



INDUSTRIAL SHIELDS

USER GUIDE

ARDBOX RELAY



Version:
004-001-70_Ardbox_Relay



Ardbox User Guide:

1 Contents

2	ARDBOX.....	3
	4
3	Precautions.....	4
1.1.	Arduino Board	4
1.2.	Intended Audience	4
1.3.	General Precautions	4
4	Technical Specifications	5
4.1	General Specifications:.....	5
4.2	Performance Specification:	6
5	Software interface.....	6
6	How to connect PLC Arduino to PC.....	6
7	How to connect PLC to power supply	8
8	Ardbox Relay I/O Pinout:.....	9
	Zone Connections.....	9
	9
9	Switch configuration	11
10	I/O technical details	13
11	Connector details	16
12	ARDBOX Family Dimensions:.....	17
13	DIN rail mounting:.....	17
14	Software Interface:.....	18



INDUSTRIAL SHIELDS

2 ARDBOX

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



INDUSTRIAL SHIELDS



Supply Voltage
24 Vcc

Compact
DIN rail mounting



COMPACT PLC ARDUINO 12-24Vdc ARDBOX RELAY		
Alimentation Voltage	12-24Vdc	Fuse protection (1A) Polarity protection
Max. current consumption	0,5A	
Size	100x45x115	
Clock Speed	16MHz	
Flash Memory	32KB of which 4KB are used by bootlader	
SRAM	2.5KB	
EEPROM	1KB	
Communications	I2C ¹ -- USB -- RS232 -- RS485 -- SPI	
TOTAL Input points	10	
TOTAL Output points	10	
INPUTS	Digital range: 5/12/24 Vdc (3.8 to 25.4 Vdc) Analog range: 0-10 Vdc	
Digital	10	5/12/24Vdc I min: 3/6 mA Separated PCB ground
Analog 10 bits	6 of 10 Digital input	0-10V Input Impedance: 39K Separated PCB ground
* Interrupt HS	4 of 10 Digital input	5/12/24Vdc I min: 5/10 mA Separated PCB ground

¹ Pull-up resistance required for i2c ([IIS.ACI2C-4.7K](#))



Safety
Industrial communications

I/Os
Digital
Analog
Relay

OUTPUTS	Digital Isolated range: 5/12/24 Vdc (4.6 to 25.4 Vdc) Analog range: 0-10 Vdc	
Relay	8	I _{max} : 5A (See Relay Specification in i/o technical details)
Analog 8 bits	2	0-10 Vdc I _{max} : 40 mA Separated PCB ground
Expandability	I2C ¹ – RS232 - RS485 - SPI	
Reference	IS.AB20AN.base	
* By using this type of signal you can no longer use Digital signal You must read product Datasheet. (1) With previous request. IMPORTANT		

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	12/24Vdc
Operating voltage range	DC power supply	11.4 to 25.4Vdc
Power consumption	DC power supply	30VAC max.
External power supply	Power supply voltage	12/24Vdc
	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.	



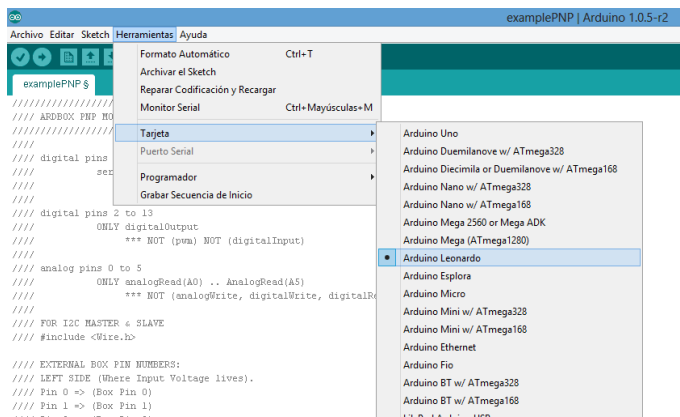
4.2 Performance Specification:

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:

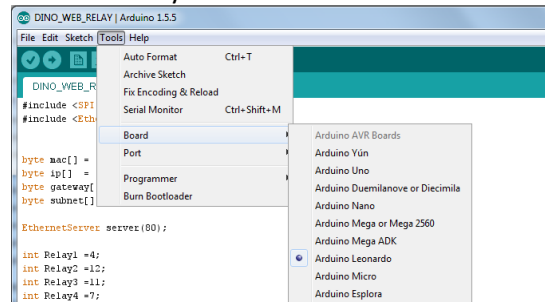
You can install with this link:

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

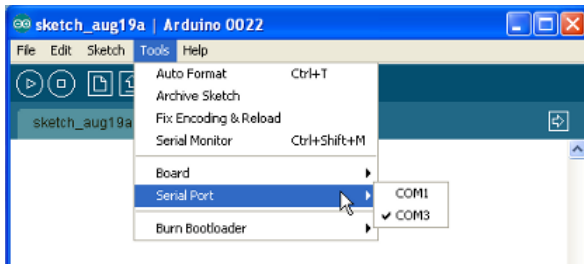
- Select Arduino Board



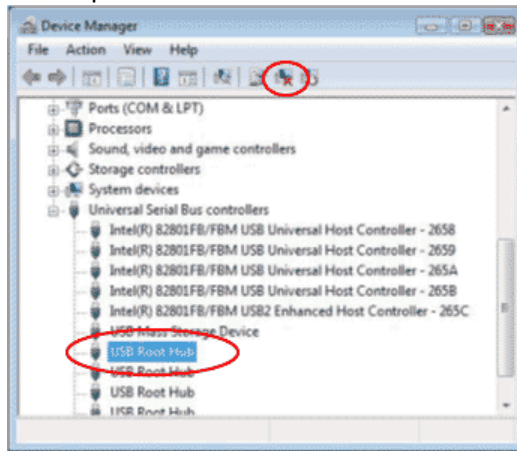
NOTE:
Ardbox Family use Arduino Leonardo.



- Select correct port.



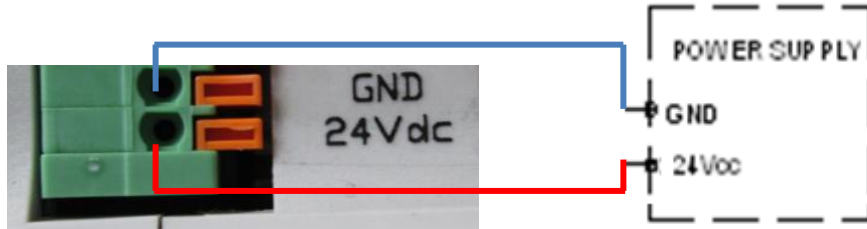
IMPORTANT:
Verify the USB port is detected:





7 How to connect PLC to power supply

- Ardbox Family PLCs are 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



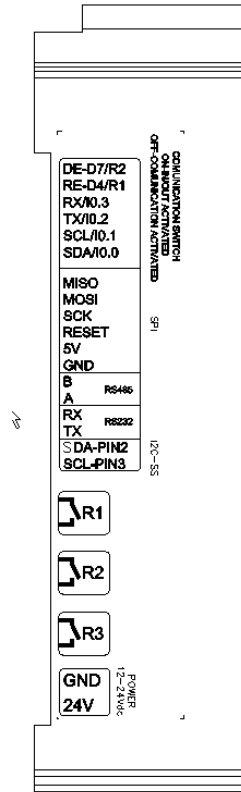
* Not recommended for industrial applications. The *Jack* connector needs to be removed and use the live and GND connectors.





8 Ardbox Relay I/O Pinout: Zone Connections

Base (common unit)		
LEFT ZONE		
Ardbox Connector	Arduino Pin	Function
MISO	-	SPI-MISO
MOSI	-	SPI-MOSI
SCK	-	SPI-CLOCK
RESET	-	SPI-RESET
B	-	RS485
A	-	RS485
TX-PIN1	1	Serial/RS232
RX-PIN0	0	Serial/RS232
SDA-PIN2	2	I2C/SPI SS
SCL-PIN3	3	I2C/SPI SS
R1 ²	4	Relay 1 Out
R2 ²	7	Relay 2 Out
R3	8	Relay 3 Out
Gnd	-	Gnd
24V	-	-



LEFT ZONE

Switch config*

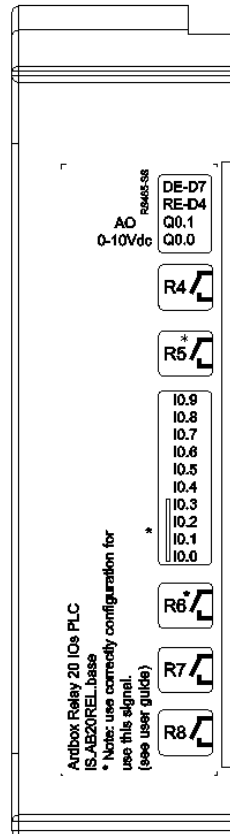
(see section 9 for Communications configuration. Enabling Communications disables some I/Os)

Communications pinout

Relay Outputs

Power supply connectors (24Vdc – Gnd)

Base (common unit)		
RIGHT ZONE		
Ardbox Connector	Arduino Pin	Function
DE	7	RS485/ SPI SS
RE	4	RS485/ SPI SS
Q0.1	6	Analog Output
Q0.0	5	Analog Output
R4	9	Relay 4 Out
R5 ²	10	Relay 5 Out
IO.9	A5	Analog/Digital Input
IO.8	A4	Analog/Digital Input
IO.7	A3	Analog/Digital Input
IO.6	A2	Analog/Digital Input
IO.5	A1	Analog/Digital Input
IO.4	A0	Analog/Digital Input
IO.3 ²	1	Digital Input/ Interrupt
IO.2 ²	0	Digital Input/ Interrupt
IO.1 ²	3	Digital Input/ Interrupt
IO.0 ²	2	Digital Input/ Interrupt
R6 ²	11	Relay 6 Out
R7	12	Relay 7 Out
R8	13	Relay 8 Out



RIGHT ZONE

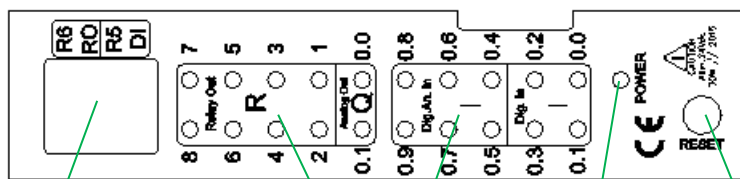
Communications pinout Outputs Pinout

Relay Outputs

Inputs pinout

Relay Outputs

² See section 10 to enable these connections.



Config switch *
(see section 9 for communications configuration)

Input / Output LED

Power LED

Arduino Reset button



9 Switch configuration

General Switches Configurations

TOP ZONE		
ENABLED CONNECTION	ON	OFF
R6	R6	RO
RO	RO	R6
R5	R5	DI
DI	DI	R5

LEFT ZONE		
SWITCH CONFIGURATION		
ARDUINO PIN	OFF*	ON
7	DE	R2
4	RE	R1
1	I0.3	RX
0	I0.2	TX
2	SCL	I0.1
3	SDA	I0.0

***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), R2 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 R6 is enabled RO must be disabled and conversely.

RS-485 Switch configuration

RS-485 CONFIGURATION			
TOP ZONE		LEFT ZONE	
R6	OFF	DE	OFF
RO	ON	RE	OFF
R5	OFF	RX	(ON/OFF)
DI	ON	TX	(ON/OFF)
		SCL	(ON/OFF)
		SDA	(ON/OFF)

RS485: Enable RE/DE/DI and RO internal pins with configuration switches. R1, R2, R5 and R6 not available. The defined Arduino Mega pins for RS485 are showed in the chart below.



RS-232 Switch configuration

RS-232 CONFIGURATION			
TOP ZONE		LEFT ZONE	
R6	(ON/OFF)	DE	(ON/OFF)
RO	(ON/OFF)	RE	(ON/OFF)
R5	(ON/OFF)	RX	ON
DI	(ON/OFF)	TX	ON
		SCL	(ON/OFF)
		SDA	(ON/OFF)

RS232: Enable RX and TX connections with configuration switches. IO.3 and IO.2 not available

I2C Switch configuration

i2c CONFIGURATION			
TOP ZONE		LEFT ZONE	
Q0.1	(ON/OFF)	DE	(ON/OFF)
RO	(ON/OFF)	RE	(ON/OFF)
Q0.2	(ON/OFF)	RX	(ON/OFF)
DI	(ON/OFF)	TX	(ON/OFF)
	(ON/OFF)	SCL	OFF
		SDA	OFF

I2C: Enable SCL and SDA connections (direct Arduino pins) with configuration switches. IO.0 and IO.1 not available. In order to implement this communication a 4.7kΩ pull-up resistor ([IS.AC12C-4.7K](#)) is required.



10 I/O technical details

Relay

■ Contact Ratings

Load	High-capacity
Rated load (resistive, p.f.= 1)	5 A at 250 VAC 3 A at 30 VDC
Max. switching voltage	250 VAC, 30 VDC
Rated carry current Max. switching current	5A 5A (AC load,) 3A (DC load)
Max. switching power	1,250 VA, 90 W

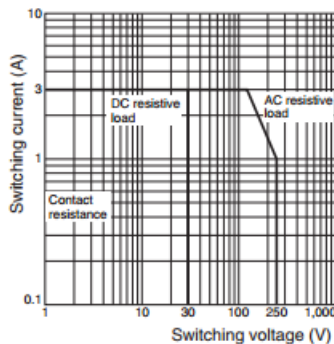
■ Characteristics

Contact resistance (see note 2)	100 mΩ max.								
Operate time	10 ms max.								
Release time	10 ms max.								
Insulation resistance (see note 3)	1,000 MΩ min. (at 500 VDC)								
Dielectric strength	4,000 VAC, 50/60 Hz for 1 min. between coil and contacts 750 VAC, 50/60 Hz for 1 min. between contacts of same polarity								
Impulse withstand voltage	10,000 V (1.2 x 50 μs) between coil and contacts								
Vibration resistance	Destruction: 10 to 55 Hz, 1.5-mm double amplitude Malfunction: 10 to 55 Hz, 1.5-mm double amplitude								
Shock resistance	Destruction: 1,000 m/s ² (approx. 100 G) Malfunction: 100 m/s ² (approx. 10 G)								
Life expectancy	Mechanical: 5,000,000 operations min. (18,000 operations/hour) Electrical: 200,000 operations minimum: <table style="margin-left: 20px;"> <tr> <td>High-capacity</td> <td>Standard</td> </tr> <tr> <td>5 A at 125 VAC</td> <td>3 A at 125 VAC</td> </tr> <tr> <td>3 A at 30 VDC</td> <td>3 A at 30 VDC</td> </tr> </table> 100,000 operations minimum: <table style="margin-left: 20px;"> <tr> <td>High-capacity</td> </tr> <tr> <td>5 A at 250 VAC</td> </tr> </table> All electrical load ratings are resistive, with operation frequency = 1,800 operations/hour.	High-capacity	Standard	5 A at 125 VAC	3 A at 125 VAC	3 A at 30 VDC	3 A at 30 VDC	High-capacity	5 A at 250 VAC
High-capacity	Standard								
5 A at 125 VAC	3 A at 125 VAC								
3 A at 30 VDC	3 A at 30 VDC								
High-capacity									
5 A at 250 VAC									
Minimum permissible load (reference value) (see note 4)	5 VDC, 10 mA								
Ambient temperature	Operating: -40°C to 70°C (with no icing or condensation)								
Ambient humidity	Operating: 5% to 85%								
Weight	Approx. 4 g								

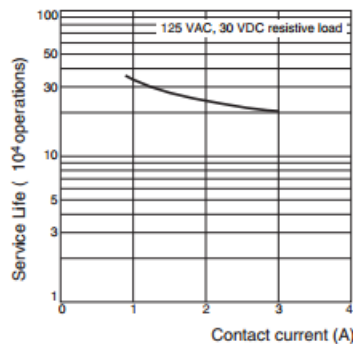
- Note: 1. The data shown above are initial value.
 2. Measurement conditions: 5 VDC, 1 A, voltage drop method
 3. Measurement conditions: Measured at the same points as the dielectric strength using a 500-VDC ohmmeter.
 4. This value is for a switching frequency of 120 operations/minute. (P level: $\lambda_{50} = 0.1 \times 10^{-6}$ operations)

Standard models

Maximum Switching Capacity



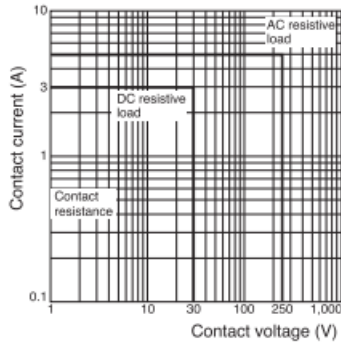
Electrical Service Life



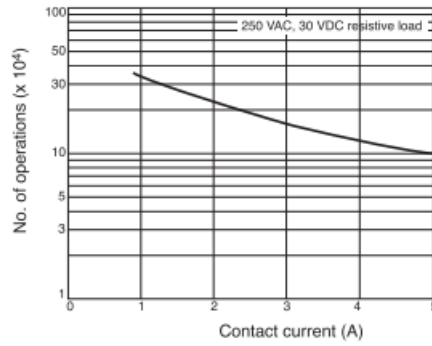


High-capacity models

Maximum Switching Capacity

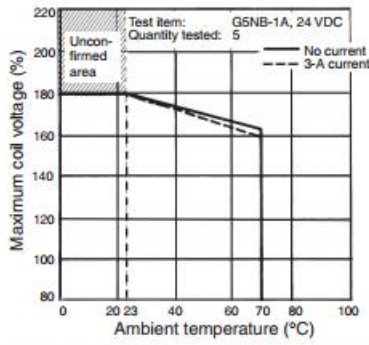


Electrical Service Life



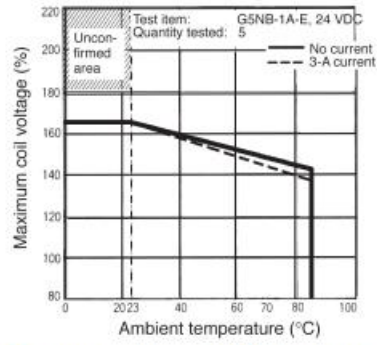
Standard models

Ambient Temperature vs. Maximum Coil Voltage



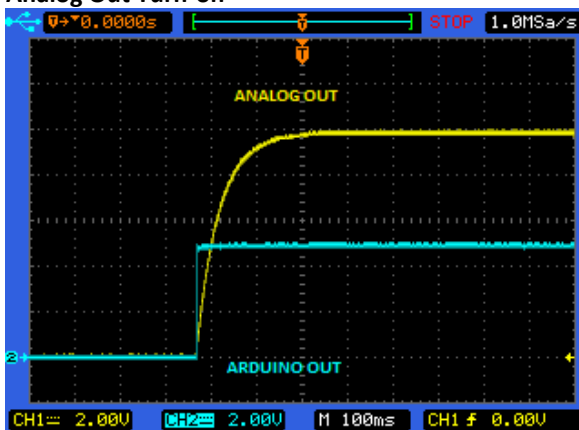
High-capacity models

Ambient Temperature vs. Maximum Coil Voltage



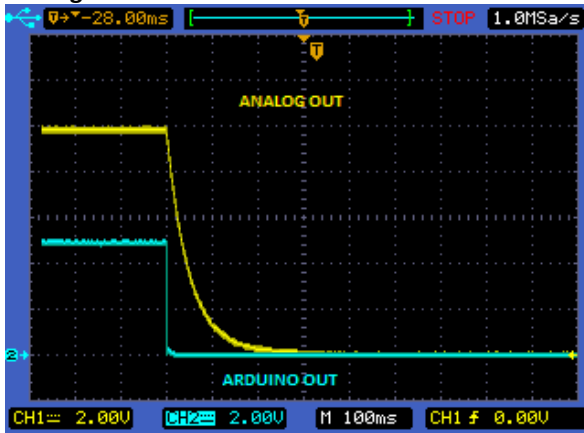
Note: The maximum coil voltage refers to the maximum value in a varying range of operating power voltage, not a continuous voltage.

Analog Out Turn-on

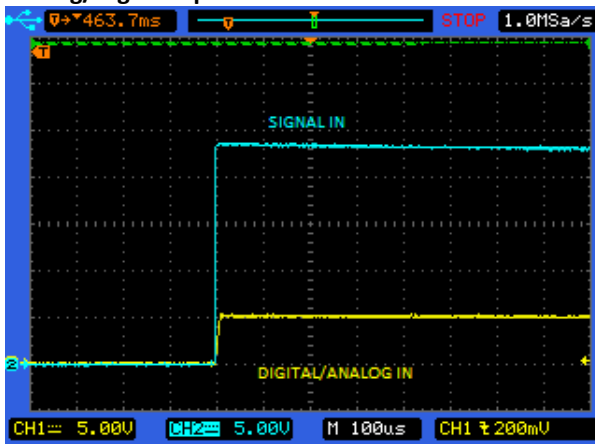




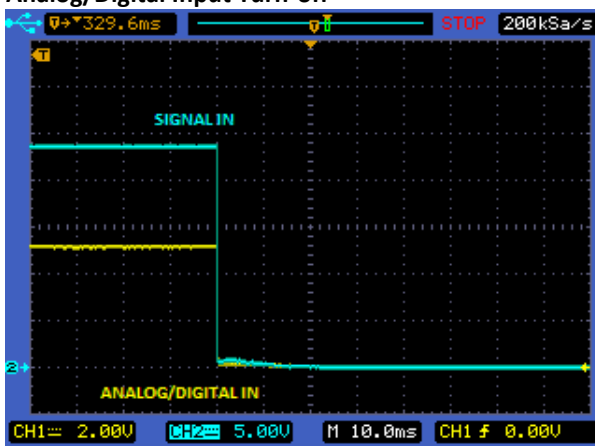
Analog Out Turn-off



Analog/Digital Input Turn-on



Analog/Digital Input Turn-off





11 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](#)

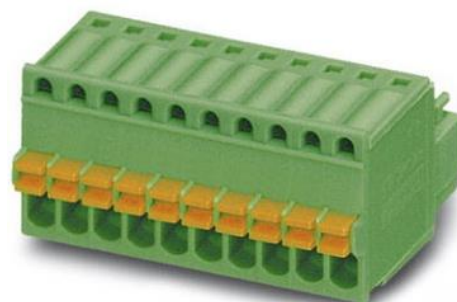
For I/O and power supply there is a FK-MC 0,5/10-ST-2,5 - 1881406 connector from Phoenix contact. [FK-MC 0,5/10-ST-2,5](#)

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

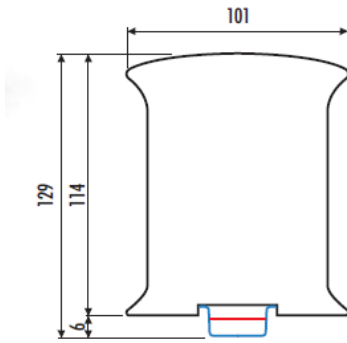


Article reference	FK-MC 0,5/10-ST-2,5
Rigid conduit section min.	0,14 mm ²
Rigid conduit section max.	0,5 mm ²
Flexible conduit section min.	0,14 mm ²
Flexible conduit section max.	0,5 mm ²
Conduit section AWG/kcmil min.	26
Conduit section AWG/kcmil max.	20



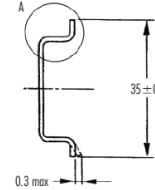
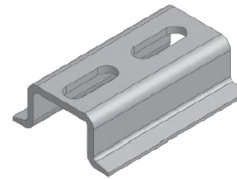


12 ARDBOX Family Dimensions:

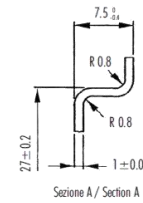


45mm width

13 DIN rail mounting:

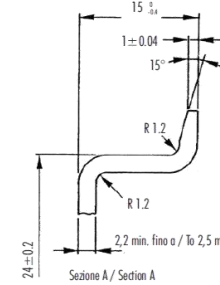


Profilato a cappello TH 35-7,5
Top hat rail TH 35-7,5



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	BLEND PC/ABS
Mecaniche			
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 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 280°C - 98N	ASTM D1238	gr/10'	11.1
Comportamento alla fiamma			
Autosostentanza (min di spessore)	UL94	-	V-0 (0.8)
Filo Incondenscon. 3.2 mm	IEC6095.2.1	°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	BLEND 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 280°C - 98N	ASTM D1238	gr/10'	11.1
Flame test			
Self extinguisher (thickness in mm)	UL94	-	V-0 (0.8)
Incondensable thread 3.2 mm	IEC6095.2.1	°C	980

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

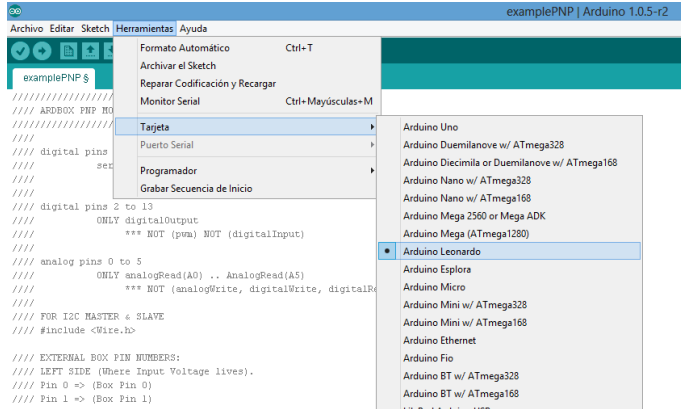


14 Software Interface:

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