

PLC ARDUINO ARDBOX 20 I/Os FAMILY HF PLUS MODBUS

PLC ARDUINO ARDBOX 20 I/Os

FAMILY HF

PLUS



PLC Arduino ARDBOX 20 I/Os Family HF PLUS User Guide

Revised September 2024

This user guide is for version PLC Arduino ARDBOX 20 I/Os Family HF PLUS with Reference name Ref.IS.AB20AN.HF+ or Ref.IS.AB20REL.HF+.

Preface

This User Guide has 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.



- 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.
- Maintenance must be performed by qualified personnel familiarised with the construction, operation, and hazards involved with the control.
- Maintenance should be performed with the control out of operation and disconnected from all sources of power.
- Care should be taken when servicing electrostatic sensitive components. The manufacturer's recommendations for these components should be followed.

- The Ardbox Family PLCs are Open Type Controllers. It is required that you install the Ardbox PLC in a housing, cabinet, or electric control room. Entry to the housing, cabinet, or electric control room should be limited to authorised personnel. Failure to follow these installation requirements could result in severe personal injury and/or property damage. Always follow these requirements when installing Ardbox family PLCs.
- In case of installation or maintenance of the Ardbox please follow the instructions marked in the Installation and Maintenance section.
- Do not disconnect equipment when a flammable or combustible atmosphere is present. Disconnection of equipment when a flammable or combustible atmosphere is present may cause a fire or explosion which could result in death, serious injury and/or property damage.



- Les broches non utilisées ne doivent pas être connectées. Ignorer la directive peut endommager le contrôleur.
- Une utilisation incorrecte de ce produit peut endommager gravement le contrôleur.
- Reportez-vous au Guide de l'utilisateur du contrôleur pour les considérations de câblage.
- Avant d'utiliser ce produit, il incombe à l'utilisateur de lire le Guide de l'utilisateur du produit et la documentation qui l'accompagne.
- La maintenance doit être effectuée par personnel qualifié familiarisé avec la fabrication, le fonctionnement et les dangers liés au contrôleur.
- La maintenance doit être effectuée avec l'équipement hors service et déconnectée de toutes les sources d'alimentation.
- Faites attention lors de l'entretien des composants sensibles à l'électricité statique. Les recommandations du fabricant pour ces composants doivent être suivies.
- Les automates de la famille Ardbox sont des contrôleurs de type ouvert. Il est nécessaire d'installer l'automate Ardbox dans un boîtier, une armoire ou une salle de contrôle électrique. L'accès au boîtier, à l'armoire ou à la salle de commande électrique doit être limité au personnel autorisé. Le non-respect de ces exigences d'installation peut entraîner des blessures graves et/ou des dommages matériels importants. Respectez toujours ces exigences lors de l'installation des automates de la famille Ardbox.
- En cas d'installation ou de maintenance du Ardbox, veuillez suivre les instructions indiquées dans la section Installation et Maintenance.
- Ne débranchez pas l'équipement en présence d'une atmosphère inflammable ou combustible. La déconnexion de l'équipement en présence d'une atmosphère inflammable ou combustible peut provoquer un incendie ou une explosion pouvant entraîner la mort, des blessures graves et/ou des dommages matériels.

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 machines, 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.

Intended use of Industrial Shields products

Consider the following:

Industrial Shields products should only be used for the cases of application foreseen in the catalogue and the associated technical documentation. If third-party products and components are used, they must have been recommended or approved by Industrial Shields.

The correct and safe operation of the products requires that your transport, storage, installation, assembly, operation and maintenance have been carried out in a correct manner. It must respect the permissible ambient conditions. You should also follow the indications and warnings that appear in the associated documentation.

The product / system dealt with in this documentation should only be handled or manipulated by qualified personnel for the task entrusted and observing what is indicated in the documentation corresponding to it, particularly the safety instructions and warnings included in it. Due to their training and experience, qualified personnel are in a position to recognize risks resulting from the handling or manipulation of such products / systems and to avoid possible hazards.

Disclaimers

Weights and Dimensions

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

Performance Data

The 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 most correlate it to actual application requirements. Actual performance is subject to the INDUSTRIAL SHIELDS Warranty and Limitations of Liability.

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.

Residual Risks

The control and drive components of an Industrial Shields PLC are approved for industrial and commercial use in industrial line supplies. Their use in public line supplies requires a different configuration and/or additional measures. These components may only be operated in closed housings or in higher-level control cabinets with protective covers that are closed, and when all of the protective devices are used. These components may only be handled by qualified and trained technical personnel who are knowledgeable and observe all of the safety information and instructions on the components and in the associated technical user documentation. When carrying out a risk assessment of a machine in accordance with the EU Machinery Directive, the machine manufacturer must consider the following residual risks associated with the control and drive components of a PDS.

1. Unintentional movements of driven machine components during commissioning, operation, maintenance, and repairs caused by, for example: – Hardware defects and/or software errors in the sensors, controllers, actuators, and connection technology – Response times of the controller and drive – Operating and/or ambient conditions not within the scope of the specification – Condensation / conductive contamination – Parameterization, programming, cabling, and installation errors – Use of radio devices / cellular phones in the immediate vicinity of the controller – External influences / damage.

 Exceptional temperatures as well as emissions of noise, particles, or gas caused by, for example: – Component malfunctions – Software errors – Operating and/or ambient conditions not within the scope of the specification – External influences / damage.

3. Hazardous shock voltages caused by, for example: – Component malfunctions – Influence of electrostatic charging – Induction of voltages in moving motors – Operating and/or ambient conditions not within the scope of the specification – Condensation / conductive contamination – External influences / damage

4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc. if they are too close.

5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly.

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, EXPRESSED 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

INDUSTRIAL SHIELDS SHALL NOT BE RESPONSIBLE FOR SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS OR COMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED ON CONTRACT, WARRANTY, NEGLIGENCE, OR STRICT LIABILITY.

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.

Table of Contents

1. Ardbox Family HF: General Features	11
2. Technical Specifications	12
2.1 General Specifications	12
2.2 Performance Specification	12
2.3 Symbology	13
3. Precautions	14
3.1 Arduino Board	14
3.2 Intended Audience	14
3.3 General Precautions	14
3.4 Isolation Precautions	14
4. Software interface	15
5. How to connect PLC Arduino to PC	18
6. How to connect PLC to power supply	19
7. Ardbox pinout	20
8. Ardbox Family I/O serigraphy	21
8.1 IS.AB20AN.HF+ Zone Connections	21
8.2 IS.AB20REL.HF+ Relay Zone Connections	23
9. Switch configuration	25
9.1 IS.AB20AN.HF+ Analog Model General Switches Configuration	25
9.2 IS.AB20REL.HF+ Relay Model General Switches Configuration	27
9.3 IS.AB20AN.HF+ Analog RS-232 and RS-485 Switch Configuration	29
9.4 IS.AB20REL.HF+ Relay RS-232 and RS-485 Switch Configuration	30
9.5 IS.AB20AN.HF+ Analog I2C Switch Configuration	31
9.6 IS.AB20REL.HF+ Relay I2C Switch Configuration	
10. Jumper Configuration	32
10.1 IS.AB20AN.HF+ Analog General Jumper Configuration	32
10.2 IS.AB20REL.HF+ Relay General Jumper Configuration	33
11. Hardware Serial RS-232 & RS-485 Configuration	34
11.1 IS.AB20AN.HF+ Analog Hardware Serial RS-485	34
11.2 IS.AB20AN.HF+ Analog Hardware Serial RS-232	35
11.3 IS.AB20REL.HF+ Relay Hardware Serial RS-485	36
11.4 IS.AB20REL.HF+ Relay Hardware Serial RS-232	37
12. Ardbox - Arduino I/Os 5V pins	38
12.1 I2C pins – SDA/SCL	38
12.2 Pin 2/Pin 3	
12.3 SPI - MISO / MOSI / SCK	39
13. Digital inputs threshold detection	

14. I/O technical details	
15. Typical Connections	
16. Connector details	47
17. ARDBOX Family Dimensions	48
18. Installation and Maintenance	
19. Revision Table	52

1.	Ardbox Family HF: General Feature	S
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COMPACT PLC ARDUINO	ARDBOX 20I/Os Family LOG HF PLUS	
Input Voltage	12 to 24Vdc	Fuse protection (2.5A) Polarity protection
Input rated voltage	24 Vdc	
Rated Power	30W	
l Max.	1.5A	
Size	100x45x115	
Clock Speed	16MHz	
Flash Memory	32KB of which 4KB are used by bootloader	
SRAM	2.5KB	
EEPROM	1KB	
Communications	I2C USB RS232 RS485 SPI	
An/Dig Input 10bit (0-10Vcc)	0 to 10Vdc Input Impedance: 39K Separated PCB ground Rated Voltage: 10Vdc 5 to 24Vdc I min: 2 to 12mA Galvanic Isolation Rated Voltage: 24 Vdc	*Check <u>Section 13</u> for digital inputs threshold detection
* Interrupt isolated Input HS (24Vcc)	5 to 24Vdc I min: 2 to 12mA Galvanic Isolation Rated Voltage: 24Vdc	5 to 24Vdc I min: 3/6mA Separated PCB ground
Analog Output 8bit (0-10Vcc)	0 to 10Vdc I max: 20mA Separated PCB ground Rated Voltage: 10Vdc	
Digital Isolated Output (24Vcc)	5 to 24Vdc I max: 70mA Galvanic Isolation Diode Protected for Relay Rated Voltage: 24Vdc	Imax 24Vdc: 410mA
Digital Isolated Output Relay	30Vdc / 250Vac Galvanic Isolation Diode protected for Relay	Imax: 3A (30Vdc) Imax: 5A (250Vac)
PWM Isolated Output 8bit (24Vcc)	5 to 24Vdc I max: 70mA Galvanic Isolation Diode Protected for Relay Rated Voltage: 24Vdc	PWM Isolated Output 8bit (24Vcc)
Expandability	I2C – RS232 – RS485 – SPI – TTL	
Reference	IS.AB20AN.HF+ IS.AB20REL.HF+	Analog Relay

2. Technical Specifications

2.1 General Specifications

Power supply voltage	DC power supply	12 to 24Vdc				
Operating voltage range	DC power supply	11.4 to 25.4Vdc = = =				
Power consumption	DC power supply	30W max.				
External	Power supply voltage	24Vdc				
power supply	Power supply output capacity	700mA				
Insulation resistance		$20 M \Omega$ min. at 500Vdc between the AC terminals and the protective ground terminal.				
Dielectric strength		2.300Vac 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 60°C				
Ambient humidity (operating)		10% to 90% (no condensation)				
Ambient environment (operating)		With no corrosive gas				
Ambient temperature (storage)		-20° to 60°C				
Power su	upply holding time	2ms min.				
	Weight	350g max.				

2.2 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 4KB are used by bootloader			
Program capacity (SRAM)	2.5КВ			
EEPROM	1КВ			
Clock Speed	16MHz			

2.3 Symbology

Table that includes all the symbology that is used in the serigraph of the Ardbox Family HF+:

Symbol	Standard No. / Standard Title	Standard Reference No. / Symbol Title	Symbol Meaning
	IEC 60417 / Graphical symbols for use on equipment	5031 / Direct Current	Indicates that the equipment is suitable for direct current only; to identify relevant terminals
\sim	IEC 60417 / Graphical symbols for use on equipment	5032 / Alternating Current	Indicates that the equipment is suitable for alternating current only; to identify relevant terminals
	IEC 60417 / Graphical symbols for use on equipment	5130 / Pulse General	To identify the control by which a pulse is started.
	IEC 60417 / Graphical symbols for use on equipment	5017 / Earth, Ground	To identify an earth (ground) terminal in cases where neither the symbol 5018 nor 5019 is explicitly required.
\otimes	IEC 60417 / Graphical symbols for use on equipment	5115 / Signal lamp	To identify the switch by means of which the signal lamp(s) is (are) switched on or off.
CE	Medical Devices Directive 93/42/EEC	CE Marking	CE marking indicates that a product complies with applicable European Union regulations
$\overline{\mathbf{v}}$	ISO 7000/ Graphical symbols for use on equipment	0434B / Warning symbol	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury
4	ISO 7000/ Graphical symbols for use on equipment	5036 / Dangerous Voltage	To indicate hazards arising from dangerous voltages

3. Precautions

Read this manual before attempting to use the ARDBOX 20 I/Os Family HF PLUS and follow its descriptions for reference during operation.

3.1 Arduino Board

The ARDBOX 20 I/Os Family HF PLUS PLCs include Arduino Leonardo Board as controller.

3.2 Intended Audience

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

3.3 General Precautions

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

Before using ARDBOX 20 I/Os Family HF PLUS under different conditions from what has been specified in this manual or integrating ARDBOX 20 I/Os Family HF PLUS 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.

3.4 Isolation Precautions

Description:

This equipment does **not include galvanic isolation between the grounds** of the different systems. This means that if an external device or sensor that shares the same ground reference (GND) with the system is connected, any potential difference between these grounds could damage the connected components. To avoid issues with interference, ground loops, or damage to external equipment, ensure that all connected devices share the same ground reference or use systems with appropriate isolation.

Recommendations:

- **Connection Review:** Verify that all ground connections are properly made and that there are no significant potential differences between them.
- Use of Isolation: Consider using galvanic isolators or isolation transformers if it is necessary to connect equipment with different ground references.

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 directly using C, but it is much easier working with Arduino IDE, as it provides lots of useful libraries.

Industrial Shields provide a boards package for programming the PLCs, making it easier and friendlier. It includes various facilities such as not having to define the pins, etc.

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

Requirements:

Arduino IDE 1.8.15 or above (recommended: 1.8.19).

Steps:

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

Preferences	×
Settings Network	
Sketchbook location:	
C:\Users\Albert\Documents\A	rduino Browse
Editor language:	English (English)
Editor font size:	15
Interface scale:	Automatic 100 🜩 % (requires restart of Arduino)
Show verbose output during:	✓ compilation ✓ upload
Compiler warnings:	None V
Display line numbers	
Enable Code Folding	
Verify code after upload	
Use external editor	
Check for updates on star	tup
Update sketch files to new	extension on save (.pde -> .ino)
Save when verifying or up	loading
Additional Boards Manager UR	Ls: [http://apps.industrialshields.com/main/arduino/boards/package_industrialshields_inde;] 🔲
More preferences can be edite	d directly in the file
C:\Users\Albert\AppData\Loca	I\Arduino15\preferences.txt
(edit only when Arduino is not	running)
	OK Cancel

2. In Additional Boards URLs write the following:

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.

1.1.8	 ✓ Install

6. Click install (selecting the latest version).

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

🥺 sketch jun29a A	rduino 1.8.13 (Windows Store 1.8.3	9.0)				×
File Edit Sketch To	ols Help					
sketch_jun29a	Auto Format Archive Sketch Fix Encoding & Reload	Ctrl+T				2
<pre>void setup() // put your }</pre>	Manage Libraries Serial Monitor Serial Plotter	Ctrl+Shift+1 Ctrl+Shift+M Ctrl+Shift+L				^
void loop() {	WiFi101 / WiFiNINA Firmware U	Jpdater				
// put your	Board: "Ardbox family"		Boards Manager			
3	Model: "Ardbox Analog" Port		Arduine AVR Boards Arduine SAMB (JC-bits AKM Contex-MU+) Boards	>		
	Get Board Info	<	Industrial Shields boards	a Ardbox family		
	Programmer Burn Bootloader	1	INSUTING General General des	Ardbox GPRS family Ardbox UPRS family Ardbox UPR (BT family Ardbox L GRa family M-Duino family M-Duino DALI family M-Duino GPRS family M-Duino UR/BT family Spartan family		
						 v

Once the Ardbox Family is selected, an extra option will appear on Tools:

 Select the correct Ardbox Family HF PLUS Board (Ardbox Analog HF+ w/HW RS-232, Ardbox Analog HF+ w/HW RS-485, Ardbox Relay HF+ w/HW RS-232 or Ardbox Relay HF+ w/HW RS-485) depending on your jumpers & switch configuration.

	duino 1.8.13 (Windows Store 1.8.39.0)		- 0	×	
File Edit Sketch Too	ols Help				
sketch_jun29a	Auto Format Ctrl+T Archive Sketch Fix Encoding & Reload			9	-
<pre>void setup() // put your) void loop() { // put your</pre>	Manage Libraries Ctrl+Sh Serial Monitor Ctrl+Sh Serial Plotter Ctrl+Sh WiF101 / WiF1NINA Firmware Updater Board: "Ardbox family"	-M			*
j	Model: "Arabox Analog" Port Get Board Info Programmer Bum Bootloader	Image: Second			
		Ardbox Relay HF (legacy) Ardbox Basic Controller	iber family on	1 50825	v

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: <u>https://github.com/Industrial-Shields</u>

5. How to connect PLC Arduino to PC

- Connect USB port from PLC to PC.

NOTE:

Ardbox Family uses micro USB cable.

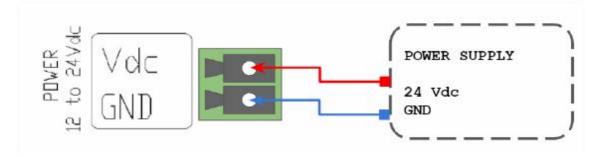


- Open Arduino IDE interface:
- Select Industrial Shields boards -> Ardbox Family
- Select the correct port.

	uto Format	Ctrl+T						×
such a string	vchive Sketch ix Encoding & Reload erial Monitor erial Plotter	Ctil+Shift+M Ctil+Shift+L						2
	WF+101 Firmware Updater							
in the second	oard: "Ardbox family" ndustrial Shields: "Ardbox Analo) 2011 - 102						
void loop(ort	1	Serial ports					
	iet Board Info		COM13 (Ardumo Leonardo)					
	rogrammer: "Arduino as ISP" ium Bootloader	>						
								-
				 	 	 Ardbox family, Ar	tox Analog on	COM34

6. How to connect PLC to power supply

- Ardbox Family PLCs are 12-24Vdc supplied. IMPORTANT: The polarity IS NOT REVERSIBLE!
- 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

Compact DIN rail power supply. Assembled on 35mm	
DIN Rail:	BERE
-12Vdc / 24Vdc	++
-2.5A	
-30W	
	STATE STATE
Industrial Shields power supplies provide parallel	and the second s
operation, overvoltage protection, and overcurrent	INPUT CONTRACTOR
protection. There is a LED inductor for power status, the	E E E
power supply is certified according to UL.	

The standard, Part 1 of IEC 61010, sets the general safety requirements for the following types of electrical devices and their accessories, regardless of where use of the device is intended.

The equipment must be powered from an external power source in accordance with IEC 61010-1, whose output is MBTS and is limited in power according to section 9.4 of IEC 61010-1.

WARNING: Once the equipment is installed inside an electrical cabinet, the MTBS cables of the equipment must be separated from the dangerous voltage cables.

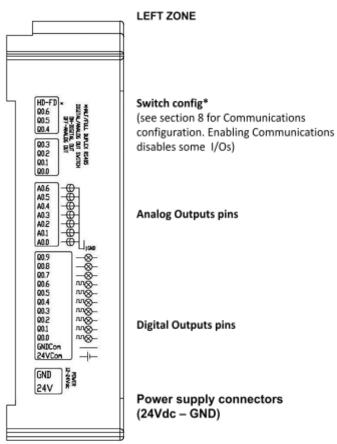
7. Ardbox pinout

		IOs Table				
Model	Reference	Analog Input	Digital Isolated Input	Digital Isolated Output	Digital/Analogic Output	Relay Output
ANALOG	IS.AB20AN.HF+	8	10	10	7	0
RELAY	IS.AB20REL.HF+	8	10	0	2	8

8. Ardbox Family I/O serigraphy

8.1 IS.AB20AN.HF+ Zone Connections

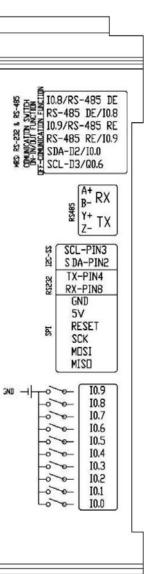
LEFT ZONE			
Ardbox Connector	Arduino Pin	Function	
A0.6 ¹ A0.5 ¹ A0.4 ¹ A0.3 ¹ A0.2 ¹ A0.1 ¹ A0.0 ¹	3 5 6 9 10 11 13	Analog Out Analog Out Analog Out Analog Out Analog Out Analog Out Analog Out	
Q0.9 ² Q0.8 ² Q0.7 Q0.6 ¹ Q0.5 Q0.4 Q0.2 Q0.1 Q0.0	1 0 7 5 6 9 10 11 13	Digital Output Digital Output Digital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



¹ See <u>section 8</u> to enable these connections

² See <u>section 9</u> to enable these connections

	RIGHT ZONE		
Ardbox Connector	Arduino Pin RS232 HS*	Function	
A+ ^{3, 4} B- ^{3, 4} Y+ ^{3, 4} Z- ^{3, 4} SCL-PIN3 ³ SDA-PIN2 ³ TX-PIN4 RX-PIN8	- - 3 2 4 8	RS485(A) RS485(B) RS485(Y) RS485(Z) SCL(I2C) SDA(I2C) -	
GND 5V RESET SCK MOSI MISO		Ground 5Vout DC RESET SPI SPI SPI	
10.9 10.8 10.7 10.6 10.5 10.4 10.3 ³ 10.2 ³ 10.1 10.0 ³	18 19 20 21 22 23 26 24 29 2	Analog/Digital Input Analog/Digital Input Analog/Digital Input Analog/Digital Input Analog/Digital Input Analog/Digital Input Analog/Digital Input Digital Input Digital Input	



RIGHT ZONE

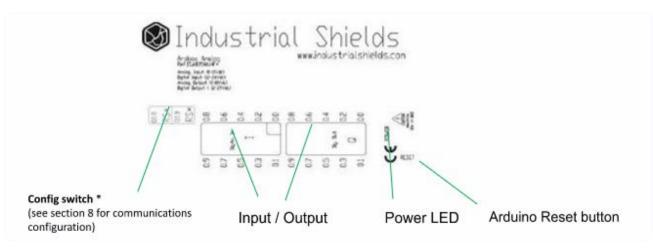
Switch config*

(see section 8 for Communications configuration. Enabling Communications disables some I/Os)

Communication pins

Digital/Analog

HS*: Hardware Serial SS*: Software Serial



³ See <u>section 8</u> to enable these connections

⁴ See <u>section 9</u> to enable these connections

8.2 IS.AB20REL.HF+ Relay Zone Connections

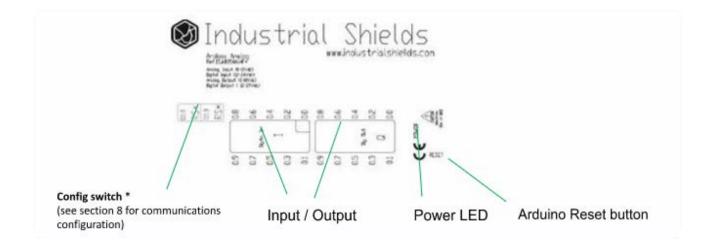
	Left Zone			LEFT ZONE
Ardbox Connector	Arduino Pin	Function	DN DFF	
MISO MOSI SCK RESET 5Vdc GND RX-RS-232 ^{5,6} TX-RS-232 ^{5,6} SCL-PIN2 ⁵ SDA-PIN3 ⁵	14 16 15 - - 8 4 2 3	SPI-MISO SPI-MOSI SPI-CLOCK SPI-RESET 5V Output GND Serial/RS232 Serial/RS232 I2C/SPI SS I2C/SPI SS	HD-FD× R5/PIN3-SCL I0.0/PIN2-SDA RE-RS485/10.4 I0.4/RE-RS485 DE-RS485/10.5 L0.5/DE-RS485 DF MISD MISD MISD MISD SCK RESET SV dc GND RX RS232 TX PIN2-SDA PIN3-SCL	Switch config* (see section 8 for Communicat configuration. Enabling Comm disables some I/Os) Communication pins
R1 R2 R3	10 9 6	Relay 1 Out Relay 2 Out Relay 3 Out		Relay Outputs
GND 24V	-	GND -	GND Vdc	Power supply connectors (24Vdc – GND)

HS*: Hardware Serial SS*: Software Serial

⁵ See <u>section 8</u> to enable these connections ⁶ See <u>section 9</u> to enable these connections

	Right	t Zone		RIGHT ZONE
Ardbox Connector	Arduino Pin	Function	Service Burger Burger Burger Burger V/A01 V+/A01 V+/A01	RS-485 pins Analog Output Pins
B- A+ Z-/A0.1 Y+/A0.0	- - 11 (FD)* 13 (FD)*	RS485 RS485 RS485/ Analog Output RS485/ Analog Output		Relay Outputs
R4 R5 10.9 10.8 10.7 10.6 10.5 10.4 10.3	5 3 22 21 20 19 18 8	Relay 4 Out Relay 5 Out Analog/ Digital Input Analog/ Digital Input Analog/ Digital Input Analog/ Digital Input Analog/ Digital Input Digital Optoisolated Input	Contrigue of tion For Contrigue of tion For Contrigue of the control for Control for Contr	Digital/ Analog Input pins
10.2 10.1 10.0 R6 R7 R8	4 12 2 7 0 1	Digital Optoisolated Input Digital Optoisolated Input Digital Input / Interrupt Relay 6 Out Relay 7 Out Relay 8 Out	v Note: use correctly con use this signal. (see user guide) & & & & & & & & & & & & & & & & & & &	Relay Outputs

*Depending on the mode HD/FD the Y+/Z- Analog Output pins are enabled or disabled. See <u>section 9</u> to see the configurations.



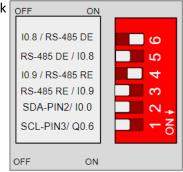
9. Switch configuration

9.1 IS.AB20AN.HF+ Analog Model General Switches Configuration

LEFT ZONE SWITCH

Communications and inputs/outputs can not work off simultaneously.

LEFT ZONE				
SWITCH	OFF	ON		
10.8 / RS-485 DE	10.8	RS-485 DE		
RS-485 DE / 10.8	RS-485 DE	10.8		
10.9 / RS-485 RE	10.9	RS-485 RE		
RS-485 RE / 10.9	RS-485 RE	10.9		
SDA-PIN2 / 10.0	SDA-D2	10.0		
SCL-PIN3 / Q0.6	SCL-D3	Q0.6		



6. IO.8 / RS-485 DE – If this switch is ON the RS-485 DE is activated, otherwise the IO.8 will be activated.

5. RS-485 DE / I0.8– If this switch is ON the I0.8 is activated, otherwise the RS-485 DE will be activated.

Note* To work with RS-485 DE, switch number 6 at ON and number 5 at OFF.

4. IO.9 / RS-485 RE – If this switch is ON the RS-485 RE is activated, otherwise the IO.9 will be activated.

3. RS-485 RE / I0.9– If this switch is ON the I0.9 is activated, otherwise the RS-485 RE will be activated.

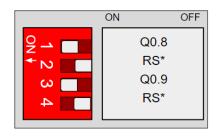
Note* To work with RS-485 RE, switch number 4 at ON and number 3 at OFF.

2. SDA-D2/I0.0 – If this switch is ON the I0.0 is activated, otherwise the (I2C) SDA-D2 will be activated.

1. SCL-D3/Q0.6 – If this switch is ON the Q0.6 is activated, otherwise the (I2C) SCL-D3 will be activated.

TOP ZONE SWITCH

	TOP ZONE				
SWITCH	ON	OFF			
Q0.8	Q0.8	RS*			
RS*	RS*	Q0.8			
Q0.9	Q0.9	RS*			
RS*	RS*	Q0.9			

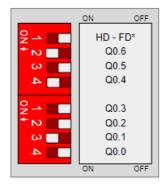


- 1. Q0.8 If this switch is ON the Q0.8 is activated, otherwise the RS* will be activated.
- 2. RS* If this switch is ON the RS* is activated, otherwise the Q0.8 will be activated.
- 3. Q0.9 If this switch is ON the Q0.9 is activated, otherwise the RS*will be activated.
- **4. RS*** If this switch is ON the RS* is activated, otherwise the Q0.9 will be activated.

Note RS * can be RS-485 or RS-232 depending on the jumper configuration you have chosen. To work with RS*, switches number 1 and 3 at OFF and number 2 and 4 at ON.*

	RIGHT ZONE			
SWITCH	ON	OFF		
HD / FD	Half Duplex	Full Duplex		
Q0.6	DIGITAL (Q0.6)	ANALOG (A0.6)		
Q0.5	DIGITAL (Q0.5)	ANALOG (A0.5)		
Q0.4	DIGITAL (Q0.4)	ANALOG (A0.4)		
Q0.3	DIGITAL (Q0.3)	ANALOG (A0.3)		
Q0.2	DIGITAL (Q0.2)	ANALOG (A0.2)		
Q0.1	DIGITAL (Q0.1)	ANALOG (A0.1)		
Q0.0	DIGITAL (Q0.0)	ANALOG (A0.0)		

RIGHT ZONE SWITCH



RIGHT ZONE.

1. HD/FD – Choosing between Half/Full Duplex for the RS485 communication. In order to use Full Duplex, it has to be considered the TOP ZONE and the JUMPER ZONE (see <u>section 9</u>).

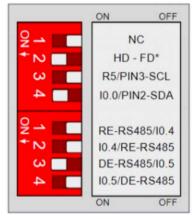
2-8. Q0.X/A0.X – The right zone configures the outputs. If the switch is set to "ON" the Q0.X will have the behaviour of a digital output. If it is set to "OFF" it will be analog.

9.2 IS.AB20REL.HF+ Relay Model General Switches Configuration

LEFT ZONE			
SWITCH	ON	OFF	
NC	-	-	
HD/FD*	Half Duplex	Full Duplex	
R5 / Pin 3-SCL	R5	Pin 3 - SCL	
10.0 / Pin 2-SDA	10.0	Pin 2 - SDA	
RE-RS485 / 10.4	RE-RS485	10.4	
10.4 / RE-RS485	10.4	RE-RS485	
DE-RS485 / 10.5	DE-RS485	10.5	
10.5 / DE-RS485	10.5	DE-RS485	

LEFT ZONE SWITCH

Communications and inputs/outputs can not work simultaneously.



1. NC - Not Connected

2. HD/FD* – Choosing between Half/Full Duplex for the RS485 communication. In order to use Full Duplex, it has to be considered the TOP ZONE and the JUMPER ZONE (see <u>section 9</u>).

3. R5 / Pin3-SCL – If this switch is ON the R5 is activated, otherwise the Pin3 - SCL will be activated.

4. IO.0 / Pin2-SDA – If this switch is ON the IO.0 is activated, otherwise the Pin2 - SDA will be activated.

1. RE-RS485 / IO.4 – If this switch is ON the RE-RS485 is activated, otherwise the IO.4 will be activated.

2. IO.4 / RE-RS485 – If this switch is ON the IO.4 is activated, otherwise the RE-RS485 will be activated.

Note* To work with RS-485 RE, switch number 1 at ON and number 2 at OFF.

3. DE-RS485 / I0.5 – If this switch is ON the DE-RS485 is activated, otherwise the I0.5 will be activated.

4. IO.5 / DE-RS485 – If this switch is ON the IO.5 is activated, otherwise the DE-RS485 will be activated.

Note* To work with RS-485 DE, switch number 3 at ON and number 4 at OFF.

TOP ZONE SWITCH

TOP ZONE				
SWITCH	ON	OFF		
RS*	RS*	R8		
R8	R8	RS*		
RS*	RS*	R7		
R7	R7	RS*		

	ON	OFF
9 H	R	S*
4 N	R	8
ω	R	S*
4	R	7*

1. **RS*** - If this switch is ON the RS* is activated, otherwise the R8 will be activated.

2. **IO.2**- If this switch is ON the R8 is activated, otherwise the RS* will be activated.

3. **RS*** - If this switch is ON the RS* is activated, otherwise the R7 will be activated.

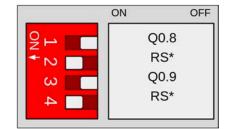
4. **IO.3** - If this switch is ON the R7 is activated, otherwise the RS* will be activated.

Note* RS * can be RS-485 or RS-232 depending on the jumper configuration you have chosen. To work with RS*, switches number 1 and 3 at ON and number 2 and 4 at OFF.

9.3 IS.AB20AN.HF+ Analog RS-232 and RS-485 Switch

Configuration

ANALOG TOP ZONE			
SWITCH MODE			
Q0.8	OFF		
RS* ON			
Q0.9	OFF		
RS*	ON		



RS* TOP ZONE: In order to enable the RS* protocol the TOP ZONE must be configured as it is shown in the table.

Having this setup, the Q0.8 & Q0.9 are disabled.

- 1. Q0.8 If this switch is ON the Q0.8 is activated, otherwise the RS* will be activated.
- 2. RS* If this switch is ON the RS* is activated, otherwise the Q0.8 will be activated.
- 3. Q0.9 If this switch is ON the Q0.9 is activated, otherwise the RS*will be activated.
- 4. RS* If this switch is ON the RS* is activated, otherwise the Q0.9 will be activated.

ANALOG LEFT ZONE			
SWITCH	RS232 MODE	RS485 MODE	
10.8 / RS* DE	OFF	ON	
RS* DE / 10.8	ON	OFF	
10.9 / RS* RE	OFF	ON	
RS* RE / 10.9	ON	OFF	
SDA-D2	-	-	
SCL-D3	-	-	

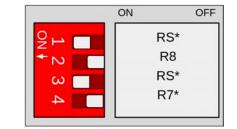
RS* LEFT ZONE: In order to enable the RS* communication protocol it is necessary that the switches of the left one are configured as it is shown in the table.

The ones marked with "-" mean that they do not affect the RS* communication protocol.

9.4 IS.AB20REL.HF+ Relay RS-232 and RS-485 Switch

Configuration

RELAY TOP ZONE		
SWITCH	MODE	
RS*	ON	
R8	OFF	
RS*	ON	
R7	OFF	



RS* TOP ZONE: In order to enable the RS* protocol the TOP ZONE must be configured as it is shown in the table.

Having this setup, the R7 & R8 are disabled.

- 1. RS* If this switch is ON the RS* is activated, otherwise the R8 will be activated.
- 2. R8 If this switch is ON the R8 is activated. otherwise the RS* will be activated.
- **3. RS*** If this switch is ON the RS* is activated, otherwise the R7 will be activated.
- **4. R7** If this switch is ON the R7 is activated, otherwise the RS* will be activated.

RELAY LEFT ZONE			
SWITCH	RS232 MODE	RS485 MODE	
NC	-	-	
HD/FD	ON / OFF	ON / OFF	
R5 / Pin 3 - SDA	-	-	
10.0 / Pin 2 - SCL	-	-	
RE-RS485 / 104	OFF	ON	
10.4 / RE-RS485	ON	OFF	
DE-RS485 / 10.5	OFF	ON	
10.5 / DE-RS485	ON	OFF	

HD/FD: Choosing between Half Duplex or Full Duplex for the RS* communication. In order to use Full Duplex, it has to be considered the TOP ZONE and the JUMPER ZONE (see section 9).

RS* LEFT ZONE: In order to enable the RS* communication protocol it is necessary that the switches of the left zone are configured as it is shown in the table.

The ones marked with "-" mean that they do not affect the RS* communication protocol.

TOP 2	ZONE	LEFT ZON	E
SWITCH	MODE	SWITCH	MODE
Q0.8	-	10.8 / RS-485 DE	-
RS*	-	RS-485 DE / 10.8	-
Q0.9	-	10.9 / RS-485 RE	-
RS*	-	RS-485 RE / 10.9	-
		SDA-D2 / 10.0	OFF
		SCL-D3 / Q0.6	OFF

9.5 IS.AB20AN.HF+ Analog I2C Switch Configuration

I2C: Enable SCL and SDA connections (direct Arduino pins) with configuration switches. I0.0 and Q0.6 will not be available. In order to implement this communication a $4.7k\Omega$ pull-up resistor is required.

The ones marked with "-" mean that they do not affect the I2C communication protocol.

9.6 IS.AB20REL.HF+ Relay I2C Switch Configuration

TOP 2	ZONE	LEFT ZON	E
SWITCH	MODE	SWITCH	MODE
RS*	-	NC	-
R8	-	HD / FD*	-
RS*	-	R5 / Pin 3 - SCL	OFF
R7	-	10.0 / Pin 2 - SDA	OFF
		RE-RS485 / 104	-
		10.4 / RE-RS485	-
		DE-RS485 / 10.5	-
		10.5 / DE-RS485	-

I2C: Enable SCL and SDA connections (direct Arduino pins) with configuration switches. I0.0 and R5 will not be available. In order to implement this communication a $4.7k\Omega$ pull-up resistor is required.

The ones marked with "-" mean that they do not affect the I2C communication protocol.

10. Jumper Configuration

10.1 IS.AB20AN.HF+ Analog General Jumper Configuration

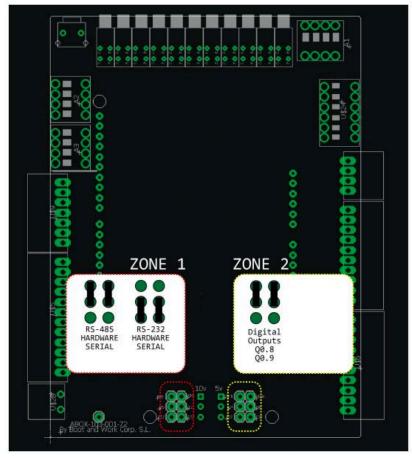
JUMPER ZONE 1		
LEFT RIGHT		
RS-485	RS-485	
D0	D1	
RS-232	RS-232	

This jumper makes the choice between connecting MAX232 to pins 0,1 of the Arduino Leonardo or with the MAX485. In order to use the RS-232 Hardware Serial protocol both RS-232 must be connected to the D1/D0. In order to use the RS-485 Hardware Serial protocol both RS-485 must be connected to the D1/D0.

JUMPER ZONE 2		
LEFT RIGHT		
Q0.9	Q0.8	
D4	D8	
RS-232 SS	RS-232 SS	

This jumper zone makes the choice between connecting the inputs Q0.9, Q0.8 to pins 4 and 8 of the Arduino Leonardo respectively, or connect the RS-232 ports to activate the Software Serial RS-232. In order to use the inputs Q0.9, Q0.8 the jumper must be connected to the pins 4 and 8. So Q0.9 must be connected with D4 and Q0.8 must be connected to D8.

*The jumpers that are not connected to the middle jumpers MUST NOT be Connected anywhere.



10.2 IS.AB20REL.HF+ Relay General Jumper Configuration

JUMPER ZONE 1		
LEFT RIGHT		
Y+	Z-	
ENABLE	ENABLE	
A0.0	A0.1	

This jumper zone makes the selection between using the RS-485 Full Duplex or the Analog Outputs. If it is wanted to use the RS-485 Full Duplex communication protocol the Y+ must be connected to ENABLE, and Z- also connected to ENABLE. If it is wanted to use the Analog Outputs, the A0.0 must be connected to ENABLE, and A0.1 also connected to ENABLE.

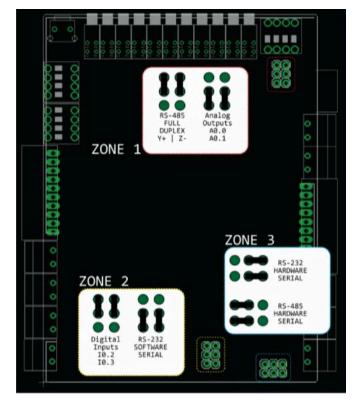
JUMPER ZONE 2		
LEFT RIGHT		
10.2	10.3	
D4	D8	
RS-232 SS	RS-232 SS	

This jumper zone makes the choice between connecting the inputs Q0.9, Q0.8 to pins 4 and 8 of the Arduino Leonardo respectively, or connect the RS-232 ports to activate the Software Serial RS-232. In order to use the inputs Q0.9, Q0.8 the jumper must be connected to the pins 4 and 8. So Q0.9 must be connected with D4 and Q0.8 must be connected to D8.

JUMPER ZONE 3		
DOWN UP		
RS-485	RS-485	
D0	D1	
RS-232	RS-232	

This jumper makes the choice between connecting MAX232 to pins 0,1 of the Arduino Leonardo or with the MAX485. In order to use the RS-232 Hardware Serial protocol both RS-232 must be connected to the D1/D0. In order to use the RS-485 Hardware Serial protocol both RS-485 must be connected to the D1/D0.

*The jumpers that are not connected to the middle jumpers MUST NOT be Connected anywhere.



11. Hardware Serial RS-232 & RS-485 Configuration

11.1 IS.AB20AN.HF+ Analog Hardware Serial RS-485

In order to enable the Hardware Serial RS-485 the total configuration of the Ardbox Analog HF PLUS will be:

Switch configuration:

TOP ZONE		LEFT ZONE	
ACTIVATED SWITCH	MODE	ACTIVATED SWITCH	MODE
Q0.8	OFF	DE-RS485	ON
RS*	ON	DE-RS485	OFF
Q0.9	OFF	RE-RS485	ON
RS*	ON	RE-RS485	OFF
		SDA-PIN2 / 10.0	-
		SCL-PIN3 / Q0.6	-

Jumper configuration:





ZONE 2



- Available communication protocols:
 - Hardware Serial RS-485.
 - I2C *If I2C is active I0.0 & Q0.6 are disabled
 - o SPI
 - TTL (SoftwareSerial)
 - USB

11.2 IS.AB20AN.HF+ Analog Hardware Serial RS-232

In order to enable the Hardware Serial RS-232 the total configuration of the Ardbox Analog HF PLUS will be:

Switch	configuration:	
	-	

TOP ZONE		LEFT ZONE		
ACTIVATED SWITCH	MODE	ACTIVATED SWITCH	MODE	
Q0.8	OFF	10.8	OFF	
RS*	ON	10.8	ON	
Q0.9	OFF	10.9	OFF	
RS*	ON	10.9	ON	
		SDA-PIN2 / 10.0	-	
		SCL-PIN3 / Q0.6	-	

Note: The switches of the left zone of the RS-485 don't interfere in the RS-232 HS. As pins 0 & 1 are reserved for the RS-232, the RS-485 is totally disabled and there is no point on configuring these switches as RS-485 mode

Jumper configuration:





- Available communication protocols:
 - Hardware Serial RS-232.
 - I2C *If I2C is active I0.0 & Q0.6 are disabled
 - o SPI
 - o TTL
 - USB

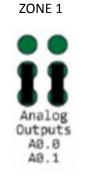
11.3 IS.AB20REL.HF+ Relay Hardware Serial RS-485

In order to enable the Hardware Serial RS-485 the total configuration of the Ardbox Relay HF PLUS will be:

Switch configuration:

TOP ZC	DNE	LEFT ZONE	
ACTIVATED SWITCH	MODE	ACTIVATED MODE SWITCH	
RS*	ON	NC	-
R8	OFF	HD / FD	ON - OFF
RS*	ON	R5 / Pin 3-SCL	-
R7	OFF	10.0 / Pin 2-SDA	-
		RE-RS485	ON
		RE-RS485	OFF
		DE-RS485	ON
		DE-RS485	OFF

Jumper configuration:





ZONE 2

Digital

Inputs I0.2

10.3



- Available communication protocols:
 - Hardware Serial RS-485.
 - I2C *If I2C is active I0.0 & R5 are disabled
 - o SPI
 - TTL
 - USB

11.4 IS.AB20REL.HF+ Relay Hardware Serial RS-232

In order to enable the Hardware Serial RS-232 the total configuration of the Ardbox Relay HF PLUS will be:

Switch configuration:

TOP ZONE		LEFT ZONE	
ACTIVATED SWITCH	MODE	ACTIVATED SWITCH	MODE
RS*	ON	NC	-
R8	OFF	HD / FD	ON - OFF
RS*	ON	R5 / Pin 3-SCL	-
R7	OFF	10.0 / Pin 2-SDA	-
		10.4	OFF
		10.4	ON
		10.5	OFF
		10.5	ON

Jumper configuration:





ZONE 2

Digital

Inputs

10.2



- Available communication protocols:
 - Hardware Serial RS-232.
 - I2C *If I2C is active I0.0 & R5 are disabled
 - o SPI
 - o TTL
 - USB

12. Ardbox - Arduino I/Os 5V pins

The Ardbox has some of the Leonardo board pins available. These pins can be programmed according to Arduino features such as I/Os operating at 5V or any additional features present in the pins (for example I2C communication in pins SCL and SDA). As these pins are directly connected to the Arduino Leonardo board they are not as well protected as the normal inputs. These pins are mainly meant to be used as prototyping.

Ardbox terminal	Arduino pin
SCL – Pin 3	3
SDA – Pin 2	2
MISO	14
SCK	15
MOSI	16

***IMPORTANT:** Do not connect the terminals in the chart above to voltages higher than 5V. These terminals provide direct access to the Leonardo board.

Apart from the switch configuration there are some special conditions depending on these 5V. Now it is going to be shown the considerations to operate with these pins.

12.1 I2C pins - SDA/SCL

The I2C protocol is meant to work in a pull-up configuration. The I2C pins in the Arduino Leonardo are not pull-up, so in order to work with the I2C an external pull-up resistor is required. If it is meant to work as a GPIO at 5V, the switches must be set as I2C, (section 8).

These pins are not established with a pull-up or a pull-down configuration. The state of these pins is unknown. If these pins must be used they require a pull-up or a pull-down configuration. The Arduino board allows the pins to be set in a pull-up configuration. If not it must be established as an external pull-up or pull-down circuit in order to correctly work with these pins.

12.2 Pin 2/Pin 3

These pins are only referred to the input I0.0 and output Q0.6 for the Analog model and inputs I0.0 and R5 for the Relay model. If the switch configuration is in OFF position the pins Pin 2/Pin 3 will be available.

These pins are not established with a pull-up or a pull-down configuration. The state of these pins is unknown. If these pins must be used, they require a pull-up or a pull-down configuration. The Arduino board allows the pins to be set in a pull-up configuration. If not it must be established as an external pull-up or pull-down circuit in order to correctly work with these pins.

12.3 SPI - MISO / MOSI / SCK

These pins are not established with a pull-up or a pull down configuration. The state of these pins is unknown. If these pins must be used, they require a pull-up or a pull-down configuration. The Arduino board allows the pins to be set in a pull-up configuration. If not it must be established as an external pull-up or pull-down circuit in order to correctly work with these pins.

13. Digital inputs threshold detection

The Ardbox inputs have a minimum voltage threshold to reliably detect the signal when used as digital input. The threshold value is different depending on the input type:

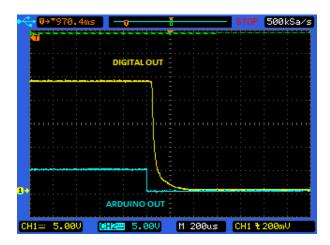
Input type	Threshold voltage (V)
Digital input	3.7
Analog input	3.3

14. I/O technical details

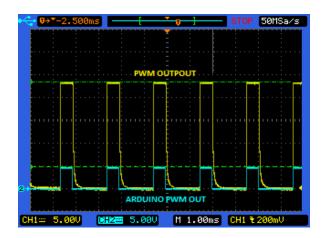
Digital Output Waveform



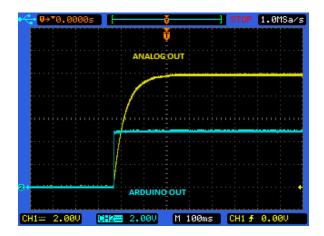
Digital Output Turn-off



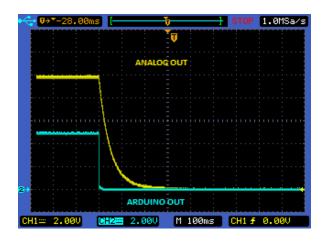
PWM Waveform



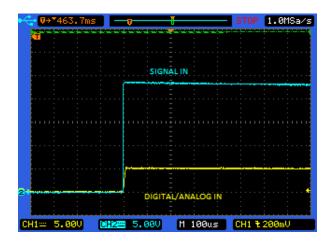
Analog Out Turn-on



Analog Out Turn-off



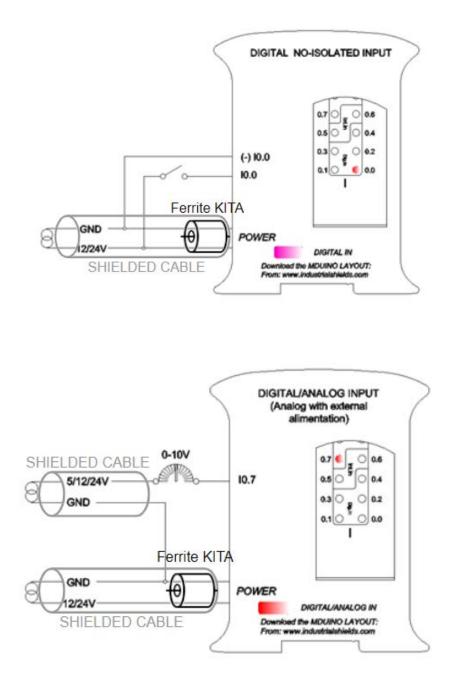
Analog/Digital Input Turn-on

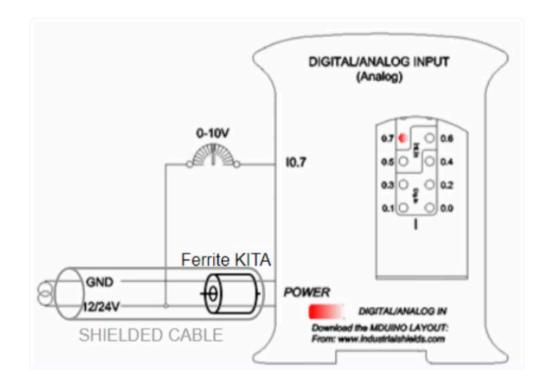


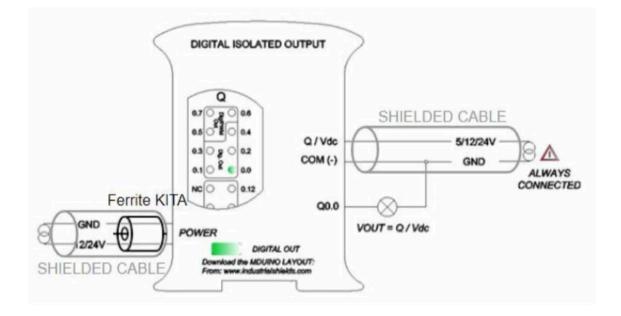
Analog/Digital Input Turn-off

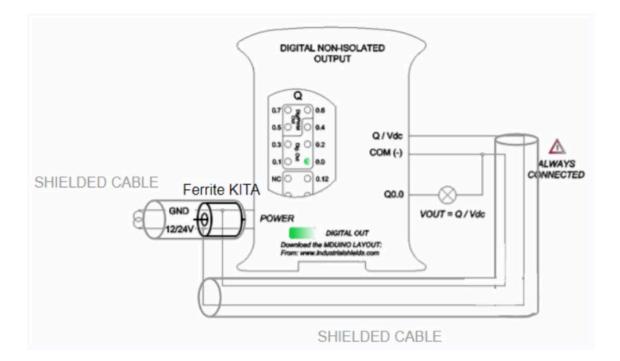
⊷ V+*329.6ms		⊽ 1	STOP	200kSa⁄s
SIG	NALIN			
- inninninnin				
21	DIGITAL IN		1	
CH1== 2.00V	H2= 5.00V	M 10.0ms	CH1 F	0.000

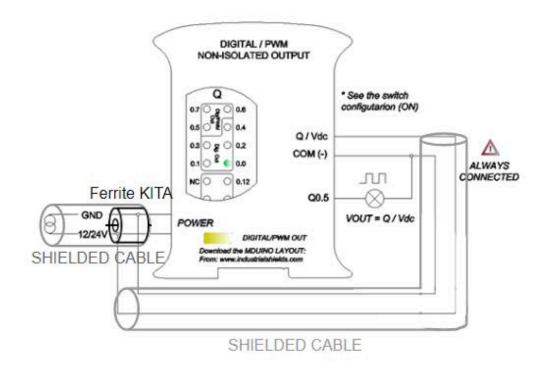
15. Typical Connections

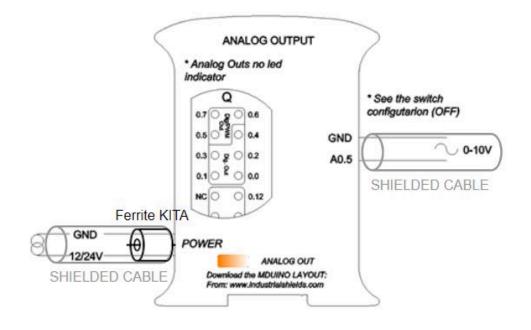












16. Connector details

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:

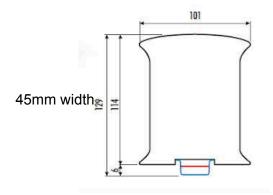
Article reference	MC 0,5/10-G-2,5 THT	
Height	8,1mm	
Pitch	2,5mm	
Dimension	22,5mm	
Pin dimensions	0,8x0,8mm	
Pin spacing	2,50mm	



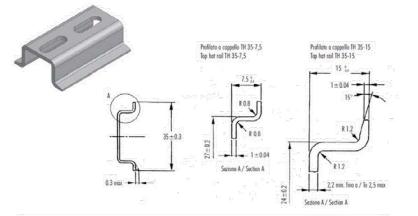
Article reference	FK-MC 0,5/10-ST-2,5
Rigid conduit section min.	0,14 mm²
Rigid conduit section max.	0,5 mm²
Flexible conduit section min.	0,14 mm²
Flexible conduit section max.	0,5 mm²
Conduit section AWG/kcmil min.	26
Conduit section AWG/kcmil max.	20



17. ARDBOX Family Dimensions



DIN rail mounting: -



CARATTERISTICHE		METODO	UNITA' DI MISURA	BLEND PC/ABS
Meccaniche	Resistenza a trazione alla svervamenta	ASTM D638	MPo	68
	Residence a trazione a rottura	ASTM D638	MPo	- 4
	Allungaments a ratium	ASTM D638	*	55
	Modulo in Bessione	ASTM 0790	MPg	2894
	Provo land con integlio	50 180/14	XI/m²	59
Termiche	Temp, di connollimento Vicot, metodo 8	ASTM DES25	°C	114
	Temperatura Ricarto 1 81 MPa	ASTM D648	20	- 97
Fisiche	Pos perfig	ASTM 0792	as'm3	12
	Ritio nello storigo	ASTM 0955	%	0.4/0.6
54 <u></u>	Melt Flow Index 260°C - 98N	ASTM 01238	01/10/	111
Comportamento	Autordinguenzo (nm di spesce)	U.94		¥-0(0.5
alla fiamma	File Incordecen, 32 mm	EG695.2.1	10	960

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18. Installation and Maintenance

Notes for installation:

- The installation position should be free from the following: dust or oil smoke, conductive dust, corrosive or flammable gas, high temperature, condensation, and rain.
- Besides, vibration and impact also affect the PLC normal operation and shorten its lifespan; electric shock, fire or misact also damages the product. During drilling or wiring, prevent the metal particles or wire segments from falling into the PLC casing, which may cause fire, fault or misact.
- After the PLC installation, clean the ventilation duct to prevent blocking, which may cause bad ventilation, or even fire, faults or misact.
- Do not online connect, plug or unplug cables, which could cause electric shock or damage the circuit. Installation and wire connection must be firm and reliable. Poor connection could cause a misact.
- Use shielded twisted pairs for the I/O of high frequency signal and analog signal to improve system IMS.

The installation environment should be free from dust, oil smoke, conductive particles, corrosive or flammable gases, high temperature, condensation, and rain.

Besides, vibration and impact also affect the PLC normal operation and shorten its lifespan. It is recommended to install the PLC, together with the matching switches and contactors, in a dedicated electric cabinet and keep the cabinet ventilated. If the location has high ambient temperature or heat generating equipment nearby, install forced convection devices on top or sides of the cabinet to avoid over-temperature. During drilling or wiring, prevent the metal particles or wire segments from falling into the PLC casing, which may cause fire, fault or misact. After the PLC installation, clean the ventilation duct to prevent blocking, which may cause bad ventilation, or even fire, faults or misact.

The only way to disconnect the equipment from the electrical network is by removing the connectors that feed the equipment. Once installed in the electrical cabinet it is very important to ensure the power connectors for proper operation.

Separate the ARDBOX 20 I/Os Family HF PLUS from heat, high voltage and electrical noise:

Always separate the devices that generate high voltage and high electrical noise from the ARDBOX 20 I/Os Family HF PLUS. When configuring the layout of the ARDBOX 20 I/Os Family HF PLUS inside your panel, consider the heat-generating devices and locate the electronic-type devices in the cooler areas of your cabinet. Reducing the exposure to a high-temperature environment will extend the operating life of any electronic device. Consider also the routing of the wiring for the devices in the electric cabinet. Avoid placing low-voltage signal wires and communications cables in the same tray with AC power wiring and high energy, rapidly-switched DC wiring.

Provide adequate clearance for cooling and wiring ARDBOX 20 I/Os Family HF PLUS. Is designed for natural convection cooling. For proper cooling, you must provide a clearance of at least 25 cm above and below the devices. Also, allow at least 25 cm of depth between the front of the modules and the inside of the enclosure.

Notes for maintenance:

A well-planned and executed maintenance program is essential to the satisfactory operation of solid-state electrical equipment. The kind and frequency of the maintenance operation will vary with the kind and complexity of the equipment as well as with the nature of the operating conditions. Maintenance recommendations of the manufacturer or appropriate product standards should be followed.

The following factors should be considered when formulating a maintenance program:

- Maintenance must be performed by qualified personnel familiar with the construction, operation, and hazards involved with the control.
- Maintenance should be performed with the control out of operation and disconnected from all sources of power.
- Care should be taken when servicing electrostatic sensitive components. The manufacturer's recommendations for these components should be followed.
- Ventilation passages should be kept open. If the equipment depends upon auxiliary cooling, e.g., air, water, or oil, periodic inspection (with filter replacement when necessary) should be made of these systems.
- The means employed for grounding or insulating the equipment from ground should be checked to assure its integrity.
- Accumulations of dust and dirt on all parts, including on semiconductor heat sinks, should be removed according to the manufacturer's instructions, if provided; otherwise, the manufacturer should be consulted. Care must be taken to avoid damaging any delicate components and to avoid displacing dust, dirt, or debris in a way that permits it to enter or settle into parts of the control equipment.
- Enclosures should be inspected for evidence of deterioration. Accumulated dust and dirt should be removed from the top of the enclosures before opening doors or removing covers.
- Certain hazardous materials removed as part of maintenance or repair procedure (e.g., polychlorinated biphenyls (PCBs) found in some liquid filled capacitors) must be disposed of as described in Federal regulations.

Safety rules for maintenance personnel

Consider the following steps to follow. A false manoeuvre could be the cause of an accident or material damage.

Do not disassemble or modify the modules. This could lead to breakdowns or malfunctions and could lead to injuries or fire.

- All types of radio communication devices, including mobile phones and personal handy-phone systems (PHS), must be kept more than **25cm** away from the PLC in all directions. Failure to observe this precaution exposes malfunctions caused by excess temperature.

- Disconnect the external power supply of the system (on all phases) before connecting or disconnecting a module. Failure to observe this precaution may cause faults or malfunctions of the module.

- Tighten the screws of the terminal ports and the screws of the connectors within the prescribed tightening torque. Insufficient tightening can lead to loose parts or wires and cause malfunctions. Excessive tightening can damage the screws and / or the module, with the risk of falling, short circuits and malfunctions.

- Before handling a module, dispose of the electrostatic charge accumulated by the human body by touching a suitable conductive object. Failure to observe this precaution may cause faults or malfunctions of the module.

Repair note:

If the equipment is suitable to be repaired, it must be verified that the equipment remains in a safe state after repair.

19. Revision Table

Revision Number	Date	Changes
0	30/08/2019	First implementation
1	03/07/2020	Second implementation
2	17/10/2022	Family Implementation
3	19/02/2024	RS* Switches Revision
4	11/03/2024	Added section 13 "Digital inputs threshold detection"
5	21/03/2024	Section 8.2 Digital inputs fix
6	26/09/2024	Added section 3.4 ("Isolation Precautions")

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PLC ARDUINO WIFI ARDBOX 20 I/Os FAMILY HF PLUS MODBUS

PLC ARDUINO WiFi ARDBOX 20 I/Os

FAMILY HF

PLUS



PLC Arduino WiFi ARDBOX 20 I/Os Family HF PLUS User Guide

Revised September 2024

This user guide is for version PLC Arduino WiFi ARDBOX 20 I/Os Family HF PLUS with Reference name 007001001200 or 007001001300.

Preface

This User Guide has 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.



- 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.
- Maintenance must be performed by qualified personnel familiarised with the construction, operation, and hazards involved with the control.
- Maintenance should be performed with the control out of operation and disconnected from all sources of power.
- Care should be taken when servicing electrostatic sensitive components. The manufacturer's recommendations for these components should be followed.

- The Ardbox Family PLCs are Open Type Controllers. It is required that you install the Ardbox PLC in a housing, cabinet, or electric control room. Entry to the housing, cabinet, or electric control room should be limited to authorised personnel. Failure to follow these installation requirements could result in severe personal injury and/or property damage. Always follow these requirements when installing Ardbox family PLCs.
- In case of installation or maintenance of the Ardbox please follow the instructions marked in the Installation and Maintenance section.
- Do not disconnect equipment when a flammable or combustible atmosphere is present. Disconnection of equipment when a flammable or combustible atmosphere is present may cause a fire or explosion which could result in death, serious injury and/or property damage.



- Les broches non utilisées ne doivent pas être connectées. Ignorer la directive peut endommager le contrôleur.
- Une utilisation incorrecte de ce produit peut endommager gravement le contrôleur.
- Reportez-vous au Guide de l'utilisateur du contrôleur pour les considérations de câblage.
- Avant d'utiliser ce produit, il incombe à l'utilisateur de lire le Guide de l'utilisateur du produit et la documentation qui l'accompagne.
- La maintenance doit être effectuée par personnel qualifié familiarisé avec la fabrication, le fonctionnement et les dangers liés au contrôleur.
- La maintenance doit être effectuée avec l'équipement hors service et déconnectée de toutes les sources d'alimentation.
- Faites attention lors de l'entretien des composants sensibles à l'électricité statique. Les recommandations du fabricant pour ces composants doivent être suivies.
- Les automates de la famille Ardbox sont des contrôleurs de type ouvert. Il est nécessaire d'installer l'automate Ardbox dans un boîtier, une armoire ou une salle de contrôle électrique. L'accès au boîtier, à l'armoire ou à la salle de commande électrique doit être limité au personnel autorisé. Le non-respect de ces exigences d'installation peut entraîner des blessures graves et/ou des dommages matériels importants. Respectez toujours ces exigences lors de l'installation des automates de la famille Ardbox.
- En cas d'installation ou de maintenance du Ardbox, veuillez suivre les instructions indiquées dans la section Installation et Maintenance.
- Ne débranchez pas l'équipement en présence d'une atmosphère inflammable ou combustible. La déconnexion de l'équipement en présence d'une atmosphère inflammable ou combustible peut provoquer un incendie ou une explosion pouvant entraîner la mort, des blessures graves et/ou des dommages matériels.

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 machines, 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.

Intended use of Industrial Shields products

Consider the following:

Industrial Shields products should only be used for the cases of application foreseen in the catalogue and the associated technical documentation. If third-party products and components are used, they must have been recommended or approved by Industrial Shields.

The correct and safe operation of the products requires that your transport, storage, installation, assembly, operation and maintenance have been carried out in a correct manner. It must respect the permissible ambient conditions. You should also follow the indications and warnings that appear in the associated documentation.

The product / system dealt with in this documentation should only be handled or manipulated by qualified personnel for the task entrusted and observing what is indicated in the documentation corresponding to it, particularly the safety instructions and warnings included in it. Due to their training and experience, qualified personnel are in a position to recognize risks resulting from the handling or manipulation of such products / systems and to avoid possible hazards.

Disclaimers

Weights and Dimensions

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

Performance Data

The 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 most correlate it to actual application requirements. Actual performance is subject to the INDUSTRIAL SHIELDS Warranty and Limitations of Liability.

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.

Residual Risks

The control and drive components of an Industrial Shields PLC are approved for industrial and commercial use in industrial line supplies. Their use in public line supplies requires a different configuration and/or additional measures. These components may only be operated in closed housings or in higher-level control cabinets with protective covers that are closed, and when all of the protective devices are used. These components may only be handled by qualified and trained technical personnel who are knowledgeable and observe all of the safety information and instructions on the components and in the associated technical user documentation. When carrying out a risk assessment of a machine in accordance with the EU Machinery Directive, the machine manufacturer must consider the following residual risks associated with the control and drive components of a PDS.

1. Unintentional movements of driven machine components during commissioning, operation, maintenance, and repairs caused by, for example: – Hardware defects and/or software errors in the sensors, controllers, actuators, and connection technology – Response times of the controller and drive – Operating and/or ambient conditions not within the scope of the specification – Condensation / conductive contamination – Parameterization, programming, cabling, and installation errors – Use of radio devices / cellular phones in the immediate vicinity of the controller – External influences / damage.

 Exceptional temperatures as well as emissions of noise, particles, or gas caused by, for example: – Component malfunctions – Software errors – Operating and/or ambient conditions not within the scope of the specification – External influences / damage.

3. Hazardous shock voltages caused by, for example: – Component malfunctions – Influence of electrostatic charging – Induction of voltages in moving motors – Operating and/or ambient conditions not within the scope of the specification – Condensation / conductive contamination – External influences / damage

4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc. if they are too close.

5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly.

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, EXPRESSED 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

INDUSTRIAL SHIELDS SHALL NOT BE RESPONSIBLE FOR SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS OR COMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED ON CONTRACT, WARRANTY, NEGLIGENCE, OR STRICT LIABILITY.

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.

Table of Contents

1. WiFi Ardbox Family HF: General Features	11
2. Technical Specifications	12
2.1 General Specifications:	12
2.2 Performance Specification:	12
2.3 Symbology	13
3. Precautions	14
3.1 Arduino Board	14
3.2 Intended Audience	14
3.3 General Precautions	14
3.4 Isolation Precautions	14
4. Software interface	15
5. How to connect PLC Arduino to PC	18
6. How to connect PLC to power supply	19
7. Ardbox WiFi/BLE pinout	20
8. Ardbox WiFi/BT Family I/O serigraphy	21
8.1 007001001200 Zone Connections	21
8.2 007001001300 Relay Zone Connections	23
9. Switch configuration	25
9.1 007001001200 Analog Model General Switches Configuration	25
9.2 007001001300 Relay Model General Switches Configuration	27
9.3 007001001200 Analog RS-232 and RS-485 Switch Configuration	29
9.4 007001001300 Relay RS-232 and RS-485 Switch Configuration	30
9.5 007001001200 Analog I2C Switch Configuration	31
9.6 007001001300 Relay I2C Switch Configuration	31
10. Jumper Configuration	32
10.1 007001001200 Analog General Jumper Configuration	32
10.2 007001001300 Relay General Jumper Configuration	33
11. Hardware Serial RS-232 & RS-485 Configuration	34
11.1 007001001200 Analog Hardware Serial RS-485	34
11.2 007001001200 Analog Hardware Serial RS-232	35
11.3 007001001300 Relay Hardware Serial RS-485	
11.4 007001001300 Relay Hardware Serial RS-232	37
12. Ardbox - Arduino I/Os 5V pins	38
12.1 I2C pins – SDA/SCL	38
12.2 Pin 2/Pin 3	
13. WiFI & BLE	39
13.1 General Specifications:	

	13.2 WiFi & Bluetooth Module Configuration	39
14. \	WiFI/BLE Programming Examples	41
	14.1 Communication system between Ardbox and WiFi module	41
	14.2 How to connect your ESP based PLC to WiFi	.41
	14.3 Interact with Ardbox WiFi/BLE PLC via Bluetooth	.41
15. I	Digital inputs threshold detection	.41
16. I	/0 technical details	42
17.1	Typical Connections	45
18. (Connector details	.49
19. /	ARDBOX Family Dimensions	.50
20. I	nstallation and Maintenance	51
21. I	Revision Table	.54

1. WiFi Ardbox Family HF: General Features

COMPACT PLC ARDUINO	WiFi ARDBOX 20I/Os Family LOG HF PLUS	
Input Voltage	12 to 24Vdc	Fuse protection (2.5A) Polarity protection
Input rated voltage	24Vdc	
Rated Power	30W	
l Max.	1.5A	
Size	100x45x115	
Clock Speed	16MHz	
Flash Memory	32KB of which 4KB are used by bootloader	
SRAM	2.5KB	
EEPROM	1KB	
Communications	I2C USB RS232 RS485	RS485
An/Dig Input 10bit (0-10Vcc)	0 to 10Vdc Input Impedance: 39K Separated PCB ground Rated Voltage: 10Vac 5 to 24Vdc I min: 2 to 12mA Galvanic Isolation Rated Voltage: 24 Vdc	*Check <u>Section 15</u> for digital inputs threshold detection
* Interrupt isolated Input HS (24Vcc)	5 to 24Vdc I min: 2 to 12mA Galvanic Isolation Rated Voltage: 24Vdc	5 to 24Vdc I min: 3/6mA Separated PCB ground
Analog Output 8bit (0-10Vcc)	0 to 10Vdc I max: 20mA Separated PCB ground Rated Voltage: 10Vac	
Digital Isolated Output (24Vcc)	5 to 24Vdc I max: 70mA Galvanic Isolation Diode Protected for Relay Rated Voltage: 24Vdc	Imax 24Vdc: 410mA
Digital Isolated Output Relay	30Vdc / 250Vac Galvanic Isolation Diode protected for Relay	lmax: 3A (30Vdc) Imax: 5A (250Vac)
PWM Isolated Output 8bit (24Vcc)	5 to 24Vdc I max: 70mA Galvanic Isolation Diode Protected for Relay Rated Voltage: 24Vdc	PWM Isolated Output 8bit (24Vcc)
Expandability	I2C – RS232 – RS485 – TTL	
Reference	007001001200 007001001300	Analog Relay

2. Technical Specifications

2.1 General Specifications:

Power supply DC power supply voltage		12 to 24Vdc		
Operating voltage range	DC power supply	11.4 to 25.4Vdc		
Power consumption	DC power supply	30W max.		
External	Power supply voltage	24Vdc		
power supply	Power supply output capacity	700mA		
Insulation resistance		$20M\Omega$ min. at 500Vdc between the AC terminals and the protective ground terminal.		
Dielectric strength		2.300Vac 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/s² in the X, Y and Z direction 2 times each.		
Ambient temperature (operating)		0° to 60°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		350g max.		

2.2 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 4KB are used by bootloader	
Program capacity (SRAM)	2.5КВ	
EEPROM	1КВ	
Clock Speed	16MHz	

2.3 Symbology

Table that includes all the symbology that is used in the serigraph of the WiFi Ardbox Family HF+:

Symbol	Standard No. / Standard Title	Standard Reference No. / Symbol Title	Symbol Meaning
	IEC 60417 / Graphical symbols for use on equipment	5031 / Direct Current	Indicates that the equipment is suitable for direct current only; to identify relevant terminals
\sim	IEC 60417 / Graphical symbols for use on equipment	5032 / Alternating Current	Indicates that the equipment is suitable for alternating current only; to identify relevant terminals
	IEC 60417 / Graphical symbols for use on equipment	5130 / Pulse General	To identify the control by which a pulse is started.
	IEC 60417 / Graphical symbols for use on equipment	5017 / Earth, Ground	To identify an earth (ground) terminal in cases where neither the symbol 5018 nor 5019 is explicitly required.
\bigotimes	IEC 60417 / Graphical symbols for use on equipment	5115 / Signal lamp	To identify the switch by means of which the signal lamp(s) is (are) switched on or off.
CE	Medical Devices Directive 93/42/EEC	CE Marking	CE marking indicates that a product complies with applicable European Union regulations
$\overline{\mathbb{N}}$	ISO 7000/ Graphical symbols for use on equipment	0434B / Warning symbol	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury
4	ISO 7000/ Graphical symbols for use on equipment	5036 / Dangerous Voltage	To indicate hazards arising from dangerous voltages

3. Precautions

Read this manual before attempting to use the ARDBOX 20 I/Os Family HF WIFI & BLE PLUS and follow its descriptions for reference during operation.

3.1 Arduino Board

The ARDBOX 20 I/Os Family HF WIFI & BLE PLUS PLCs include Arduino Leonardo Board as controller.

3.2 Intended Audience

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

3.3 General Precautions

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

Before using ARDBOX 20 I/Os Family HF WIFI & BLE PLUS under different conditions from what has been specified in this manual or integrating ARDBOX 20 I/Os Family HF WIFI & BLE PLUS 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.

3.4 Isolation Precautions

Description:

This equipment does **not include galvanic isolation between the grounds** of the different systems. This means that if an external device or sensor that shares the same ground reference (GND) with the system is connected, any potential difference between these grounds could damage the connected components. To avoid issues with interference, ground loops, or damage to external equipment, ensure that all connected devices share the same ground reference or use systems with appropriate isolation.

Recommendations:

- **Connection Review:** Verify that all ground connections are properly made and that there are no significant potential differences between them.
- Use of Isolation: Consider using galvanic isolators or isolation transformers if it is necessary to connect equipment with different ground references.

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 directly using C, but it is much easier working with Arduino IDE, as it provides lots of useful libraries.

Industrial Shields provide a boards package for programming the PLCs, making it easier and friendlier. It includes various facilities such as not having to define the pins, etc.

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

Requirements:

Arduino IDE 1.8.15 or above (recommended: 1.8.19).

Steps:

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

Preferences	×
Settings Network	
Sketchbook location:	
C:\Users\Albert\Documents\A	rduino Browse
Editor language:	English (English) · (requires restart of Arduino)
Editor font size:	15
Interface scale:	Automatic 100 🔷 % (requires restart of Arduino)
Show verbose output during:	compilation upload
Compiler warnings:	None 🗸
Display line numbers	
Enable Code Folding	
Verify code after upload	
Use external editor	
Check for updates on star	tup
Update sketch files to nev	/ extension on save (.pde -> .ino)
Save when verifying or up	loading
Additional Boards Manager UR	tLs: [http://apps.industrialshields.com/main/arduino/boards/package_industrialshields_inde]
More preferences can be edit	ed directly in the file
C:\Users\Albert\AppData\Loca	il\Arduino15\preferences.bt
(edit only when Arduino is not	:running)
	OK Cancel

2. In Additional Boards URLs write the following:

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.

pe All	v industrialshields	
RDBOX family, I <u>nline help</u>	s in this package: 1-Duino family.	
<u>ore info</u>		1.1.8 V Install

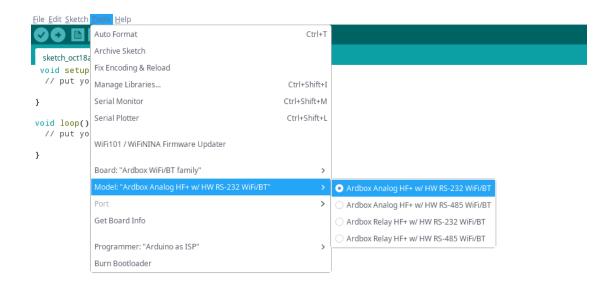
6. Click install (selecting the latest version).

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

Ele Edit Sketch	Belp Help		1			-
00 🖬	Auto Format	Ctrl+T				ø
sketch oct18a	Archive Sketch					
void setun(Fix Encoding & Reload					
// put yo	Manage Libraries	Ctrl+Shift+I				
}	Serial Monitor	Ctrl+Shift+M				
void loop()	Senal Plotter	Ctrl+Shift+L				
// put yo	WiFi101 / WiFiNINA Firmware Updater					
)	wirtion / wirking Himware opdater					
	Board: "Ardbox WiFi/BT family"		Boards Manager			
	Model: "Ardbox Analog HF+ w/ HW RS-232 WiFi/BT"	5	A REAL TO BE AND A REAL AND A REA			
	Part	>	Arduino AVR Boards	>		
	Get Board Info Programmer: "Arduino as ISP" Burn Bootloader	>	Industrial Shields boards	2	O Ardbox family	
			Industrial Shields ESP32		Ardbox DALI family	
					C Ardbox GPRS family	
					Ardbox WiFi/BT family	
					C Ardbox LoRa family	
					O M-Duino family	
					O M-Duino DAU family	
					O M-Duino GPRS family	
					C M-Duino LoRa family	
					O M-Duino WiFi/BT family	
					O M-Duino WiFi/BT + GPRS family	
					Spartan family	

Once the Ardbox Family is selected, an extra option will appear on Tools:

Select the correct Ardbox Family HF PLUS Board (Ardbox Analog HF+ w/HW RS-232 WIFI/BT, Ardbox Analog HF+ w/HW RS-485 WIFI/BT, Ardbox Relay HF+ w/HW RS-232 WIFI/BT or Ardbox Relay HF+ w/HW RS-485 WIFI/BT) depending on your jumpers & switch configuration.



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

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

https://github.com/Industrial-Shields/

5. How to connect PLC Arduino to PC

- Connect USB port from PLC to PC.

NOTE:

Ardbox Family uses micro USB cable.



- Open Arduino IDE interface:
- Select Industrial Shields boards -> Ardbox WIFI/BT Family
- Select the correct port.

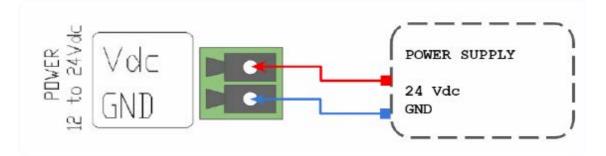
💿 sketch_mar16a | Arduino 1.8.0

File Edit Sketch Tools Help

	Auto Format Archive Sketch	Ctrl+T	
sketch_mar16	Fix Encoding & Reload		
oid setup	Serial Monitor	Ctrl+Shift+M	
// put y	Serial Plotter	Ctrl+Shift+L	
	WiFi101 Firmware Updater		
}	Board: "Ardbox family"	>	
	Industrial Shields: "Ardbox Analog"	>	
oid loop(Port	>	Serial ports
// put y	Get Board Info		COM13 (Arduino Leonardo)
}	Programmer: "Arduino as ISP"	>	
	Burn Bootloader		

6. How to connect PLC to power supply

- Ardbox WIFI/BT Family PLCs are 12-24Vdc supplied. IMPORTANT: The polarity IS NOT REVERSIBLE!
- 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

Compact DIN rail power supply. Assembled on 35mm	
DIN Rail:	- 11
-12Vdc / 24Vdc	DEPER
-2.5A	+ +
-30W	(I III
	• · · · ·
Industrial Shields power supplies provide parallel	3000-224
operation, overvoltage protection, and overcurrent	-
protection. There is a LED inductor for power status, the	LNO
power supply is certified according to UL.	CEE

The standard, Part 1 of IEC 61010, sets the general safety requirements for the following types of electrical devices and their accessories, regardless of where use of the device is intended.

The equipment must be powered from an external power source in accordance with IEC 61010-1, whose output is MBTS and is limited in power according to section 9.4 of IEC 61010-1.

WARNING: Once the equipment is installed inside an electrical cabinet, the MTBS cables of the equipment must be separated from the dangerous voltage cables.

7. Ardbox WiFi/BLE pinout

		IOs Table				
Model	Reference	Analog Input				
ANALOG	007001001200	8	10	10	7	0
RELAY	007001001300	8	10	0	2	8

8. Ardbox WiFi/BT Family I/O serigraphy

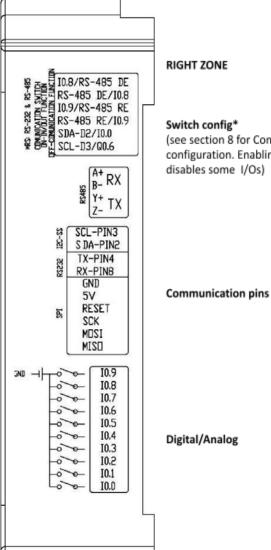
8.1 007001001200 Zone Connections

				LEFT ZONE
	LEFT ZO	NE		Switch config*
Ardbox Connector	Arduino Pin	Function	HD-FD 8 BF-1006 00.5 00.4 00.5 00.4	(see section 8 for Communications configuration. Enabling Communications disables some I/Os)
A0.6 ¹ A0.5 ¹ A0.4 ¹ A0.3 ¹ A0.2 ¹	3 5 6 9 10	Analog Out Analog Out Analog Out Analog Out Analog Out		Analog Outputs pins
A0.1 ¹ A0.0 ¹ Q0.9 ² Q0.8 ²	11 13 1 0	Analog Out Analog Out Digital Output Digital Output		
Q0.7 Q0.6 Q0.5 Q0.4 Q0.3 Q0.2 Q0.1 Q0.0	7 3 5 6 9 10 11 13	Digital Output Digital Output PWM/digital Output PWM/digital Output PWM/digital Output PWM/digital Output PWM/digital Output	20.9 —⊗- 20.8 —⊗- 20.7 —⊗- 20.6 = 2r⊗- 20.5 = 2r⊗- 20.4 = 2r⊗- 20.3 = 2r⊗- 20.2 = 2r⊗- 20.1 = 2r⊗-	Digital Outputs pins
GNDCOM 24VCOM		GND Power Supply		Power supply connectors (24Vdc – GND)

¹ See<u>section 8</u> to enable these connections

² See <u>section 9</u> to enable these connections

	RIGHT Z	ONE		
Ardbox Connector	Flinction			
A+ ^{3,4} B- ^{3,4} Y+ ^{3,4} Z- ^{3,4} SCL-PIN3 ³ SDA-PIN2 ³ TX-RS232 ^{3,4} RX-RS232 ^{3,4}	- - 3 2 1 0	RS485(A) RS485(B) RS485(Y) RS485(Z) SCL(I2C) SDA(I2C) -		
GND 5V RESET SCK NC NC	- - - -	Ground 5Vout DC RESET SPI-CLOCK - -		
10.9 10.8 10.7 10.5 10.4 10.3 ³ 10.2 ³ 10.1 10.0 ³	18 19 20 21 22 23 8 4 12 2	Analog/Digital Input Analog/Digital Input Analog/Digital Input Analog/Digital Input Analog/Digital Input Analog/Digital Input Analog/Digital Input Digital Input Digital Input		

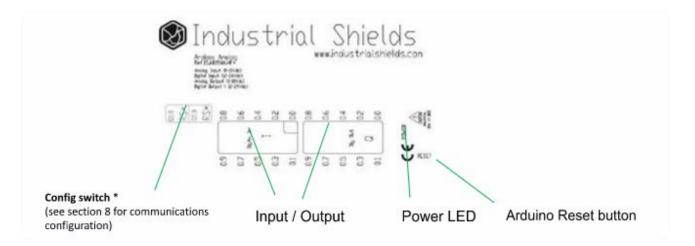


RIGHT ZONE

Switch config* (see section 8 for Communications configuration. Enabling Communications disables some I/Os)

Digital/Analog

HS*: Hardware Serial SS*: Software Serial



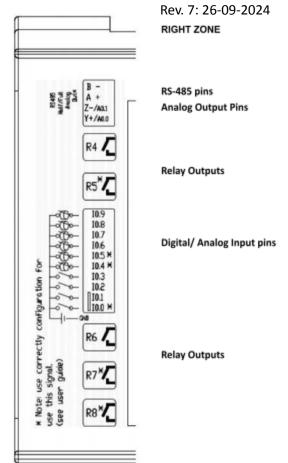
³ See <u>section 8</u> to enable these connections

⁴ See <u>section 9</u> to enable these connections

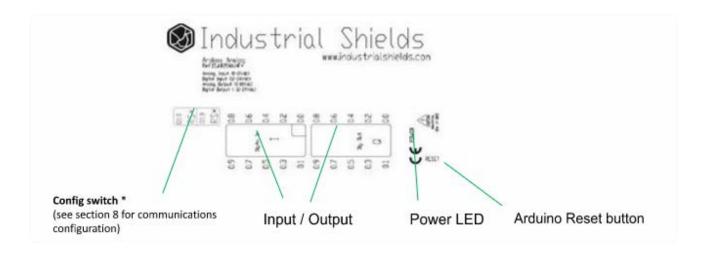
8.2 007001001300 Relay Zone Connections

 ⁵ See <u>section 8</u> to enable these connections
 ⁶ See <u>section 9</u> to enable these connections

Right Zone				
Ardbox Pin Connector RS-485 HD*				
B- A+ Z-/A0.1 Y+/A0.0 R4 R5 I0.9 I0.9 I0.8 I0.7 I0.6 I0.5 I0.4 I0.5 I0.4 I0.3 I0.2 I0.1 I0.0 R6 P7	- 11 (FD)* 13 (FD)* 5 3 23 22 21 20 19 18 8 4 12 2 7 7	RS485 RS485/Digital Output RS485/Digital Output Relay 4 Out Relay 5 Out Analog/Digital Input Analog/Digital Input Analog/Digital Input Analog/Digital Input Analog/Digital Input Analog/Digital Input Digital Optoisolated Input Digital Optoisolated Input Digital Optoisolated Input Digital Optoisolated Input Digital Input / Interrupt Relay 6 Out		
R7 R8	0 1	Relay 7 Out Relay 8 Out		



*Depending on the mode HD/FD the Y+/Z- Analog Output pins are enabled or disabled. See <u>section 9</u> to see the configurations.



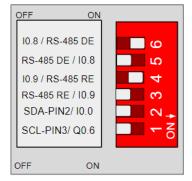
9. Switch configuration

9.1 007001001200 Analog Model General Switches Configuration

LEFT ZONE				
SWITCH OFF ON				
10.8 / RS-485 DE	10.8	RS-485 DE		
RS-485 DE / 10.8	RS-485 DE	10.8		
10.9 / RS-485 RE	10.9	RS-485 RE		
RS-485 RE / 10.9	RS-485 RE	10.9		
SDA-PIN2 / 10.0	SDA-D2	10.0		
SCL-PIN3 / Q0.6	SCL-D3	Q0.6		

LEFT ZONE SWITCH

Communications and inputs/outputs can not work simultaneously.



6. IO.8 / RS-485 DE – If this switch is ON the RS-485 DE is activated, otherwise the IO.8 will be activated.

5. RS-485 DE / I0.8– If this switch is ON the I0.8 is activated, otherwise the RS-485 DE will be activated.

*Note** To work with RS-485 DE, switch number 6 at ON and number 5 at OFF.

4. IO.9 / RS-485 RE – If this switch is ON the RS-485 RE is activated, otherwise the IO.9 will be activated.

3. RS-485 RE / I0.9– If this switch is ON the I0.9 is activated, otherwise the RS-485 RE will be activated.

Note* To work with RS-485 RE, switch number 4 at ON and number 3 at OFF.

2. SDA-D2/I0.0 – If this switch is ON the I0.0 is activated, otherwise the (I2C) SDA-D2 will be activated.

1. SCL-D3/Q0.6 – If this switch is ON the Q0.6 is activated, otherwise the (I2C) SCL-D3 will be activated.

TOP ZONE SWITCH

TOP ZONE				
SWITCH ON OFF				
Q0.8	Q0.8	RS*		
RS*	Q0.8			
Q0.9	Q0.9	RS*		
RS*	RS*	Q0.9		

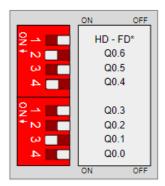
	ON	OFF
9-1	Q0.8	
[↓] N	RS*	
ω	Q0.9	
4	RS*	

- 1. **Q0.8** If this switch is ON the Q0.8 is activated, otherwise the RS* will be activated.
- 2. RS* If this switch is ON the RS* is activated, otherwise the Q0.8 will be activated.
- 3. Q0.9 If this switch is ON the Q0.9 is activated, otherwise the RS*will be activated.
- **4. RS*** If this switch is ON the RS* is activated, otherwise the Q0.9 will be activated.

Note* RS * can be RS-485 or RS-232 depending on the jumper configuration you have chosen. To work with RS*, switches number 1 and 3 at OFF and number 2 and 4 at ON.

RIGHT ZONE				
SWITCH	ON	OFF		
HD / FD	Half Duplex	Full Duplex		
Q0.6	DIGITAL (Q0.6)	ANALOG (A0.6)		
Q0.5	DIGITAL (Q0.5)	ANALOG (A0.5)		
Q0.4	DIGITAL (Q0.4)	ANALOG (A0.4)		
Q0.3	DIGITAL (Q0.3)	ANALOG (A0.3)		
Q0.2	DIGITAL (Q0.2)	ANALOG (A0.2)		
Q0.1	DIGITAL (Q0.1)	ANALOG (A0.1)		
Q0.0	DIGITAL (Q0.0)	ANALOG (A0.0)		

RIGHT ZONE SWITCH



RIGHT ZONE.

1. HD/FD – Choosing between Half/Full Duplex for the RS485 communication. In order to use Full Duplex, it has to be considered the TOP ZONE and the JUMPER ZONE (see <u>section 9</u>).

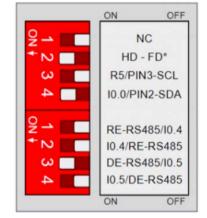
2-8. Q0.X/A0.X – The right zone configures the outputs. If the switch is set to "ON" the Q0.X will have the behaviour of a digital output. If it is set to "OFF" it will be analog.

9.2 007001001300 Relay Model General Switches Configuration

LEFT ZONE				
SWITCH	ON	OFF		
NC	-	-		
HD/FD*	Half Duplex	Full Duplex		
R5 / Pin 3-SCL	R5	Pin 3 - SCL		
10.0 / Pin 2-SDA	10.0	Pin 2 - SDA		
RE-RS485 / 104	RE-RS485	10.4		
10.4 / RE-RS485	10.4	RE-RS485		
DE-RS485 / 10.5	DE-RS485	10.5		
10.5 / DE-RS485	10.5	DE-RS485		

LEFT ZONE SWITCH

Communications and inputs/outputs can not work simultaneously.



1. NC - Not Connected

2. HD/FD* – Choosing between Half/Full Duplex for the RS* communication. In order to use Full Duplex, it has to be considered the TOP ZONE and the JUMPER ZONE (see <u>section 9</u>).

3. R5 / Pin3-SCL – If this switch is ON the R5 is activated, otherwise the Pin3 - SCL will be activated.

4. IO.0 / Pin2-SDA – If this switch is ON the IO.0 is activated, otherwise the Pin2 - SDA will be activated.

1. RE-RS485 / IO.4 – If this switch is ON the RE-RS485 is activated, otherwise the IO.4 will be activated.

2. IO.4 / RE-RS485 – If this switch is ON the IO.4 is activated, otherwise the RE-RS485 will be activated.

Note* To work with RS-485 RE, switch number 1 at ON and number 2 at OFF.

3. DE-RS485 / I0.5 – If this switch is ON the DE-RS485 is activated, otherwise the I0.5 will be activated.

4. IO.5 / DE-RS485 – If this switch is ON the IO.5 is activated, otherwise the DE-RS485 will be activated.

Note* To work with RS-485 DE, switch number 3 at ON and number 4 at OFF.

TOP ZONE SWITCH

TOP ZONE		
SWITCH	ON	OFF
RS*	RS*	R8
R8	R8	RS*
RS*	RS*	R7
R7	R7	RS*

	ON	OFF
9 H	R	S*
4 N	R	8
ω	R	S*
4	R	7*

1. **RS*** - If this switch is ON the RS* is activated, otherwise the R8 will be activated.

2. **IO.2**- If this switch is ON the R8 is activated, otherwise the RS* will be activated.

3. **RS*** - If this switch is ON the RS* is activated, otherwise the R7 will be activated.

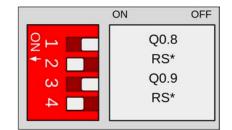
4. **IO.3** - If this switch is ON the R7 is activated, otherwise the RS* will be activated.

Note* RS * can be RS-485 or RS-232 depending on the jumper configuration you have chosen. To work with RS*, switches number 1 and 3 at ON and number 2 and 4 at OFF.

9.3 007001001200 Analog RS-232 and RS-485 Switch

Configuration

ANALOG TOP ZONE	
SWITCH MODE	
Q0.8	OFF
RS* ON	
Q0.9 OFF	
RS* ON	



RS* TOP ZONE: In order to enable the RS* protocol the TOP ZONE must be configured as it is shown in the table.

Having this setup, the Q0.8 & Q0.9 are disabled.

- **1. Q0.8** If this switch is ON the Q0.8 is activated, otherwise the RS* will be activated.
- 2. RS* If this switch is ON the RS* is activated, otherwise the Q0.8 will be activated.
- **3. Q0.9** If this switch is ON the Q0.9 is activated, otherwise the RS*will be activated.
- 4. RS* If this switch is ON the RS* is activated, otherwise the Q0.9 will be activated.

ANALOG LEFT ZONE		
SWITCH	RS232 MODE	RS485 MODE
10.8 / RS* DE	OFF	ON
RS* DE / 10.8	ON	OFF
10.9 / RS* RE	OFF	ON
RS* RE / 10.9	ON	OFF
SDA-D2	-	-
SCL-D3	-	-

RS* LEFT ZONE: In order to enable the RS* communication protocol it is necessary that the switches of the left one are configured as it is shown in the table.

The ones marked with "-" mean that they do not affect the RS* communication protocol.

9.4 007001001300 Relay RS-232 and RS-485 Switch

Configuration

RELAY TOP ZONE	
SWITCH	MODE
RS*	ON
R8	OFF
RS*	ON
R7	OFF

	ON	OFF
9	RS*	
⁴ N	R8	
ω	RS*	
4	R7*	

RS* TOP ZONE: In order to enable the RS* protocol the TOP ZONE must be configured as it is shown in the table.

Having this setup, the R7 & R8 are disabled.

- 1. RS* If this switch is ON the RS* is activated, otherwise the R8 will be activated.
- 2. R8 If this switch is ON the R8 is activated. otherwise the RS* will be activated.
- **3. RS*** If this switch is ON the RS* is activated, otherwise the R7 will be activated.
- **4. R7** If this switch is ON the R7 is activated, otherwise the RS* will be activated.

RELAY LEFT ZONE		
SWITCH	RS232 MODE	RS485 MODE
NC	-	-
HD/FD	ON / OFF	ON / OFF
R5 / Pin 3 - SCL	-	-
10.0 / Pin 2 - SDA	-	-
RE-RS485 / 104	OFF	ON
10.4 / RE-RS485	ON	OFF
DE-RS485 / 10.5	OFF	ON
10.5 / DE-RS485	ON	OFF

HD/FD: Choosing between Half Duplex or Full Duplex for the RS* communication. In order to use Full Duplex, it has to be considered the TOP ZONE and the JUMPER ZONE (see <u>section 9</u>).

RS* LEFT ZONE: In order to enable the RS* communication protocol it is necessary that the switches of the left zone are configured as it is shown in the table.

The ones marked with "-" mean that they do not affect the RS* communication protocol.

тор 2	ZONE	LEFT ZON	E
SWITCH	MODE	SWITCH	MODE
Q0.8	-	10.8 / RS-485 DE	-
RS*	-	RS-485 DE / 10.8	-
Q0.9	-	10.9 / RS-485 RE	-
RS*	-	RS-485 RE / 10.9	-
		SDA-D2 / 10.0	OFF
		SCL-D3 / Q0.6	OFF

9.5 007001001200 Analog I2C Switch Configuration

I2C: Enable SCL and SDA connections (direct Arduino pins) with configuration switches. I0.0 and Q0.6 will not be available. In order to implement this communication a $4.7k\Omega$ pull-up resistor is required.

The ones marked with "-" mean that they do not affect the I2C communication protocol.

9.6 007001001300 Relay I2C Switch Configuration

TOP	ZONE	LEFT ZON	E
SWITCH	MODE	SWITCH	MODE
RS*	-	NC	-
R8	-	HD / FD*	-
RS*	-	R5 / Pin 3 - SCL	OFF
R7	-	10.0 / Pin 2 - SDA	OFF
		RE-RS485 / 104	-
		10.4 / RE-RS485	-
		DE-RS485 / 10.5	_
		10.5 / DE-RS485	-

I2C: Enable SCL and SDA connections (direct Arduino pins) with configuration switches. I0.0 and R5 will not be available. In order to implement this communication a $4.7k\Omega$ pull-up resistor is required.

The ones marked with "-" mean that they do not affect the I2C communication protocol.

10. Jumper Configuration

10.1 007001001200 Analog General Jumper Configuration

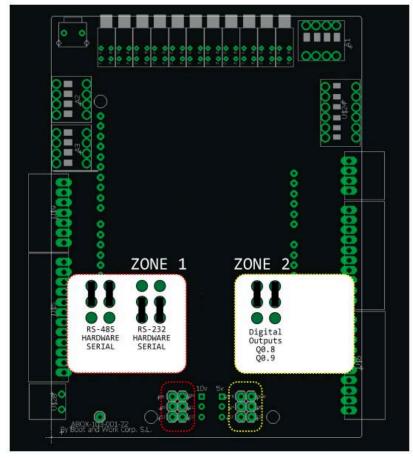
JUMPER ZONE 1		
LEFT	RIGHT	
RS-485	RS-485	
D0	D1	
RS-232	RS-232	

This jumper makes the choice between connecting MAX232 to pins 0,1 of the Arduino Leonardo or with the MAX485. In order to use the RS-232 Hardware Serial protocol both RS-232 must be connected to the D1/D0. In order to use the RS-485 Hardware Serial protocol both RS-485 must be connected to the D1/D0.

JUMPER ZONE 2		
LEFT RIGHT		
Q0.9	Q0.8	
D4	D8	
RS-232 SS	RS-232 SS	

This jumper zone makes the choice between connecting the inputs Q0.9, Q0.8 to pins 4 and 8 of the Arduino Leonardo respectively, or connect the RS-232 ports to activate the Software Serial RS-232. In order to use the inputs Q0.9, Q0.8 the jumper must be connected to the pins 4 and 8. So Q0.9 must be connected with D4 and Q0.8 must be connected to D8.

*The jumpers that are not connected to the middle jumpers MUST NOT be Connected anywhere.



10.2 007001001300 Relay General Jumper Configuration

JUMPER ZONE 1		
LEFT RIGHT		
Y+	Z-	
ENABLE	ENABLE	
A0.0	A0.1	

This jumper zone makes the selection between using the RS-485 Full Duplex or the Analog Outputs. If it is wanted to use the RS-485 Full Duplex communication protocol the Y+ must be connected to ENABLE, and Z- also connected to ENABLE. If it is wanted to use the Analog Outputs, the A0.0 must be connected to ENABLE, and A0.1 also connected to ENABLE.

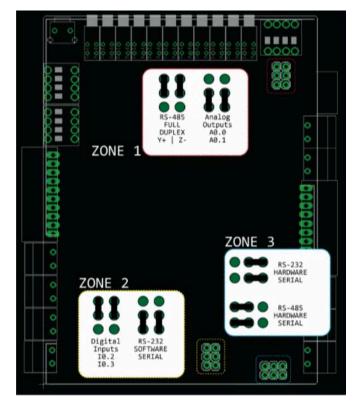
JUMPER ZONE 2			
LEFT RIGHT			
10.2	10.3		
D4	D8		
RS-232	RS232		

This jumper zone makes the choice between connecting the inputs Q0.9, Q0.8 to pins 4 and 8 of the Arduino Leonardo respectively, or connect the RS-232 ports to activate the Software Serial RS-232. In order to use the inputs Q0.9, Q0.8 the jumper must be connected to the pins 4 and 8. So Q0.9 must be connected with D4 and Q0.8 must be connected to D8.

JUMPER ZONE 3			
DOWN UP			
RS-485	RS-485		
D0	D1		
RS-232	RS-232		

This jumper makes the choice between connecting MAX232 to pins 0,1 of the Arduino Leonardo or with the MAX485. In order to use the RS-232 Hardware Serial protocol both RS-232 must be connected to the D1/D0. In order to use the RS-485 Hardware Serial protocol both RS-485 must be connected to the D1/D0.

*The jumpers that are not connected to the middle jumpers MUST NOT be Connected anywhere.



11. Hardware Serial RS-232 & RS-485 Configuration

11.1 007001001200 Analog Hardware Serial RS-485

In order to enable the Hardware Serial RS-485 the total configuration of the Ardbox Analog HF PLUS will be:

Switch configuration:

TOP ZONE		LEFT ZONE	
ACTIVATED SWITCH	MODE	ACTIVATED SWITCH	MODE
Q0.8	OFF	DE-RS485	ON
RS*	ON	DE-RS485	OFF
Q0.9	OFF	RE-RS485	ON
RS*	ON	RE-RS485	OFF
		SDA-PIN2 / 10.0	-
		SCL-PIN3 / Q0.6 -	

Jumper configuration:







00.9

- Available communication protocols:
 - Hardware Serial RS-485.
 - I2C *If I2C is active I0.0 & Q0.6 are disabled
 - TTL (SoftwareSerial)
 - USB

11.2 007001001200 Analog Hardware Serial RS-232

In order to enable the Hardware Serial RS-232 the total configuration of the Ardbox Analog HF PLUS will be:

TOP ZONE		LEFT ZONE	
ACTIVATED SWITCH	MODE	ACTIVATED SWITCH	MODE
Q0.8	OFF	10.8	OFF
RS*	ON	10.8	ON
Q0.9	OFF	10.9	OFF
RS*	ON	10.9	ON
		SDA-PIN2 / 10.0	-
		SCL-PIN3 / Q0.6	

Note: The switches of the left zone of the RS-485 don't interfere in the RS-232 HS. As pins 0 & 1 are reserved for the RS-232, the RS-485 is totally disabled and there is no point on configuring these switches as RS-485 mode

Jumper configuration:





- Available communication protocols:
 - Hardware Serial RS-232.
 - I2C *If I2C is active I0.0 & Q0.6 are disabled
 - o TTL
 - USB

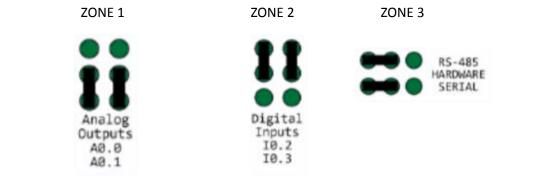
11.3 007001001300 Relay Hardware Serial RS-485

In order to enable the Hardware Serial RS-485 the total configuration of the Ardbox Relay HF PLUS will be:

Switch configuration:

TOP ZONE		LEFT ZONE	
ACTIVATED SWITCH	MODE	ACTIVATED SWITCH	MODE
RS*	ON	NC	-
R8	OFF	HD / FD	ON - OFF
RS*	ON	R5 / Pin 3-SCL -	
R7	OFF	10.0 / Pin 2-SDA -	
		RE-RS485	ON
		RE-RS485	OFF
		DE-RS485	ON
		DE-RS485 OFF	

Jumper configuration:



- Available communication protocols:
 - Hardware Serial RS-485.
 - I2C *If I2C is active I0.0 & R5 are disabled
 - TTL
 - USB

11.4 007001001300 Relay Hardware Serial RS-232

In order to enable the Hardware Serial RS-232 the total configuration of the Ardbox Relay HF PLUS will be:

Switch configuration:

TOP ZONE		LEFT ZONE	
ACTIVATED SWITCH	MODE	ACTIVATED MODE SWITCH	
RS*	ON	NC	-
R8	OFF	HD / FD	ON - OFF
RS*	ON	R5 / Pin 3-SCL -	
R7	OFF	I0.0 / Pin 2-SDA -	
		10.4	OFF
		10.4	ON
		10.5	OFF
		10.5	ON

Jumper configuration:





ZONE 3



- Available communication protocols:
 - Hardware Serial RS-232.
 - I2C *If I2C is active I0.0 & R5 are disabled
 - o TTL
 - USB

12. Ardbox - Arduino I/Os 5V pins

The Ardbox has some of the Leonardo board pins available. These pins can be programmed according to Arduino features such as I/Os operating at 5V or any additional features present in the pins (for example I2C communication in pins SCL and SDA). As these pins are directly connected to the Arduino Leonardo board they are not as well protected as the normal inputs. These pins are mainly meant to be used as prototyping.

Ardbox terminal	Arduino pin
SCL – Pin 3	3
SDA – Pin 2	2
MISO	14
SCK	15
MOSI	16

***IMPORTANT:** Do not connect the terminals in the chart above to voltages higher than 5V. These terminals provide direct access to the Leonardo board.

Apart from the switch configuration there are some special conditions depending on these 5V. Now it is going to be shown the considerations to operate with these pins.

12.1 I2C pins - SDA/SCL

The I2C protocol is meant to work in a pull-up configuration. The I2C pins in the Arduino Leonardo are not pull-up, so in order to work with the I2C an external pull-up resistor is required. If it is meant to work as a GPIO at 5V, the switches must be set as I2C, (section 8).

These pins are not established with a pull-up or a pull-down configuration. The state of these pins is unknown. If these pins must be used they require a pull-up or a pull-down configuration. The Arduino board allows the pins to be set in a pull-up configuration. If not it must be established as an external pull-up or pull-down circuit in order to correctly work with these pins.

12.2 Pin 2/Pin 3

These pins are only referred to the input I0.0 and output Q0.6 for the Analog model and inputs I0.0 and R0.5 for the Relay model. If the switch configuration is in OFF position the pins Pin 2/Pin 3 will be available.

These pins are not established with a pull-up or a pull-down configuration. The state of these pins is unknown. If these pins must be used, they require a pull-up or a pull-down configuration. The Arduino board allows the pins to be set in a pull-up configuration. If not it must be established as an external pull-up or pull-down circuit in order to correctly work with these pins.

13. WiFI & BLE

The WiFi and Bluetooth integrated module consists of a single 2.4 GHz Wi-Fi and Bluetooth combo chip designed with the TSMC ultra-low-power, 40 nm technology. It is designed to achieve the best power and RF performance, showing robustness, versatility and reliability in a wide variety of applications and power scenarios. Some applications are Generic Low-power IoT Sensor Hub, Generic Low-power IoT Data Loggers and Mesh Network.

It is designed for Internet-of-Things (IoT) applications.

13.1 General Specifications:

Wi-Fi

- 802.11 b/g/n
- 802.11 n (2.4 GHz), up to 150 Mbps

Bluetooth

- Bluetooth 4.2 BR/EDR BLE dual mode controller
- +12 dBm transmitting power
- NZIF receiver with -97 dBm BLE sensitivity

13.2 WiFi & Bluetooth Module Configuration

In order to configure the WiFi & BLE module, you must connect it to a PC. To connect it you will need a micro USB to USB cable.

The slot for the micro USB input is located on the right side of your equipment.

To load the program into the ESP32 you have to use the appropriate board. For that, update our board to the latest version. Go to *Tools -> Board -> Boards Manager*. Search by **industrialshields-esp32**.



Now you are able to install the board. Go to *Tools -> Boards -> industrialshields-esp32 -> WiFi module*.

<u>File</u> <u>E</u> di	t <u>S</u> ketch	Tools Help					
00		Auto Format	Ctrl+T				
sket	ch_sep27	Archive Sketch					
void	setup	Fix Encoding & Reload					
//	put y	Manage Libraries	Ctrl+Shift+I				
}		Serial Monitor	Ctrl+Shift+M				
void	loop(Serial Plotter	Ctrl+Shift+L				
	put y	WiFi101 / WiFiNINA Firmware Updater		ly:			
}		Board: "WiFi module"	×	Boards Manager			
			· · · · ·	Boards Manager			
		Port	>	Arduino AVR Boards	>		
		Get Board Info					
				Industrial Shields boards	>		
		Programmer	>	industrialshields-esp32	>	🔿 10 IOS PLC Family	
		Burn Bootloader				O ESP32 PLC Family	
						 WiFi module 	

The internal connection between the ESP32 module and the Arduino Mega is the following:

Arduino Leonardo Pinout	ESP32 Pinout
5Vdc	Vcc
GND	GND
MOSI (Pin 16)	TxD
MISO (Pin 14)	RxD

WiFi and Bluetooth are always enabled as there are no switches that configure it. The WiFi and Bluetooth module uses SPI pins for communication.

More information:

https://www.industrialshields.com/blog/arduino-industrial-1/post/esp32-bluetooth-ble-wifi-13 3

14. WiFI/BLE Programming Examples

14.1 Communication system between Ardbox and WiFi module

As seen in the <u>chart</u> above, serial communication is used to interact between Arduino Leonardo board and ESP32 module. In this <u>post</u>⁷, an introduction to this communication between modules is done using an example code.

14.2 How to connect your ESP based PLC to WiFi

If having problems connecting your ESP32 based PLC to Wi-Fi, follow this other <u>post</u>⁸. There you can find a brief description of the code provided and also an explanation about how the ESP32 board and the Arduino shield are connected to each other.

14.3 Interact with Ardbox WiFi/BLE PLC via Bluetooth

To learn how to work with BLE using the ESP32 board, follow the instructions on this <u>post</u>⁹. In it, a useful example of usage of the BLE feature is explained. In addition, communication between the Arduino board and the ESP32 is also covered in the post.

In the examples the communication with an M-Duino WiFi PLC is shown, but the process is identical with the Ardbox models. Select the correct Ardbox board in the Arduino IDE while doing any tutorial.

15. Digital inputs threshold detection

The Ardbox inputs have a minimum voltage threshold to reliably detect the signal when used as digital input. The threshold value is different depending on the input type:

Input type	Threshold voltage (V)
Digital input	3.7
Analog input	3.3

⁷ https://www.industrialshields.com/blog/arduino-industrial-1/post/communication-system-between-m-duino-and-wifi-module-148

⁸ https://www.industrialshields.com/blog/arduino-industrial-1/post/how-to-connect-your-esp32-based-plc-to-wi-fi-452

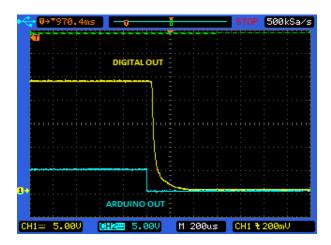
⁹ https://www.industrialshields.com/blog/arduino-industrial-1/post/interact-with-m-duino-wifi-ble-plc-via-bluetooth-480

16. I/O technical details

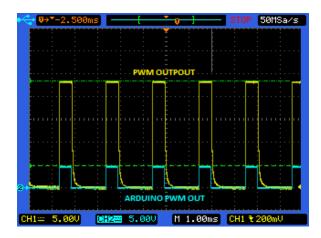
Digital Output Waveform



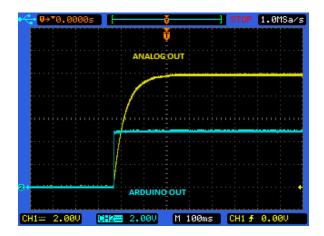
Digital Output Turn-off



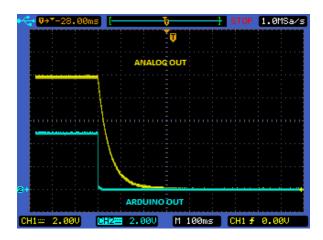
PWM Waveform



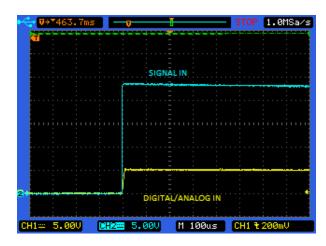
Analog Out Turn-on



Analog Out Turn-off



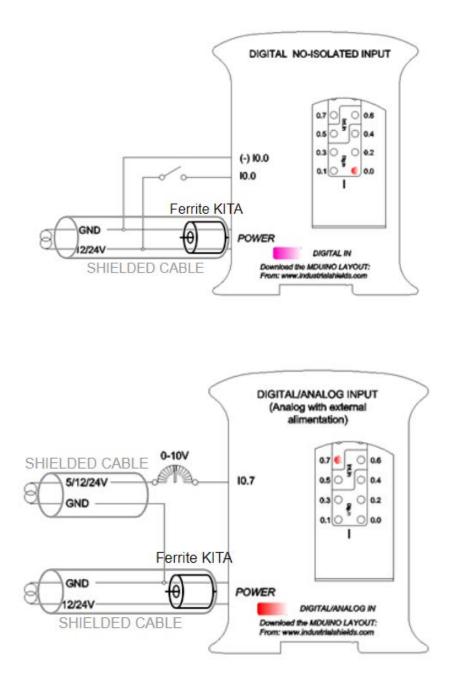
Analog/Digital Input Turn-on

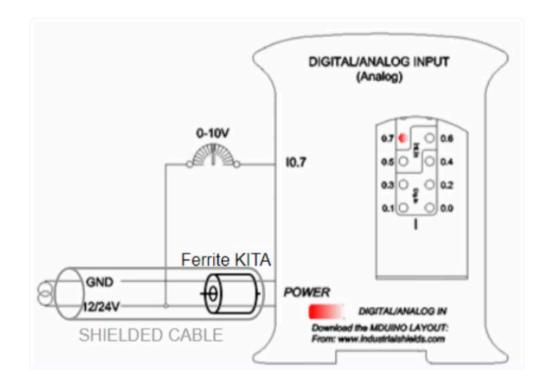


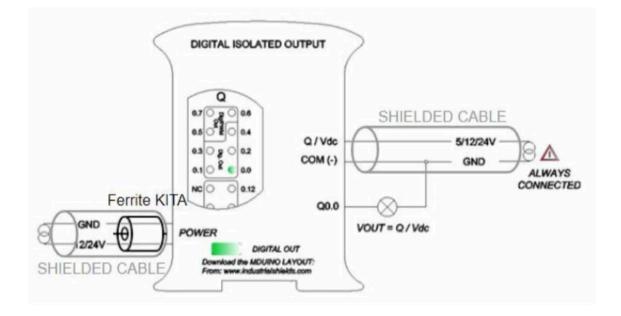
Analog/Digital Input Turn-off

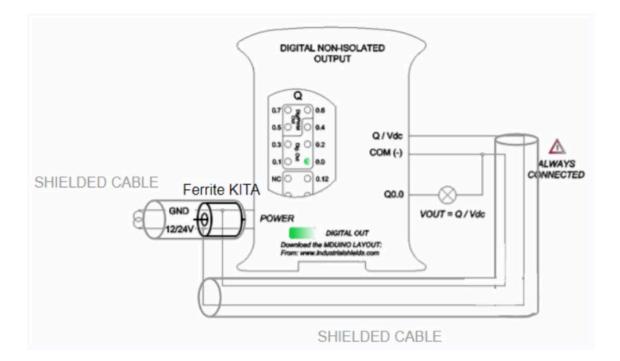
•숙 🕬	329.6ms		v I	STOP 20	0kSa⁄s
	5	IIGNAL IN			
2+	ANALO	G/DIGITAL IN			
		a biolination			

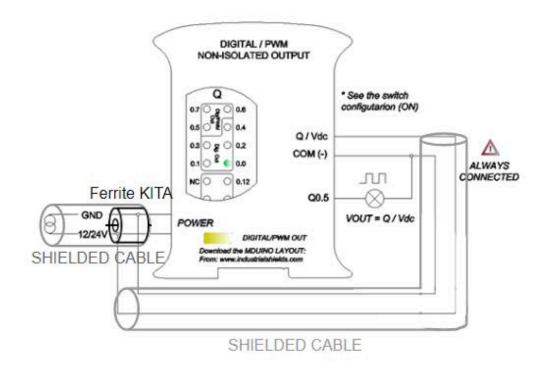
17. Typical Connections

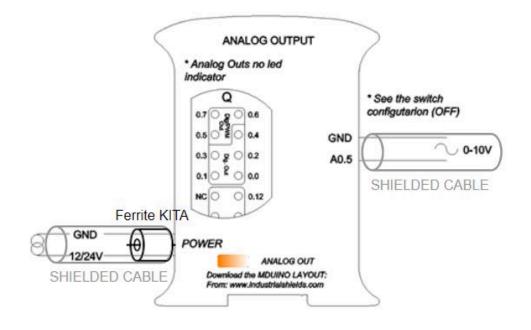












18. Connector details

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:

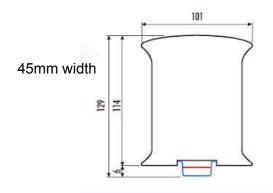
Article reference	MC 0,5/10-G-2,5 THT			
Height	8,1mm			
Pitch	2,5mm			
Dimension	22,5mm			
Pin dimensions	0,8x0,8mm			
Pin spacing	2,50mm			



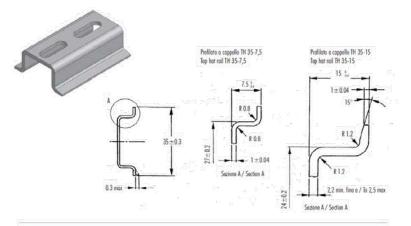
Article reference	FK-MC 0,5/10-ST-2,5	
Rigid conduit section min.	0,14 mm²	
Rigid conduit section max.	0,5 mm²	
Flexible conduit section min.	0,14 mm²	
Flexible conduit section max.	0,5 mm²	
Conduit section AWG/kcmil min.	26	
Conduit section AWG/kcmil max.	20	



19. ARDBOX Family Dimensions



- DIN rail mounting:



CARATTERISTIC	HE	METODO	UNITA' DI MISURA	BLEND PC/ABS
Meccaniche	Resistenza a trazione alla svervamenta	ASTM D638	MPo	68
	Residence a tracione a ratura	ASTM D638	NPo	- 48
	Allungaments a ratium	ASTM D638	*	59
	Modulo in Bessione	ASTM 0790	MPg	2894
	Provo land con integlio	50 180/14	XVm	5.5
Termiche	Temp, di connollimento Vicot, metodo 8	ASTM DES25	×	114
	Temperatura Ricarto 1.81 MPa	ASTM D648	20	- 97
Re	Pos perfig	ASTM 0792	ar/m3	121
	Ritio nello storgo	ASTM 0955	%	0.4/0.6
	Melt Flow Index 260°C - 98N	ASTM 01238	01/10/	11.1
Comportamento	Autordinguenzo (mm di spessole)	11.94		¥-0(0.5)
alla fiamma	File Incordecen, 3.2 mm	EG695.2.1	1	960

Italhanik si eiseva il deitto di modificate il materiale con cui realizzo i propri prodotti senze obbligo di preovriso.

FEATURES		TEST METHOD	UNITS	BLEND PC/ABS
Mechanical test	Resistance to tensile stress of yield	ASTM D-638	MPt	68
	knole strength	ASTM 0-638	期後	48
	Utimante elongation	ASTM D638	- Mar - G	59
	Reving modulus	ASTM 0.790	MPt	2894
	lead test outcled	150 180/14	Xim	5.5
Thermal test	Vict softening temperature method 8 -	AS1M 01525	1	114
	Robecting temperature 1.81 MPg	ASTM 0.648	8	- 97
Physical test	South anyly -	ASTM 0792	ep/m3	1.21
	Mould shrinkape	ASTM 0955	16	0.40.6
	Melt Flow Index 260°C - 99N	ASTM 01238	. 0/10	11.1
Flome test	Self extinguisher (thickness in mm)	UL94		V-0 (0.8)
	Improdescente thread 3.2 mm	IEC695.2.1	°C .	960

Italitatic can operate any change of the materials without being obligad to forewarm.

20. Installation and Maintenance

Notes for installation:

- The installation position should be free from the following: dust or oil smoke, conductive dust, corrosive or flammable gas, high temperature, condensation, and rain.
- Besides, vibration and impact also affect the PLC normal operation and shorten its lifespan; electric shock, fire or misact also damages the product. During drilling or wiring, prevent the metal particles or wire segments from falling into the PLC casing, which may cause fire, fault or misact.
- After the PLC installation, clean the ventilation duct to prevent blocking, which may cause bad ventilation, or even fire, faults or misact.
- Do not online connect, plug or unplug cables, which are apt to cause electric shock or damage the circuit. Installation and wire connection must be firm and reliable. Poor connection could cause misact.
- Use shielded twisted pairs for the I/O of high frequency signal and analog signal to improve system IMS.

The installation environment should be free from dust, oil smoke, conductive particles, corrosive or flammable gases, high temperature, condensation, and rain.

Besides, vibration and impact also affect the PLC normal operation and shorten its lifespan. It is recommended to install the PLC, together with the matching switches and contactors, in a dedicated electric cabinet and keep the cabinet ventilated. If the location has high ambient temperature or heat generating equipment nearby, install forced convection devices on top or sides of the cabinet to avoid over-temperature. During drilling or wiring, prevent the metal particles or wire segments from falling into the PLC casing, which may cause fire, fault or misact. After the PLC installation, clean the ventilation duct to prevent blocking, which may cause bad ventilation, or even fire, faults or misact.

The only way to disconnect the equipment from the electrical network is by removing the connectors that feed the equipment. Once installed in the electrical cabinet it is very important to ensure the power connectors for proper operation.

Separate the ARDBOX 20 I/Os Family HF PLUS from heat, high voltage and electrical noise:

Always separate the devices that generate high voltage and high electrical noise from the ARDBOX 20 I/Os Family HF PLUS. When configuring the layout of the ARDBOX 20 I/Os Family HF PLUS inside your panel, consider the heat-generating devices and locate the electronic-type devices in the cooler areas of your cabinet. Reducing the exposure to a high-temperature environment will extend the operating life of any electronic device. Consider also the routing of the wiring for the devices in the electric cabinet. Avoid placing low-voltage signal wires and communications cables in the same tray with AC power wiring and high energy, rapidly-switched DC wiring.

Provide adequate clearance for cooling and wiring ARDBOX 20 I/Os Family HF PLUS. Is designed for natural convection cooling. For proper cooling, you must provide a clearance of at least 25cm above and below the devices. Also, allow at least 25cm of depth between the front of the modules and the inside of the enclosure.

Notes for maintenance:

A well-planned and executed maintenance program is essential to the satisfactory operation of solid-state electrical equipment. The kind and frequency of the maintenance operation will vary with the kind and complexity of the equipment as well as with the nature of the operating conditions. Maintenance recommendations of the manufacturer or appropriate product standards should be followed.

The following factors should be considered when formulating a maintenance program:

- Maintenance must be performed by qualified personnel familiar with the construction, operation, and hazards involved with the control.
- Maintenance should be performed with the control out of operation and disconnected from all sources of power.
- Care should be taken when servicing electrostatic sensitive components. The manufacturer's recommendations for these components should be followed.
- Ventilation passages should be kept open. If the equipment depends upon auxiliary cooling, e.g., air, water, or oil, periodic inspection (with filter replacement when necessary) should be made of these systems.
- The means employed for grounding or insulating the equipment from ground should be checked to assure its integrity.
- Accumulations of dust and dirt on all parts, including on semiconductor heat sinks, should be removed according to the manufacturer's instructions, if provided; otherwise, the manufacturer should be consulted. Care must be taken to avoid damaging any delicate components and to avoid displacing dust, dirt, or debris in a way that permits it to enter or settle into parts of the control equipment.
- Enclosures should be inspected for evidence of deterioration. Accumulated dust and dirt should be removed from the top of the enclosures before opening doors or removing covers.
- Certain hazardous materials removed as part of maintenance or repair procedure (e.g., polychlorinated biphenyls (PCBs) found in some liquid filled capacitors) must be disposed of as described in Federal regulations.

Safety rules for maintenance personnel

Consider the following steps to follow. A false manoeuvre could be the cause of an accident or material damage.

Do not disassemble or modify the modules. This could lead to breakdowns or malfunctions and could lead to injuries or fire.

- All types of radio communication devices, including mobile phones and personal handy-phone systems (PHS), must be kept more than **25cm** away from the PLC in all directions. Failure to observe this precaution exposes malfunctions caused by excess temperature.

- Disconnect the external power supply of the system (on all phases) before connecting or disconnecting a module. Failure to observe this precaution may cause faults or malfunctions of the module.

- Tighten the screws of the terminal ports and the screws of the connectors within the prescribed tightening torque. Insufficient tightening can lead to loose parts or wires and cause malfunctions. Excessive tightening can damage the screws and / or the module, with the risk of falling, short circuits and malfunctions.

- Before handling a module, dispose of the electrostatic charge accumulated by the human body by touching a suitable conductive object. Failure to observe this precaution may cause faults or malfunctions of the module.

Repair note:

If the equipment is suitable to be repaired, it must be verified that the equipment remains in a safe state after repair.

21. Revision Table

Revision Number	Date	Changes
0	30/08/2019	First implementation
1	02/03/2020	Second implementation
2	04/02/2022	Third Implementation
3	17/10/2022	Family Implementation
4	11/03/2024	Added section 15 "Digital inputs threshold detection"
5	13/03/2024	RS* Switches Revision
6	21/03/2024	Section 8.2 Digital inputs fix
7	26/09/2024	Added section 3.4 ("Isolation Precautions")

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PLC ARDUINO GPRS ARDBOX 20 I/Os FAMILY HF PLUS MODBUS

PLC ARDUINO GPRS ARDBOX 20 I/Os

FAMILY HF

PLUS



PLC Arduino GPRS ARDBOX 20 I/Os Family HF PLUS User Guide

Revised September 2024

This user guide is for version PLC Arduino GPRS ARDBOX 20 I/Os Family HF PLUS with Reference name 006001001200 or 006001001300.

Preface

This User Guide has 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.



- 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.
- Maintenance must be performed by qualified personnel familiarised with the construction, operation, and hazards involved with the control.
- Maintenance should be performed with the control out of operation and disconnected from all sources of power.
- Care should be taken when servicing electrostatic sensitive components. The manufacturer's recommendations for these components should be followed.

- The Ardbox Family PLCs are Open Type Controllers. It is required that you install the Ardbox PLC in a housing, cabinet, or electric control room. Entry to the housing, cabinet, or electric control room should be limited to authorised personnel. Failure to follow these installation requirements could result in severe personal injury and/or property damage. Always follow these requirements when installing Ardbox family PLCs.
- In case of installation or maintenance of the Ardbox please follow the instructions marked in the Installation and Maintenance section.
- Do not disconnect equipment when a flammable or combustible atmosphere is present. Disconnection of equipment when a flammable or combustible atmosphere is present may cause a fire or explosion which could result in death, serious injury and/or property damage.



- Les broches non utilisées ne doivent pas être connectées. Ignorer la directive peut endommager le contrôleur.
- Une utilisation incorrecte de ce produit peut endommager gravement le contrôleur.
- Reportez-vous au Guide de l'utilisateur du contrôleur pour les considérations de câblage.
- Avant d'utiliser ce produit, il incombe à l'utilisateur de lire le Guide de l'utilisateur du produit et la documentation qui l'accompagne.
- La maintenance doit être effectuée par personnel qualifié familiarisé avec la fabrication, le fonctionnement et les dangers liés au contrôleur.
- La maintenance doit être effectuée avec l'équipement hors service et déconnectée de toutes les sources d'alimentation.
- Faites attention lors de l'entretien des composants sensibles à l'électricité statique. Les recommandations du fabricant pour ces composants doivent être suivies.
- Les automates de la famille Ardbox sont des contrôleurs de type ouvert. Il est nécessaire d'installer l'automate Ardbox dans un boîtier, une armoire ou une salle de contrôle électrique. L'accès au boîtier, à l'armoire ou à la salle de commande électrique doit être limité au personnel autorisé. Le non-respect de ces exigences d'installation peut entraîner des blessures graves et/ou des dommages matériels importants. Respectez toujours ces exigences lors de l'installation des automates de la famille Ardbox.
- En cas d'installation ou de maintenance du Ardbox, veuillez suivre les instructions indiquées dans la section Installation et Maintenance.
- Ne débranchez pas l'équipement en présence d'une atmosphère inflammable ou combustible. La déconnexion de l'équipement en présence d'une atmosphère inflammable ou combustible peut provoquer un incendie ou une explosion pouvant entraîner la mort, des blessures graves et/ou des dommages matériels.

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 machines, 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.

Intended use of Industrial Shields products

Consider the following:

Industrial Shields products should only be used for the cases of application foreseen in the catalogue and the associated technical documentation. If third-party products and components are used, they must have been recommended or approved by Industrial Shields.

The correct and safe operation of the products requires that your transport, storage, installation, assembly, operation and maintenance have been carried out in a correct manner. It must respect the permissible ambient conditions. You should also follow the indications and warnings that appear in the associated documentation.

The product / system dealt with in this documentation should only be handled or manipulated by qualified personnel for the task entrusted and observing what is indicated in the documentation corresponding to it, particularly the safety instructions and warnings included in it. Due to their training and experience, qualified personnel are in a position to recognize risks resulting from the handling or manipulation of such products / systems and to avoid possible hazards.

Disclaimers

Weights and Dimensions

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

Performance Data

The 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 most correlate it to actual application requirements. Actual performance is subject to the INDUSTRIAL SHIELDS Warranty and Limitations of Liability.

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.

Residual Risks

The control and drive components of an Industrial Shields PLC are approved for industrial and commercial use in industrial line supplies. Their use in public line supplies requires a different configuration and/or additional measures. These components may only be operated in closed housings or in higher-level control cabinets with protective covers that are closed, and when all of the protective devices are used. These components may only be handled by qualified and trained technical personnel who are knowledgeable and observe all of the safety information and instructions on the components and in the associated technical user documentation. When carrying out a risk assessment of a machine in accordance with the EU Machinery Directive, the machine manufacturer must consider the following residual risks associated with the control and drive components of a PDS.

1. Unintentional movements of driven machine components during commissioning, operation, maintenance, and repairs caused by, for example: – Hardware defects and/or software errors in the sensors, controllers, actuators, and connection technology – Response times of the controller and drive – Operating and/or ambient conditions not within the scope of the specification – Condensation / conductive contamination – Parameterization, programming, cabling, and installation errors – Use of radio devices / cellular phones in the immediate vicinity of the controller – External influences / damage.

 Exceptional temperatures as well as emissions of noise, particles, or gas caused by, for example: – Component malfunctions – Software errors – Operating and/or ambient conditions not within the scope of the specification – External influences / damage.

3. Hazardous shock voltages caused by, for example: – Component malfunctions – Influence of electrostatic charging – Induction of voltages in moving motors – Operating and/or ambient conditions not within the scope of the specification – Condensation / conductive contamination – External influences / damage

4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc. if they are too close.

5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly.

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, EXPRESSED 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

INDUSTRIAL SHIELDS SHALL NOT BE RESPONSIBLE FOR SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS OR COMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED ON CONTRACT, WARRANTY, NEGLIGENCE, OR STRICT LIABILITY.

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.

Table of Contents

1. GPRS Ardbox Family HF: General Features	11
2. Technical Specifications	12
2.1 General Specifications	12
2.2 Performance Specification	12
2.3 Symbology	13
3. Precautions	14
3.1 Arduino Board	14
3.2 Intended Audience	14
3.3 General Precautions	14
3.4 Isolation Precautions	14
4. Software interface	15
5. How to connect PLC Arduino to PC	
6. How to connect PLC to power supply	19
7. Ardbox GPRS pinout	20
8. Ardbox GPRS Family I/O serigraphy	21
8.1 006001001200 Zone Connections	
8.2 006001001300 Relay Zone Connections	23
9. Switch configuration	25
9.1 006001001200 Analog Model General Switches Configuration	25
9.2 006001001300 Relay Model General Switches Configuration	
9.3 006001001200 Analog RS-232 and RS-485 Switch Configuration	29
9.4 006001001300 Relay RS-232 and RS-485 Switch Configuration	30
9.5 006001001200 Analog I2C Switch Configuration	31
9.6 006001001300 Relay I2C Switch Configuration	
10. Jumper Configuration	32
10.1 006001001200 Analog General Jumper Configuration	32
10.2 006001001300 Relay General Jumper Configuration	
11. Hardware Serial RS-232 & RS-485 Configuration	34
11.1 006001001200 Analog Hardware Serial RS-485	34
11.2 006001001200 Analog Hardware Serial RS-232	35
11.3 006001001300 Relay Hardware Serial RS-485	
11.4 006001001300 Relay Hardware Serial RS-232	
12. Ardbox - Arduino I/Os 5V pins	
12.1 I2C pins – SDA/SCL	
12.2 Pin 3	38
13. GPRS & GSM	
14. GPRS & GSM Programming Examples	40

14.1 How to use the GPRS Module	
14.2 How to send SMS using GPRS from a GPRS Ardbox PLC	40
15. Digital inputs threshold detection	40
16. I/O technical details	41
17. Typical Connections	
18. Connector details	48
19. ARDBOX Family Dimensions	49
20. Installation and Maintenance	50
21. Revision Table	53

1. GPRS Ardbox Family HF: General Features

COMPACT PLC ARDUINO G	SPRS ARDBOX 20I/Os Family LOG HF PLUS	
Input Voltage	12 to 24Vdc	Fuse protection (2.5A) Polarity protection
Input rated voltage	24Vdc	
Rated Power	30W	
I Max.	1.5A	
Size	100x45x115	
Clock Speed	16MHz	
Flash Memory	32KB of which 4KB are used by bootloader	
SRAM	2.5KB	
EEPROM	1KB	
Communications	I2C USB RS232 RS485	RS485
An/Dig Input 10bit (0-10Vcc)	0 to 10Vdc Input Impedance: 39K Separated PCB ground Rated Voltage: 10Vdc 5 to 24Vdc I min: 2 to 12mA Galvanic Isolation Rated Voltage: 24 Vdc	*Check <u>Section 15</u> for digital inputs threshold detection
* Interrupt isolated Input HS (24Vcc)	5 to 24Vdc I min: 2 to 12mA Galvanic Isolation Rated Voltage: 24Vdc	5 to 24Vdc I min: 3/6mA Separated PCB ground
Analog Output 8bit (0-10Vcc)	0 to 10Vdc I max: 20mA Separated PCB ground Rated Voltage: 10Vdc	
Digital Isolated Output (24Vcc)	5 to 24Vdc I max: 70mA Galvanic Isolation Diode Protected for Relay Rated Voltage: 24Vdc	Imax 24Vdc: 410mA
Digital Isolated Output Relay	30Vdc / 250Vac Galvanic Isolation Diode protected for Relay	Imax: 3A (30Vdc) Imax: 5A (250Vac)
PWM Isolated Output 8bit (24Vcc)	5 to 24Vdc I max: 70mA Galvanic Isolation Diode Protected for Relay Rated Voltage: 24Vdc	PWM Isolated Output 8bit (24Vcc)
Expandability	I2C – RS232 – RS485 – TTL	
Reference	006001001200 006001001300	Analog Relay

2. Technical Specifications

2.1 General Specifications

Power supply voltage	DC power supply	12 to 24Vdc =	
Operating voltage range DC power supply		11.4 to 25.4Vdc	
Power consumption	DC power supply	30W max.	
External	Power supply voltage	24Vdc	
power supply	Power supply output capacity	700mA	
Insula	tion resistance	$20M\Omega$ min. at 500Vdc between the AC terminals and the protective ground terminal.	
Diele	ectric strength	2.300Vac 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 60°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		350g max.	

2.2 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 pla composed of a programming language. "similar to the C"). http://arduino.cc/en/Tutorial/HomePage	
Microcontroller	ATmega32u4
Flash Memory	32KB of which 4KB are used by bootloader
Program capacity (SRAM)	2.5KB
EEPROM	1КВ
Clock Speed	16MHz

2.3 Symbology

Table that includes all the symbology that is used in the serigraph of the GPRS Ardbox Family HF+:

Symbol	Standard No. / Standard Title	Standard Reference No. / Symbol Title	Symbol Meaning
	IEC 60417 / Graphical symbols for use on equipment	5031 / Direct Current	Indicates that the equipment is suitable for direct current only; to identify relevant terminals
\sim	IEC 60417 / Graphical symbols for use on equipment	5032 / Alternating Current	Indicates that the equipment is suitable for alternating current only; to identify relevant terminals
	IEC 60417 / Graphical symbols for use on equipment	5130 / Pulse General	To identify the control by which a pulse is started.
	IEC 60417 / Graphical symbols for use on equipment	5017 / Earth, Ground	To identify an earth (ground) terminal in cases where neither the symbol 5018 nor 5019 is explicitly required.
\bigotimes	IEC 60417 / Graphical symbols for use on equipment	5115 / Signal lamp	To identify the switch by means of which the signal lamp(s) is (are) switched on or off.
CE	Medical Devices Directive 93/42/EEC	CE Marking	CE marking indicates that a product complies with applicable European Union regulations
$\overline{\mathbb{N}}$	ISO 7000/ Graphical symbols for use on equipment	0434B / Warning symbol	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury
4	ISO 7000/ Graphical symbols for use on equipment	5036 / Dangerous Voltage	To indicate hazards arising from dangerous voltages

3. Precautions

Read this manual before attempting to use the ARDBOX 20 I/Os Family HF GPRS PLUS and follow its descriptions for reference during operation.

3.1 Arduino Board

The ARDBOX 20 I/Os Family HF GPRS PLUS PLCs include Arduino Leonardo Board as controller.

3.2 Intended Audience

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

3.3 General Precautions

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

Before using ARDBOX 20 I/Os Family HF GPRS PLUS under different conditions from what has been specified in this manual or integrating ARDBOX 20 I/Os Family HF GPRS PLUS 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.

3.4 Isolation Precautions

Description:

This equipment does **not include galvanic isolation between the grounds** of the different systems. This means that if an external device or sensor that shares the same ground reference (GND) with the system is connected, any potential difference between these grounds could damage the connected components. To avoid issues with interference, ground loops, or damage to external equipment, ensure that all connected devices share the same ground reference or use systems with appropriate isolation.

Recommendations:

- **Connection Review:** Verify that all ground connections are properly made and that there are no significant potential differences between them.
- Use of Isolation: Consider using galvanic isolators or isolation transformers if it is necessary to connect equipment with different ground references.

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 directly using C, but it is much easier working with Arduino IDE, as it provides lots of useful libraries.

Industrial Shields provide a boards package for programming the PLCs, making it easier and friendlier. It includes various facilities such as not having to define the pins, etc.

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

Requirements:

Arduino IDE 1.8.15 or above (recommended: 1.8.19).

Steps:

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

Preferences	×
Settings Network	
Sketchbook location:	
C:\Users\Albert\Documents\A	rduino Browse
Editor language:	English (English)
Editor font size:	15
Interface scale:	Automatic 100 🜩 % (requires restart of Arduino)
Show verbose output during:	✓ compilation ✓ upload
Compiler warnings:	None V
Display line numbers	
Enable Code Folding	
Verify code after upload	
Use external editor	
Check for updates on star	tup
Update sketch files to new	extension on save (.pde -> .ino)
Save when verifying or up	loading
Additional Boards Manager UR	Ls: [http://apps.industrialshields.com/main/arduino/boards/package_industrialshields_inde;] 🔲
More preferences can be edite	d directly in the file
C:\Users\Albert\AppData\Loca	I\Arduino15\preferences.txt
(edit only when Arduino is not	running)
	OK Cancel

2. In Additional Boards URLs write the following:

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.

pe All	v industrialshields	
RDBOX family, I <u>nline help</u>	s in this package: 1-Duino family.	
<u>ore info</u>		1.1.8 V Install

6. Click install (selecting the latest version).

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

<u>E</u> dit <u>S</u> ketch			7		
o di	Auto Format	Ctrl+T			
etch_oct19a	Archive Sketch				
d setup(Fix Encoding & Reload				
/ put yo	Manage Libraries	Ctrl+Shift+I			
	Serial Monitor	Ctrl+Shift+M			
loop()	Serial Plotter	Ctrl+Shift+L			
put yo	WiFi101 / WiFiNINA Firmware Updater				
	wiener opuater				
	Board: "Ardbox GPRS family"		Boards Manager		
	Model: "Ardbox Analog HF+ w/ HW RS-232 GPRS"	>			
	Port	>	Arduino AVR Boards	>	
	Get Board Info		Industrial Shields boards	>	🔘 Ardbox family
			Industrial Shields ESP32	>	O Ardbox DALI family
	Programmer: "Arduino as ISP"	>			 Ardbox GPRS family
	Burn Bootloader				O Ardbox WiFi/BT family
					🔘 Ardbox LoRa family
					🔿 M-Duino family
					O M-Duino DALI family
					O M-Duino GPRS family
					M-Duino LoRa family
					O M-Duino WiFi/BT family
					O M-Duino WiFi/BT + GPRS family
					 Spartan family

Once the Ardbox Family is selected, an extra option will appear on Tools:

- Select the correct Ardbox Family HF PLUS Board (Ardbox Analog HF+ w/HW RS-232 GPRS, Ardbox Analog HF+ w/HW RS-485 GPRS, Ardbox Relay HF+ w/HW RS-232 GPRS or Ardbox Relay HF+ w/HW RS-485 GPRS) depending on your jumpers & switch configuration.

Ele Edit Sketch	Help			
00	Auto Format	Ctri+T		ø
sketch oct194	Archive Sketch			
void setun(Fix Encoding & Reload			
// put yo	Manage Libraries	Ctrl+Shift+I		
}	Serial Monitor	Ctrl+Shift+M		
// put yo	Senal Plotter	Ctrl+Shift+L		
}	WiFi101 / WiFiNINA Firmware Updater			
	Board: "Ardbox GPRS family"	×		
	Model: "Ardbox Analog HF+ w/ HW RS-232 GPRS"	×	O Ardbox Analog HF+ w/ HW RS-232 GPRS	
	Part	>	C Ardbox Analog HF+ w/ HW RS-485 GPRS	
	Get Board Info		C Ardbox Relay HF+ w/ HW RS-232 GPRS	
	Programmer: "Arduino as ISP"	,	Ardbox Relay HF+ w/ HW R5-485 GPRS	
	Burn Bootloader			
7			Ardbox GPRS family, Ardbox Analog HF+ w/ HW RS-232 GPRS on /d	ew/ttyUSB0

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

Furthermore there are some extra libraries that can be found in Industrial Shields GitHub: https://github.com/Industrial-Shields/

5. How to connect PLC Arduino to PC

- Connect USB port from PLC to PC.

NOTE:

Ardbox Family uses micro USB cable.



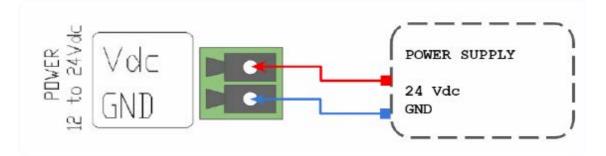
- Open Arduino IDE interface:
- Select Industrial Shields boards -> Ardbox GPRS Family
- Select the correct port.

💿 sketch_mar16a | Arduino 1.8.0

File Edit Sketch Tools Help Auto Form at Ctrl+T -Archive Sketch sketch_mar16 Fix Encoding & Reload Serial Monitor Ctrl+Shift+M void setup Serial Plotter Ctrl+Shift+L // put y WiFi101 Firmware Updater } Board: "Ardbox family" Industrial Shields: "Ardbox Analog" void loop(Port Serial ports // put y Get Board Info COM13 (Arduino Leonardo) Programmer: "Arduino as ISP" > } Burn Bootloader

6. How to connect PLC to power supply

- Ardbox GPRS Family PLCs are 12-24Vdc supplied. IMPORTANT: The polarity IS NOT REVERSIBLE!
- 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

power supply is certified according to UL.

Compact DIN rail power supply. Assembled on 35mm	
DIN Rail:	
-12Vdc / 24Vdc	
-2.5A	
-30W	
Industrial Shields power supplies provide parallel	
operation, overvoltage protection, and overcurrent	
protection. There is a LED inductor for power status, the	



The standard, Part 1 of IEC 61010, sets the general safety requirements for the following types of electrical devices and their accessories, regardless of where use of the device is intended.

The equipment must be powered from an external power source in accordance with IEC 61010-1, whose output is MBTS and is limited in power according to section 9.4 of IEC 61010-1.

WARNING: Once the equipment is installed inside an electrical cabinet, the MTBS cables of the equipment must be separated from the dangerous voltage cables.

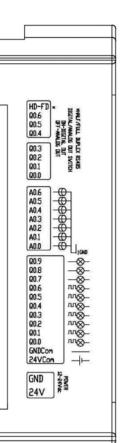
7. Ardbox GPRS pinout

		IOs Table				
Model	Reference	Analog Input	Digital Isolated Input	Digital Isolated Output	Digital/Analogic Output	Relay Output
ANALOG	006001001200	8	9	10	7	0
RELAY	006001001300	8	9	0	2	8

8. Ardbox GPRS Family I/O serigraphy

8.1 006001001200 Zone Connections

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



LEFT ZONE

Switch config* (see section 8 for Communications configuration. Enabling Communications disables some I/Os)

Analog Outputs pins

Digital Outputs pins

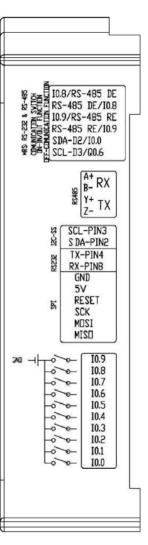
Power supply connectors (24Vdc – GND)

¹ See<u>section 8</u> to enable these connections

² See <u>section 9</u> to enable these connections

RIGHT ZONE				
Ardbox Connector	Ardbox Connector Arduino Pin			
A+ ^{3,4} B- ^{3,4} Y+ ^{3,4} Z- ^{3,4} SCL-PIN3 ³ SDA - RST GPRS ³ TX-RS232 ^{3,4} RX-RS232 ^{3,4}	- - 3 2 1 0	RS485(A) RS485(B) RS485(Y) RS485(Z) SCL(I2C) SDA (I2C) - RST GPRS - -		
GND 5V RESET NC NC NC	- - - -	Ground 5Vout DC RESET - - - -		
10.9 10.8 10.7 10.6 10.5 10.4 10.3 ³ 10.2 ³ 10.1 10.0 ³	18 19 20 21 22 23 8 4 12 2	Analog/Digital Input Analog/Digital Input Analog/Digital Input Analog/Digital Input Analog/Digital Input Analog/Digital Input Analog/Digital Input Digital Input Digital Input		

HS*: Hardware Serial SS*: Software Serial



RIGHT ZONE

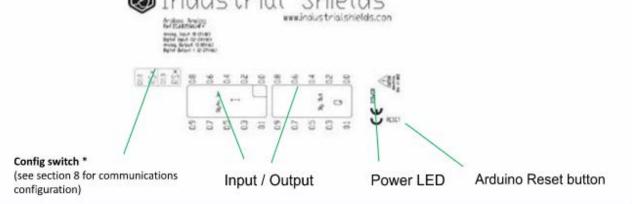
Switch config*

(see section 8 for Communications configuration. Enabling Communications disables some I/Os)

Communication pins

Digital/Analog

🕲 Industrial Shiel ds www.industrialshields.con Artes Main



³ See <u>section 8</u> to enable these connections

⁴ See <u>section 9</u> to enable these connections

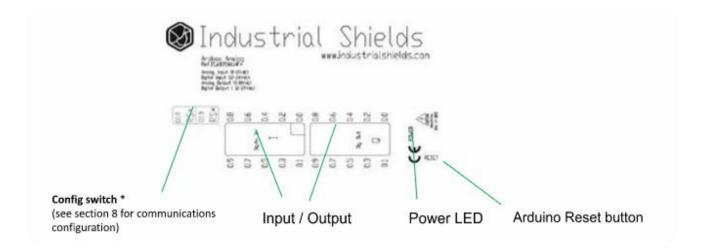
8.2 006001001300 Relay Zone Connections

Arduino Pin Function NC - NC -
HD-FDM R5/PIN3-SCL I0.0/PIN2-SDA RE-R\$485/I0.4 I0.4/RE-R\$485 IDE-R\$485/I0.5 L05/DE-R\$485
NC - - MISD NC - - MISD RESET - RESET SCK 5Vdc - 5V Output SCK GND - GND GND RX-RS-232 ^{5,6} 8 Serial/RS232 RX TX-RS-232 ^{5,6} 4 Serial/RS232 RX DA - RST GPRS 2 SDA- RESET GPRS PIN2-SDA SCL-PIN3 ⁵ 3 SCL - SS PIN3-SOL
SCL-PIN3*3SCL - SSR1 R2 R310 9 6Relay 1 Out Relay 2 Out Relay 3 OutPIN3-SCL #
GND - GND 24V

⁵ See <u>section 8</u> to enable these connections ⁶ See <u>section 9</u> to enable these connections

				RIGHT ZONE
	Rig	ht Zone	B -	
Ardbox Connector	Arduino Pin	Function	85 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	RS-485 pins Analog Output Pins
B- A+ Z-/A0.1 Y+/A0.0	- - 11 (FD)* 13 (FD)*	RS485 RS485 RS485/ Digital Output RS485/ Digital Output	R5 ^K	Relay Outputs
R4 R5 10.9 10.8 10.7 10.6 10.5	5 3 23 22 21 20 19	Relay 4 Out Relay 5 Out Analog/ Digital Input Analog/ Digital Input Analog/ Digital Input Analog/ Digital Input Analog/ Digital Input	antigare time for antigare tim	Digital/ Analog Input pins
10.4 10.3 10.2 10.1 10.0 R6 R7 R8	18 8 4 12 2 7 0 1	Analog/ Digital Input Digital Optoisolated Input Digital Optoisolated Input Digital Optoisolated Input Digital Input / Interrupt Relay 6 Out Relay 7 Out Relay 8 Out	* Note: use correctly configuration use this signal. Gee user gueto	Relay Outputs

*Depending on the mode HD/FD the Y+/Z- Analog Output pins are enabled or disabled. See <u>section 9</u> to see the configurations.



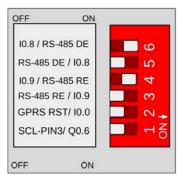
9. Switch configuration

9.1 006001001200 Analog Model General Switches Configuration

LEFT ZONE				
SWITCH	OFF	ON		
10.8 / RS-485 DE	10.8	RS-485 DE		
RS-485 DE / 10.8	RS-485 DE	10.8		
10.9 / RS-485 RE	10.9	RS-485 RE		
RS-485 RE / 10.9	RS-485 RE	10.9		
SDA - GPRS RST / I0.0	SDA - GPRS	10.0		
SCL-PIN3 / Q0.6	SCL-D3	Q0.6		

LEFT ZONE SWITCH

Communications and inputs/outputs can not work simultaneously.



6. IO.8 / RS-485 DE – If this switch is ON the RS-485 DE is activated, otherwise the IO.8 will be activated.

5. RS-485 DE / I0.8 – If this switch is ON the I0.8 is activated, otherwise the RS-485 DE will be activated.

Note* To work with RS-485 DE, switch number 6 at ON and number 5 at OFF.

4. IO.9 / RS-485 RE – If this switch is ON the RS-485 RE is activated, otherwise the IO.9 will be activated.

3. RS-485 / IO.9 – If this switch is ON the IO.9 is activated, otherwise the RS-485 RE will be activated.

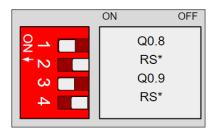
Note* To work with RS-485 RE, switch number 4 at ON and number 3 at OFF.

2. GPRS RST / IO.O – If this switch is ON the IO.O is activated, otherwise the (I2C) SDA - GPRS RST will be activated.

1. SCL-D3 / Q0.6 – If this switch is ON the Q0.6 is activated, otherwise the (I2C) SCL-D3 will be activated.

TOP ZONE SWITCH

TOP ZONE				
SWITCH	ON	OFF		
Q0.8	Q0.8	RS*		
RS*	RS*	Q0.8		
Q0.9	Q0.9	RS*		
RS*	RS*	Q0.9		

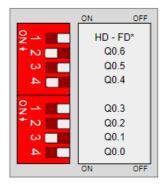


- 1. Q0.8 If this switch is ON the Q0.8 is activated, otherwise the RS* will be activated.
- 2. RS* If this switch is ON the RS* is activated, otherwise the Q0.8 will be activated.
- 3. Q0.9 If this switch is ON the Q0.9 is activated, otherwise the RS*will be activated.
- **4. RS*** If this switch is ON the RS* is activated, otherwise the Q0.9 will be activated.

Note RS * can be RS-485 or RS-232 depending on the jumper configuration you have chosen. To work with RS*, switches number 1 and 3 at OFF and number 2 and 4 at ON.*

	RIGHT ZONE				
SWITCH	ON	OFF			
HD / FD	Half Duplex	Full Duplex			
Q0.6	DIGITAL (Q0.6)	ANALOG (A0.6)			
Q0.5	DIGITAL (Q0.5)	ANALOG (A0.5)			
Q0.4	DIGITAL (Q0.4)	ANALOG (A0.4)			
Q0.3	DIGITAL (Q0.3)	ANALOG (A0.3)			
Q0.2	DIGITAL (Q0.2)	ANALOG (A0.2)			
Q0.1	DIGITAL (Q0.1)	ANALOG (A0.1)			
Q0.0	DIGITAL (Q0.0)	ANALOG (A0.0)			

RIGHT ZONE SWITCH



RIGHT ZONE.

1. HD/FD – Choosing between Half/Full Duplex for the RS485 communication. In order to use Full Duplex, it has to be considered the TOP ZONE and the JUMPER ZONE (see <u>section 9</u>).

2-8. Q0.X/A0.X – 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 analog.

9.2 006001001300 Relay Model General Switches Configuration

LEFT ZONE				
SWITCH	ON	OFF		
NC	-	-		
HD/FD*	Half Duplex	Full Duplex		
R5 / Pin 3-SCL	R5	Pin 3 - SCL		
I0.0 / GPRS RST-SDA	10.0	GPRS - SDA		
RE-RS485 / 10.4	RE-RS485	10.4		
10.4 / RE-RS485	10.4	RE-RS485		
DE-RS485 / 10.5	DE-RS485	10.5		
10.5 / DE-RS485	10.5	DE-RS485		

ON OFF NC HD* / FD* R5 / PIN3-SCL I0.0 / GPRS RST I0.4 / RE-RS485 / I0.4 I0.4 / RE-RS485 / I0.5 DE-RS485 / I0.5 I0.5 / DE-RS485 ON OFF

LEFT ZONE SWITCH

Communications and inputs/outputs can not work simultaneously.

1. NC – Not Connected

2. HD/FD* – Choosing between Half/Full Duplex for the RS485 communication. In order to use Full Duplex, it has to be considered the TOP ZONE and the JUMPER ZONE (see <u>section 9</u>).

3. R5 / Pin3-SCL – If this switch is ON the R5 is activated, otherwise the Pin3 - SCL will be activated.

4. IO.0 / GPRS RST - SDA – If this switch is ON the IO.0 is activated, otherwise the GPRS RST - SDA will be activated.

1. RE-RS485 / IO.4 – If this switch is ON the RE-RS485 is activated, otherwise the IO.4 will be activated.

2. IO.4 / RE-RS485 – If this switch is ON the IO.4 is activated, otherwise the RE-RS485 will be activated.

Note* To work with RS-485 RE, switch number 1 at ON and number 2 at OFF.

3. DE-RS485 / I0.5 – If this switch is ON the DE-RS485 is activated, otherwise the I0.5 will be activated.

4. IO.5 / DE-RS485 – If this switch is ON the IO.5 is activated, otherwise the DE-RS485 will be activated.

Note* To work with RS-485 DE, switch number 3 at ON and number 4 at OFF.

TOP ZONE SWITCH

TOP ZONE				
SWITCH	ON	OFF		
RS*	RS*	R8		
R8	R8	RS*		
RS*	RS*	R7		
R7	R7	RS*		

	2
91	RS*
⁴ N	R8
ω	RS*
4	R7*

1. **RS*** - If this switch is ON the RS* is activated, otherwise the R8 will be activated.

2. **IO.2**- If this switch is ON the R8 is activated, otherwise the RS* will be activated.

3. **RS*** - If this switch is ON the RS* is activated, otherwise the R7 will be activated.

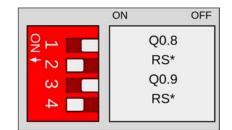
4. **IO.3** - If this switch is ON the R7 is activated, otherwise the RS* will be activated.

Note* RS * can be RS-485 or RS-232 depending on the jumper configuration you have chosen. To work with RS*, switches number 1 and 3 at ON and number 2 and 4 at OFF.

9.3 006001001200 Analog RS-232 and RS-485 Switch

Configuration

ANALOG TOP ZONE		
SWITCH MODE		
Q0.8	OFF	
RS*	ON	
Q0.9	OFF	
RS*	ON	



RS* TOP ZONE: In order to enable the RS* protocol the TOP ZONE must be configured as it is shown in the table.

Having this setup, the Q0.8 & Q0.9 are disabled.

- **1. Q0.8** If this switch is ON the Q0.8 is activated, otherwise the RS* will be activated.
- 2. RS* If this switch is ON the RS* is activated, otherwise the Q0.8 will be activated.
- **3. Q0.9** If this switch is ON the Q0.9 is activated, otherwise the RS*will be activated.
- 4. RS* If this switch is ON the RS* is activated, otherwise the Q0.9 will be activated.

ANALOG LEFT ZONE			
SWITCH	RS232 MODE	RS485 MODE	
10.8 / RS* DE	OFF	ON	
RS* DE / 10.8	ON	OFF	
10.9 / RS* RE	OFF	ON	
RS* RE / 10.9	ON	OFF	
SDA - GPRS RST	-	-	
SCL-D3	-	-	

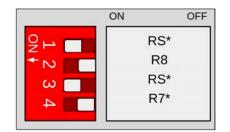
RS* LEFT ZONE: In order to enable the RS* communication protocol it is necessary that the switches of the left one are configured as it is shown in the table.

The ones marked with "-" mean that they do not affect the RS* communication protocol.

9.4 006001001300 Relay RS-232 and RS-485 Switch

Configuration

RELAY TOP ZONE		
SWITCH MODE		
RS*	ON	
R8	OFF	
RS*	ON	
R7	OFF	



RS* TOP ZONE: In order to

enable the RS* protocol

the TOP ZONE must be configured as it is shown in the table.

Having this setup, the R7 & R8 are disabled.

- 1. RS* If this switch is ON the RS* is activated, otherwise the R8 will be activated.
- 2. R8 If this switch is ON the R8 is activated. otherwise the RS* will be activated.
- **3. RS*** If this switch is ON the RS* is activated, otherwise the R7 will be activated.
- **4. R7** If this switch is ON the R7 is activated, otherwise the RS* will be activated.

RELAY LEFT ZONE			
SWITCH	RS232 MODE	RS485 MODE	
NC	-	-	
HD/FD	ON / OFF	ON / OFF	
R5 / Pin 3-SCL	-	-	
I0.0 / GPRS RST-SDA	-	-	
RE-RS485 / 10.4	OFF	ON	
10.4 / RE-RS485	ON	OFF	
DE-RS485 / 10.5	OFF	ON	
10.5 / DE-RS485	ON	OFF	

HD/FD: Choosing between Half Duplex or Full Duplex for the RS* communication. In order to use Full Duplex, it has to be considered the TOP ZONE and the JUMPER ZONE (see <u>section 9</u>).

RS* LEFT ZONE: In order to enable the RS* communication protocol it is necessary that the switches of the left zone are configured as it is shown in the table.

The ones marked with "-" mean that they do not affect the RS* communication protocol.

TOP	ZONE	LEFT ZONE	
SWITCH	MODE	SWITCH	MODE
Q0.8	-	10.8 / RS-485 DE	-
RS*	-	RS-485 DE / 10.8	-
Q0.9	-	10.9 / RS-485 RE	-
RS*	-	RS-485 RE / 10.9	-
		SDA-GPRS RST / 10.0	OFF
		SCL-D3 / Q0.6	OFF

9.5 006001001200 Analog I2C Switch Configuration

I2C: Enable SCL and SDA connections (direct Arduino pins) with configuration switches. I0.0 and Q0.6 will not be available. In order to implement this communication a $4.7k\Omega$ pull-up resistor is required.

The ones marked with "-" mean that they do not affect the I2C communication protocol.

9.6 006001001300 Relay I2C Switch Configuration

TOP	ZONE	LEFT ZONE	
SWITCH	MODE	SWITCH	MODE
RS*	-	NC	-
R8	-	HD / FD*	-
RS*	-	R5 / Pin 3-SCL	OFF
R7	-	I0.0 / GPRS RST-SDA	OFF
		RE-RS485 / 104	-
		10.4 / RE-RS485	-
		DE-RS485 / 10.5	_
		10.5 / DE-RS485	-

I2C: Enable SCL and SDA connections (direct Arduino pins) with configuration switches. I0.0 and R5 will not be available. In order to implement this communication a $4.7k\Omega$ pull-up resistor is required.

The ones marked with "-" mean that they do not affect the I2C communication protocol.

10. Jumper Configuration

10.1 006001001200 Analog General Jumper Configuration

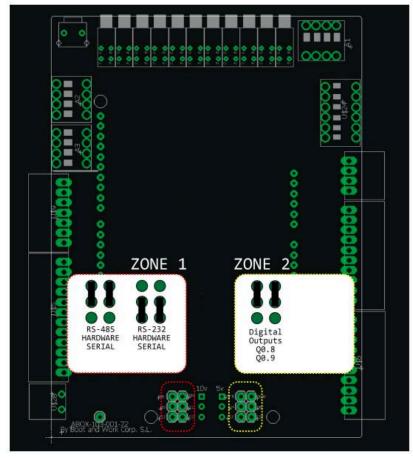
JUMPER ZONE 1		
LEFT	RIGHT	
RS-485	RS-485	
D0	D1	
RS-232	RS-232	

This jumper makes the choice between connecting MAX232 to pins 0,1 of the Arduino Leonardo or with the MAX485. In order to use the RS-232 Hardware Serial protocol both RS-232 must be connected to the D1/D0. In order to use the RS-485 Hardware Serial protocol both RS-485 must be connected to the D1/D0.

JUMPER ZONE 2		
LEFT	RIGHT	
Q0.9	Q0.8	
D4	D8	
RS-232 SS	RS-232 SS	

This jumper zone makes the choice between connecting the inputs Q0.9, Q0.8 to pins 4 and 8 of the Arduino Leonardo respectively, or connect the RS-232 ports to activate the Software Serial RS-232. In order to use the inputs Q0.9, Q0.8 the jumper must be connected to the pins 4 and 8. So Q0.9 must be connected with D4 and Q0.8 must be connected to D8.

*The jumpers that are not connected to the middle jumpers MUST NOT be Connected anywhere.



10.2 006001001300 Relay General Jumper Configuration

JUMPER ZONE 1		
LEFT	RIGHT	
Y+	Z-	
ENABLE	ENABLE	
A0.0	A0.1	

This jumper zone makes the selection between using the RS-485 Full Duplex or the Analog Outputs. If it is wanted to use the RS-485 Full Duplex communication protocol the Y+ must be connected to ENABLE, and Z- also connected to ENABLE. If it is wanted to use the Analog Outputs, the A0.0 must be connected to ENABLE, and A0.1 also connected to ENABLE.

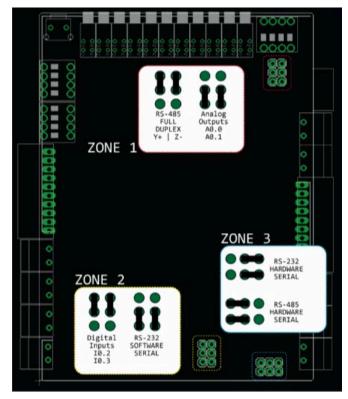
JUMPER ZONE 2		
LEFT RIGHT		
10.2	10.3	
D4	D8	
RS-232	RS232	

This jumper zone makes the choice between connecting the inputs Q0.9, Q0.8 to pins 4 and 8 of the Arduino Leonardo respectively, or connect the RS-232 ports to activate the Software Serial RS-232. In order to use the inputs Q0.9, Q0.8 the jumper must be connected to the pins 4 and 8. So Q0.9 must be connected with D4 and Q0.8 must be connected to D8.

JUMPER ZONE 3		
DOWN UP		
RS-485	RS-485	
D0	D1	
RS-232	RS-232	

This jumper makes the choice between connecting MAX232 to pins 0,1 of the Arduino Leonardo or with the MAX485. In order to use the RS-232 Hardware Serial protocol both RS-232 must be connected to the D1/D0. In order to use the RS-485 Hardware Serial protocol both RS-485 must be connected to the D1/D0.

*The jumpers that are not connected to the middle jumpers MUST NOT be Connected anywhere.



11. Hardware Serial RS-232 & RS-485 Configuration

11.1 006001001200 Analog Hardware Serial RS-485

In order to enable the Hardware Serial RS-485 the total configuration of the Ardbox Analog HF PLUS will be:

Switch configuration:

TOP ZONE		LEFT ZONE	
ACTIVATED SWITCH	MODE	ACTIVATED SWITCH	MODE
Q0.8	OFF	DE-RS485	ON
RS*	ON	DE-RS485	OFF
Q0.9	OFF	RE-RS485	ON
RS*	ON	RE-RS485	OFF
		GPRS RST / 10.0	-
		SCL-PIN3 / Q0.6	-

Jumper configuration:





ZONE 2



- Available communication protocols:
 - Hardware Serial RS-485.
 - I2C *If I2C is active I0.0 & Q0.6 are disabled.
 - TTL (SoftwareSerial)
 - USB

11.2 006001001200 Analog Hardware Serial RS-232

In order to enable the Hardware Serial RS-232 the total configuration of the Ardbox Analog HF PLUS will be:

TOP ZONE		LEFT ZONE		
ACTIVATED SWITCH	MODE	ACTIVATED SWITCH	MODE	
Q0.8	OFF	10.8	OFF	
RS*	ON	10.8	ON	
Q0.9	OFF	10.9	OFF	
RS*	ON	10.9 ON		
	-	GPRS RST / 10.0	-	
		SCL-PIN3 / Q0.6	-	

Switch configuration:

Note: The switches of the left zone of the RS-485 don't interfere in the RS-232 HS. As pins 0 & 1 are reserved for the RS-232, the RS-485 is totally disabled and there is no point on configuring these switches as RS-485 mode

Jumper configuration:





- Available communication protocols:
 - Hardware Serial RS-232.
 - I2C *If I2C is active I0.0 & Q0.6 are disabled
 - o TTL
 - USB

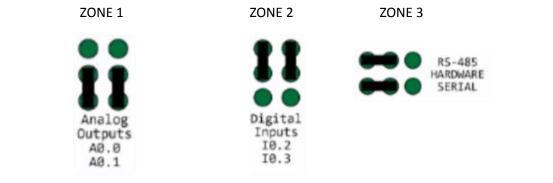
11.3 006001001300 Relay Hardware Serial RS-485

In order to enable the Hardware Serial RS-485 the total configuration of the Ardbox Relay HF PLUS will be:

Switch configuration:

TOP ZONE		LEFT ZONE		
ACTIVATED SWITCH	MODE	ACTIVATED MODE SWITCH		
RS*	ON	NC	-	
R8	OFF	HD / FD	ON - OFF	
RS*	ON	R5 / Pin 3-SCL	-	
R7	OFF	IO.0 / GPRS RST -		
		RE-RS485	ON	
		RE-RS485	OFF	
		DE-RS485	ON	
		DE-RS485	OFF	

Jumper configuration:



- Available communication protocols:
 - Hardware Serial RS-485.
 - I2C *If I2C is active I0.0 & R5 are disabled
 - TTL
 - USB

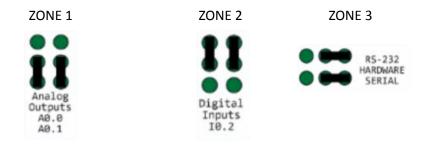
11.4 006001001300 Relay Hardware Serial RS-232

In order to enable the Hardware Serial RS-232 the total configuration of the Ardbox Relay HF PLUS will be:

Switch configuration:

TOP ZONE		LEFT ZONE		
ACTIVATED SWITCH	MODE	ACTIVATED MODE SWITCH		
RS*	ON	NC	-	
R8	OFF	HD / FD	ON - OFF	
RS*	ON	R5 / Pin 3-SCL	-	
R7	OFF	IO.0 / GPRS RST -		
		10.4	OFF	
		10.4	ON	
		10.5	OFF	
		10.5	ON	

Jumper configuration:



- Available communication protocols:
 - Hardware Serial RS-232.
 - I2C *If I2C is active I0.0 & R5 are disabled
 - TTL
 - USB

12. Ardbox - Arduino I/Os 5V pins

The Ardbox has one of the Leonardo board pins available. This pin can be programmed according to Arduino features such as I/Os operating at 5V. As the pin is directly connected to the Arduino Leonardo board they are not as well protected as the normal inputs. The pin is mainly meant to be used as prototyping.

Ardbox terminal	Arduino pin
SCL – Pin 3	3

***IMPORTANT:** Do not connect the pin in the chart above to voltages higher than 5V. This terminal provides direct access to the Leonardo board.

12.1 I2C pins – SDA/SCL

The I2C protocol is meant to work in a pull-up configuration. The I2C pins in the Arduino Leonardo are not pull-up, so in order to work with the I2C an external pull-up resistor is required. If it is meant to work as a GPIO at 5V, the switches must be set as I2C, (section 8).

These pins are not established with a pull-up or a pull-down configuration. The state of these pins is unknown. If these pins must be used they require a pull-up or a pull-down configuration. The Arduino board allows the pins to be set in a pull-up configuration. If not it must be established as an external pull-up or pull-down circuit in order to correctly work with these pins.

12.2 Pin 3

Pin 3 is only referred to the output Q0.6 for the Analog model and R5 for the Relay model. If the switch configuration is in OFF position the Pin 3 will be available.

The pin is not established with a pull-up or a pull-down configuration. The state of the pin is unknown. If the pin must be used, it requires a pull-up or a pull-down configuration. The Arduino board allows the pin to be set in a pull-up configuration. If not it must be established as an external pull-up or pull-down circuit in order to correctly work with Pin 3.

13. GPRS & GSM

The SIM800L module is the integrated module for the use of GPRS / GSM in this PLC. Its principal features are:

- Quad-band 850/900/1800/1900MHz.
- Only works with 2G technology.
- Can send / receive SMS messages.
- Can send / receive GPRS data (TCP/IP, HTTP, MQTT).
- Controlled by AT Commands (3GPP TS 27.0077, 27.005 and SIMCOM enhanced AT Commands).
- AT Command interface with transmission speed "automatic" detection.
- Max. transmission speed: 85.6 Kbps.
- Serial transmission speed: 1200 bps up to 115200 bps (Baud rate).
- SIM size: Micro SIM.

When defining the pins in the program, take into account that the internal connections between the SIM800L module and the Arduino Leonardo are the following:

Arduino Leonardo Pinout	SIM800L Pinout
5Vdc	Vcc
GND	GND
MOSI (Pin 16)	TxD
MISO (Pin 14)	RxD
Pin 2	GPRS RESET

The GPRS / GSM protocol is always enabled as there are no switches that configure it. The protocol uses the SPI pins of the equipment to be able to communicate and the Pin 2 for the module reset.

14. GPRS & GSM Programming Examples

14.1 How to use the GPRS Module

By following the steps on this <u>post</u>⁷, you will learn how to work with the GPRS Module that is inside the PLC. A brief explanation about the examples provided by the Industrial Shields libraries from GPRS is also done.

14.2 How to send SMS using GPRS from a GPRS Ardbox PLC

Two posts about how SMSs can be sent using GPRS have been written. The first one talks about sending SMS when a temperature sensor reaches a certain threshold. You can find the post <u>here</u>⁸.

The second one is about general features of the GPRS module and describes an example from Adafruit FONA libraries. Check the <u>link⁹</u> to go to the post.

In the examples the communication with an M-Duino GPRS PLC is shown, but the process is identical with the Ardbox models. Select the correct Ardbox board in the Arduino IDE while doing any tutorial.

15. Digital inputs threshold detection

The Ardbox inputs have a minimum voltage threshold to reliably detect the signal when used as digital input. The threshold value is different depending on the input type:

Input type	Threshold voltage (V)
Digital input	3.7
Analog input	3.3

⁷ https://www.industrialshields.com/blog/arduino-industrial-1/post/how-to-use-gprs-module-158

⁸ https://www.industrialshields.com/blog/arduino-industrial-1/post/how-to-send-sms-using-gprs-from-an-mduino-403

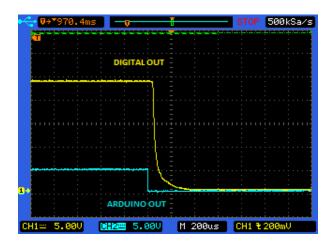
⁹ https://www.industrialshields.com/blog/arduino-industrial-1/post/how-to-send-sms-by-using-plc-controller-arduino-296

16. I/O technical details

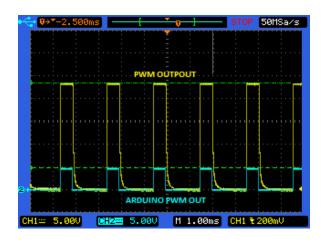
Digital Output Waveform



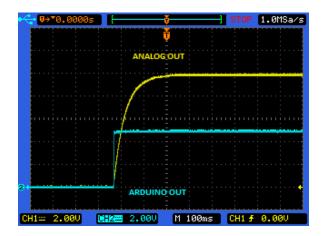
Digital Output Turn-off



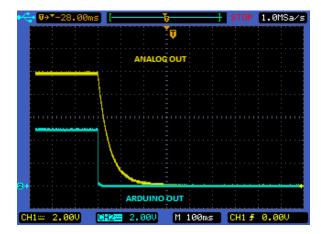
PWM Waveform



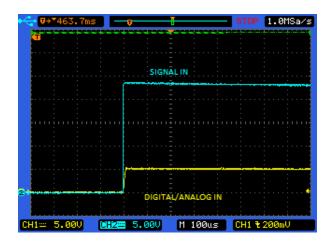
Analog Out Turn-on



Analog Out Turn-off



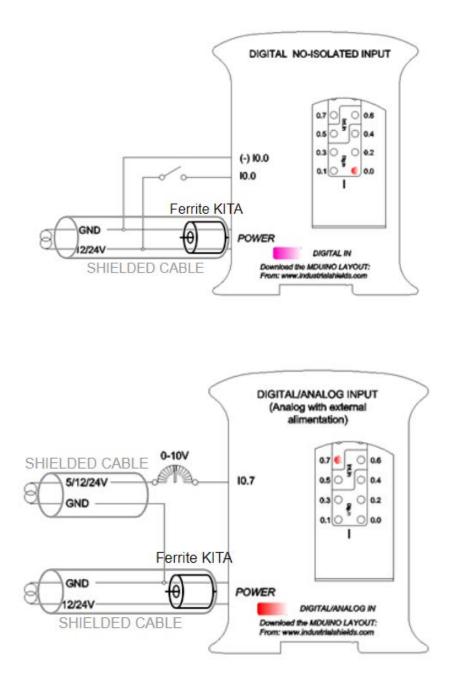
Analog/Digital Input Turn-on

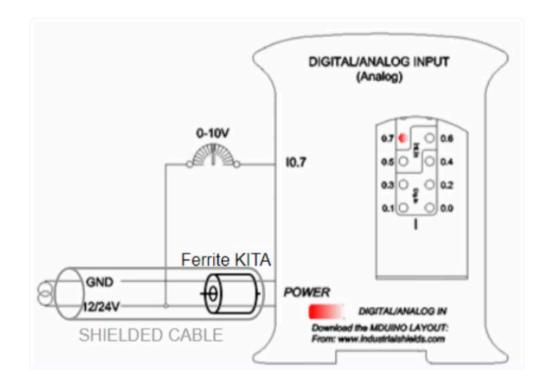


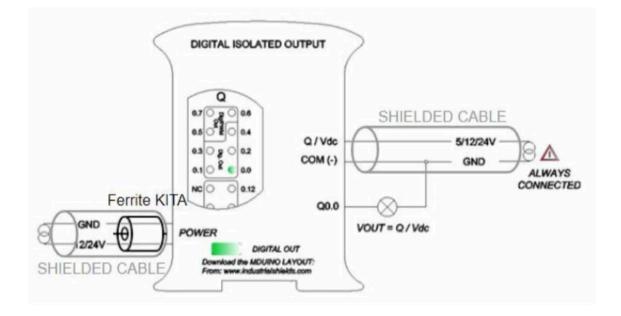
Analog/Digital Input Turn-off

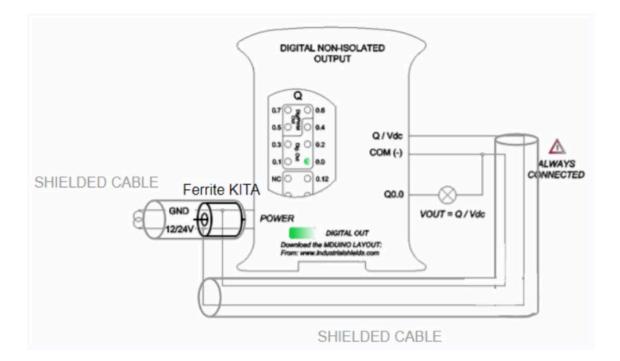
⊷ 🗘 🖓 😽 😽 🖓	6ms		v T	STOP	200kSa/s
(T)					
	SIGNAL IN				
	L			:	
2 AN	ALOG/DIGITAL	LIN			
CH1== 2.000		5.000	M 10.0m	s CH1 F	0.00V

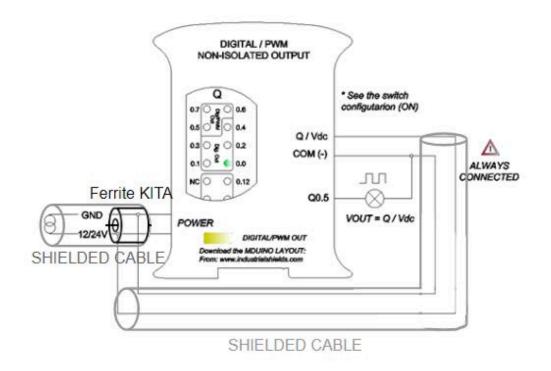
17. Typical Connections

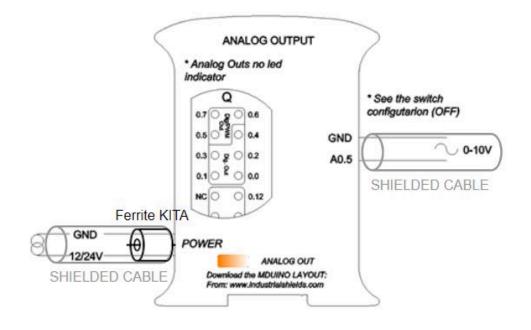












18. Connector details

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:

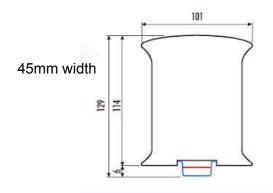
Article reference	MC 0,5/10-G-2,5 THT
Height	8,1mm
Pitch	2,5mm
Dimension	22,5mm
Pin dimensions	0,8x0,8mm
Pin spacing	2,50mm



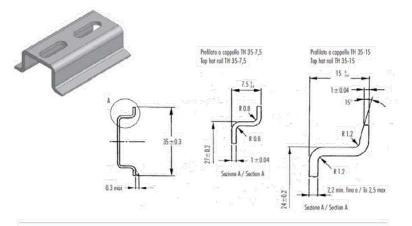
Article reference	FK-MC 0,5/10-ST-2,5
Rigid conduit section min.	0,14 mm²
Rigid conduit section max.	0,5 mm²
Flexible conduit section min.	0,14 mm²
Flexible conduit section max.	0,5 mm²
Conduit section AWG/kcmil min.	26
Conduit section AWG/kcmil max.	20



19. ARDBOX Family Dimensions



- DIN rail mounting:



CARATTERISTIC	HE	METODO	UNITA' DI MISURA	BLEND PC/ABS
Mecconiche	Resistenza a trazione alla svervamenta	ASTM D638	MPa	68
	Relidence o tazione o rotturo	ASTM D638	MPo	- 48
	Allungamente a rattura	ASTM D638	*	59
	Notub in flexione	ASTM 0790	MPg	2894
	Prova laad can intaglia	50 180/14	XI/m²	55
Termiche	Temp, di connollimento Vicot, metado B	ASTM D1525	°C	114
	Temperatura Ricarto 1.81 MPa	ASTM D648	20	- 97
Fisiche	Pos section	ASTM 0792	as'm3	121
	Rhip sello storgo	ASTM 0955	%	0.4/0.6
51 0.00	Melt Flow Index 260°C - 98N	ASTM 01238	01/10/	11.1
Comportamento	Autordinguenzo (mm di spessole)	U.94		¥-0(0.5)
alla fiomma	File Incondescen, 3.2 mm	EG695.2.1	10	960

Italhanik si eiseva il deitto di modificate il materiale con cui realizzo i propri prodotti senze obblgo di preovriso.

FEATURES		TEST METHOD	UNITS	BLEND PC/ABS
Mechanical test	Resistance to tessile stress of yield	ASTM D.638	MPt	68
	knole strength	ASTM 0-638	期後	48
	Utimonite elongation	ASTIN D.638	- Mar - G	59
	Reving modules	ASTM 0.790	MPt	2894
	lead test outcled	150 180/14	Xim	55
Thermal test	Vict softening temperature method 8	ASTM 01525	1	114
	Releating temperature 1,81 MPg	ASTIM 0.648	8	- 97
Physical test	South and -	ASTM 0792	ep/m3	1.21
	Mould thrinkape	ASTM 0955	16	0.40.6
	Melt Flow Index 260°C - 99N	ASTN 01238	. 0/10	11.1
Flome test	Self extinguisher (fildmess in mm)	UL94		V-0(0.8)
	Improdescente thread 32 mm	IEC69521	×	960

Italitatic can operate any change of the materials without being obligad to forewarm.

20. Installation and Maintenance

Notes for installation:

- The installation position should be free from the following: dust or oil smoke, conductive dust, corrosive or flammable gas, high temperature, condensation, and rain.
- Besides, vibration and impact also affect the PLC normal operation and shorten its lifespan; electric shock, fire or misact also damages the product. During drilling or wiring, prevent the metal particles or wire segments from falling into the PLC casing, which may cause fire, fault or misact.
- After the PLC installation, clean the ventilation duct to prevent blocking, which may cause bad ventilation, or even fire, faults or misact.
- Do not online connect, plug or unplug cables, which are apt to cause electric shock or damage the circuit. Installation and wire connection must be firm and reliable. Poor connection could cause misact.
- Use shielded twisted pairs for the I/O of high frequency signal and analog signal to improve system IMS.

The installation environment should be free from dust, oil smoke, conductive particles, corrosive or flammable gases, high temperature, condensation, and rain.

Besides, vibration and impact also affect the PLC normal operation and shorten its lifespan. It is recommended to install the PLC, together with the matching switches and contactors, in a dedicated electric cabinet and keep the cabinet ventilated. If the location has high ambient temperature or heat generating equipment nearby, install forced convection devices on top or sides of the cabinet to avoid over-temperature. During drilling or wiring, prevent the metal particles or wire segments from falling into the PLC casing, which may cause fire, fault or misact. After the PLC installation, clean the ventilation duct to prevent blocking, which may cause bad ventilation, or even fire, faults or misact.

The only way to disconnect the equipment from the electrical network is by removing the connectors that feed the equipment. Once installed in the electrical cabinet it is very important to ensure the power connectors for proper operation.

Separate the ARDBOX 20 I/Os Family HF PLUS from heat, high voltage and electrical noise:

Always separate the devices that generate high voltage and high electrical noise from the ARDBOX 20 I/Os Family HF PLUS. When configuring the layout of the ARDBOX 20 I/Os Family HF PLUS inside your panel, consider the heat-generating devices and locate the electronic-type devices in the cooler areas of your cabinet. Reducing the exposure to a high-temperature environment will extend the operating life of any electronic device. Consider also the routing of the wiring for the devices in the electric cabinet. Avoid placing low-voltage signal wires and communications cables in the same tray with AC power wiring and high energy, rapidly-switched DC wiring.

Provide adequate clearance for cooling and wiring ARDBOX 20 I/Os Family HF PLUS. Is designed for natural convection cooling. For proper cooling, you must provide a clearance of at least 25cm above and below the devices. Also, allow at least 25cm of depth between the front of the modules and the inside of the enclosure.

Notes for maintenance:

A well-planned and executed maintenance program is essential to the satisfactory operation of solid-state electrical equipment. The kind and frequency of the maintenance operation will vary with the kind and complexity of the equipment as well as with the nature of the operating conditions. Maintenance recommendations of the manufacturer or appropriate product standards should be followed.

The following factors should be considered when formulating a maintenance program:

- Maintenance must be performed by qualified personnel familiar with the construction, operation, and hazards involved with the control.
- Maintenance should be performed with the control out of operation and disconnected from all sources of power.
- Care should be taken when servicing electrostatic sensitive components. The manufacturer's recommendations for these components should be followed.
- Ventilation passages should be kept open. If the equipment depends upon auxiliary cooling, e.g., air, water, or oil, periodic inspection (with filter replacement when necessary) should be made of these systems.
- The means employed for grounding or insulating the equipment from ground should be checked to assure its integrity.
- Accumulations of dust and dirt on all parts, including on semiconductor heat sinks, should be removed according to the manufacturer's instructions, if provided; otherwise, the manufacturer should be consulted. Care must be taken to avoid damaging any delicate components and to avoid displacing dust, dirt, or debris in a way that permits it to enter or settle into parts of the control equipment.
- Enclosures should be inspected for evidence of deterioration. Accumulated dust and dirt should be removed from the top of the enclosures before opening doors or removing covers.
- Certain hazardous materials removed as part of maintenance or repair procedure (e.g., polychlorinated biphenyls (PCBs) found in some liquid filled capacitors) must be disposed of as described in Federal regulations.

Safety rules for maintenance personnel

Consider the following steps to follow. A false manoeuvre could be the cause of an accident or material damage.

Do not disassemble or modify the modules. This could lead to breakdowns or malfunctions and could lead to injuries or fire.

- All types of radio communication devices, including mobile phones and personal handy-phone systems (PHS), must be kept more than **25cm** away from the PLC in all directions. Failure to observe this precaution exposes malfunctions caused by excess temperature.

- Disconnect the external power supply of the system (on all phases) before connecting or disconnecting a module. Failure to observe this precaution may cause faults or malfunctions of the module.

- Tighten the screws of the terminal ports and the screws of the connectors within the prescribed tightening torque. Insufficient tightening can lead to loose parts or wires and cause malfunctions. Excessive tightening can damage the screws and / or the module, with the risk of falling, short circuits and malfunctions.

- Before handling a module, dispose of the electrostatic charge accumulated by the human body by touching a suitable conductive object. Failure to observe this precaution may cause faults or malfunctions of the module.

Repair note:

If the equipment is suitable to be repaired, it must be verified that the equipment remains in a safe state after repair.

21. Revision Table

Revision Number	Date	Changes
0	30/08/2019	First implementation
1	04/03/2020	Second implementation
2	19/10/2022	Family Implementation
3	11/03/2024	Added section 15 "Digital inputs threshold detection"
4	13/03/2024	RS* Switches Revision
5	21/03/2024	Section 8.2 Digital inputs fix
6	26/09/2024	Added section 3.4 ("Isolation Precautions")

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PLC ARDUINO LORA ARDBOX 20 I/Os FAMILY HF PLUS MODBUS

PLC ARDUINO LORa ARDBOX 20 I/Os

FAMILY HF

PLUS



PLC Arduino LoRa ARDBOX 20 I/Os Family HF PLUS User Guide

Revised September 2024

This user guide is for version PLC Arduino LoRa ARDBOX 20 I/Os Family HF PLUS with Reference name 015001001200 or 015001001300.

Preface

This User Guide has 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.



- 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.
- Maintenance must be performed by qualified personnel familiarised with the construction, operation, and hazards involved with the control.
- Maintenance should be performed with the control out of operation and disconnected from all sources of power.
- Care should be taken when servicing electrostatic sensitive components. The manufacturer's recommendations for these components should be followed.

- The Ardbox Family PLCs are Open Type Controllers. It is required that you install the Ardbox PLC in a housing, cabinet, or electric control room. Entry to the housing, cabinet, or electric control room should be limited to authorised personnel. Failure to follow these installation requirements could result in severe personal injury and/or property damage. Always follow these requirements when installing Ardbox family PLCs.
- In case of installation or maintenance of the Ardbox please follow the instructions marked in the Installation and Maintenance section.
- Do not disconnect equipment when a flammable or combustible atmosphere is present. Disconnection of equipment when a flammable or combustible atmosphere is present may cause a fire or explosion which could result in death, serious injury and/or property damage.



- Les broches non utilisées ne doivent pas être connectées. Ignorer la directive peut endommager le contrôleur.
- Une utilisation incorrecte de ce produit peut endommager gravement le contrôleur.
- Reportez-vous au Guide de l'utilisateur du contrôleur pour les considérations de câblage.
- Avant d'utiliser ce produit, il incombe à l'utilisateur de lire le Guide de l'utilisateur du produit et la documentation qui l'accompagne.
- La maintenance doit être effectuée par personnel qualifié familiarisé avec la fabrication, le fonctionnement et les dangers liés au contrôleur.
- La maintenance doit être effectuée avec l'équipement hors service et déconnectée de toutes les sources d'alimentation.
- Faites attention lors de l'entretien des composants sensibles à l'électricité statique. Les recommandations du fabricant pour ces composants doivent être suivies.
- Les automates de la famille Ardbox sont des contrôleurs de type ouvert. Il est nécessaire d'installer l'automate Ardbox dans un boîtier, une armoire ou une salle de contrôle électrique. L'accès au boîtier, à l'armoire ou à la salle de commande électrique doit être limité au personnel autorisé. Le non-respect de ces exigences d'installation peut entraîner des blessures graves et/ou des dommages matériels importants. Respectez toujours ces exigences lors de l'installation des automates de la famille Ardbox.
- En cas d'installation ou de maintenance du Ardbox, veuillez suivre les instructions indiquées dans la section Installation et Maintenance.
- Ne débranchez pas l'équipement en présence d'une atmosphère inflammable ou combustible. La déconnexion de l'équipement en présence d'une atmosphère inflammable ou combustible peut provoquer un incendie ou une explosion pouvant entraîner la mort, des blessures graves et/ou des dommages matériels.

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 machines, 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.

Intended use of Industrial Shields products

Consider the following:

Industrial Shields products should only be used for the cases of application foreseen in the catalogue and the associated technical documentation. If third-party products and components are used, they must have been recommended or approved by Industrial Shields.

The correct and safe operation of the products requires that your transport, storage, installation, assembly, operation and maintenance have been carried out in a correct manner. It must respect the permissible ambient conditions. You should also follow the indications and warnings that appear in the associated documentation.

The product / system dealt with in this documentation should only be handled or manipulated by qualified personnel for the task entrusted and observing what is indicated in the documentation corresponding to it, particularly the safety instructions and warnings included in it. Due to their training and experience, qualified personnel are in a position to recognize risks resulting from the handling or manipulation of such products / systems and to avoid possible hazards.

Disclaimers

Weights and Dimensions

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

Performance Data

The 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 most correlate it to actual application requirements. Actual performance is subject to the INDUSTRIAL SHIELDS Warranty and Limitations of Liability.

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.

Residual Risks

The control and drive components of an Industrial Shields PLC are approved for industrial and commercial use in industrial line supplies. Their use in public line supplies requires a different configuration and/or additional measures. These components may only be operated in closed housings or in higher-level control cabinets with protective covers that are closed, and when all of the protective devices are used. These components may only be handled by qualified and trained technical personnel who are knowledgeable and observe all of the safety information and instructions on the components and in the associated technical user documentation. When carrying out a risk assessment of a machine in accordance with the EU Machinery Directive, the machine manufacturer must consider the following residual risks associated with the control and drive components of a PDS.

1. Unintentional movements of driven machine components during commissioning, operation, maintenance, and repairs caused by, for example: – Hardware defects and/or software errors in the sensors, controllers, actuators, and connection technology – Response times of the controller and drive – Operating and/or ambient conditions not within the scope of the specification – Condensation / conductive contamination – Parameterization, programming, cabling, and installation errors – Use of radio devices / cellular phones in the immediate vicinity of the controller – External influences / damage.

 Exceptional temperatures as well as emissions of noise, particles, or gas caused by, for example: - Component malfunctions - Software errors - Operating and/or ambient conditions not within the scope of the specification - External influences / damage.

3. Hazardous shock voltages caused by, for example: – Component malfunctions – Influence of electrostatic charging – Induction of voltages in moving motors – Operating and/or ambient conditions not within the scope of the specification – Condensation / conductive contamination – External influences / damage

4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc. if they are too close.

5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly.

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, EXPRESSED 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

INDUSTRIAL SHIELDS SHALL NOT BE RESPONSIBLE FOR SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS OR COMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED ON CONTRACT, WARRANTY, NEGLIGENCE, OR STRICT LIABILITY.

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.

Table of Contents

1. LoRa Ardbox Family HF: General Features	11
2. Technical Specifications	12
2.1 General Specifications	
2.2 Performance Specification	
2.3 Symbology	13
3. Precautions	14
3.1 Arduino Board	
3.2 Intended Audience	
3.3 General Precautions	
3.4 Isolation Precautions	14
4. Software interface	
5. How to connect PLC Arduino to PC	
6. How to connect PLC to power supply	
7. Ardbox LoRa pinout	
8. Ardbox LoRa Family I/O serigraphy	
8.1 015001001200 Zone Connections	
8.2 015001001300 Relay Zone Connections	
9. Switch configuration	25
9.1 015001001200 Analog Model General Switches Configuration	25
9.2 015001001300 Relay Model General Switches Configuration	27
9.3 015001001200 Analog RS-232 and RS-485 Switch Configuration	29
9.4 015001001300 Relay RS-232 and RS-485 Switch Configuration	30
9.5 015001001200 Analog LoRa Switch Configuration	
9.6 015001001300 Relay LoRa Switch Configuration	
10. Jumper Configuration	32
10.1 015001001200 Analog General Jumper Configuration	
10.2 015001001300 Relay General Jumper Configuration	
11. Hardware Serial RS-232 & RS-485 Configuration	
11.1 015001001200 Analog Hardware Serial RS-485	34
11.2 015001001200 Analog Hardware Serial RS-232	35
11.3 015001001300 Relay Hardware Serial RS-485	36
11.4 015001001300 Relay Hardware Serial RS-232	37
12. Ardbox - Arduino I/Os 5V pins	
12.1 SPI - MISO / MOSI / SCK	
13. LoRa Programming Examples	
13.1 Introduction to LoRa	39
13.2 How to work with LoRaWAN	

14. Digital inputs threshold detection	39
15. I/O technical details	40
16. Typical Connections	43
17. Connector details	47
18. ARDBOX Family Dimensions	48
19. Installation and Maintenance	49
20. Revision Table	52

1. LoRa Ardbox Family HF: General Features

COMPACT PLC ARDUINO	LoRa ARDBOX 20I/Os Family LOG HF PLUS		
Input Voltage	12 to 24Vdc	Fuse protection (2.5A) Polarity protection	
Input rated voltage	24Vdc		
Rated Power	30 W		
l Max.	1.5A		
Size	100x45x115		
Clock Speed	16MHz		
Flash Memory	32KB of which 4KB are used by bootloader		
SRAM	2.5KB		
EEPROM	1KB		
Communications	SPI USB RS232 RS485	RS485	
An/Dig Input 10bit (0-10Vcc)	An/Dig Input 10bit (0-10Vcc) 0 to 10Vdc Input Impedance: 39K Separated PCB ground Rated Voltage: 10Vdc 5 to 24Vdc I min: 2 to 12mA Galvanic Isolation Rated Voltage: 24 Vdc		
* Interrupt isolated Input HS (24Vcc)	5 to 24Vdc I min: 2 to 12mA Galvanic Isolation Rated Voltage: 24Vdc	5 to 24Vdc I min: 3/6mA Separated PCB ground	
Analog Output 8bit (0-10Vcc)	0 to 10Vdc I max: 20mA Separated PCB ground Rated Voltage: 10Vdc		
Digital Isolated Output (24Vcc)	5 to 24Vdc I max: 70mA Galvanic Isolation Diode Protected for Relay Rated Voltage: 24Vdc	Imax 24Vdc: 410mA	
Digital Isolated Output Relay			
PWM Isolated Output 8bit (24Vcc)	5 to 24Vdc I max: 70mA Galvanic Isolation Diode Protected for Relay Rated Voltage: 24Vdc	PWM Isolated Output 8bit (24Vcc)	
Expandability	RS232 – RS485 – TTL		
Reference	015001001200 015001001300	Analog Relay	

2. Technical Specifications

2.1 General Specifications

Power supply DC power supply voltage		12 to 24Vdc			
Operating voltage range DC power supply		11.4 to 25.4Vdc			
Power consumption DC power supply		30W max.			
External	Power supply voltage	24Vdc			
power supply	Power supply output capacity	700mA			
Insulation resistance		$20 M \Omega$ min. at 500Vdc between the AC terminals and the protective ground terminal.			
Dielectric strength		2.300Vac 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 60°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		350g max.			

2.2 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 4KB are used by bootloader				
Program capacity (SRAM) 2.5KB				
EEPROM	1КВ			
Clock Speed 16MHz				

2.3 Symbology

Table that includes all the symbology that is used in the serigraph of the LoRa Ardbox Family HF+:

Symbol	Standard No. / Standard Title	Standard Reference No. / Symbol Title	Symbol Meaning	
	IEC 60417 / Graphical symbols for use on equipment	5031 / Direct Current	Indicates that the equipment is suitable for direct current only; to identify relevant terminals	
\sim	 IEC 60417 / Graphical symbols for use on equipment 5032 / Alter Currer 		Indicates that the equipment is suitable for alternating current only; to identify relevant terminals	
	IEC 60417 / Graphical symbols for use on equipment	5130 / Pulse General	To identify the control by which a pulse is started.	
	IEC 60417 / Graphical symbols for use on equipment		To identify an earth (ground) terminal in cases where neither the symbol 5018 nor 5019 is explicitly required.	
\otimes	IEC 60417 / Graphical symbols for use on equipment		To identify the switch by means of which the signal lamp(s) is (are) switched on or off.	
CE	Medical Devices Directive 93/42/EEC	CE Marking	CE marking indicates that a product complies with applicable European Union regulations	
$\overline{\mathbb{N}}$	ISO 7000/ Graphical symbols for use on equipment	0434B / Warning symbol	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury	
4	ISO 7000/ Graphical symbols for use on equipment		To indicate hazards arising from dangerous voltages	

3. Precautions

Read this manual before attempting to use the ARDBOX 20 I/Os Family HF LoRa PLUS and follow its descriptions for reference during operation.

3.1 Arduino Board

The ARDBOX 20 I/Os Family HF LoRa PLUS PLCs include Arduino Leonardo Board as controller.

3.2 Intended Audience

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

3.3 General Precautions

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

Before using ARDBOX 20 I/Os Family HF LoRa PLUS under different conditions from what has been specified in this manual or integrating ARDBOX 20 I/Os Family HF LoRa PLUS 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.

3.4 Isolation Precautions

Description:

This equipment does **not include galvanic isolation between the grounds** of the different systems. This means that if an external device or sensor that shares the same ground reference (GND) with the system is connected, any potential difference between these grounds could damage the connected components. To avoid issues with interference, ground loops, or damage to external equipment, ensure that all connected devices share the same ground reference or use systems with appropriate isolation.

Recommendations:

- **Connection Review:** Verify that all ground connections are properly made and that there are no significant potential differences between them.
- Use of Isolation: Consider using galvanic isolators or isolation transformers if it is necessary to connect equipment with different ground references.

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 directly using C, but it is much easier working with Arduino IDE, as it provides lots of useful libraries.

Industrial Shields provide a boards package for programming the PLCs, making it easier and friendlier. It includes various facilities such as not having to define the pins, etc.

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

Requirements:

Arduino IDE 1.8.15 or above (recommended: 1.8.19).

Steps:

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

Preferences	×
Settings Network	
Sketchbook location:	
C:\Users\Albert\Documents\A	rduino Browse
Editor language:	English (English) v (requires restart of Arduino)
Editor font size:	15
Interface scale:	Automatic 100 🜩 % (requires restart of Arduino)
Show verbose output during:	compilation upload
Compiler warnings:	None 🗸
Display line numbers	
Enable Code Folding	
Verify code after upload	
Use external editor	
Check for updates on star	tup
Update sketch files to new	/ extension on save (.pde -> .ino)
Save when verifying or up	loading
Additional Boards Manager UR	tLs: http://apps.industrialshields.com/main/arduino/boards/package_industrialshields_inde: 🔲
More preferences can be edit	ed directly in the file
C:\Users\Albert\AppData\Loca	il\Arduino15\preferences.bt
(edit only when Arduino is not	:running)
	OK Cancel

2. In Additional Boards URLs write the following:

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.

pe All	✓ industrialshields	
ndustrialshiel oards include	ds J in this package: M-Duino family.	
		1.1.8 V Install

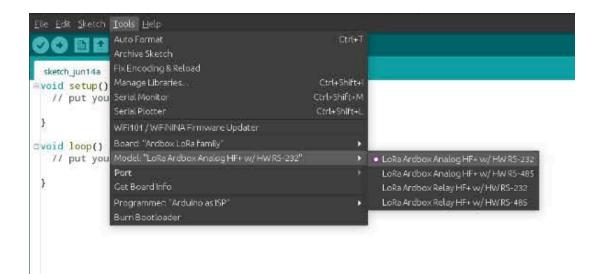
6. Click install (selecting the latest version).

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

Eile Edit Sketch	Tools Help					
OO BE	Auto Format Archive Sketch					
	Fix Encoding & Reload					
<pre>svoid setup()</pre>	Manage Libraries	Ctrl+Shift+				
// put you	Serial Monitor Serial Plotter	Ctrl+Shift+M Ctrl+Shift+L				
}	WFi101/WFININA Firmware Updater					
⊡void loop()	Board "Ardbox LsRa Family"		Boards Manager			
// put you	Model: "LoRa Ardbox Analog HF+ w/ HWRS-232"		Arduino AVR Boards			
1	Port		ESP32 Arduino			
	Get Board Info		Industrial Shields boards		Ardbox Family	
	Programmer: "Arduino as ISP"	2	Industrial Shields ESP32	•	ArdboxDALIFamily	
	Burn Bootloader				Ardbox GPRS Family	
					Ardbox WIFI/BT Family • Ardbox LoRe Family	
				- 18	M-Duinc Family	
					M-Duino DALI family	
					M-Duino GPRS family	
					M-Duino LoRa Family	
					M-Duino WFi/BT family	
					M-Duino WFI/BT + GPRS Family	
					Spartan Family	

Once the Ardbox Family is selected, an extra option will appear on Tools:

 Select the correct Ardbox Family HF PLUS Board (Ardbox Analog HF+ w/HW RS-232 LoRa, Ardbox Analog HF+ w/HW RS-485 LoRa, Ardbox Relay HF+ w/HW RS-232 LoRa or Ardbox Relay HF+ w/HW RS-485 LoRa) depending on your jumpers & switch configuration.



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

Furthermore there are some extra libraries that can be found in Industrial Shields GitHub: https://github.com/Industrial-Shields/

5. How to connect PLC Arduino to PC

- Connect USB port from PLC to PC.

NOTE:

Ardbox Family uses micro USB cable.



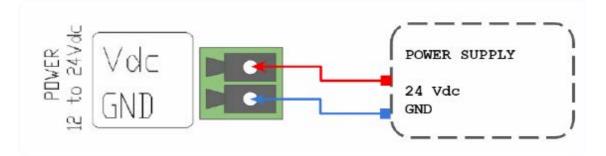
- Open Arduino IDE interface:
- Select Industrial Shields boards -> Ardbox LoRa Family
- Select the correct port.

💿 sketch_mar16a | Arduino 1.8.0

File Edit Sketch Too	ls Help			
	Auto Format Archive Sketch	Ctrl+T		
sketch_mar16	Fix Encoding & Reload			
void setup	Serial Monitor Serial Plotter	Ctrl+Shift+M Ctrl+Shift+L		
// put y	WiFi101 Firmware Updater			
}	Board: "Ardbox family"	>		
	Industrial Shields: "Ardbox Analog"	>		
void loop(Port	>	Serial ports	
// put y	Get Board Info		COM13 (Arduino Leonardo)	
}	Programmer: "Arduino as ISP" Burn Bootloader	>		

6. How to connect PLC to power supply

- Ardbox LoRa Family PLCs are 12-24Vdc supplied. IMPORTANT: The polarity IS NOT REVERSIBLE!
- 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

Compact DIN rail power supply. Assembled on 35mm	
DIN Rail:	
-12Vdc / 24Vdc	DEEC
-2.5A	+ +
-30W	
	0 ma
Industrial Shields power supplies provide parallel	BOW-22V
operation, overvoltage protection, and overcurrent	- Aller
protection. There is a LED inductor for power status, the	L N G
power supply is certified according to UL.	eee

The standard, Part 1 of IEC 61010, sets the general safety requirements for the following types of electrical devices and their accessories, regardless of where use of the device is intended.

The equipment must be powered from an external power source in accordance with IEC 61010-1, whose output is MBTS and is limited in power according to section 9.4 of IEC 61010-1.

WARNING: Once the equipment is installed inside an electrical cabinet, the MTBS cables of the equipment must be separated from the dangerous voltage cables.

7. Ardbox LoRa pinout

				IOs Table		
Model	Reference	Analog Input	Digital Isolated Input	Digital Isolated Output	Digital/Analogic Output	Relay Output
ANALOG	015001001200	7	8	9	6	0
RELAY	015001001300	7	8	0	2	7

8. Ardbox LoRa Family I/O serigraphy

8.1 015001001200 Zone Connections

Ardbox Connector	r Pin Function		HD-FI
NC A0.5 ¹ A0.4 ¹ A0.3 ¹ A0.2 ¹ A0.1 ¹ A0.0 ¹ Q0.9 ¹ Q0.8 ² Q0.7 NC Q0.5 Q0.7 NC Q0.5 Q0.4 Q0.3 Q0.2 Q0.1 Q0.0	- 5 6 9 10 11 13 7 - 5 6 9 10 11 13	Not Connected Analog Out Analog Out Analog Out Analog Out Analog Out Analog Out Digital Output Digital Output Digital Output Not Connected PWM/digital Output PWM/digital Output PWM/digital Output PWM/digital Output PWM/digital Output PWM/digital Output	NC 00.5 00.2 00.1 00.2 00.1 00.0 00.0 00.0 00.0
GNDCOM 24VCOM	-	GND Power Supply	Vdc

LEFT ZONE

Switch config* (see section 8 for Communications configuration. Enabling Communications disables some I/Os)

Analog Outputs pins

Digital Outputs pins

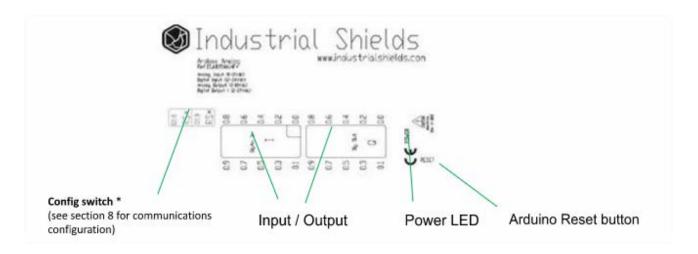
000

Power supply connectors (24Vdc – GND)

¹ See <u>section 9</u> to enable these connections

	RIGHT ZON	1E	
dbox nector	Arduino Pin RS232 HS*	Function	G I0.8 RS-485 DE g2 RS-485 DE 10.8 g2 RS-485 DE 10.8
A+ ^{2, 3} B- ^{3, 4} Y+ ^{3, 4} Z- ^{3, 4} NC NC K-PIN4 K-PIN8	- - - - 4 8	RS485(A) RS485(B) RS485(Y) RS485(Z) Not Connected Not Connected	Switch config* (see section 8 for Communication LORa UFF M A+RX B-RX Y+TX Z-TX
ND SV SET CK OSI SO		Ground 5Vout DC RESET SPI-SCK SPI-MOSI SPI-MISO	NC NC TX-PIN4 RX-PIN8 GND 5V GND 5V SV RESET SCK MOSI MISD
	- 18 19 20 21 22 - 26 24 29	Analog/Digital Input Analog/Digital Input Analog/Digital Input Analog/Digital Input Analog/Digital Input Not Connected Analog/Digital Input Analog/Digital Input Digital Input	3ND → CO = 10.9 - CO = 10.8 - CO = 10.7 - CO = 10.5 NC - CO = 10.3 - CO = 10.2 - CO = 10

HS*: Hardware Serial SS*: Software Serial



 $^{^{\}rm 2}$ See section 8 to enable these connections

³ See <u>section 9</u> to enable these connections

8.2 015001001300 Relay Zone Connections

	Left Zone			LEFT ZONE
Ardbox Connector	Arduino Pin	Function		
MISO MOSI SCK RESET 5Vdc GND RX-RS-232 ^{4, 5} TX-RS-232 ^{5, 6} NC NC	14 16 15 - - 8 4 - -	SPI-MISO SPI-MOSI SPI-SCK SPI-RESET 5V Output GND Serial/RS232 Serial/RS232 Not Connected Not Connected	LoRa LoRa RE-R5465 I0.4 I0.4 RE-R5465 DE-R5465 I0.5 I.05 DE-R5465 DN DFF MISD MISD MISI SCK RESET 5Volc GND RX R5232 TX NC NC	Switch config* (see section 8 for Communications configuration. Enabling Communications disables some I/Os) Communication pins
R1 R2 R3	10 9 6	Relay 1 Out Relay 2 Out Relay 3 Out		Relay Outputs Power supply connectors (24Vdc – GND)
GND 24V	-	GND -		

HS*: Hardware Serial SS*: Software Serial

⁴ See <u>section 8</u> to enable these connections ⁵ See <u>section 9</u> to enable these connections

			F		RIGHT ZONE
Ardbox Connector	Right Arduino Pin	Zone Function	-	88 - A + Z-/401 Y+/40.0 R4 (RS-485 pins Analog Output Pins
B- A+	-	RS485 RS485			Relay Outputs
Z-/A0.1 Y+/A0.0 R4 NC NC I0.8 I0.7 I0.6	- 5 - 22 21 20	RS485/ Digital Output RS485/ Digital Output Relay 4 Out Not Connected Not Connected Analog/ Digital Input Analog/ Digital Input Analog/ Digital Input	tention for	×C 10.8 -×C 10.7 -×C 10.6 -×C 10.6 10.5	Digital/ Analog Input pins
10.5 10.4 10.3 10.2 10.1 NC R6 R7 R8	19 18 8 4 12 - 7 0 1	Analog/ Digital Input Analog/ Digital Input Digital Optoisolated Input Digital Optoisolated Input Digital Input Not Connected Relay 6 Out Relay 7 Out Relay 8 Out	* Note use concertio configuration for		Relay Outputs

*Depending on the mode HD/FD the Y+/Z- Analog Output pins are enabled or disabled. See <u>section 9</u> to see the configurations.

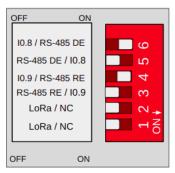
9. Switch configuration

9.1 015001001200 Analog Model General Switches Configuration

LEFT ZONE				
SWITCH	OFF	ON		
I0.8 / RS-485 DE	10.8	RS-485 DE		
RS-485 DE / 10.8	RS-485 DE	10.8		
I0.9 / RS-485 RE	10.9	RS-485 RE		
RS-485 RE / 10.9	RS-485 RE	10.9		
LoRa / NC	LoRa	NC		
LoRa / NC	LoRa	NC		

LEFT ZONE SWITCH

Communications and inputs/outputs can not work simultaneously.



6. IO.8 / RS-485 DE – If this switch is ON the RS-485 DE is activated, otherwise the IO.8 will be activated.

5. RS-485 DE / 10.8 – If this switch is ON the I0.8 is activated, otherwise the RS-485 DE will be activated.

Note* To work with RS-485 DE, switch number 6 at ON and number 5 at OFF.

4. IO.9 / RS-485 RE – If this switch is ON the RS-485 RE is activated, otherwise the IO.9 will be activated.

3. RS-485 / IO.9 – If this switch is ON the IO.9 is activated, otherwise the RS-485 RE will be activated.

Note* To work with RS-485 RE, switch number 4 at ON and number 3 at OFF.

2. LoRa / NC – If this switch is ON the LoRa is deactivated, otherwise LoRa will be activated. Always in OFF mode as NC stands for not connected and Lora will not be enabled therefore.

1. LoRa / NC – If this switch is ON the LoRa is deactivated, otherwise LoRa will be activated. Always in OFF mode as NC stands for not connected and Lora will not be enabled therefore.

TOP ZONE SWITCH

TOP ZONE				
SWITCH	ON	OFF		
Q0.8	Q0.8	RS*		
RS*	RS*	Q0.8		
Q0.9	Q0.9	RS*		
RS*	RS*	Q0.9		

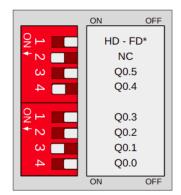
	ON	OFF
9-1	Q0.8	
[↓] N	RS*	
ω	Q0.9	
4	RS*	

- 1. Q0.8 If this switch is ON the Q0.8 is activated, otherwise the RS* will be activated.
- 2. RS* If this switch is ON the RS* is activated, otherwise the Q0.8 will be activated.
- 3. Q0.9 If this switch is ON the Q0.9 is activated, otherwise the RS*will be activated.
- 4. RS* If this switch is ON the RS* is activated, otherwise the Q0.9 will be activated.

*Note** RS * can be RS-485 or RS-232 depending on the jumper configuration you have chosen. To work with RS*, switches number 1 and 3 at OFF and number 2 and 4 at ON.

	RIGHT ZONE				
SWITCH	ON	OFF			
HD / FD	Half Duplex	Full Duplex			
NC	NC -				
Q0.5	DIGITAL (Q0.5)	ANALOG (A0.5)			
Q0.4	DIGITAL (Q0.4)	ANALOG (A0.4)			
Q0.3	DIGITAL (Q0.3)	ANALOG (A0.3)			
Q0.2 DIGITAL (Q0.2)		ANALOG (A0.2)			
Q0.1	DIGITAL (Q0.1)	ANALOG (A0.1)			
Q0.0	DIGITAL (Q0.0)	ANALOG (A0.0)			

RIGHT ZONE SWITCH



RIGHT ZONE.

1. HD/FD – Choosing between Half/Full Duplex for the RS485 communication. In order to use Full Duplex, it has to be considered the TOP ZONE and the JUMPER ZONE (see <u>section 9</u>).

2-8. Q0.X/A0.X – 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 analog.

9.2 015001001300 Relay Model General Switches Configuration

LEFT ZONE SWITCH

Communications and inputs/outputs can not work simultaneously.

LEFT ZONE				
SWITCH	ON	OFF		
NC	-	-		
HD/FD*	Half Duplex	Full Duplex		
NC / LoRa	NC	LoRa		
NC / LoRa	NC	LoRa		
RE-RS485 / 10.4	RE-RS485	10.4		
10.4 / RE-RS485	10.4	RE-RS485		
DE-RS485 / 10.5	DE-RS485	10.5		
10.5 / DE-RS485	10.5	DE-RS485		

ON OFF ON OFF NC HD* / FD* NC / LoRa ON OFF

1. NC - Not Connected

2. HD/FD* – Choosing between Half/Full Duplex for the RS485 communication. In order to use Full Duplex, it has to be considered the TOP ZONE and the JUMPER ZONE (see section 9).
3. LoRa / NC – If this switch is ON the LoRa is deactivated, otherwise LoRa will be activated. Always in OFF mode as NC stands for not connected and Lora will not be enabled therefore.
4. LoRa / NC – If this switch is ON the LoRa is deactivated, otherwise LoRa will be activated. Always in OFF mode as NC stands for not connected and Lora will not be enabled therefore.
4. LoRa / NC – If this switch is ON the LoRa is deactivated, otherwise LoRa will be activated. Always in OFF mode as NC stands for not connected and Lora will not be enabled therefore.

1. RE-RS485 / IO.4 – If this switch is ON the RE-RS485 is activated, otherwise the IO.4 will be activated.

2. IO.4 / RE-RS485 – If this switch is ON the IO.4 is activated, otherwise the RE-RS485 will be activated.

Note* To work with RS-485 RE, switch number 1 at ON and number 2 at OFF.

3. DE-RS485 / I0.5 – If this switch is ON the DE-RS485 is activated, otherwise the I0.5 will be activated.

4. IO.5 / DE-RS485 – If this switch is ON the IO.5 is activated, otherwise the DE-RS485 will be activated.

Note* To work with RS-485 DE, switch number 3 at ON and number 4 at OFF.

TOP ZONE SWITCH

TOP ZONE			
SWITCH ON OFF			
RS*	RS*	R8	
R8	R8	RS*	
RS * RS* R7			
R7	R7	RS*	

	ON	OFF
9 H	R	S*
4 N	R	8
ω	R	S*
4	R	7*

1. **RS*** - If this switch is ON the RS* is activated, otherwise the R8 will be activated.

2. **IO.2**- If this switch is ON the R8 is activated, otherwise the RS* will be activated.

3. **RS*** - If this switch is ON the RS* is activated, otherwise the R7 will be activated.

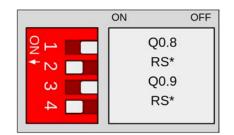
4. **IO.3** - If this switch is ON the R7 is activated, otherwise the RS* will be activated.

Note* RS * can be RS-485 or RS-232 depending on the jumper configuration you have chosen. To work with RS*, switches number 1 and 3 at ON and number 2 and 4 at OFF.

9.3 015001001200 Analog RS-232 and RS-485 Switch

Configuration

ANALOG TOP ZONE	
SWITCH MODE	
Q0.8	OFF
RS*	ON
Q0.9 OFF	
RS* ON	



RS* TOP ZONE: In order to

enable the RS* protocol the

TOP ZONE must be configured as it is shown in the table.

Having this setup, the Q0.8 & Q0.9 are disabled.

- **1. Q0.8** If this switch is ON the Q0.8 is activated, otherwise the RS* will be activated.
- 2. RS* If this switch is ON the RS* is activated, otherwise the Q0.8 will be activated.
- **3. Q0.9** If this switch is ON the Q0.9 is activated, otherwise the RS*will be activated.
- 4. RS* If this switch is ON the RS* is activated, otherwise the Q0.9 will be activated.

ANALOG LEFT ZONE		
SWITCH	RS232 MODE	RS485 MODE
10.8 / RS* DE	OFF	ON
RS* DE / 10.8	ON	OFF
10.9 / RS* RE	OFF	ON
RS* RE / 10.9	ON	OFF
LoRa / NC	-	-
LoRa / NC	-	-

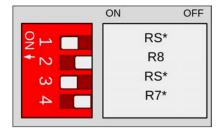
RS* LEFT ZONE: In order to enable the RS* communication protocol it is necessary that the switches of the left one are configured as it is shown in the table.

The ones marked with "-" mean that they do not affect the RS* communication protocol.

9.4 015001001300 Relay RS-232 and RS-485 Switch

Configuration

RELAY TOP ZONE	
SWITCH MODE	
RS*	ON
R8	OFF
RS*	ON
R7	OFF



RS* TOP ZONE: In order to enable the RS* protocol the TOP ZONE must be configured as it is shown in the table.

Having this setup, the R7 & R8 are disabled.

- 1. RS* If this switch is ON the RS* is activated, otherwise the R8 will be activated.
- 2. R8 If this switch is ON the R8 is activated. otherwise the RS* will be activated.
- **3. RS*** If this switch is ON the RS* is activated, otherwise the R7 will be activated.
- **4. R7** If this switch is ON the R7 is activated, otherwise the RS* will be activated.

RELAY LEFT ZONE		
SWITCH	RS232 MODE	RS485 MODE
NC	-	-
HD/FD	ON / OFF	ON / OFF
LoRa / NC	-	-
LoRa / NC	-	-
RE-RS485 / 10.4	OFF	ON
10.4 / RE-RS485	ON	OFF
DE-RS485 / 10.5	OFF	ON
10.5 / DE-RS485	ON	OFF

HD/FD: Choosing between Half Duplex or Full Duplex for the RS* communication. In order to use Full Duplex, it has to be considered the TOP ZONE and the JUMPER ZONE (see <u>section 9</u>).

RS* LEFT ZONE: In order to enable the RS* communication protocol it is necessary that the switches of the left zone are configured as it is shown in the table.

The ones marked with "-" mean that they do not affect the RS* communication protocol.

тор 2	ZONE	LEFT ZON	E
SWITCH	MODE	SWITCH	MODE
Q0.8	-	10.8 / RS-485 DE	-
RS*	-	RS-485 DE / 10.8	-
Q0.9	-	10.9 / RS-485 RE	-
RS*	-	RS-485 RE / 10.9	-
		LoRa / NC	OFF
		LoRa / NC	OFF

9.5 015001001200 Analog LoRa Switch Configuration

The ones marked with "-" mean that they do not affect the LoRa communication protocol.

9.6 015001001300 Relay LoRa Switch Configuration

TOP	ZONE	LEFT ZON	E
SWITCH	MODE	SWITCH	MODE
RS*	-	NC	-
R8	-	HD / FD*	-
RS*	-	NC / LoRa	OFF
R7	-	NC / LoRa	OFF
		RE-RS485 / 104	-
		10.4 / RE-RS485	-
		DE-RS485 / 10.5	-
		10.5 / DE-RS485	-

The ones marked with "-" mean that they do not affect the LoRa communication protocol.

10.Jumper Configuration

10.1 015001001200 Analog General Jumper Configuration

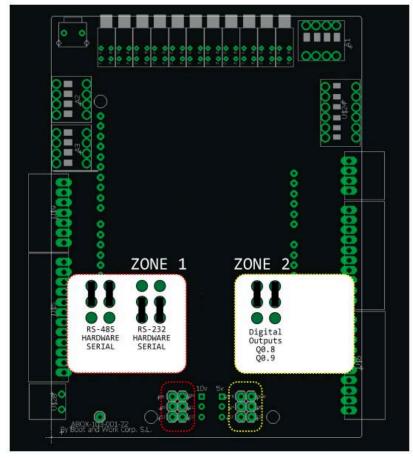
JUMPER ZONE 1		
LEFT RIGHT		
RS-485	RS-485	
D0	D1	
RS-232	RS-232	

This jumper makes the choice between connecting MAX232 to pins 0,1 of the Arduino Leonardo or with the MAX485. In order to use the RS-232 Hardware Serial protocol both RS-232 must be connected to the D1/D0. In order to use the RS-485 Hardware Serial protocol both RS-485 must be connected to the D1/D0.

JUMPER ZONE 2		
LEFT RIGHT		
Q0.9	Q0.8	
D4	D8	
RS-232 SS	RS-232 SS	

This jumper zone makes the choice between connecting the inputs Q0.9, Q0.8 to pins 4 and 8 of the Arduino Leonardo respectively, or connect the RS-232 ports to activate the Software Serial RS-232. In order to use the inputs Q0.9, Q0.8 the jumper must be connected to the pins 4 and 8. So Q0.9 must be connected with D4 and Q0.8 must be connected to D8.

*The jumpers that are not connected to the middle jumpers MUST NOT be Connected anywhere.



10.2 015001001300 Relay General Jumper Configuration

JUMPER ZONE 1		
LEFT RIGHT		
Y+	Z-	
ENABLE	ENABLE	
A0.0	A0.1	

This jumper zone makes the selection between using the RS-485 Full Duplex or the Analog Outputs. If it is wanted to use the RS-485 Full Duplex communication protocol the Y+ must be connected to ENABLE, and Z- also connected to ENABLE. If it is wanted to use the Analog Outputs, the A0.0 must be connected to ENABLE, and A0.1 also connected to ENABLE.

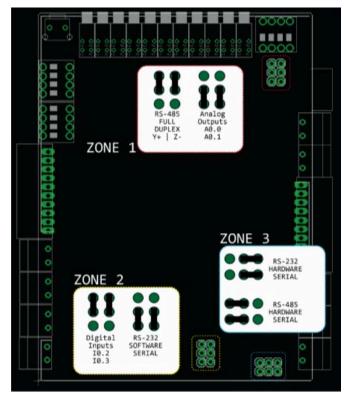
JUMPER ZONE 2		
LEFT RIGHT		
10.2	10.3	
D4	D8	
RS-232	RS232	

This jumper zone makes the choice between connecting the inputs Q0.9, Q0.8 to pins 4 and 8 of the Arduino Leonardo respectively, or connect the RS-232 ports to activate the Software Serial RS-232. In order to use the inputs Q0.9, Q0.8 the jumper must be connected to the pins 4 and 8. So Q0.9 must be connected with D4 and Q0.8 must be connected to D8.

JUMPER ZONE 3		
DOWN UP		
RS-485	RS-485	
D0	D1	
RS-232	RS-232	

This jumper makes the choice between connecting MAX232 to pins 0,1 of the Arduino Leonardo or with the MAX485. In order to use the RS-232 Hardware Serial protocol both RS-232 must be connected to the D1/D0. In order to use the RS-485 Hardware Serial protocol both RS-485 must be connected to the D1/D0.

*The jumpers that are not connected to the middle jumpers MUST NOT be Connected anywhere.



11. Hardware Serial RS-232 & RS-485 Configuration

11.1 015001001200 Analog Hardware Serial RS-485

In order to enable the Hardware Serial RS-485 the total configuration of the Ardbox Analog HF PLUS will be:

Switch configuration:

TOP ZONE		LEFT ZONE	
ACTIVATED SWITCH	MODE	ACTIVATED MODE SWITCH	
Q0.8	OFF	DE-RS485	ON
RS*	ON	DE-RS485	OFF
Q0.9	OFF	RE-RS485	ON
RS*	ON	RE-RS485 OFF	
		LoRa / NC	-
		LoRa / NC	-

Jumper configuration:





ZONE 2



- Available communication protocols:
 - Hardware Serial RS-485.
 - o SPI
 - TTL (SoftwareSerial)
 - USB

11.2 015001001200 Analog Hardware Serial RS-232

In order to enable the Hardware Serial RS-232 the total configuration of the Ardbox Analog HF PLUS will be:

TOP ZONE		LEFT ZONE	
ACTIVATED SWITCH	MODE	ACTIVATED MOD SWITCH	
Q0.8	OFF	10.8	OFF
RS*	ON	10.8	ON
Q0.9	OFF	10.9	OFF
RS*	ON	10.9	ON
		LoRa / NC	-
		LoRa / NC	-

Switch configuration:

Note: The switches of the left zone of the RS-485 don't interfere in the RS-232 HS. As pins 0 & 1 are reserved for the RS-232, the RS-485 is totally disabled and there is no point on configuring these switches as RS-485 mode

Jumper configuration:





- Available communication protocols:
 - Hardware Serial RS-232.
 - o SPI
 - o TTL
 - USB

11.3 015001001300 Relay Hardware Serial RS-485

In order to enable the Hardware Serial RS-485 the total configuration of the Ardbox Relay HF PLUS will be:

Switch configuration:

TOP ZONE		LEFT ZONE	
ACTIVATED SWITCH	MODE	ACTIVATED MODE SWITCH	
RS*	ON	NC	-
R8	OFF	HD / FD	ON - OFF
RS*	ON	LoRa / NC	-
R7	OFF	LoRa / NC -	
		RE-RS485	ON
		RE-RS485	OFF
		DE-RS485	ON
		DE-RS485	OFF

Jumper configuration:







ZONE 3



• Available communication protocols:

- \circ $\,$ Hardware Serial RS-485.
- o SPI
- o TTL
- USB

11.4 015001001300 Relay Hardware Serial RS-232

In order to enable the Hardware Serial RS-232 the total configuration of the Ardbox Relay HF PLUS will be:

Switch configuration:

TOP ZO	TOP ZONE LEFT ZO		NE
ACTIVATED SWITCH	MODE	ACTIVATED MODE SWITCH	
RS*	ON	NC	-
R8	OFF	HD / FD	ON - OFF
RS*	ON	LoRa / NC	-
R7	OFF	LoRa / NC -	
		10.4	OFF
		10.4	ON
		10.5	OFF
		10.5	ON

Jumper configuration:









• Available communication protocols:

- Hardware Serial RS-232.
- o SPI
- o TTL
- USB

12.Ardbox - Arduino I/Os 5V pins

The Ardbox has one of the Leonardo board pins available. This pin can be programmed according to Arduino features such as I/Os operating at 5V. As the pin is directly connected to the Arduino Leonardo board they are not as well protected as the normal inputs. The pin is mainly meant to be used as prototyping.

Ardbox terminal	Arduino pin
MISO	14
SCK	15
MOSI	16

***IMPORTANT:** Do not connect the pin in the chart above to voltages higher than 5V. This terminal provides direct access to the Leonardo board.

12.1 SPI - MISO / MOSI / SCK

These pins are not established with a pull-up or a pull down configuration. The state of these pins is unknown. If these pins must be used, they require a pull-up or a pull-down configuration. The Arduino board allows the pins to be set in a pull-up configuration. If not it must be established as an external pull-up or pull-down circuit in order to correctly work with these pins.

13.LoRa Programming Examples

13.1 Introduction to LoRa

A brief explanation about LorRa can be found in this <u>post</u>⁶. LoRa is perfect for industrial projects due to its long-range capability and its affordability.

13.2 How to work with LoRaWAN

LoRaWAN is a low-power, wide-area networking protocol based on LoRa. Its usage in industrial environments and smart cities is very popular as it is easy to use and it uses the free and unlicensed ISM radio bands. Find how to work with LoRaWAN <u>here</u>⁷.

In the examples the communication with an M-Duino LoRa PLC is shown, but the process is identical with the Ardbox models. Select the correct Ardbox board in the Arduino IDE while doing any tutorial.

14. Digital inputs threshold detection

The Ardbox inputs have a minimum voltage threshold to reliably detect the signal when used as digital input. The threshold value is different depending on the input type:

Input type	Threshold voltage (V)
Digital input	3.7
Analog input	3.3

⁶ https://www.industrialshields.com/blog/arduino-industrial-1/post/what-is-lora-254

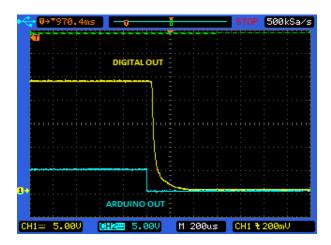
⁷ https://www.industrialshields.com/blog/arduino-industrial-1/post/how-to-work-with-lorawan-and-a-plc-controller-255

15.I/O technical details

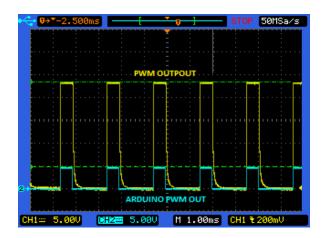
Digital Output Waveform



Digital Output Turn-off



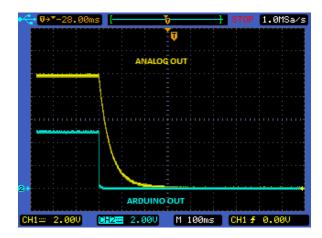
PWM Waveform



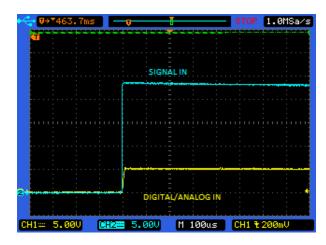
Analog Out Turn-on



Analog Out Turn-off



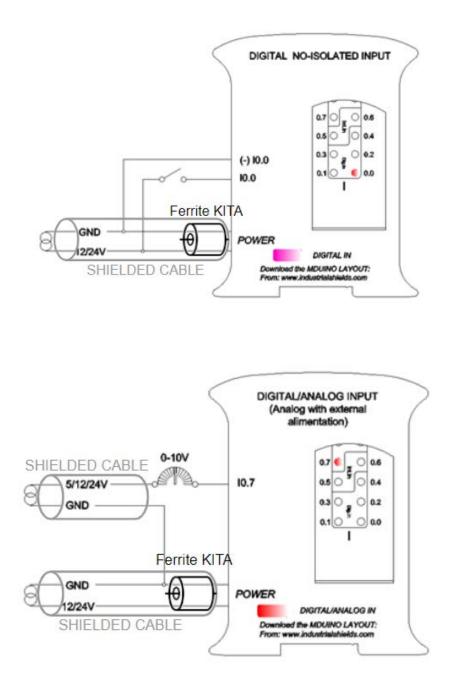
Analog/Digital Input Turn-on

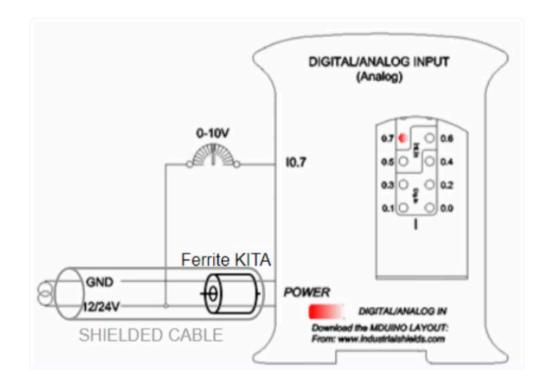


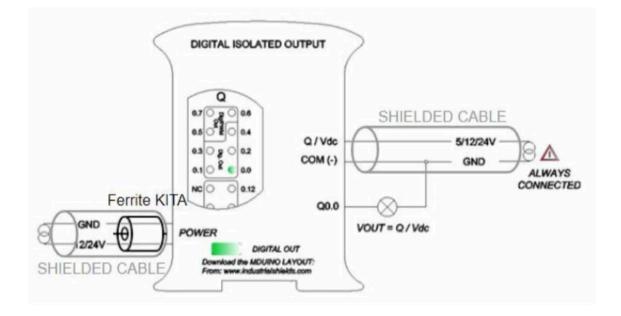
Analog/Digital Input Turn-off

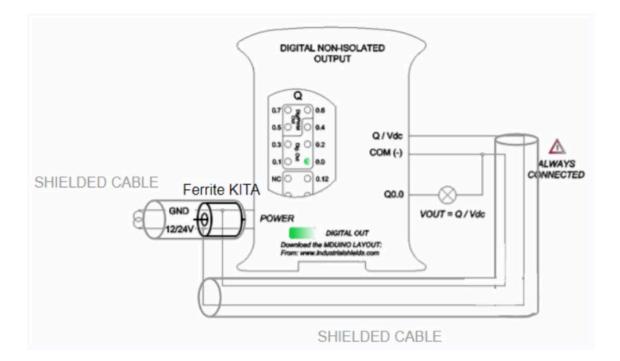


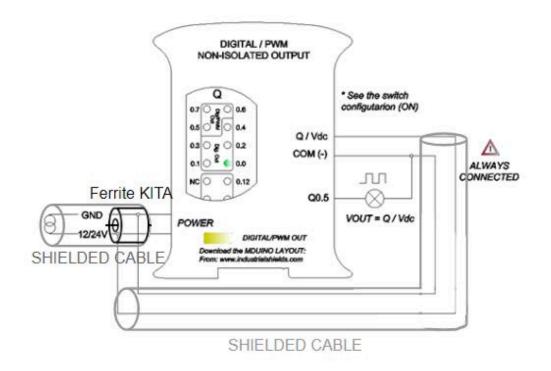
16.Typical Connections

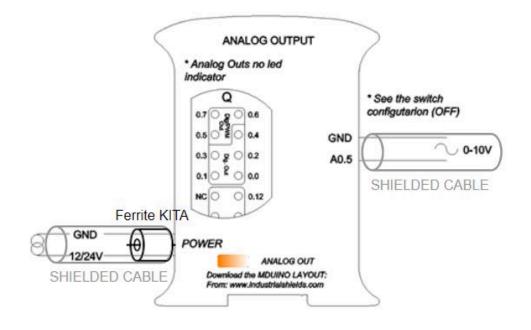












17.Connector details

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

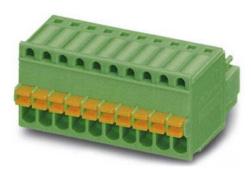
For I/O and power supply there is a FK-MC 0,5/10-ST-2,5 - 1881406 connector from Phoenix contact. FK-MC 0,5/10-ST-2,5

Connection details:

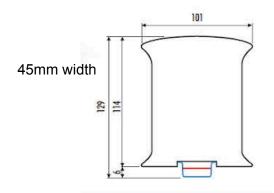
Article reference	MC 0,5/10-G-2,5 THT
Height	8,1mm
Pitch	2,5mm
Dimension	22,5mm
Pin dimensions	0,8x0,8mm
Pin spacing	2,50mm



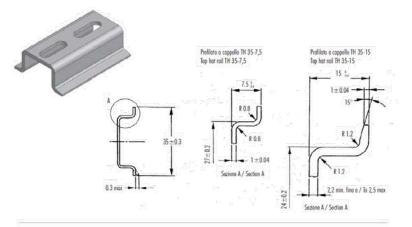
Article reference	FK-MC 0,5/10-ST-2,5
Rigid conduit section min.	0,14 mm²
Rigid conduit section max.	0,5 mm²
Flexible conduit section min.	0,14 mm²
Flexible conduit section max.	0,5 mm²
Conduit section AWG/kcmil min.	26
Conduit section AWG/kcmil max.	20



18.ARDBOX Family Dimensions



- DIN rail mounting:



CARATTERISTIC	HE	METODO	UNITA' DI MISURA	BLEND PC/ABS
Mecconiche	Resistenza a trazione alla svervamenta	ASTM D638	MPa	68
	Relidence o tazione o rotturo	ASTM D638	MPo	- 48
	Allungamente a rattura	ASTM D638	*	59
	Notub in flexione	ASTM 0790	MPg	2894
	Prova laad can intaglia	50 180/14	XI/m²	55
Termiche	Temp, di connollimento Vicot, metado B	ASTM D1525	°C	114
	Temperatura Ricarto 1.81 MPa	ASTM D648	20	- 97
Fisiche	Pos section	ASTM 0792	as'm3	121
	Rhip sello storgo	ASTM 0955	%	0.4/0.6
51 0.00	Melt Flow Index 260°C - 98N	ASTM 01238	01/10/	11.1
Comportamento	Autordinguenzo (mm di spessole)	U.94		¥-0(0.5)
alla fiomma	File Incondescen, 3.2 mm	EG695.2.1	10	960

Inditionic si riserva il divitto di modificare il moteriale can cui realizza i propri prodotti sanza obbligo di preovisa.

FEATURES		TEST METHOD	UNITS	BLEND PC/ABS
Mechanical test	Resistance to tensile stress of yield	ASTM D-638	MPt	68
	knole strength	ASTM 0-638	期行	48
	Utimante elorgation	ASTM 0.638	- Mar - G	59
	Reving modules	ASTM 0.790	MPt	2894
	lead test outcled	150 180/14	Xim	5.5
Thermal test	Vict softening temperature method 8 -	AS1M 01525	1	114
	Robecting temperature 1.81 MPg	ASTM 0.648	8	- 97
Physical test	South anyly -	ASTM 0792	ep/m3	1.21
	Mould shrinkape	ASTM 0955	16	0.40.6
	Melt Flow Index 260°C - 99N	ASTM 01238	. 0/10	11.1
Flame test	Self extinguisher (thickness in mm)	UL94		V-0 (0.8)
Contraction of the local data	Improdescente thread 3.2 mm	IEC695.2.1	°C .	960

Italitatic can operate any change of the materials without being obligad to forewarm.

19. Installation and Maintenance

Notes for installation:

- The installation position should be free from the following: dust or oil smoke, conductive dust, corrosive or flammable gas, high temperature, condensation, and rain.
- Besides, vibration and impact also affect the PLC normal operation and shorten its lifespan; electric shock, fire or misact also damages the product. During drilling or wiring, prevent the metal particles or wire segments from falling into the PLC casing, which may cause fire, fault or misact.
- After the PLC installation, clean the ventilation duct to prevent blocking, which may cause bad ventilation, or even fire, faults or misact.
- Do not online connect, plug or unplug cables, which are apt to cause electric shock or damage the circuit. Installation and wire connection must be firm and reliable. Poor connection could cause a misact.
- Use shielded twisted pairs for the I/O of high frequency signal and analog signal to improve system IMS.

The installation environment should be free from dust, oil smoke, conductive particles, corrosive or flammable gases, high temperature, condensation, and rain.

Besides, vibration and impact also affect the PLC normal operation and shorten its lifespan. It is recommended to install the PLC, together with the matching switches and contactors, in a dedicated electric cabinet and keep the cabinet ventilated. If the location has high ambient temperature or heat generating equipment nearby, install forced convection devices on top or sides of the cabinet to avoid over-temperature. During drilling or wiring, prevent the metal particles or wire segments from falling into the PLC casing, which may cause fire, fault or misact. After the PLC installation, clean the ventilation duct to prevent blocking, which may cause bad ventilation, or even fire, faults or misact.

The only way to disconnect the equipment from the electrical network is by removing the connectors that feed the equipment. Once installed in the electrical cabinet it is very important to ensure the power connectors for proper operation.

Separate the ARDBOX 20 I/Os Family HF PLUS from heat, high voltage and electrical noise:

Always separate the devices that generate high voltage and high electrical noise from the ARDBOX 20 I/Os Family HF PLUS. When configuring the layout of the ARDBOX 20 I/Os Family HF PLUS inside your panel, consider the heat-generating devices and locate the electronic-type devices in the cooler areas of your cabinet. Reducing the exposure to a high-temperature environment will extend the operating life of any electronic device. Consider also the routing of the wiring for the devices in the electric cabinet. Avoid placing low-voltage signal wires and communications cables in the same tray with AC power wiring and high energy, rapidly-switched DC wiring.

Provide adequate clearance for cooling and wiring ARDBOX 20 I/Os Family HF PLUS. Is designed for natural convection cooling. For proper cooling, you must provide a clearance of at least 25cm above and below the devices. Also, allow at least 25cm of depth between the front of the modules and the inside of the enclosure.

Notes for maintenance:

A well-planned and executed maintenance program is essential to the satisfactory operation of solid-state electrical equipment. The kind and frequency of the maintenance operation will vary with the kind and complexity of the equipment as well as with the nature of the operating conditions. Maintenance recommendations of the manufacturer or appropriate product standards should be followed.

The following factors should be considered when formulating a maintenance program:

- Maintenance must be performed by qualified personnel familiar with the construction, operation, and hazards involved with the control.
- Maintenance should be performed with the control out of operation and disconnected from all sources of power.
- Care should be taken when servicing electrostatic sensitive components. The manufacturer's recommendations for these components should be followed.
- Ventilation passages should be kept open. If the equipment depends upon auxiliary cooling, e.g., air, water, or oil, periodic inspection (with filter replacement when necessary) should be made of these systems.
- The means employed for grounding or insulating the equipment from ground should be checked to assure its integrity.
- Accumulations of dust and dirt on all parts, including on semiconductor heat sinks, should be removed according to the manufacturer's instructions, if provided; otherwise, the manufacturer should be consulted. Care must be taken to avoid damaging any delicate components and to avoid displacing dust, dirt, or debris in a way that permits it to enter or settle into parts of the control equipment.
- Enclosures should be inspected for evidence of deterioration. Accumulated dust and dirt should be removed from the top of the enclosures before opening doors or removing covers.
- Certain hazardous materials removed as part of maintenance or repair procedure (e.g., polychlorinated biphenyls (PCBs) found in some liquid filled capacitors) must be disposed of as described in Federal regulations.

Safety rules for maintenance personnel

Consider the following steps to follow. A false manoeuvre could be the cause of an accident or material damage.

Do not disassemble or modify the modules. This could lead to breakdowns or malfunctions and could lead to injuries or fire.

- All types of radio communication devices, including mobile phones and personal handy-phone systems (PHS), must be kept more than **25cm** away from the PLC in all directions. Failure to observe this precaution exposes malfunctions caused by excess temperature.

- Disconnect the external power supply of the system (on all phases) before connecting or disconnecting a module. Failure to observe this precaution may cause faults or malfunctions of the module.

- Tighten the screws of the terminal ports and the screws of the connectors within the prescribed tightening torque. Insufficient tightening can lead to loose parts or wires and cause malfunctions. Excessive tightening can damage the screws and / or the module, with the risk of falling, short circuits and malfunctions.

- Before handling a module, dispose of the electrostatic charge accumulated by the human body by touching a suitable conductive object. Failure to observe this precaution may cause faults or malfunctions of the module.

Repair note:

If the equipment is suitable to be repaired, it must be verified that the equipment remains in a safe state after repair.

20. Revision Table

Revision Number	Date	Changes
0	30/08/2019	First implementation
1	04/03/2020	Second implementation
2	08/06/2023	Family Implementation
3	11/03/2024	Added section 14 "Digital inputs threshold detection"
4	13/03/2024	RS* Switches Revision
5	21/03/2024	Section 8.2 Digital inputs fix
6	02/07/2024	LoRa Switches Revision
7	26/09/2024	Added section 3.4 ("Isolation Precautions")

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PLC ARDUINO DALI ARDBOX 20 I/Os FAMILY HF PLUS MODBUS

PLC ARDUINO DALI ARDBOX 20 I/Os

FAMILY HF

PLUS



PLC Arduino DALI ARDBOX 20 I/Os Family HF PLUS User Guide

Revised September 2024

This user guide is for version PLC Arduino DALI ARDBOX 20 I/Os Family HF PLUS with Reference name 004001001200 or 004001001300.

Preface

This User Guide has 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.



- 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.
- Maintenance must be performed by qualified personnel familiarised with the construction, operation, and hazards involved with the control.
- Maintenance should be performed with the control out of operation and disconnected from all sources of power.
- Care should be taken when servicing electrostatic sensitive components. The manufacturer's recommendations for these components should be followed.

- The Ardbox Family PLCs are Open Type Controllers. It is required that you install the Ardbox PLC in a housing, cabinet, or electric control room. Entry to the housing, cabinet, or electric control room should be limited to authorised personnel. Failure to follow these installation requirements could result in severe personal injury and/or property damage. Always follow these requirements when installing Ardbox family PLCs.
- In case of installation or maintenance of the Ardbox please follow the instructions marked in the Installation and Maintenance section.
- Do not disconnect equipment when a flammable or combustible atmosphere is present. Disconnection of equipment when a flammable or combustible atmosphere is present may cause a fire or explosion which could result in death, serious injury and/or property damage.



- Les broches non utilisées ne doivent pas être connectées. Ignorer la directive peut endommager le contrôleur.
- Une utilisation incorrecte de ce produit peut endommager gravement le contrôleur.
- Reportez-vous au Guide de l'utilisateur du contrôleur pour les considérations de câblage.
- Avant d'utiliser ce produit, il incombe à l'utilisateur de lire le Guide de l'utilisateur du produit et la documentation qui l'accompagne.
- La maintenance doit être effectuée par personnel qualifié familiarisé avec la fabrication, le fonctionnement et les dangers liés au contrôleur.
- La maintenance doit être effectuée avec l'équipement hors service et déconnectée de toutes les sources d'alimentation.
- Faites attention lors de l'entretien des composants sensibles à l'électricité statique. Les recommandations du fabricant pour ces composants doivent être suivies.
- Les automates de la famille Ardbox sont des contrôleurs de type ouvert. Il est nécessaire d'installer l'automate Ardbox dans un boîtier, une armoire ou une salle de contrôle électrique. L'accès au boîtier, à l'armoire ou à la salle de commande électrique doit être limité au personnel autorisé. Le non-respect de ces exigences d'installation peut entraîner des blessures graves et/ou des dommages matériels importants. Respectez toujours ces exigences lors de l'installation des automates de la famille Ardbox.
- En cas d'installation ou de maintenance du Ardbox, veuillez suivre les instructions indiquées dans la section Installation et Maintenance.
- Ne débranchez pas l'équipement en présence d'une atmosphère inflammable ou combustible. La déconnexion de l'équipement en présence d'une atmosphère inflammable ou combustible peut provoquer un incendie ou une explosion pouvant entraîner la mort, des blessures graves et/ou des dommages matériels.

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 machines, 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.

Intended use of Industrial Shields products

Consider the following:

Industrial Shields products should only be used for the cases of application foreseen in the catalogue and the associated technical documentation. If third-party products and components are used, they must have been recommended or approved by Industrial Shields.

The correct and safe operation of the products requires that your transport, storage, installation, assembly, operation and maintenance have been carried out in a correct manner. It must respect the permissible ambient conditions. You should also follow the indications and warnings that appear in the associated documentation.

The product / system dealt with in this documentation should only be handled or manipulated by qualified personnel for the task entrusted and observing what is indicated in the documentation corresponding to it, particularly the safety instructions and warnings included in it. Due to their training and experience, qualified personnel are in a position to recognize risks resulting from the handling or manipulation of such products / systems and to avoid possible hazards.

Disclaimers

Weights and Dimensions

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

Performance Data

The 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 most correlate it to actual application requirements. Actual performance is subject to the INDUSTRIAL SHIELDS Warranty and Limitations of Liability.

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.

Residual Risks

The control and drive components of an Industrial Shields PLC are approved for industrial and commercial use in industrial line supplies. Their use in public line supplies requires a different configuration and/or additional measures. These components may only be operated in closed housings or in higher-level control cabinets with protective covers that are closed, and when all of the protective devices are used. These components may only be handled by qualified and trained technical personnel who are knowledgeable and observe all of the safety information and instructions on the components and in the associated technical user documentation. When carrying out a risk assessment of a machine in accordance with the EU Machinery Directive, the machine manufacturer must consider the following residual risks associated with the control and drive components of a PDS.

1. Unintentional movements of driven machine components during commissioning, operation, maintenance, and repairs caused by, for example: – Hardware defects and/or software errors in the sensors, controllers, actuators, and connection technology – Response times of the controller and drive – Operating and/or ambient conditions not within the scope of the specification – Condensation / conductive contamination – Parameterization, programming, cabling, and installation errors – Use of radio devices / cellular phones in the immediate vicinity of the controller – External influences / damage.

 Exceptional temperatures as well as emissions of noise, particles, or gas caused by, for example: – Component malfunctions – Software errors – Operating and/or ambient conditions not within the scope of the specification – External influences / damage.

3. Hazardous shock voltages caused by, for example: – Component malfunctions – Influence of electrostatic charging – Induction of voltages in moving motors – Operating and/or ambient conditions not within the scope of the specification – Condensation / conductive contamination – External influences / damage

4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc. if they are too close.

5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly.

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, EXPRESSED 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

INDUSTRIAL SHIELDS SHALL NOT BE RESPONSIBLE FOR SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS OR COMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED ON CONTRACT, WARRANTY, NEGLIGENCE, OR STRICT LIABILITY.

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.

Table of Contents

1. DALI Ardbox Family HF: General Features	10
2. Technical Specifications	11
2.1 General Specifications:	11
2.2 Performance Specification:	11
2.3 Symbology	12
3. Precautions	13
3.1 Arduino Board	13
3.2 Intended Audience	13
3.3 General Precautions	13
3.4 Isolation Precautions	13
4. Software interface	14
5. How to connect PLC Arduino to PC	17
6. How to connect PLC to power supply	18
7. Ardbox DALI pinout	19
8. Ardbox DALI Family I/O serigraphy	20
8.1 004001001200 Zone Connections	20
8.2 004001001300 Relay Zone Connections	22
9. Switch configuration	24
9.1 004001001200 Analog Model General Switches Configuration	24
9.2 004001001300 Relay Model General Switches Configuration	26
9.3 004001001200 Analog RS-232 and RS-485 Switch Configuration	28
9.4 004001001300 Relay RS-232 and RS-485 Switch Configuration	29
9.5 004001001200 Analog I2C Switch Configuration	30
9.6 004001001300 Relay I2C Switch Configuration	
10. Jumper Configuration	31
10.1 004001001200 Analog General Jumper Configuration	31
10.2 004001001300 Relay General Jumper Configuration	32
11. Hardware Serial RS-232 & RS-485 Configuration	33
11.1 004001001200 Analog Hardware Serial RS-485	33
11.2 004001001200 Analog Hardware Serial RS-232	34
11.3 004001001300 Relay Hardware Serial RS-485	35
11.4 004001001300 Relay Hardware Serial RS-232	36
12. Ardbox - Arduino I/Os 5V pins	37
12.1 I2C pins – SDA/SCL	37
12.2 Pin 2/Pin 3	37
13. DALI Programming Examples	38
13.1 How to work with DALI	38

14. Digital inputs threshold detection	
15. I/O technical details	39
16. Typical Connections	42
17. Connector details	46
18. ARDBOX Family Dimensions	47
19. Installation and Maintenance	48
20. Revision Table	51

1. DALI Ardbox Family HF: General Features

COMPACT PLC ARDUINO	DALI ARDBOX 20I/Os Family LOG HF PLUS	
Input Voltage	12 to 24Vdc	Fuse protection (2.5A) Polarity protection
Input rated voltage	24Vdc	
Rated Power	30 W	
I Max.	1,5A	
Size	100x45x115	
Clock Speed	16MHz	
Flash Memory	32KB of which 4KB are used by bootloader	
SRAM	2.5KB	
EEPROM	1KB	
Communications	I2C USB RS232 RS485	RS485
An/Dig Input 10bit (0-10Vcc)	0 to 10Vdc Input Impedance: 39K Separated PCB ground Rated Voltage: 10Vdc 5 to 24Vdc I min: 2 to 12mA Galvanic Isolation Rated Voltage: 24Vdc	*Check <u>Section 14</u> for digital inputs threshold detection
* Interrupt isolated Input HS (24Vcc)	HS Galvanic Isolation	
Analog Output 8bit (0-10Vcc)	0 to 10Vdc I max: 20mA Separated PCB ground Rated Voltage: 10Vdc	
Digital Isolated Output (24Vcc)	5 to 24Vdc I max: 70mA Galvanic Isolation Diode Protected for Relay Rated Voltage: 24Vdc	Imax 24Vdc: 410mA
Digital Isolated Output Relay		
PWM Isolated Output 8bit (24Vcc)		
Expandability	I2C – RS232 – RS485 – TTL	
Reference	004001001200	Analog
	004001001300	Relay

2. Technical Specifications

2.1 General Specifications:

Power supply voltage DC power supply		12 to 24Vdc = = =
Operating voltage range DC power supply		11.4 to 25.4Vdc = = =
Power consumption	DC power supply	30W max.
External	Power supply voltage	24Vdc ===
power supply	Power supply output capacity	700mA
Insula	tion resistance	$20 M \Omega$ min. at 500Vdc between the AC terminals and the protective ground terminal.
Dielectric strength		2.300Vac 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 ten	nperature (operating)	0° to 60°C
Ambient h	umidity (operating)	10% to 90% (no condensation)
Ambient environment (operating)		With no corrosive gas
Ambient te	mperature (storage)	-20° to 60°C
Power su	upply holding time	2ms min.
	Weight	350g max.

2.2 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 4KB are used by bootloader		
Program capacity (SRAM)	2.5КВ		
EEPROM	1КВ		
Clock Speed	16MHz		

2.3 Symbology

Table that includes all the symbology that is used in the serigraph of the DALI Ardbox Family HF+:

Symbol	Standard No. / Standard Standard Title Reference No. / Symbol Title		Symbol Meaning
	IEC 60417 / Graphical symbols for use on equipment	5031 / Direct Current	Indicates that the equipment is suitable for direct current only; to identify relevant terminals
\sim	IEC 60417 / Graphical symbols for use on equipment	5032 / Alternating Current	Indicates that the equipment is suitable for alternating current only; to identify relevant terminals
	IEC 60417 / Graphical symbols for use on equipment	5130 / Pulse General	To identify the control by which a pulse is started.
	IEC 60417 / Graphical symbols for use on equipment	5017 / Earth, Ground	To identify an earth (ground) terminal in cases where neither the symbol 5018 nor 5019 is explicitly required.
\otimes	IEC 60417 / Graphical symbols for use on equipment	5115 / Signal lamp	To identify the switch by means of which the signal lamp(s) is (are) switched on or off.
CE	Medical Devices Directive 93/42/EEC	CE Marking	CE marking indicates that a product complies with applicable European Union regulations
$\overline{\mathbf{v}}$	ISO 7000/ Graphical symbols for use on equipment	0434B / Warning symbol	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury
4	ISO 7000/ Graphical symbols for use on equipment	5036 / Dangerous Voltage	To indicate hazards arising from dangerous voltages

3. Precautions

Read this manual before attempting to use the ARDBOX 20 I/Os Family HF DALI PLUS and follow its descriptions for reference during operation.

3.1 Arduino Board

The ARDBOX 20 I/Os Family HF DALI PLUS PLCs include Arduino Leonardo Board as controller.

3.2 Intended Audience

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

3.3 General Precautions

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

Before using ARDBOX 20 I/Os Family HF DALI PLUS under different conditions from what has been specified in this manual or integrating ARDBOX 20 I/Os Family HF DALI PLUS 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.

3.4 Isolation Precautions

Description:

This equipment does **not include galvanic isolation between the grounds** of the different systems. This means that if an external device or sensor that shares the same ground reference (GND) with the system is connected, any potential difference between these grounds could damage the connected components. To avoid issues with interference, ground loops, or damage to external equipment, ensure that all connected devices share the same ground reference or use systems with appropriate isolation.

Recommendations:

- **Connection Review:** Verify that all ground connections are properly made and that there are no significant potential differences between them.
- Use of Isolation: Consider using galvanic isolators or isolation transformers if it is necessary to connect equipment with different ground references.

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 directly using C, but it is much easier working with Arduino IDE, as it provides lots of useful libraries.

Industrial Shields provide a boards package for programming the PLCs, making it easier and friendlier. It includes various facilities such as not having to define the pins, etc.

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

Requirements:

Arduino IDE 1.8.15 or above (recommended: 1.8.19).

Steps:

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

Preferences	×
Settings Network	
Sketchbook location:	
C:\Users\Albert\Documents\A	rduino Browse
Editor language:	English (English)
Editor font size:	15
Interface scale:	Automatic 100 🜩 % (requires restart of Arduino)
Show verbose output during:	✓ compilation ✓ upload
Compiler warnings:	None V
Display line numbers	
Enable Code Folding	
Verify code after upload	
Use external editor	
Check for updates on star	tup
Update sketch files to new	extension on save (.pde -> .ino)
Save when verifying or up	loading
Additional Boards Manager UR	Ls: [http://apps.industrialshields.com/main/arduino/boards/package_industrialshields_inde;] 🔲
More preferences can be edite	d directly in the file
C:\Users\Albert\AppData\Loca	I\Arduino15\preferences.txt
(edit only when Arduino is not	running)
	OK Cancel

2. In Additional Boards URLs write the following:

http://apps.industrialshields.com/main/arduino/boards/package_industrialshields_index.json

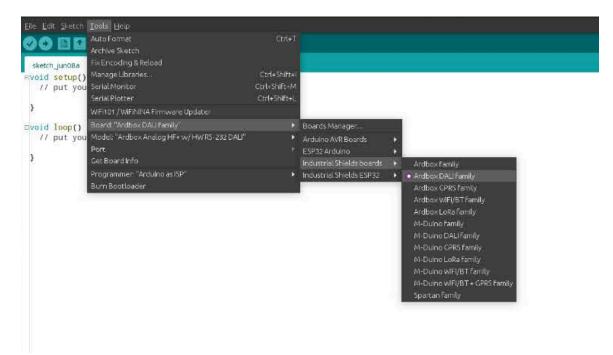
- 3. Press OK to save the changes.
- 4. Go to: Tools -> Board: ... -> Boards Manager

5. Search for industrialshields.

pe All	✓ industrialshields	
ndustrialshiel oards include RDBOX family, <u>online help</u> lore info	ls 1 in this package: M-Duino family.	1.1.8 V Install

6. Click install (selecting the latest version).

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



Once the Ardbox Family is selected, an extra option will appear on Tools:

 Select the correct Ardbox Family HF PLUS Board (Ardbox Analog HF+ w/HW RS-232 DALI, Ardbox Analog HF+ w/HW RS-485 DALI, Ardbox Relay HF+ w/HW RS-232 DALI or Ardbox Relay HF+ w/HW RS-485 DALI) depending on your jumpers & switch configuration.

Eile Edit Sketch	Eosts Help			
	Auto Format	Ctrl+T		
	Archive Sketch			
and an interest	Fix Encoding & Reload	21202		
sord second	Manage Librarles	Ctrl+Shift+r		
// put you		Ctrl+Shift+M		
	Serial Plotter	Ctrl+Shift+L		
,	WiFi101 / WiFiNINA Firmware Updater			
void loop()	Board: "Ardbox DALI family"	×		
	Model: "Ardbox Analog HF+ w/ HWRS-232 DALI"		Ardbox Analog HF+ w/ HW/RS-232 DALL	
DE 50	Port		Ardbox Analog HF+ w/ HW/RS-485 DALI	
}	Get Board Info		Ardbox Relay HF+ w/ HW RS-232 DALI	
	Programmer: "Arduing as ISP"	×	Ardbox Relay HF+ w/ HW R5-485 DALI	
	Burn Bootloader			

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

Furthermore there are some extra libraries that can be found in Industrial Shields GitHub: https://github.com/Industrial-Shields/

5. How to connect PLC Arduino to PC

- Connect USB port from PLC to PC.

NOTE:

Ardbox Family uses micro USB cable.

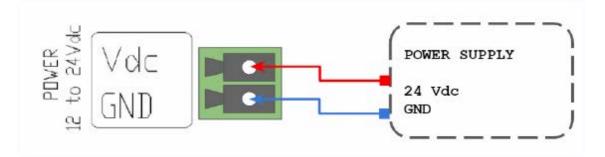


- Open Arduino IDE interface:
- Select Industrial Shields boards -> Ardbox DALI Family
- Select the correct port.

sketch_mar16a / File Edit Sketch To							(<u> </u>	σ	×
sketch_mar16	Auto Format Archive Sketch Fix Encoding & Reload Serial Monitor Serial Plotter	Cttl+T Cttl+Shift+M Cttl+Shift+L							
// put y	WiFi101 Firmware Updater	CB1+Shift+L							
5	Board "Ardbox family"								
void loop(Industrial Shields: "Ardbox And	alog"							
// put y	Port Get Board Info		Serial ports COM13 (Arduno Leonardo)						
j.	Programmer: "Arduino as ISP" Burn Bootloader								
									ç
						Arth	as family, Ardbox/	Analog on C	OW34
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								_	

6. How to connect PLC to power supply

- Ardbox DALI 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

Compact DIN rail power supply. Assembled on 35mm DIN Rail: -12Vdc / 24Vdc -2.5A -30W

Industrial Shields power supplies provide parallel operation, overvoltage protection, and overcurrent protection. There is a LED inductor for power status, the power supply is certified according to UL.

The standard, Part 1 of IEC 61010, sets the general safety requirements for the following types of electrical devices and their accessories, regardless of where use of the device is intended.

The equipment must be powered from an external power source in accordance with IEC 61010-1, whose output is MBTS and is limited in power according to section 9.4 of IEC 61010-1.

WARNING: Once the equipment is installed inside an electrical cabinet, the MTBS cables of the equipment must be separated from the dangerous voltage cables.

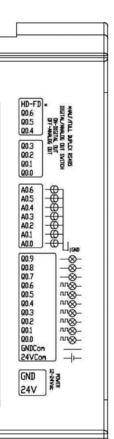
7. Ardbox DALI pinout

		IOs Table				
Model	Reference	Analog Input	Digital Isolated Input	Digital Isolated Output	Digital/Analogic Output	Relay Output
ANALOG	004001001200	8	10	10	7	0
RELAY	004001001300	8	10	0	2	8

8. Ardbox DALI Family I/O serigraphy

8.1 004001001200 Zone Connections

LEFT ZONE				
Ardbox Connector	Arduino Pin	Function		
A0.6 ¹ A0.5 ¹ A0.4 ¹ A0.3 ¹ A0.2 ¹ A0.1 ¹ A0.0 ¹	3 5 6 9 10 11 13	Analog Out Analog Out Analog Out Analog Out Analog Out Analog Out Analog Out		
Q0.9 ¹ Q0.8 ² Q0.7 Q0.6 ¹ Q0.5 Q0.4 Q0.3 Q0.2 Q0.1 Q0.0	1 0 7 3 5 6 9 10 11 13	Digital Output Digital Output Digital Output PWM/digital Output PWM/digital Output PWM/digital Output PWM/digital Output PWM/digital Output PWM/digital Output		
GNDCOM 24VCOM		PWM/digital Output GND Power Supply		



LEFT ZONE

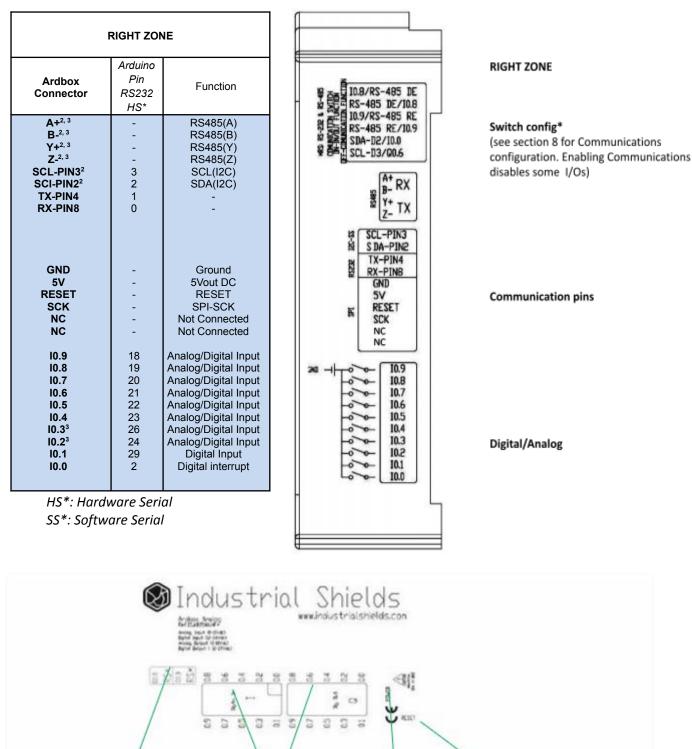
Switch config* (see section 8 for Communications configuration. Enabling Communications disables some I/Os)

Analog Outputs pins

Digital Outputs pins

Power supply connectors (24Vdc – GND)

¹ See <u>section 9</u> to enable these connections



Config switch * (see section 8 for communications configuration) Input / Output

Power LED

Arduino Reset button

² See <u>section 8</u> to enable these connections

³ See <u>section 9</u> to enable these connections

8.2 004001001300 Relay Zone Connections

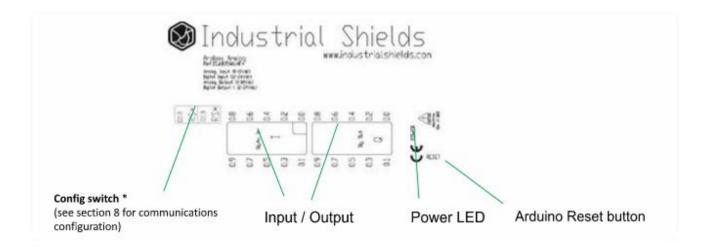
	Left Zone	1	LEFT ZO	NE
Ardbox Connector	Arduino Pin	Function		
NC NC SCK RESET 5Vdc GND RX-RS-232 ^{4, 5} TX-RS-232 ^{4, 5} SCL-PIN2 ⁴ SDA-PIN3 ⁴	- - - - - 8 4 2 3	Not Connected Not Connected SPI-SCK SPI-RESET 5V Output GND Serial/RS232 Serial/RS232 I2C/SPI SS I2C/SPI SS	RE-RS465 10.4 10.4 RE-RS465 10.5 IE-RS465 10.5 ISC RE-RS465 007 NC NC NC SCK SCK SCK	nfig* on 8 for Communication: tion. Enabling Communic ome I/Os) cation pins
R1 R2 R3	10 9 6	Relay 1 Out Relay 2 Out Relay 3 Out	Relay Out	puts
GND 24V	-	GND -	GND Vdc	upply connectors · GND)

HS*: Hardware Serial SS*: Software Serial

⁴ See <u>section 8</u> to enable these connections ⁵ See <u>section 9</u> to enable these connections

	Right	Zone	99 22 - (Aq)	RIGHT ZONE
Ardbox Connector	Arduino Pin RS-485 HD*	Function	₹2-7411 ¥+/40.0 R4 √	RS-485 pins Analog Output Pins
B- A+	-	RS485 RS485	R5*	Relay Outputs
Z-/A0.1	-	RS485/ Digital Output		
Y+/A0.0 R4	- 5	RS485/ Digital Output Relay 4 Out		
R5	5 3	Relay 5 Out		
10.9	23	Analog/ Digital Input	5 -000- 10.4 ×	Digital/ Analog Input pins
10.8 10.7	22 21	Analog/ Digital Input Analog/ Digital Input		
10.6	20	Analog/ Digital Input	2 0 0 [10.1	
10.5	19	Analog/ Digital Input		
10.4	18	Analog/ Digital Input		
10.3 10.2	8 4	Digital Optoisolated Input Digital Optoisolated Input	fr Ko 🖌	
10.2	12	Digital Optoisolated Input		
10.0 ¹	2	Digital Input / Interrupt	signal. r guide 2, 28 9 8 9 8 9 8	Relay Outputs
R6	7	Relay 6 Out		neiay outputs
R7 R8	0 1	Relay 7 Out Relay 8 Out	K Moter use this Gee use	

*Depending on the mode HD/FD the Y+/Z- Analog Output pins are enabled or disabled. See section 9 to see the configurations.



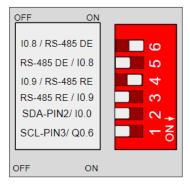
9. Switch configuration

9.1 004001001200 Analog Model General Switches Configuration

LEFT ZONE				
SWITCH	OFF	ON		
10.8 / RS-485 DE	10.8	RS-485 DE		
RS-485 DE / 10.8	RS-485 DE	10.8		
10.9 / RS-485 RE	10.9	RS-485 RE		
RS-485 RE / 10.9	RS-485 RE	10.9		
SDA-PIN2 / 10.0	SDA-D2	10.0		
SCL-PIN3 / Q0.6	SCL-D3	Q0.6		

LEFT ZONE SWITCH

Communications and inputs/outputs can not work simultaneously.



6. IO.8 / RS-485 DE – If this switch is ON the RS-485 DE is activated, otherwise the IO.8 will be activated.

5. RS-485 DE / I0.8 – If this switch is ON the I0.8 is activated, otherwise the RS-485 DE will be activated.

Note* To work with RS-485 DE, switch number 6 at ON and number 5 at OFF.

4. IO.9 / RS-485 RE – If this switch is ON the RS-485 RE is activated, otherwise the IO.9 will be activated.

3. RS-485 / IO.9 – If this switch is ON the IO.9 is activated, otherwise the RS-485 RE will be activated.

Note* To work with RS-485 RE, switch number 4 at ON and number 3 at OFF.

2. SDA-D2/I0.0 – If this switch is ON the I0.0 is activated, otherwise the (I2C) SDA-D2 will be activated.

1. SCL-D3/Q0.6 – If this switch is ON the Q0.6 is activated, otherwise the (I2C) SCL-D3 will be activated.

TOP ZONE SWITCH

TOP ZONE				
SWITCH	ON	OFF		
Q0.8	Q0.8	RS*		
RS*	RS*	Q0.8		
Q0.9	Q0.9	RS*		
RS*	RS*	Q0.9		

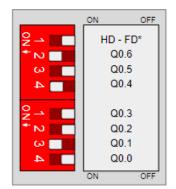
	ON	OFF
9-1	Q0.8	
►N	RS*	
ω	Q0.9	
4	RS*	

- 1. **Q0.8** If this switch is ON the Q0.8 is activated, otherwise the RS* will be activated.
- 2. RS* If this switch is ON the RS* is activated, otherwise the Q0.8 will be activated.
- 3. Q0.9 If this switch is ON the Q0.9 is activated, otherwise the RS*will be activated.
- **4. RS*** If this switch is ON the RS* is activated, otherwise the Q0.9 will be activated.

Note RS * can be RS-485 or RS-232 depending on the jumper configuration you have chosen. To work with RS*, switches number 1 and 3 at OFF and number 2 and 4 at ON.*

RIGHT ZONE					
SWITCH	ON	OFF			
HD / FD	Half Duplex	Full Duplex			
Q0.6	DIGITAL (Q0.6)	ANALOG(A0.6)			
Q0.5	DIGITAL (Q0.5)	ANALOG (A0.5)			
Q0.4	DIGITAL (Q0.4)	ANALOG (A0.4)			
Q0.3	DIGITAL (Q0.3)	ANALOG (A0.3)			
Q0.2	DIGITAL (Q0.2)	ANALOG (A0.2)			
Q0.1	DIGITAL (Q0.1)	ANALOG (A0.1)			
Q0.0	DIGITAL (Q0.0)	ANALOG (A0.0)			

RIGHT ZONE SWITCH



RIGHT ZONE.

1. HD/FD – Choosing between Half/Full Duplex for the RS485 communication. In order to use Full Duplex, it has to be considered the TOP ZONE and the JUMPER ZONE (see <u>section 9</u>).

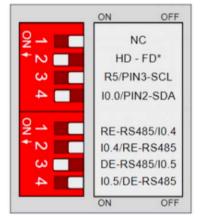
2-8. Q0.X/A0.X – The right zone configures the outputs. If the switch is set to "ON" the Q0.X will have the behaviour of a digital output. If it is set to "OFF" it will be analog.

9.2 004001001300 Relay Model General Switches Configuration

LEFT ZONE				
SWITCH	ON	OFF		
NC	-	-		
HD/FD*	Half Duplex	Full Duplex		
R5 / PIN3-SCL	R5	PIN3-SCL		
10.0 / PIN2-SDA	i0.0	PIN2-SDA		
RE-RS485 / 10.4	RE-RS485	10.4		
10.4 / RE-RS485	10.4	RE-RS485		
DE-RS485 / 10.5	DE-RS485	10.5		
10.5 / DE-RS485	10.5	DE-RS485		

LEFT ZONE SWITCH

Communications and inputs/outputs can not work simultaneously.



1. NC - Not Connected

2. HD/FD* – Choosing between Half/Full Duplex for the RS485 communication. In order to use Full Duplex, it has to be considered the TOP ZONE and the JUMPER ZONE (see <u>section 9</u>).

3. R5 / PIN3-SCL – If this switch is ON the R5 is activated, otherwise the Pin3 - SCL will be activated.

4. IO.O / PIN2-SDA – If this switch is ON the IO.0 is activated, otherwise the Pin2 - SDA will be activated.

1. RE-RS485 / IO.4 – If this switch is ON the RE-RS485 is activated, otherwise the IO.4 will be activated.

2. IO.4 / RE-RS485 – If this switch is ON the IO.4 is activated, otherwise the RE-RS485 will be activated.

Note* To work with RS-485 RE, switch number 1 at ON and number 2 at OFF.

3. DE-RS485 / I0.5 – If this switch is ON the DE-RS485 is activated, otherwise the I0.5 will be activated.

4. IO.5 / DE-RS485 – If this switch is ON the IO.5 is activated, otherwise the DE-RS485 will be activated.

Note* To work with RS-485 DE, switch number 3 at ON and number 4 at OFF.

TOP ZONE SWITCH

TOP ZONE				
SWITCH	ON	OFF		
RS*	RS*	R8		
R8	R8	RS*		
RS*	RS*	R7		
R7	R7	RS*		

	ON	OFF
9 H	R	S*
4 N	R	8
ω	R	S*
4	R	7*

1. **RS*** - If this switch is ON the RS* is activated, otherwise the R8 will be activated.

2. **IO.2**- If this switch is ON the R8 is activated, otherwise the RS* will be activated.

3. **RS*** - If this switch is ON the RS* is activated, otherwise the R7 will be activated.

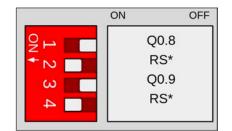
4. **IO.3** - If this switch is ON the R7 is activated, otherwise the RS* will be activated.

Note* RS * can be RS-485 or RS-232 depending on the jumper configuration you have chosen. To work with RS*, switches number 1 and 3 at ON and number 2 and 4 at OFF.

9.3 004001001200 Analog RS-232 and RS-485 Switch

Configuration

ANALOG TOP ZONE		
SWITCH MODE		
Q0.8	OFF	
RS*	ON	
Q0.9	OFF	
RS*	ON	



RS* TOP ZONE: In order to enable the RS* protocol the TOP ZONE must be configured as it is shown in the table.

Having this setup, the Q0.8 & Q0.9 are disabled.

- **1. Q0.8** If this switch is ON the Q0.8 is activated, otherwise the RS* will be activated.
- 2. RS* If this switch is ON the RS* is activated, otherwise the Q0.8 will be activated.
- **3. Q0.9** If this switch is ON the Q0.9 is activated, otherwise the RS*will be activated.
- 4. RS* If this switch is ON the RS* is activated, otherwise the Q0.9 will be activated.

ANALOG LEFT ZONE				
SWITCH	RS232 MODE	RS485 MODE		
10.8 / RS* DE	OFF	ON		
RS* DE / 10.8	ON	OFF		
10.9 / RS* RE	OFF	ON		
RS* RE / 10.9	ON	OFF		
SDA-D2 / 10.0	-	-		
SCL-D3 / Q0.6	-	-		

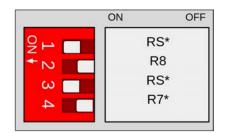
RS* LEFT ZONE: In order to enable the RS* communication protocol it is necessary that the switches of the left one are configured as it is shown in the table.

The ones marked with "-" mean that they do not affect the RS* communication protocol.

9.4 004001001300 Relay RS-232 and RS-485 Switch

Configuration

RELAY TOP ZONE		
SWITCH MODE		
RS*	ON	
R8	OFF	
RS*	ON	
R7	OFF	



RS* TOP ZONE: In order to

enable the RS* protocol the

TOP ZONE must be configured as it is shown in the table.

Having this setup, the R7 & R8 are disabled.

- 1. RS* If this switch is ON the RS* is activated, otherwise the R8 will be activated.
- 2. R8 If this switch is ON the R8 is activated. otherwise the RS* will be activated.
- **3. RS*** If this switch is ON the RS* is activated, otherwise the R7 will be activated.
- **4. R7** If this switch is ON the R7 is activated, otherwise the RS* will be activated.

RELAY LEFT ZONE				
SWITCH	RS232 MODE	RS485 MODE		
NC	-	-		
HD/FD	ON / OFF	ON / OFF		
R5 / PIN3-SCL	-	-		
10.0 / PIN2 - SDA	-	-		
RE-RS485 / 10.4	OFF	ON		
10.4 / RE-RS485	ON	OFF		
DE-RS485 / 10.5	OFF	ON		
10.5 / DE-RS485	ON	OFF		

HD/FD: Choosing between Half Duplex or Full Duplex for the RS* communication. In order to use Full Duplex, it has to be considered the TOP ZONE and the JUMPER ZONE (see <u>section 9</u>).

RS* LEFT ZONE: In order to enable the RS* communication protocol it is necessary that the switches of the left zone are configured as it is shown in the table.

The ones marked with "-" mean that they do not affect the RS* communication protocol.

TOP	ZONE	LEFT ZON	E
SWITCH	MODE	SWITCH	MODE
Q0.8	-	10.8 / RS-485 DE	-
RS*	-	RS-485 DE / 10.8	-
Q0.9	-	10.9 / RS-485 RE	-
RS*	-	RS-485 RE / 10.9	-
		SDA-D2 / 10.0	OFF
		SCL-D3 / Q0.6	OFF

9.5 004001001200 Analog I2C Switch Configuration

I2C: Enable SCL and SDA connections (direct Arduino pins) with configuration switches. I0.0 and Q0.6 will not be available. In order to implement this communication a $4.7k\Omega$ pull-up resistor is required.

The ones marked with "-" mean that they do not affect the I2C communication protocol.

9.6 004001001300 Relay I2C Switch Configuration

TOP	ZONE	LEFT ZON	E
SWITCH	MODE	SWITCH	MODE
RS*	-	NC	-
R8	-	HD / FD*	-
RS*	-	R5 / Pin 3-SCL	OFF
R7	-	10.0 / Pin 2 - SDA	OFF
		RE-RS485 / 104	-
		10.4 / RE-RS485	-
		DE-RS485 / 10.5	-
		10.5 / DE-RS485	-

I2C: Enable SCL and SDA connections (direct Arduino pins) with configuration switches. I0.0 and R5 will not be available. In order to implement this communication a $4.7k\Omega$ pull-up resistor is required.

The ones marked with "-" mean that they do not affect the I2C communication protocol.

10. Jumper Configuration

10.1 004001001200 Analog General Jumper Configuration

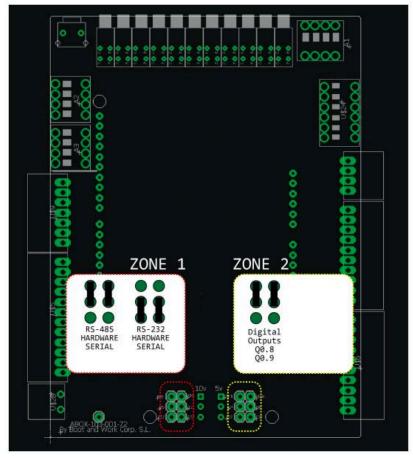
JUMPER ZONE 1		
LEFT RIGHT		
RS-485	RS-485	
D0 D1		
RS-232 RS-232		

This jumper makes the choice between connecting MAX232 to pins 0,1 of the Arduino Leonardo or with the MAX485. In order to use the RS-232 Hardware Serial protocol both RS-232 must be connected to the D1/D0. In order to use the RS-485 Hardware Serial protocol both RS-485 must be connected to the D1/D0.

JUMPER ZONE 2		
LEFT RIGHT		
Q0.9	Q0.8	
D4 D8		
RS-232 SS	RS-232 SS	

This jumper zone makes the choice between connecting the inputs Q0.9, Q0.8 to pins 4 and 8 of the Arduino Leonardo respectively, or connect the RS-232 ports to activate the Software Serial RS-232. In order to use the inputs Q0.9, Q0.8 the jumper must be connected to the pins 4 and 8. So Q0.9 must be connected with D4 and Q0.8 must be connected to D8.

*The jumpers that are not connected to the middle jumpers MUST NOT be Connected anywhere.



10.2 004001001300 Relay General Jumper Configuration

JUMPER ZONE 1		
LEFT RIGHT		
Y+	Z-	
ENABLE	ENABLE	
A0.0 A0.1		

This jumper zone makes the selection between using the RS-485 Full Duplex or the Analog Outputs. If it is wanted to use the RS-485 Full Duplex communication protocol the Y+ must be connected to ENABLE, and Z- also connected to ENABLE. If it is wanted to use the Analog Outputs, the A0.0 must be connected to ENABLE, and A0.1 also connected to ENABLE.

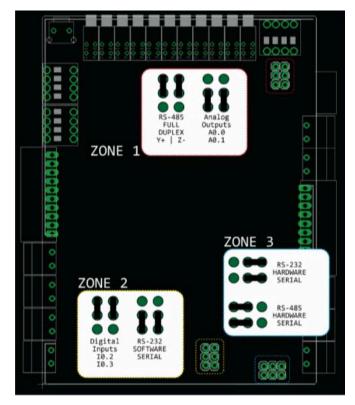
JUMPER ZONE 2		
LEFT RIGHT		
10.2	10.3	
D4 D8		
RS-232	RS232	

This jumper zone makes the choice between connecting the inputs Q0.9, Q0.8 to pins 4 and 8 of the Arduino Leonardo respectively, or connect the RS-232 ports to activate the Software Serial RS-232. In order to use the inputs Q0.9, Q0.8 the jumper must be connected to the pins 4 and 8. So Q0.9 must be connected with D4 and Q0.8 must be connected to D8.

JUMPER ZONE 3		
DOWN UP		
RS-485	RS-485	
D0	D1	
RS-232	RS-232	

This jumper makes the choice between connecting MAX232 to pins 0,1 of the Arduino Leonardo or with the MAX485. In order to use the RS-232 Hardware Serial protocol both RS-232 must be connected to the D1/D0. In order to use the RS-485 Hardware Serial protocol both RS-485 must be connected to the D1/D0.

*The jumpers that are not connected to the middle jumpers MUST NOT be Connected anywhere.



11. Hardware Serial RS-232 & RS-485 Configuration

11.1 004001001200 Analog Hardware Serial RS-485

In order to enable the Hardware Serial RS-485 the total configuration of the Ardbox Analog HF PLUS will be:

Switch configuration:

TOP ZC	DNE	LEFT ZO	NE
ACTIVATED SWITCH	MODE	ACTIVATED SWITCH	MODE
Q0.8	OFF	DE-RS485	ON
RS*	ON	DE-RS485	OFF
Q0.9	OFF	RE-RS485	ON
RS*	ON	RE-RS485	OFF
		SDA-PIN2 / 10.0	-
		SCL-PIN3 / Q0.6	-

Jumper configuration:

ZONE 1



ZONE 2



- Available communication protocols:
 - Hardware Serial RS-485.
 - I2C *If I2C is active I0.0 & Q0.6 are disabled
 - TTL (SoftwareSerial)
 - USB

11.2 004001001200 Analog Hardware Serial RS-232

In order to enable the Hardware Serial RS-232 the total configuration of the Ardbox Analog HF PLUS will be:

TOP ZC	DNE	LEFT ZONE	
ACTIVATED SWITCH	MODE	ACTIVATED SWITCH	MODE
Q0.8	OFF	10.8	OFF
RS*	ON	10.8	ON
Q0.9	OFF	10.9	OFF
RS*	ON	10.9	ON
		SDA-PIN2 / 10.0	-
		SCL-PIN3 / Q0.6	-

Switch configuration:

Note: The switches of the left zone of the RS-485 don't interfere in the RS-232 HS. As pins 0 & 1 are reserved for the RS-232, the RS-485 is totally disabled and there is no point on configuring these switches as RS-485 mode

Jumper configuration:





- Available communication protocols:
 - Hardware Serial RS-232.
 - I2C *If I2C is active I0.0 & Q0.6 are disabled
 - o TTL
 - USB

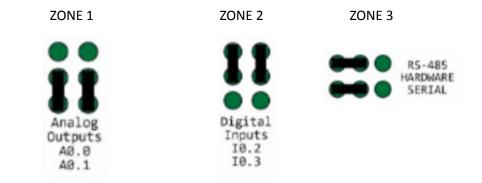
11.3 004001001300 Relay Hardware Serial RS-485

In order to enable the Hardware Serial RS-485 the total configuration of the Ardbox Relay HF PLUS will be:

Switch configuration:

TOP ZC	P ZONE LEFT ZONE		
ACTIVATED SWITCH	MODE	ACTIVATED SWITCH	MODE
RS*	ON	NC	-
R8	OFF	HD / FD	ON - OFF
RS*	ON	R5 / PIN3-SCL	-
R7	OFF	10.0 / PIN2-SDA	-
		RE-RS485	ON
		RE-RS485	OFF
		DE-RS485	ON
		DE-RS485	OFF

Jumper configuration:



- Available communication protocols:
 - Hardware Serial RS-485.
 - I2C *If I2C is active I0.0 & Q0.6 are disabled
 - TTL
 - USB

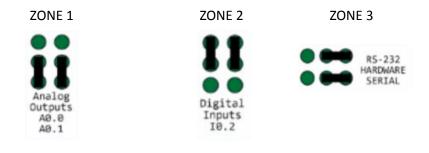
11.4 004001001300 Relay Hardware Serial RS-232

In order to enable the Hardware Serial RS-232 the total configuration of the Ardbox Relay HF PLUS will be:

Switch configuration:

TOP ZONE		LEFT ZONE	
ACTIVATED SWITCH	MODE	ACTIVATED SWITCH	MODE
RS*	ON	NC	-
R8	OFF	HD / FD	ON - OFF
RS*	ON	R5 / PIN3-SCL	-
R7	OFF	10.0 / PIN2-SDA -	
		10.4	OFF
		10.4	ON
		10.5	OFF
		10.5	ON

Jumper configuration:



- Available communication protocols:
 - Hardware Serial RS-232.
 - I2C *If I2C is active I0.0 & Q0.6 are disabled
 - TTL
 - USB

12. Ardbox - Arduino I/Os 5V pins

The Ardbox has some of the Leonardo board pins available. This pin can be programmed according to Arduino features such as I/Os operating at 5V. As the pin is directly connected to the Arduino Leonardo board they are not as well protected as the normal inputs. The pin is mainly meant to be used as prototyping.

Ardbox terminal	Arduino pin
SCL - PIN3	3
SDA - PIN2	2

***IMPORTANT:** Do not connect the pin in the chart above to voltages higher than 5V. This terminal provides direct access to the Leonardo board.

12.1 I2C pins – SDA/SCL

The I2C protocol is meant to work in a pull-up configuration. The I2C pins in the Arduino Leonardo are not pull-up, so in order to work with the I2C an external pull-up resistor is required. If it is meant to work as a GPIO at 5V, the switches must be set as I2C, (section 8).

These pins are not established with a pull-up or a pull-down configuration. The state of these pins is unknown. If these pins must be used they require a pull-up or a pull-down configuration. The Arduino board allows the pins to be set in a pull-up configuration. If not it must be established as an external pull-up or pull-down circuit in order to correctly work with these pins.

12.2 Pin 2/Pin 3

These pins are only referred to the input I0.0 and output Q0.6 for the Analog model and inputs I0.0 and R5 for the Relay model. If the switch configuration is in OFF position the pins Pin 2/Pin 3 will be available.

These pins are not established with a pull-up or a pull-down configuration. The state of these pins is unknown. If these pins must be used, they require a pull-up or a pull-down configuration. The Arduino board allows the pins to be set in a pull-up configuration. If not it must be established as an external pull-up or pull-down circuit in order to correctly work with these pins.

13. DALI Programming Examples

13.1 How to work with DALI

DALI, or Digital Addressable Lighting Interface, is a dedicated protocol for digital lighting control that enables the easy installation of robust, scalable and flexible lighting networks. Find how to work with DALI <u>here</u>⁶.

In the examples the communication with an M-Duino DALI PLC is shown, but the process is identical with the Ardbox models. Select the correct Ardbox board in the Arduino IDE while doing any tutorial.

14. Digital inputs threshold detection

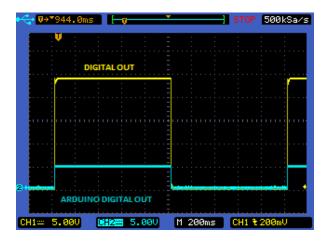
The Ardbox inputs have a minimum voltage threshold to reliably detect the signal when used as digital input. The threshold value is different depending on the input type:

Input type	Threshold voltage (V)
Digital input	3.7
Analog input	3.3

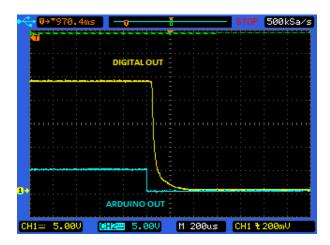
⁶https://www.industrialshields.com/blog/arduino-industrial-1/post/how-to-work-with-dali-arduino-library-and-an-industrial-plc-22 1

15. I/O technical details

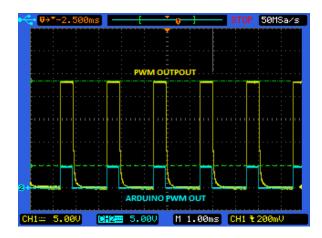
Digital Output Waveform



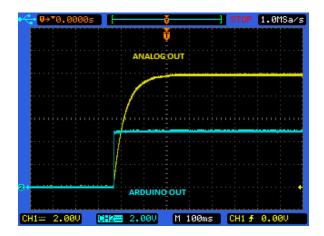
Digital Output Turn-off



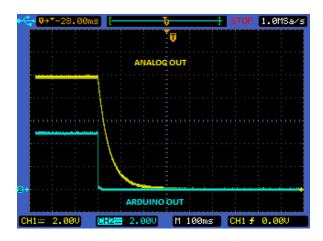
PWM Waveform



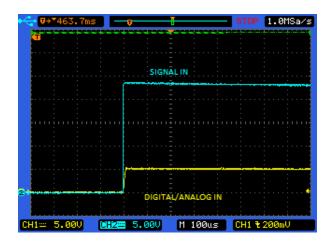
Analog Out Turn-on



Analog Out Turn-off



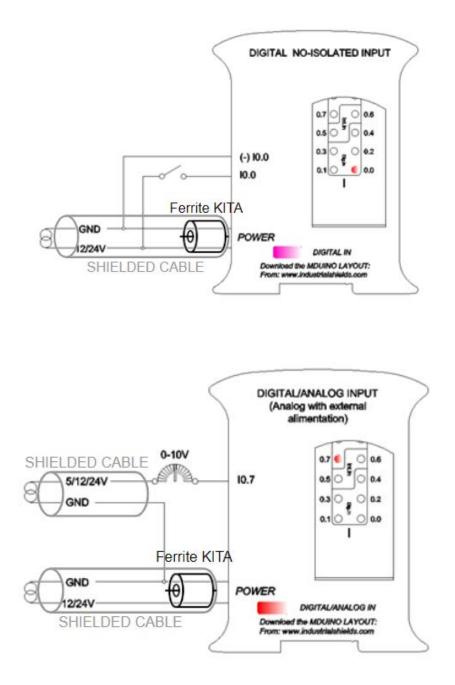
Analog/Digital Input Turn-on

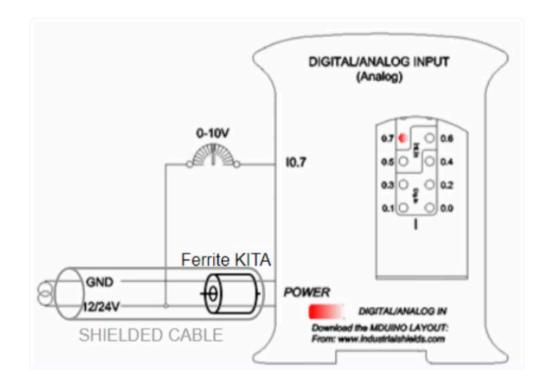


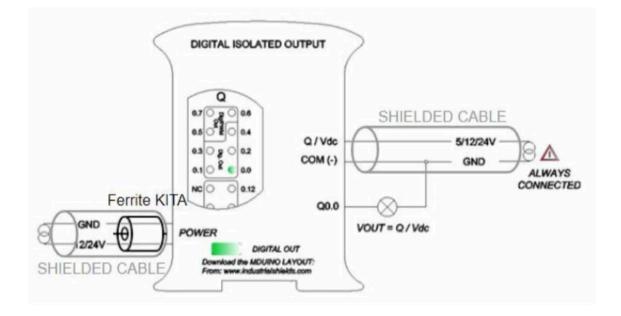
Analog/Digital Input Turn-off

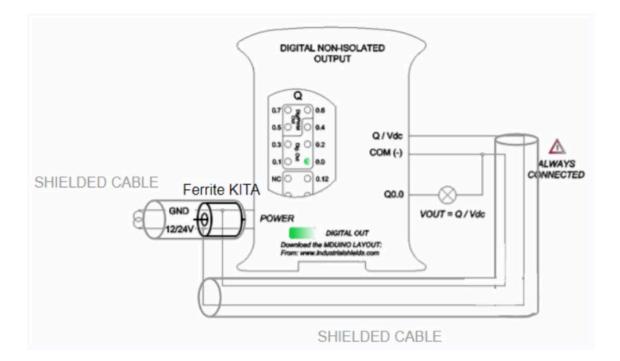
•😋 ♥→▼329.6ms		vī —	STOP 20	0kSa/s
Si	IGNAL IN			
2.			: :	
	/DIGITAL IN			
CH1== 2.00V	0:2: 5.00V	M 10.0ms	СН1 ƒ 0.	00V

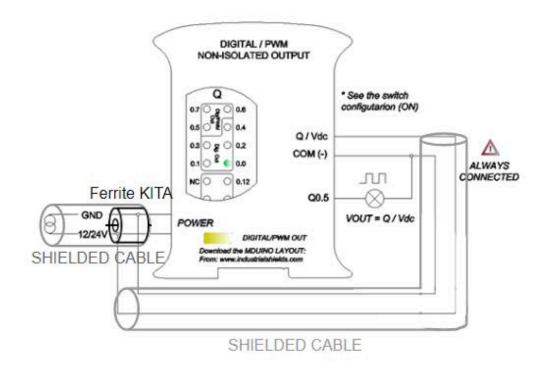
16. Typical Connections

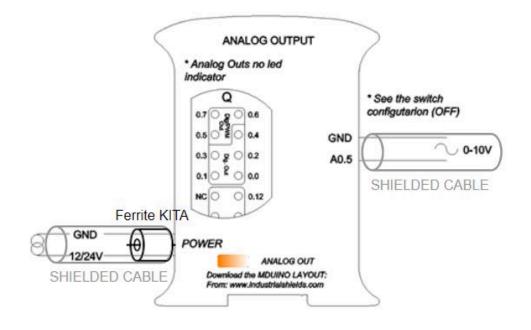












17. Connector details

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:

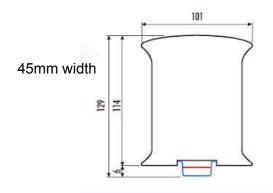
Article reference	MC 0,5/10-G-2,5 THT
Height	8,1mm
Pitch	2,5mm
Dimension	22,5mm
Pin dimensions	0,8x0,8mm
Pin spacing	2,50mm



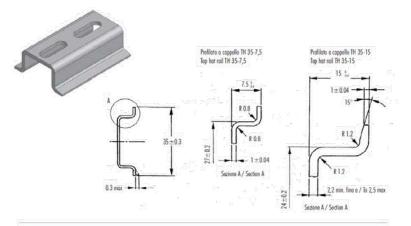
Article reference	FK-MC 0,5/10-ST-2,5	
Rigid conduit section min.	0,14 mm²	
Rigid conduit section max.	0,5 mm²	
Flexible conduit section min.	0,14 mm²	
Flexible conduit section max.	0,5 mm²	
Conduit section AWG/kcmil min. 26		
Conduit section AWG/kcmil max.	20	



18. ARDBOX Family Dimensions



- DIN rail mounting:



CARATTERISTIC	HE	METODO	UNITA' DI MISURA	BLEND PC/ABS
Meccaniche	Resistenza a trazione alla svervamenta	ASTM D638	MPo	68
	Residence a tracione a ratura	ASTM D638	NPo	- 48
	Allungaments a ratium	ASTM D638	*	59
	Modulo in Bessione	ASTM 0790	MPg	2894
	Provo land con integlio	50 180/14	XVm	5.5
Termiche	Temp di connollimento Vicot, metado B	ASTM D1525	×	114
	Temperatura Ricarto 1.81 MPa	ASTM D648	2	- 97
Fisiche	Pos perfig	ASTM 0792	ar/m3	121
	Ritio nello storgo	ASTM 0955	%	0.4/0.6
	Melt Flow Index 260°C - 98N	ASTM 01238	01/10/	11.1
Comportamento	Autordinguenzo (mm di spesce)	U.94		¥-0(0.5)
alla fiamma	File Incordecen, 3.2 mm	EG695.2.1	1	960

Italitanic si riserva il divitto di modificato il motoriale can cui realizza i propri prodotti sanza obbligo di prezvisa.

FEATURES		TEST METHOD	UNITS	BLEND PC/ABS
Mechanical test	Resistance to tensile stress of yield	ASTM 0.638	MPt	68
	knole strength	ASTM 0-638	期行	48
	Utimante elongation	ASTIN 0.638	96	59
	Reving modulus	ASTM 0.790	MPg	2894
	lead test outcled	150 180/14	Xim	55
Thermal test	Vict softening temperature method 8 -	ASTM 01525	1	114
	Robecting temperature 1.81 MPg	ASTIM 0.648	8	- 97
Physical test	South anyly -	ASTM 0792	er/m3	1.21
	Mould shrinkape	ASTM 0955	16	0.40.6
	Melt Flow Index 260°C - 99N	ASTN 01238	. 0/10	11.1
Flame test	Self extinguisher (thickness in mm)	UL94	*	V-0(0.8)
	Improdescente thread 3.2 mm	IEC69521	°C .	960

Italitanic can operate any change of the materials without being obligad to forewarm.

19. Installation and Maintenance

Notes for installation:

- The installation position should be free from the following: dust or oil smoke, conductive dust, corrosive or flammable gas, high temperature, condensation, and rain.
- Besides, vibration and impact also affect the PLC normal operation and shorten its lifespan; electric shock, fire or misact also damages the product. During drilling or wiring, prevent the metal particles or wire segments from falling into the PLC casing, which may cause fire, fault or misact.
- After the PLC installation, clean the ventilation duct to prevent blocking, which may cause bad ventilation, or even fire, faults or misact.
- Do not online connect, plug or unplug cables, which are apt to cause electric shock or damage the circuit. Installation and wire connection must be firm and reliable. Poor connection could cause a misact.
- Use shielded twisted pairs for the I/O of high frequency signal and analog signal to improve system IMS.

The installation environment should be free from dust, oil smoke, conductive particles, corrosive or flammable gases, high temperature, condensation, and rain.

Besides, vibration and impact also affect the PLC normal operation and shorten its lifespan. It is recommended to install the PLC, together with the matching switches and contactors, in a dedicated electric cabinet and keep the cabinet ventilated. If the location has high ambient temperature or heat generating equipment nearby, install forced convection devices on top or sides of the cabinet to avoid over-temperature. During drilling or wiring, prevent the metal particles or wire segments from falling into the PLC casing, which may cause fire, fault or misact. After the PLC installation, clean the ventilation duct to prevent blocking, which may cause bad ventilation, or even fire, faults or misact.

The only way to disconnect the equipment from the electrical network is by removing the connectors that feed the equipment. Once installed in the electrical cabinet it is very important to ensure the power connectors for proper operation.

Separate the ARDBOX 20 I/Os Family HF PLUS from heat, high voltage and electrical noise:

Always separate the devices that generate high voltage and high electrical noise from the ARDBOX 20 I/Os Family HF PLUS. When configuring the layout of the ARDBOX 20 I/Os Family HF PLUS inside your panel, consider the heat-generating devices and locate the electronic-type devices in the cooler areas of your cabinet. Reducing the exposure to a high-temperature environment will extend the operating life of any electronic device. Consider also the routing of the wiring for the devices in the electric cabinet. Avoid placing low-voltage signal wires and communications cables in the same tray with AC power wiring and high energy, rapidly-switched DC wiring.

Provide adequate clearance for cooling and wiring ARDBOX 20 I/Os Family HF PLUS. Is designed for natural convection cooling. For proper cooling, you must provide a clearance of at least 25cm above and below the devices. Also, allow at least 25cm of depth between the front of the modules and the inside of the enclosure.

Notes for maintenance:

A well-planned and executed maintenance program is essential to the satisfactory operation of solid-state electrical equipment. The kind and frequency of the maintenance operation will vary with the kind and complexity of the equipment as well as with the nature of the operating conditions. Maintenance recommendations of the manufacturer or appropriate product standards should be followed.

The following factors should be considered when formulating a maintenance program:

- Maintenance must be performed by qualified personnel familiar with the construction, operation, and hazards involved with the control.
- Maintenance should be performed with the control out of operation and disconnected from all sources of power.
- Care should be taken when servicing electrostatic sensitive components. The manufacturer's recommendations for these components should be followed.
- Ventilation passages should be kept open. If the equipment depends upon auxiliary cooling, e.g., air, water, or oil, periodic inspection (with filter replacement when necessary) should be made of these systems.
- The means employed for grounding or insulating the equipment from ground should be checked to assure its integrity.
- Accumulations of dust and dirt on all parts, including on semiconductor heat sinks, should be removed according to the manufacturer's instructions, if provided; otherwise, the manufacturer should be consulted. Care must be taken to avoid damaging any delicate components and to avoid displacing dust, dirt, or debris in a way that permits it to enter or settle into parts of the control equipment.
- Enclosures should be inspected for evidence of deterioration. Accumulated dust and dirt should be removed from the top of the enclosures before opening doors or removing covers.
- Certain hazardous materials removed as part of maintenance or repair procedure (e.g., polychlorinated biphenyls (PCBs) found in some liquid filled capacitors) must be disposed of as described in Federal regulations.

Safety rules for maintenance personnel

Consider the following steps to follow. A false manoeuvre could be the cause of an accident or material damage.

Do not disassemble or modify the modules. This could lead to breakdowns or malfunctions and could lead to injuries or fire.

- All types of radio communication devices, including mobile phones and personal handy-phone systems (PHS), must be kept more than **25cm** away from the PLC in all directions. Failure to observe this precaution exposes malfunctions caused by excess temperature.

- Disconnect the external power supply of the system (on all phases) before connecting or disconnecting a module. Failure to observe this precaution may cause faults or malfunctions of the module.

- Tighten the screws of the terminal ports and the screws of the connectors within the prescribed tightening torque. Insufficient tightening can lead to loose parts or wires and cause malfunctions. Excessive tightening can damage the screws and / or the module, with the risk of falling, short circuits and malfunctions.

- Before handling a module, dispose of the electrostatic charge accumulated by the human body by touching a suitable conductive object. Failure to observe this precaution may cause faults or malfunctions of the module.

Repair note:

If the equipment is suitable to be repaired, it must be verified that the equipment remains in a safe state after repair.

20. Revision Table

Revision Number	Date	Changes
0	30/08/2019	First implementation
1	04/03/2020	Second implementation
2	08/06/2023	Family Implementation
3	11/03/2024	Added section 14 "Digital inputs threshold detection"
4	13/03/2024	RS* Switches Revision
5	21/03/2024	Section 8.2 Digital inputs fix
6	26/09/2024	Added section 3.4 ("Isolation Precautions")

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