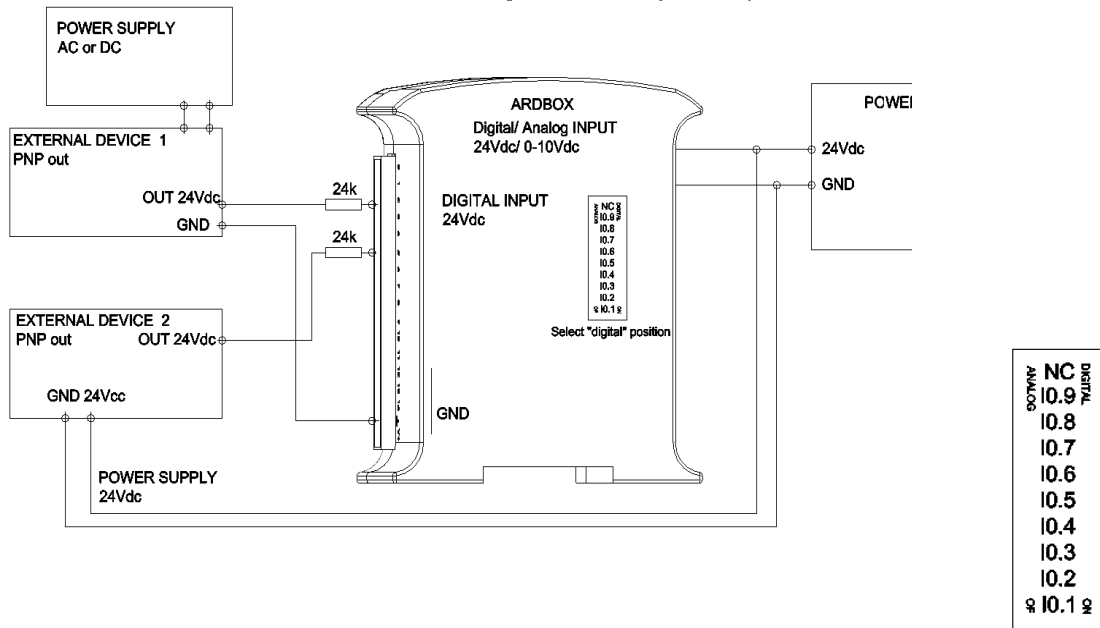
int I01 = A05; // select the Analog (0-10Vdc) / Digital (24Vdc)IN /**warning** (if Analog selection connect 10Vdc MAX).
int I02 = A04; // select the Analog (0-10Vdc) / Digital (24Vdc)IN /**warning** (if Analog selection connect 10Vdc MAX).
void setup() {
  pinMode(I01, INPUT);
}
Void loop(){
  value = analogRead(A5);
  /* Lo que se quiera */ = digitalRead(I01);
}

```

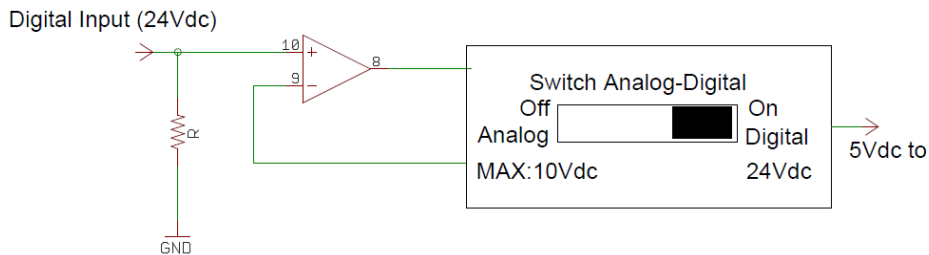


13.1.2 Digital configuration mode:

Connection digital Inputs (24Vdc)



Switch configuration (Select digital position)



- Programation Code (example):

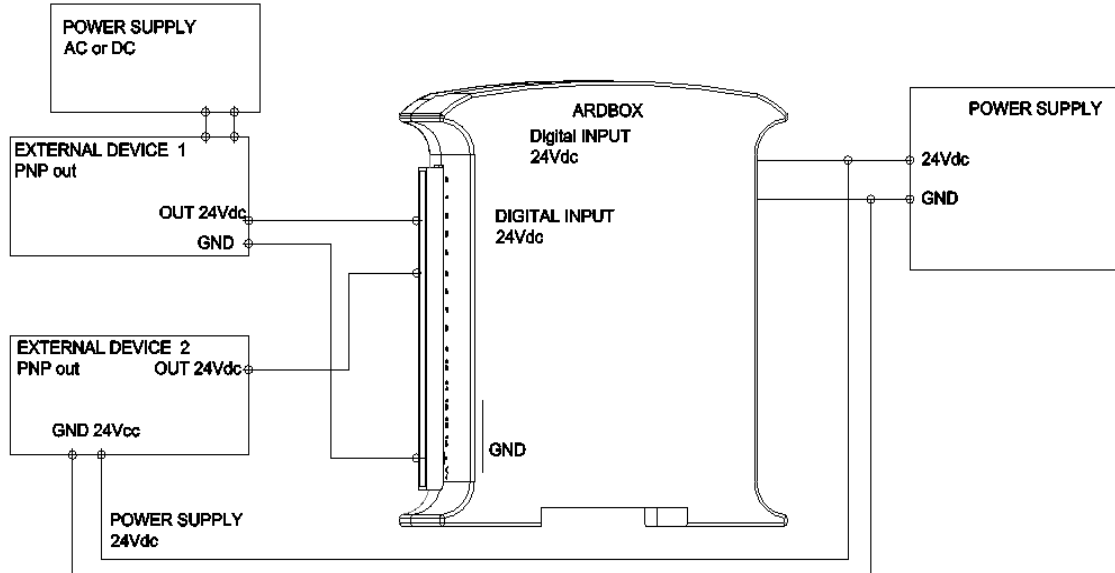
```
int I01 = A05; // select the Analog (0-10Vdc) / Digital (24Vdc)IN /**warning** (if Analog slection connect 10Vdc MAX).
int I02 = A04; // select the Analog (0-10Vdc) / Digital (24Vdc)IN /**warning** (if Analog slection connect 10Vdc MAX).
void setup() {
  pinMode(I01, INPUT);
}
Void loop(){
  value = analogRead(A5);
  /* Lo que se quiera */ = digitalRead(I01);
}
}
```



14 How does it work:

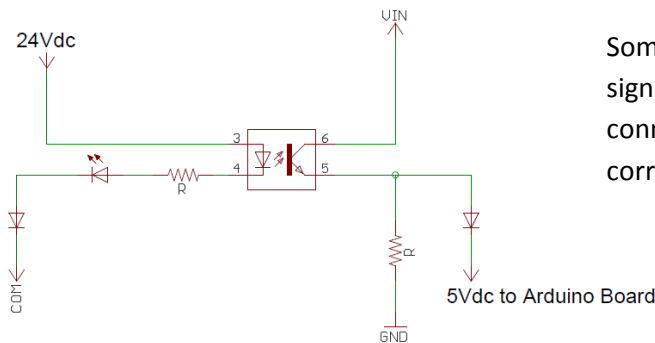
14.1 Digital Inputs

Connection digital Inputs (24Vdc)



NOTE:

Some digital Inputs have an isolated signal. In this case is necessary to connect correctly ground (GND) in correctly "com" pin.



- Programation Code (example):

```
int I01 = 12; // Digital (24Vdc)
void setup() {
  pinMode(I01, INPUT);
}
void loop(){
  /* Lo que se quiera */ = digitalRead(I01);
}
```

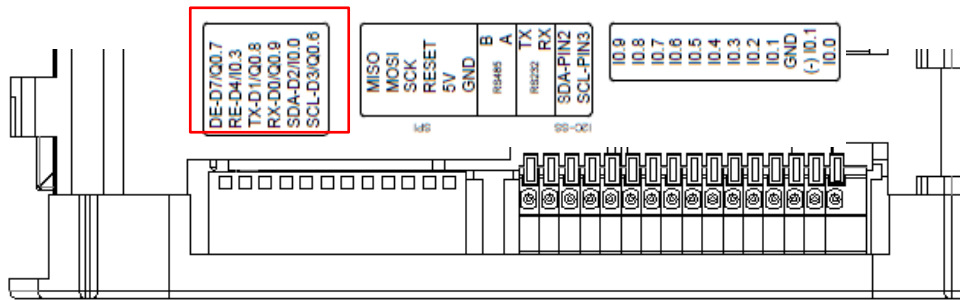


15 Communications pinout

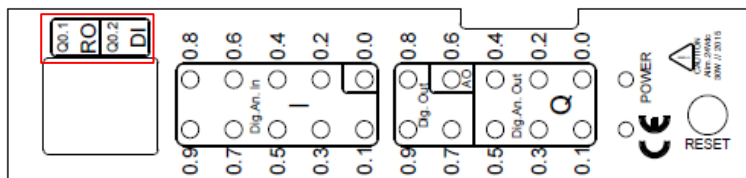
In LEFT Zone and TOP Zone Arduino communication PINS can be enabled:

15.1 LEFT Zone

Arduino Pin	Switch mode OFF*	Switch mode ON
7	DE	Q0.7
4	RE	I0.3
1	TX	Q0.8
0	RX	Q0.9
2	SDA	I0.0
3	SCL	Q0.6



15.2 TOP Zone



TOP Zone		
ENABLED* CONNECTION	ON	OFF
Q0.1	Q0.1	RO
RO	RO	Q0.1
Q0.2	Q0.2	DI
DI	DI	Q0.2

*IMPORTANT:

LEFT ZONE. To enable communication connections the switches must be set to “OFF”. Set to “ON” position to enable I/Os PLC connection. Communications and I/Os on the chart can not work simultaneously. For example if DE is enabled (OFF), Q0.7 will not work. OFF position provides direct connection to Arduino Pin (NOT for TX and RX), so they can be programmed according to Arduino pin features.

TOP ZONE. Communications and outputs can not work simultaneously. If Q0.1 is enabled RO must be disabled and conversely.



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

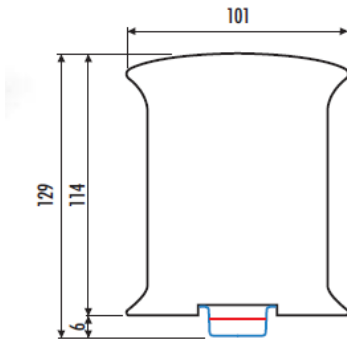
RS485 pinout	
Function	Arduino Pin
DI	10
RO	11
RE	4
DE	7

For I2C communication, Ardbox family products are directly connected to Arduino Mega Board. In order to implement this communication a 10k Ω pull-up resistor is required.

<http://www.industrialshields.com/accesories>

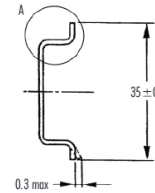
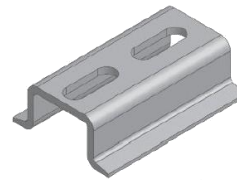


16 ARDBOX Family Dimensions:

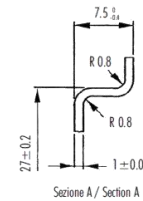


45mm width

17 DIN rail mounting:

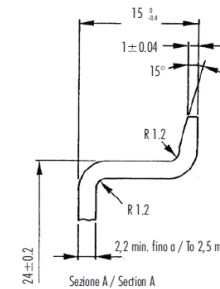


Profilato a cappello TH 35-7,5
Top hat rail TH 35-7,5



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
Mecaniche			
Resistenza a trazione allo staccamento	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 Load con intaglio	ISO 180/14	KJ/m ²	5.5
Termiche			
Temp. di ammolimento Vicat, metodo B	ASTM D1525	°C	114
Temperatura Ricetta 1.81 MPa	ASTM D448	°C	97
Fisiche			
Peso specifico	ASTM D792	g/cm ³	1.21
Ritiro nello stampo	ASTM D955	%	0.4/0.6
Melt Flow Index 260°C - 98N	ASTM D1238	g/10'	11.1
Comportamento alla fiamma			
Autosostentanza (min di spessore)	UL94	-	V-0 (0.8)
Filo Intendesante 3.2 mm	IEC 695.2.1	°C	980

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
Mechanical test			
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 notched	ISO 180/14	KJ/m ²	5.5
Thermal test			
Vicat softening temperature method B	ASTM D1525	°C	114
Reheating temperature 1.81 MPa	ASTM D448	°C	97
Physical test			
Specific gravity	ASTM D792	g/cm ³	1.21
Mold shrinkage	ASTM D955	%	0.4/0.6
Melt Flow Index 260°C - 98N	ASTM D1238	g/10'	11.1
Flame test			
Self extinguisher (thickness in mm)	UL94	-	V-0 (0.8)
Intendesante thread 3.2 mm	IEC 695.2.1	°C	980

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

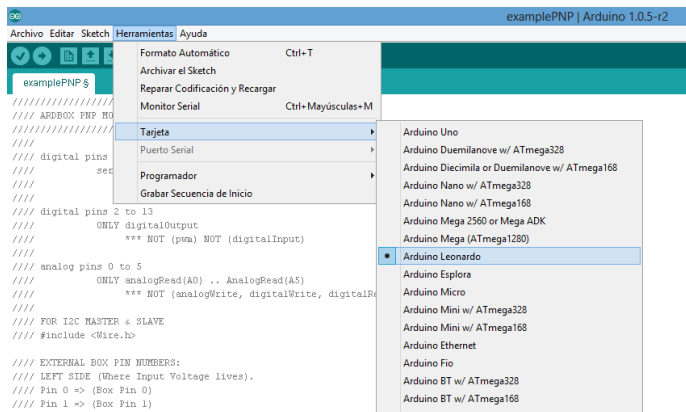


18 Software Interface:

Arduino IDE is compatible to program these PLCs. You must download a start code in www.industrialshields.com at product page in “document files” section and then open it with Arduino IDE.

Configuration of Arduino IDE:

All Ardbox PLCs use an Arduino Leonardo and you need to choose these option in Arduino IDE.



About Industrial Shields:

SPAIN

Avda. Castell de Barberà 26, nave 9

08210 Barberà del Vallès (Barcelona)

Tel.+34 635693611

Mail: industrialshields@industrialshields.com