CNC 8060 8065

Remote modules

(Ref: 1402)

FAGOR AUTOMATION

MACHINE SAFETY

It is up to the machine manufacturer to make sure that the safety of the machine is enabled in order to prevent personal injury and damage to the CNC or to the products connected to it. On start-up and while validating CNC parameters, it checks the status of the following safety elements. If any of them is disabled, the CNC shows a warning message.

- Feedback alarm for analog axes.
- Software limits for analog and sercos linear axes.
- Following error monitoring for analog and sercos axes (except the spindle) both at the CNC and at the drives.
- Tendency test on analog axes.

FAGOR AUTOMATION shall not be held responsible for any personal injuries or physical damage caused or suffered by the CNC resulting from any of the safety elements being disabled.

HARDWARE EXPANSIONS

FAGOR AUTOMATION shall not be held responsible for any personal injuries or physical damage caused or suffered by the CNC resulting from any hardware manipulation by personnel unauthorized by Fagor Automation.

If the CNC hardware is modified by personnel unauthorized by Fagor Automation, it will no longer be under warranty.

COMPUTER VIRUSES

FAGOR AUTOMATION guarantees that the software installed contains no computer viruses. It is up to the user to keep the unit virus free in order to guarantee its proper operation.

Computer viruses at the CNC may cause it to malfunction. An antivirus software is highly recommended if the CNC is connected directly to another PC, it is part of a computer network or floppy disks or other computer media is used to transmit data.

FAGOR AUTOMATION shall not be held responsible for any personal injuries or physical damage caused or suffered by the CNC due a computer virus in the system.

If a computer virus is found in the system, the unit will no longer be under warranty.

All rights reserved. No part of this documentation may be transmitted, transcribed, stored in a backup device or translated into another language without Fagor Automation's consent. Unauthorized copying or distributing of this software is prohibited.

The information described in this manual may be changed due to technical modifications. Fagor Automation reserves the right to make any changes to the contents of this manual without prior notice.

All the trade marks appearing in the manual belong to the corresponding owners. The use of these marks by third parties for their own purpose could violate the rights of the owners.

It is possible that CNC can execute more functions than those described in its associated documentation; however, Fagor Automation does not guarantee the validity of those applications. Therefore, except under the express permission from Fagor Automation, any CNC application that is not described in the documentation must be considered as "impossible". In any case, Fagor Automation shall not be held responsible for any personal injuries or physical damage caused or suffered by the CNC if it is used in any way other than as explained in the related documentation.

The content of this manual and its validity for the product described here has been verified. Even so, involuntary errors are possible, thus no absolute match is guaranteed. Anyway, the contents of the manual is periodically checked making and including the necessary corrections in a future edition. We appreciate your suggestions for improvement.

The examples described in this manual are for learning purposes. Before using them in industrial applications, they must be properly adapted making sure that the safety regulations are fully met.

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ABOUT THE PRODUCT

BASIC CHARACTERISTICS.

Remote modules.	RIOW	RIO5	RIO70	RCS-S
Communication with the remote modules.	CANopen	CANopen	CANfagor	Sercos
Digital inputs per module.	8	16 / 32	16	- - -
Digital outputs per module.	8	24 / 48	16	- - -
Analog inputs per module.	4	4	8	- - -
Analog outputs per module.	4	4	4	4
Inputs for PT100 temperature sensors.	2	2	- - -	- - -
Feedback inputs.	- - -	- - -	4 (*)	4 (**)

(*) Differential TTL / Sinusoidal 1 Vpp (**) TTL / Differential TTL / Sinusoidal 1 Vpp / SSI protocol

DECLARATION OF CONFORMITY

The manufacturer:

Fagor Automation S. Coop.

Barrio de San Andrés Nº 19, C.P.20500, Mondragón -Guipúzcoa- (Spain).

Declares:

The manufacturer declares under their exclusive responsibility the conformity of the product:

8060 CNC

Consisting of the following modules and accessories:

CN60-10H, CN60-10HT, CN60-10V, CN60-10VT
OP-PANEL, OP-PANEL+SPDL RATE
Remote Modules RIOW, RIO5, RIO70, RCS-S, RIOR.

Note. Some additional characters may follow the model references indicated above. They all comply with the directives listed here. However, compliance may be verified on the label of the unit itself.

Referred to by this declaration with following directives:

Low-voltage regulations.

IEC 60204-1:2005/A1:2008 Electrical equipment on machines. Part1. General requirements.

Regulation on electromagnetic compatibility.

EN 61131-2: 2007 PLC. Part 2. Equipment requirements and tests.

According to the European Community Directives 2006/95/EC on Low Voltage and 2004/108/EC on Electromagnetic Compatibility and their updates.

In Mondragón, February 1st, 2014.

Fagor Automation, S. Coop.

Director Gerente
Pedro Ruiz de Aguirre

DECLARATION OF CONFORMITY

The manufacturer:

Fagor Automation S. Coop.

Barrio de San Andrés Nº 19, C.P.20500, Mondragón -Guipúzcoa- (Spain).

Declares:

The manufacturer declares under their exclusive responsibility the conformity of the product:

8065 CNC

Consisting of the following modules and accessories:

8065-M-ICU, 8065-T-ICU
MONITOR-LCD-10K, MONITOR-LCD-15, MONITOR-SVGA-15
HORIZONTAL-KEYB, VERTICAL-KEYB, OP-PANEL
BATTERY
Remote Modules RIOW, RIO5, RIO70, RCS-S.

Note. Some additional characters may follow the model references indicated above. They all comply with the directives listed here. However, compliance may be verified on the label of the unit itself.

Referred to by this declaration with following directives:

Low-voltage regulations.

IEC 60204-1:2005/A1:2008 Electrical equipment on machines. Part1. General requirements.

Regulation on electromagnetic compatibility.

EN 61131-2: 2007 PLC. Part 2. Equipment requirements and tests.

According to the European Community Directives 2006/95/EC on Low Voltage and 2004/108/EC on Electromagnetic Compatibility and their updates.

In Mondragón, September 1st, 2013.

Fagor Automation, S. Coop.

Director Gerente
Pedro Ruiz de Aguirre

VERSION HISTORY

Here is a list of the features added to each manual reference.

Ref. 1402

First version.

SAFETY CONDITIONS

Read the following safety measures in order to prevent harming people or damage to this product and those products connected to it. Fagor Automation shall not be held responsible of any physical damage or defective unit resulting from not complying with these basic safety regulations.

Before start-up, verify that the machine that integrates this CNC meets the 89/392/CEE Directive.

PRECAUTIONS BEFORE CLEANING THE UNIT

If the CNC does not turn on when actuating the start-up switch, verify the connections.

Do not get into the inside of the unit.	Only personnel authorized by Fagor Automation may manipulate the inside of this unit.
Do not handle the connectors with the unit connected to AC power.	Before manipulating the connectors (inputs/outputs, feedback, etc.) make sure that the unit is not connected to AC power.

PRECAUTIONS DURING REPAIR

In case of a malfunction or failure, disconnect it and call the technical service.

Do not get into the inside of the unit.	Only personnel authorized by Fagor Automation may manipulate the inside of this unit.
Do not handle the connectors with the unit connected to AC power.	Before manipulating the connectors (inputs/outputs, feedback, etc.) make sure that the unit is not connected to AC power.

PRECAUTIONS AGAINST PERSONAL DAMAGE

Interconnection of modules.	Use the connection cables provided with the unit.
Use proper cables.	To prevent risks, use the proper cables for mains, Sercos and Bus CAN recommended for this unit. In order to avoid electrical shock at the central unit, use the proper power (mains) cable. Use 3-wire power cables (one for ground connection).
Avoid electrical overloads.	In order to avoid electrical discharges and fire hazards, do not apply electrical voltage outside the range selected on the rear panel of the central unit.
Ground connection.	In order to avoid electrical discharges, connect the ground terminals of all the modules to the main ground terminal. Before connecting the inputs and outputs of this unit, make sure that all the grounding connections are properly made. In order to avoid electrical shock, before turning the unit on verify that the ground connection is properly made.
Do not work in humid environments.	In order to avoid electrical discharges, always work under 90% of relative humidity (non-condensing) and 50 ºC (122 ºF).
Do not work in explosive environments.	In order to avoid risks or damages, do no work in explosive environments.

PRECAUTIONS AGAINST PRODUCT DAMAGE

Working environment.

This unit is ready to be used in industrial environments complying with the directives and regulations effective in the European Community.

Fagor Automation shall not be held responsible for any damage suffered or caused by the CNC when installed in other environments (residential or homes).

Install the unit in the right place.

It is recommended, whenever possible, to install the CNC away from coolants, chemical product, blows, etc. that could damage it.

This unit complies with the European directives on electromagnetic compatibility. Nevertheless, it is recommended to keep it away from sources of electromagnetic disturbance such as:

- Powerful loads connected to the same AC power line as this equipment.
- Nearby portable transmitters (Radio-telephones, Ham radio transmitters).
- Nearby radio/TV transmitters.
- Nearby arc welding machines.
- Nearby High Voltage power lines.

Enclosures.

The manufacturer is responsible of assuring that the enclosure involving the equipment meets all the currently effective directives of the European Community.

Avoid disturbances coming from the machine.

The machine must have all the interference generating elements (relay coils, contactors, motors, etc.) uncoupled.

Use the proper power supply.

Use an external regulated 24 Vdc power supply for the keyboard and the remote modules.

Grounding of the power supply.

The zero volt point of the external power supply must be connected to the main ground point of the machine.

Analog inputs and outputs connection.

Use shielded cables connecting all their meshes to the corresponding pin.

Ambient conditions.

The storage temperature must be between +5 ºC and +55 ºC (41 ºF and 131 ºF).

The storage temperature must be between -25 ºC and 70 ºC (-13 ºF and 158 ºF).

Central unit enclosure.

Make sure that the needed gap is kept between the central unit and each wall of the enclosure.

Use a DC fan to improve enclosure ventilation.

Main AC power switch.

This switch must be easy to access and at a distance between 0.7 and 1.7 m (2.3 and 5.6 ft) off the floor.

PROTECTIONS OF THE UNIT ITSELF

Remote modules.

All the digital inputs and outputs have galvanic isolation via optocouplers between the CNC circuitry and the outside.

SAFETY SYMBOLS

Symbols that may appear on the manual.



Danger or prohibition symbol.
It indicates actions or operations that may hurt people or damage products.



Warning symbol.
It indicates situations that certain operations could cause and the suggested actions to prevent them.



Obligation symbol.
It indicates actions and operations that must be carried out.



Information symbol.
It indicates notes, warnings and advises.

Symbols that the product may carry.



Ground protection symbol.
It indicates that that point must be under voltage.

WARRANTY TERMS

INITIAL WARRANTY

All products manufactured or marketed by FAGOR carry a 12-month warranty for the end user which could be controlled by the our service network by means of the warranty control system established by FAGOR for this purpose.

In order to prevent the possibility of having the time period from the time a product leaves our warehouse until the end user actually receives it run against this 12-month warranty, FAGOR has set up a warranty control system based on having the manufacturer or agent inform FAGOR of the destination, identification and on-machine installation date, by filling out the document accompanying each FAGOR product in the warranty envelope. This system, besides assuring a full year of warranty to the end user, enables our service network to know about FAGOR equipment coming from other countries into their area of responsibility.

The warranty starting date will be the one appearing as the installation date on the above mentioned document. FAGOR offers the manufacturer or agent 12 months to sell and install the product. This means that the warranty starting date may be up to one year after the product has left our warehouse so long as the warranty control sheet has been sent back to us. This translates into the extension of warranty period to two years since the product left our warehouse. If this sheet has not been sent to us, the warranty period ends 15 months from when the product left our warehouse.

This warranty covers all costs of material and labour involved in repairs at FAGOR carried out to correct malfunctions in the equipment. FAGOR undertakes to repair or replace their products within the period from the moment manufacture begins until 8 years after the date on which it disappears from the catalogue.

It is entirely up to FAGOR to determine whether the repair is or not under warranty.

EXCLUDING CLAUSES

Repairs will be carried out on our premises. Therefore, all expenses incurred as a result of trips made by technical personnel to carry out equipment repairs, despite these being within the above-mentioned period of warranty, are not covered by the warranty.

Said warranty will be applied whenever the equipment has been installed in accordance with instructions, has not be mistreated, has not been damaged by accident or by negligence and has not been tampered with by personnel not authorised by FAGOR. If, once servicing or repairs have been made, the cause of the malfunction cannot be attributed to said elements, the customer is obliged to cover the expenses incurred, in accordance with the tariffs in force.

Other warranties, implicit or explicit, are not covered and FAGOR AUTOMATION cannot be held responsible for other damages which may occur.

WARRANTY ON REPAIRS

In a similar way to the initial warranty, FAGOR offers a warranty on standard repairs according to the following conditions:

PERIOD	12 months.
CONCEPT	Covers parts and labor for repairs (or replacements) at the network's own facilities.
EXCLUDING CLAUSES	The same as those applied regarding the chapter on initial warranty. If the repair is carried out within the warranty period, the warranty extension has no effect.

When the customer does not choose the standard repair and just the faulty material has been replaced, the warranty will cover just the replaced parts or components within 12 months.

For sold parts the warranty is 12 moths length.

SERVICE CONTRACTS

The SERVICE CONTRACT is available for the distributor or manufacturer who buys and installs our CNC systems.

MATERIAL RETURNING TERMS

When sending the central nit or the remote modules, pack them in its original package and packaging material. If the original packaging material is not available, pack it as follows:

1. Get a cardboard box whose three inside dimensions are at least 15 cm (6 inches) larger than those of the unit. The cardboard being used to make the box must have a resistance of 170 Kg (375 lb.).
2. Attach a label indicating the owner of the unit, person to contact, type of unit and serial number. In case of malfunction also indicate symptom and a brief description of the problem.
3. Wrap the unit in a polyethylene roll or similar material to protect it. When sending a central unit with monitor, protect especially the screen.
4. Pad the unit inside the cardboard box with poly-utherane foam on all sides.
5. Seal the cardboard box with packing tape or industrial staples.

CNC MAINTENANCE

CLEANING

The accumulated dirt inside the unit may act as a screen preventing the proper dissipation of the heat generated by the internal circuitry which could result in a harmful overheating of the unit and, consequently, possible malfunctions. Accumulated dirt can sometimes act as an electrical conductor and short-circuit the internal circuitry, especially under high humidity conditions.

To clean the operator panel and the monitor, a smooth cloth should be used which has been dipped into de-ionized water and /or non abrasive dish-washer soap (liquid, never powder) or 75º alcohol. Do not use highly compressed air to clean the unit because it could generate electrostatic discharges.

The plastics used on the front panel are resistant to grease and mineral oils, bases and bleach, dissolved detergents and alcohol. Avoid the action of solvents such as chlorine hydrocarbons, venzole, esters and ether which can damage the plastics used to make the unit's front panel.

PRECAUTIONS BEFORE CLEANING THE UNIT

Fagor Automation shall not be held responsible for any material or physical damage derived from the violation of these basic safety requirements.

- Do not handle the connectors with the unit connected to AC power. Before handling these connectors (I/O, feedback, etc.), make sure that the unit is not connected to main AC power.
- Do not get into the inside of the unit. Only personnel authorized by Fagor Automation may manipulate the inside of this unit.
- If the CNC does not turn on when actuating the start-up switch, verify the connections.

1 PREVIOUS INFORMATION.

About this manual.

This manual describes the characteristics, technical data and connections of the remote modules. The characteristics, technical data and connections of the CNC hardware are described in its own manual. The installation manual describes the CNC configuration, machine adaptation and start-up. The installation CD that comes with the unit has the necessary documentation to install, set up and operate the unit.

Installation and startup.

The hardware described in this manual is ready to be used in industrial environments complying with the directives and regulations effective in the European Community. Before start-up, verify that the machine that integrates this CNC meets the 89/392/CEE directive.

Safety conditions.

In order to avoid personal injuries and damage to this product or to those connected to it, read carefully the section on safety conditions in the introduction to this manual. Fagor Automation shall not be held responsible of any physical damage or defective unit resulting from not complying with these basic safety regulations.



Do not handle the connectors with the unit connected to AC power. Before doing it, make sure that the unit is unplugged from the power outlet.

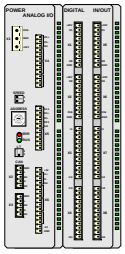
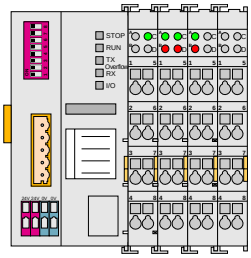
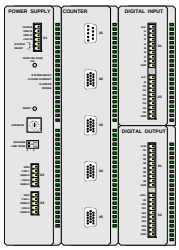


Do not get into the inside of the unit. This unit MUST NOT be opened by unauthorized personnel. Only personnel authorized by Fagor Automation may manipulate the inside of this unit.

2 HARDWARE STRUCTURE.

Remote modules may be used to have an additional number of digital and analog inputs and outputs (remote I/O) that, distributed at different points of the machine or mounted in the cabinet, permit controlling various devices of the machine. The remote modules are distributed by groups (nodes) and are connected to the central unit through the CAN bus (RIO5, RIO70 or RIOW) or of the Sercos bus (RCS-S).

The CNC has remote modules for CANfagor bus (RIO70 series) and for CANopen bus (series RIO5 and RIOW) When the CNC works with CANopen bus, this bus lets combine in the bus groups (nodes) formed by RIO5 and RIOW series modules; modules of both series cannot be combined in the same group.

Identification.	Description.
	**RIO5 modules (CANopen protocol).** • Digital inputs and outputs. • General purpose analog inputs and outputs. • Analog inputs for PT100 temperature sensors.
	**RIOW modules (CANopen protocol).** • Digital inputs and outputs. • General purpose analog inputs and outputs. • Analog inputs for PT100 temperature sensors.
	**RIO70 modules (CANfagor protocol).** • Digital inputs and outputs. • General purpose analog inputs and outputs. • Feedback inputs.
	**RCS-S module (Sercos protocol).** • Feedback inputs. • Analog outputs.

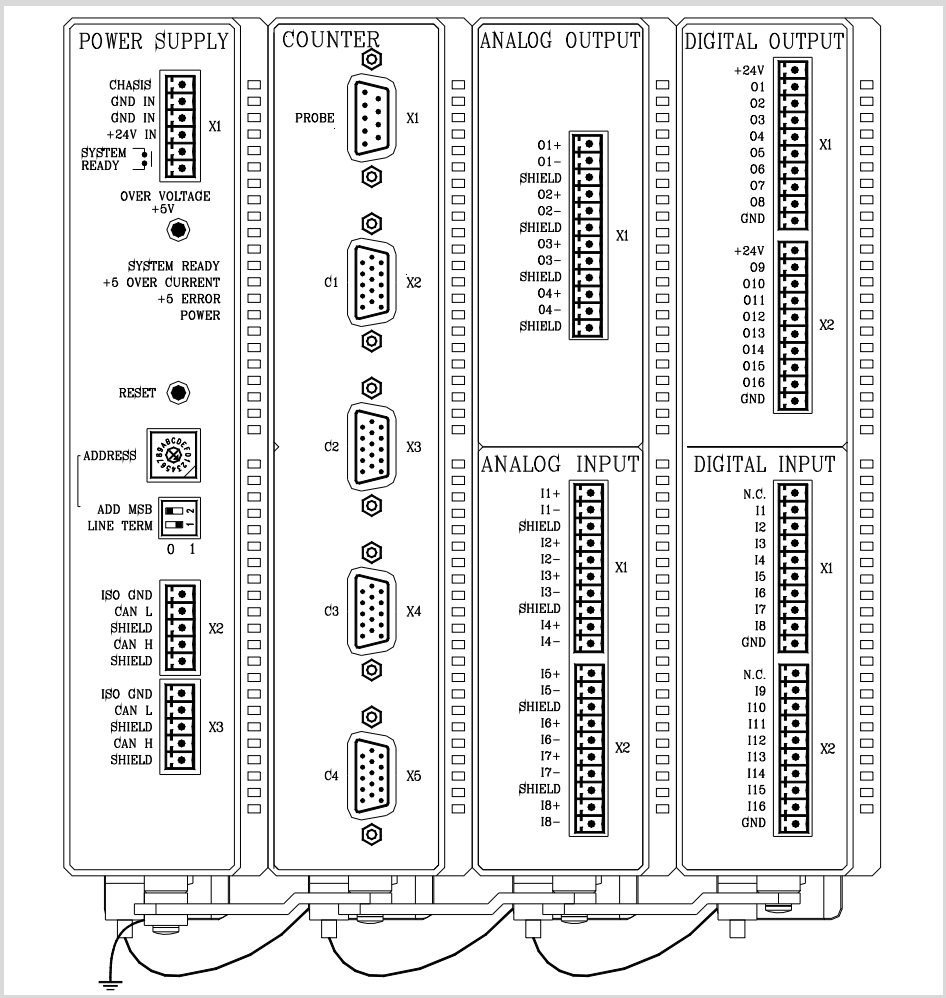
3 RIO70 REMOTE MODULES. (CANFAGOR PROTOCOL).

Remote modules may be used to have an additional number of digital and analog inputs and outputs (remote I/O) that, distributed at different points of the machine or mounted in the cabinet, permit controlling various devices of the machine. The remote modules are distributed by groups (nodes) and are connected to the central unit through the CAN bus that can have up to 32 nodes, including the central unit and the keyboards. The following elements may be available with RIO70 series modules.

Type of input/output	Amount.
Digital inputs.	1024
Digital outputs.	1024
General purpose analog inputs.	60
Analog outputs.	40
Feedback inputs.	40

Fagor remote modules, RIO70 series, available for CAN bus with CANfagor protocol.

There are full-size modules (those occupying the whole box) and half-size modules (occupying half the box). Two half-size modules may be mounted in a box. Each group may have up to 5 complete modules depending on consumption. See *"3.2 Consumption of the remote modules"* on page 29.



Fagor supplies all types of possible combinations with half-size modules, even units with a single half-size module (the other half will be a cover). The available modules are the following.

- Power supply.

  The power supply module must be present in each group. This module must be powered at 24 V DC and connected to the system CAN bus.
- Feedback inputs.

  Each module has 4 feedback inputs.
- Digital inputs. Half size.

  Each module has 16 digital inputs.
- Digital outputs. Half size.

  Each module has 16 digital outputs.
- Analog inputs. Half size.

  Each module has 8 analog inputs.
- Analog outputs. Half size.

  Each module has 4 analog outputs.

Protection and power supply of the modules.

Class III safety protection unit, DCVA that must be powered with a SELV power supply.

Probe connection.

The digital inputs let you handle the signal of the two 24 V DC probes . Use machine parameters to define which digital input is associated with each probe and their type of pulse.

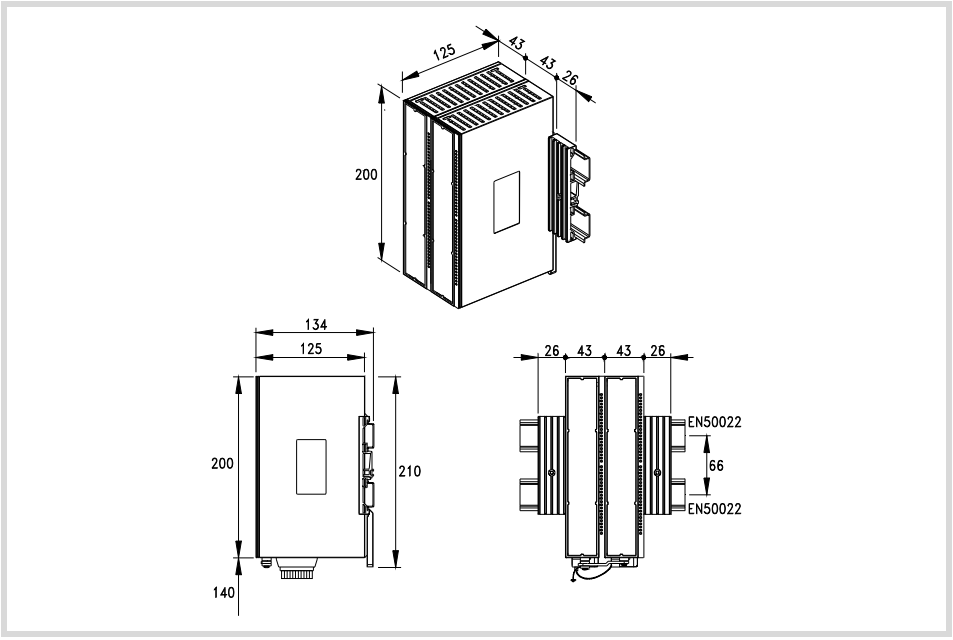
3.1 Dimensions and mounting of the modules.

Place the modules on 2 profiles, according to the UNE 50022 standard, with 2 securing ends, one at each end of the group; they help securing the modules besides maintaining the right gap between the profiles. The mounting order to be followed from left to right is:

- Power Supply.
- Counters.
- Analog outputs. Half size.
- Analog inputs. Half size.
- Digital outputs. Half size.
- Digital inputs. Half size.

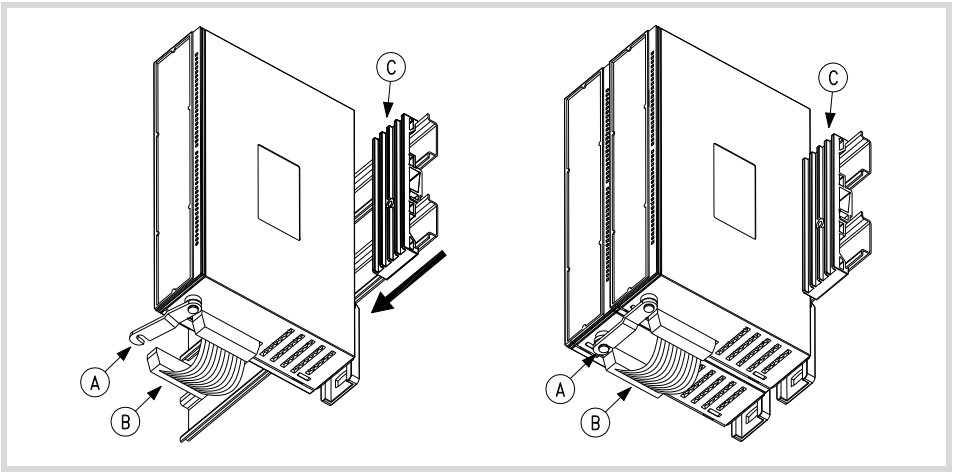
Dimensions of the modules.

Always leave a 140 mm gap under the modules for ventilation and later handling.



Connection of the modules.

The modules of the group are connected as follows:



A For ground connection.

B Ribbon cable to interconnect the modules.

C Securing ends.

Each group is connected to the system (CPU, Keyboard, etc.) through the CAN bus as described later on.

DO NOT make any connection or connect any module to the power supply while the latter is turned on. Before making any connection, ribbon cable included, turn the power supply off by unplugging the power cable.

3.2 Consumption of the remote modules

The power supply is in charge of supplying to the rest of the modules through +5 V and ±18 V and managing the internal bus of the group. The total consumption of the group depends on the configuration of the modules.

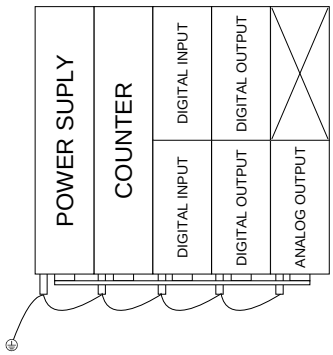
	5 V	±18 V
(DI) Digital inputs.	0,40 watts	- - -
(DO) Digital outputs.	0,65 watts	- - -
(AI) Analog inputs.	0,3 watts	1,8 watts
(AO) Analog outputs.	0,35 watts	3,4 watts
(CT) Counters.	1,75 watts	- - -
(CPU) CPU-CAN.	0,6 watts	- - -

The consumption of the CPU-CAN is added to each module of the configuration. When mounting two half-size modules together (in the same box), the consumption of the CPU-CAN must only be added once.

The total consumption of the group must not exceed the following maximums. If any of them is exceeded, double the group. Use two power supplies and distribute the modules.

- For +5 V, a maximum consumption of 10 watts.
- For 18 V, a maximum consumption of 7.2 watts.

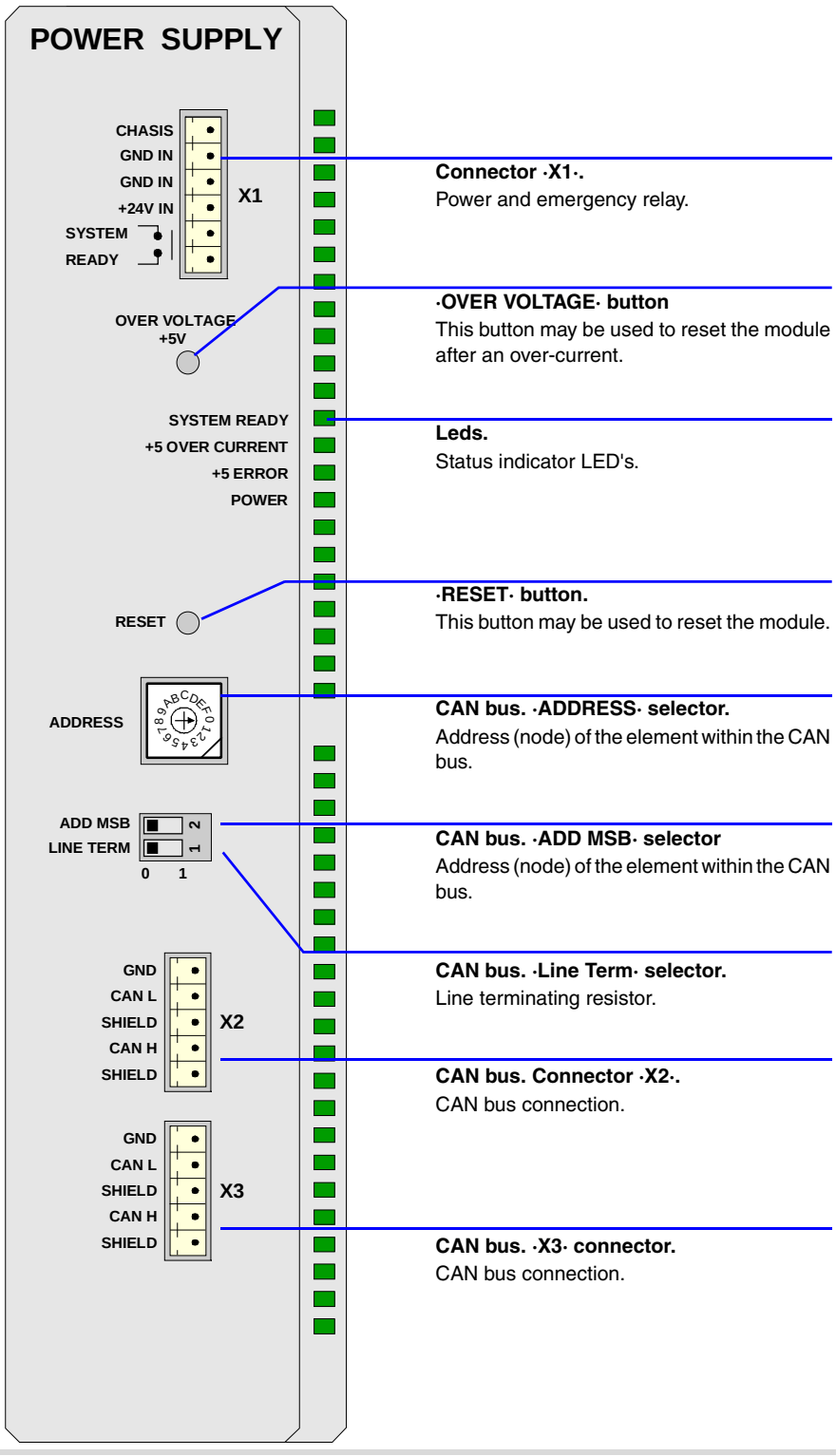
Example.



Modules.	5 V	±18 V
(CT) + (CPU)	1,75 + 0,6	- - -
(DI) + (DI) +(CPU)	0,4 + 0,4 + 0,6	- - -
(DO) + (DO) + (CPU)	0,65 + 0,65 + 0,6	- - -
(AO) + (CPU)	0,35 + 0,6	3,4
Total consumption	6,60 watts	3,4 watts

3.3 Power Supply.

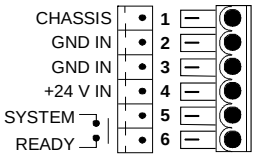
The power supply must be present in all the configurations (1 per group), it must be powered at 24 Vdc and connected to the CAN bus of the system.



3.3.1 Elements (connectors).

Connector ·X1·. Power and emergency relay.

6-pin male Phoenix minicombicon contact (3.5 mm pitch).



Signal.	Function.
Chassis	Shield.
GND IN	Power input.
GND IN	Power input.
+ 24 V	Power input.
System Ready	Relay for the emergency chain.

The relay may be used to connect the modules to the emergency chain of the electrical cabinet. The relay is an internal contact that closes when the group is ready; it opens again when an internal failure occurs.

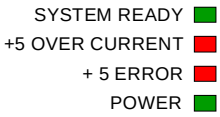
·OVER VOLTAGE· button and status LED.

This button may be used to reactivate the power supply after an over-current. An over-current activates the safety device inside the power supply turns on the external red LED. The power supply will not be operative while the LED is on. There are two ways to reactivate the power supply after an over-current.

- Unplug the power supply from mains and wait for about 30 seconds until the red light turns off.
- Unplug the power supply and press the button. The red LED will turn off indicating that the power supply is ready.

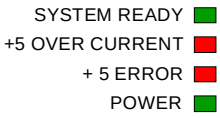
If after reactivating the power supply, the LED turns back on, call the Technical Service Department.

·SYSTEM READY· LED. Module under power.



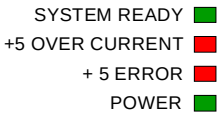
The LED is green. This LED blinks when the module is under power.

·OVER CURRENT· LED. Over-current at the power supply.



Red LED. This LED turns on when the +5 V power supply is outputting the maximum current.

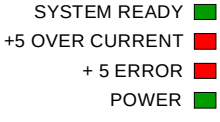
·ERROR· LED. Error at the power supply.



Red LED. This LED turns on when the power supply is not capable of supplying the 5 V DC due to a current overload

To eliminate the error, remove the load from the power supply or duplicate the group.

·POWER· LED. Status of the 5 V.



The LED is green. This LED turns on when the +5 V power supply is working properly.

·RESET· button.

The ·RESET· button may be used to reset the module after changing the node address; however, it is recommended to change the address while the modules and the CNC are off.

CAN bus. ·ADDRESS· selector. Address (node) of the element within the bus.

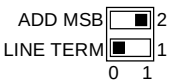


Each one of the elements integrated into the CAN bus is identified by the 16-position rotary switch (0-15) "Address" (also referred to as "Node_Select"). With the ADD MSB" switch, the positions or elements integrated in the CAN bus may be expanded up to 32.

The CNC must always occupy position "0" and the rest of the elements of the bus will occupy consecutive positions starting with 1. In order for any change at the "Address" switch to be assumed, the CNC must be restarted and the corresponding drive must be reset, however, we recommend to change the address while the modules and the CNC are off.

The "Address" switch also sets the priority of the group within the bus; the lower the number the higher the priority. We recommend the keyboard and jog panel to be the last node of the bus.

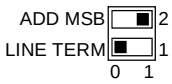
CAN bus. ·ADD MSB· selector Address (node) of the element within the bus.



With the ·2· switch (ADD MSB), the positions or elements integrated in the CAN bus may be expanded up to 32. Positions 0-15 are selected with ADD MSB=0 and positions 16-31 with ADD MSB=1.

·ADD MSB·.	Address (node) of the element.
OFF	Positions 0-15 within the bus.
ON	Positions 16-31 within the bus.

CAN bus. ·Line Term· selector.

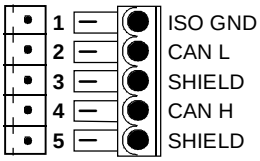


Line terminating resistor. The ·LT· switch identifies which are the elements that occupy the ends of the CAN bus; i.e. the first and last physical element in the connection.

The switch position of the terminating elements must be "1" and that of the rest of the elements "0".

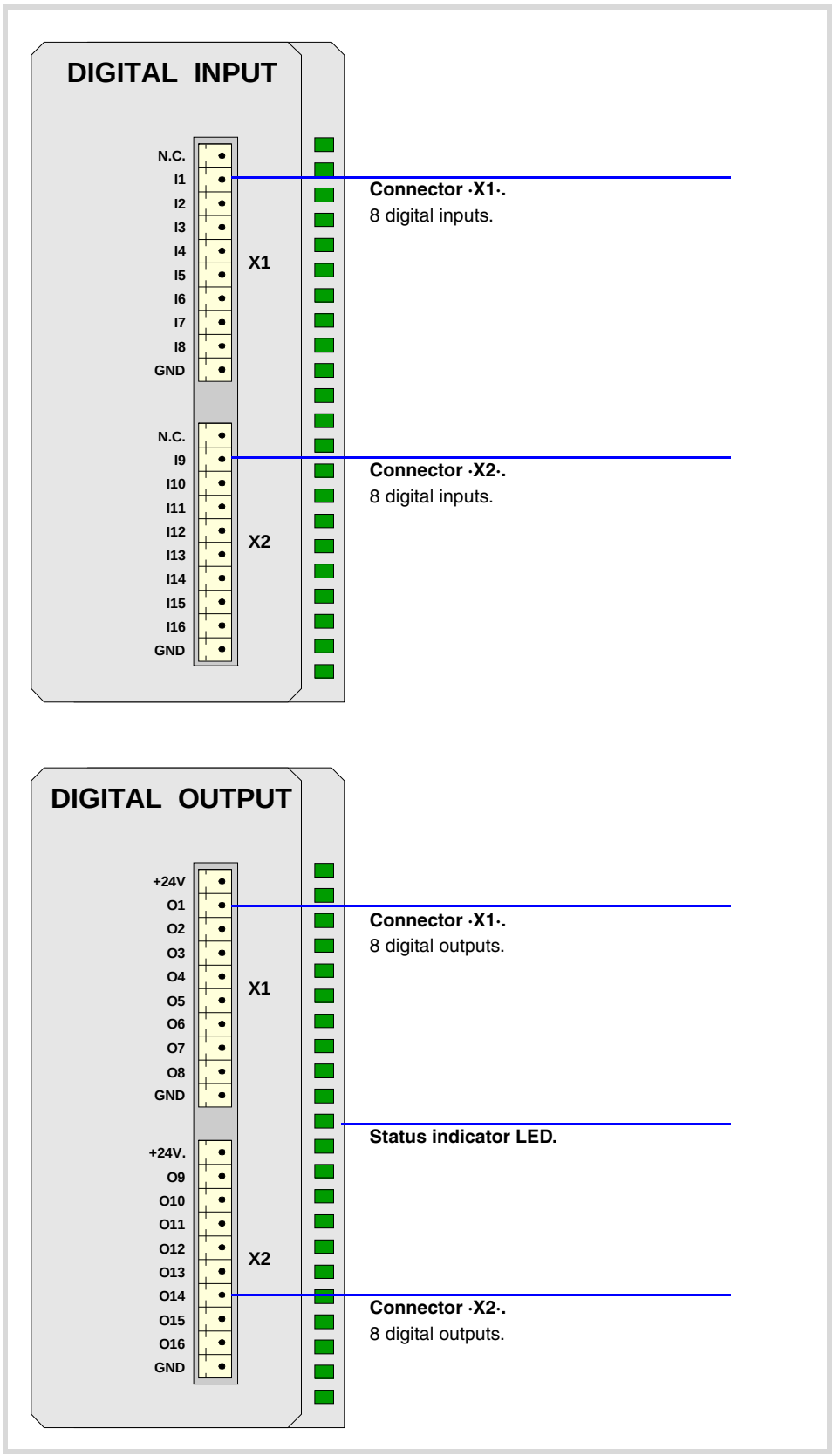
CAN bus. ·CAN· connector. Connector ·X2· & ·X3·.

5-pin male Phoenix minicombicon contact (3.5 mm pitch).



Pin.	Signal.	Function.
1	ISO GND	Ground / 0 V.
2	CAN L	(LOW) bus signal.
3	SHIELD	CAN shield.
4	CAN H	(HIGH) bus signal.
5	SHIELD	CAN shield.

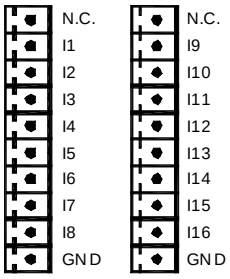
3.4 Digital inputs and outputs.



3.4.1 Elements (connectors).

Connector ·X1· & ·X2·. Digital inputs (8 inputs in each connector).

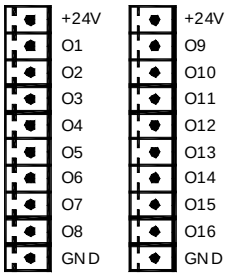
10-pin male Phoenix minicombicon contact (3.5 mm pitch).



Signal.	Function.
N.C.	Not being used.
I1 - I8	Digital inputs.
I9 - I16	Digital inputs.
GND	0 V reference signal.

Connector ·X1· & ·X2·. Digital outputs (8 outputs in each connector).

10-pin male Phoenix minicombicon contact (3.5 mm pitch). Both connectors must be powered with 24 V DC and GND.

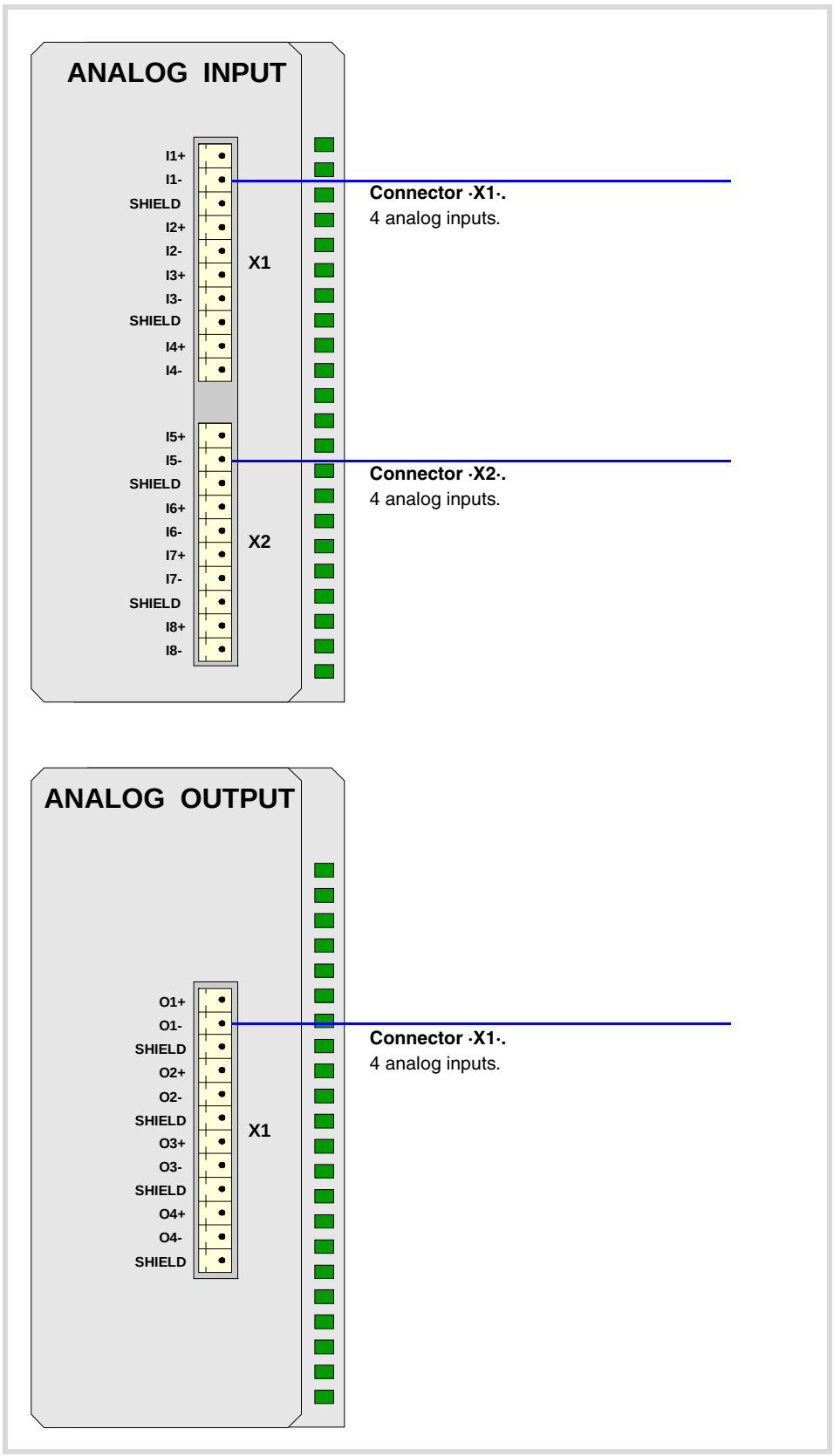


Signal.	Function.
+ 24 V	Power supply.
O1 - O8	Digital outputs.
O9 - O16	Digital outputs.
GND	0 V reference signal.

Status indicator LED.

The green LED located in the middle of the digital output module turns on when the module is powered with 24 Vdc and the inside fuse is OK.

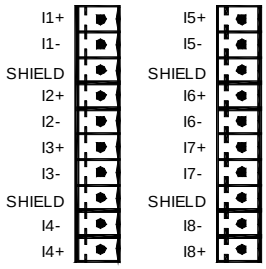
3.5 Analog inputs and outputs



3.5.1 Elements (connectors).

Connector ·X1· & ·X2·. Analog inputs (4 inputs in each connector).

10-pin male Phoenix minicombicon contact (3.5 mm pitch).

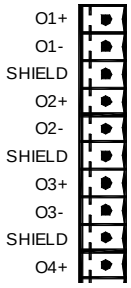


Signal.	Function.
I1+ I1-	Analog inputs.
SHIELD	Shield connection.

Each analog input has three pins (I+, I-, SH). Use shielded cables connecting their meshes to the corresponding shield pin.

Connector ·X1·. Analaog outputs (4 outputs in each connector).

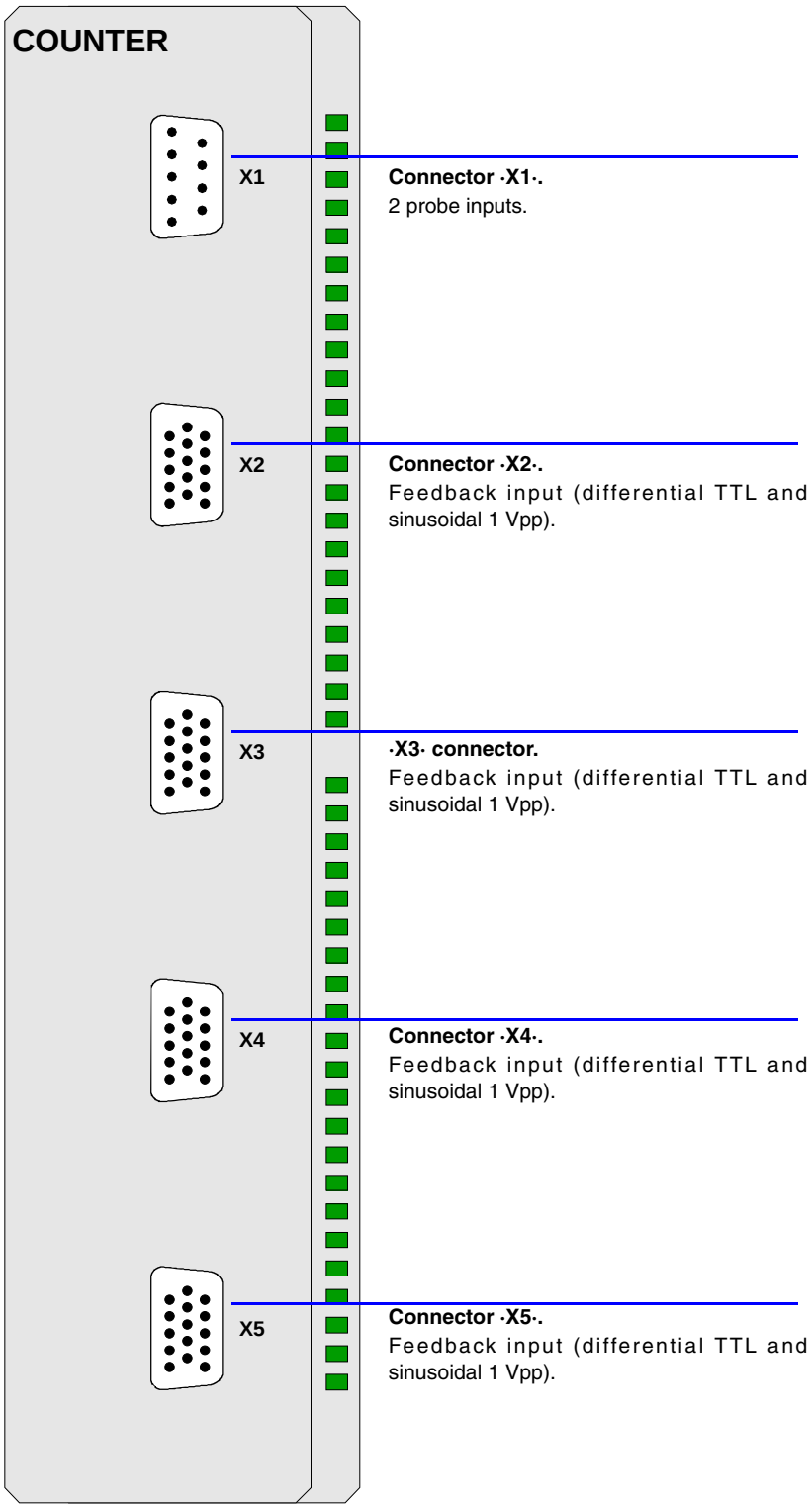
12-pin male Phoenix minicombicon contact (3.5 mm pitch).



Signal.	Function.
O1+ O1-	Analog outputs.
O2+ O2-	Analog outputs.
O3+ O3-	Analog outputs.
O4+ O4-	Analog outputs.
SHIELD	Shield connection.

Each analog output has three pins (O+, O-, SH). Use shielded cables connecting their meshes to the corresponding shield pin.

3.6 Feedback inputs (counter).



Connector ·X1·.
2 probe inputs.

Connector ·X2·.
Feedback input (differential TTL and sinusoidal 1 Vpp).

·X3· connector.
Feedback input (differential TTL and sinusoidal 1 Vpp).

Connector ·X4·.
Feedback input (differential TTL and sinusoidal 1 Vpp).

Connector ·X5·.
Feedback input (differential TTL and sinusoidal 1 Vpp).

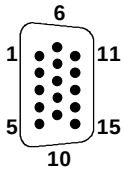
3.6.1 Elements (connectors).

Connector ·X1·.

Not being used from software version V01.10 on. Previous versions allowed connecting 2 probes of 5 V DC or 24 V DC.

Connectors ·X2· & ·X3· & ·X4· & ·X5·. Feedback inputs (differential TTL and sinusoidal 1 Vpp).

4 15-pin female SUB-D HD type connectors.



Pin.	Signal.	Function.
1	A	Feedback signals.
2	/ A	
3	B	
4	/ B	
5	I0	Reference signals.
6	/ I0	
7	AL	Feedback alarm.
8	/ AL	
9	+5 Vdc	Voltage supply for the feedback system.
10	- - -	
11	GND	0 V reference signal.
12	- - -	
13	- - -	
14	- - -	
15	Chassis(*)	Shield.

(*) Pin ·15· is offered for compatibility. We recommed to connect the cable shield to the connector housing at both ends.

To connect feedback devices with differential TTL or 1 Vpp sinusoidal signals. See *"3.8 Feedback inputs. Technical characteristics and connection."* on page 40.

3.7 Electrical characteristics of the inputs and outputs.

Digital inputs.

All digital inputs, 16 per module, have a status indicating LED and are galvanically protected with opto-couplers. The electrical characteristics of the inputs are:

Nominal voltage.	+24 V DC (between +18 V DC and +30 V DC).
High threshold "1".	Over +18 V DC.
Low threshold "0".	Under +9 V DC.
Typical consumption of each input.	5 mA.
Maximum consumption of each input.	7 mA.

Digital outputs.

All digital outputs, 16 per module, have a status indicating LED and are galvanically protected with opto-couplers. The electrical characteristics of the outputs are:

Nominal voltage.	+24 V DC (between +18 V DC and +30 V DC).
Output voltage.	2 V less than the supply voltage.
Maximum output current.	500 mA per output.

The digital output modules have an 8A fuse inside for protection against over-voltage (over 33 Vdc) and against reverse connection.

Analog inputs.

Use shielded cables connecting their meshes to the corresponding shield pin. All the analog inputs, 8 per module, have the following characteristics:

Voltage within range.	± 10 V.
Resolution.	12 bits.
Input impedance.	20 kΩ
Maximum cable length (unshielded).	75 mm.

Analog outputs.

Use shielded cables connecting their meshes to the corresponding shield pin. All the analog outputs, 4 per module, have the following characteristics:

Command voltage within range.	± 10 V.
Resolution.	16 bits.
Minimum impedance of the connected device.	10 kΩ
Maximum cable length (unshielded).	75 mm.

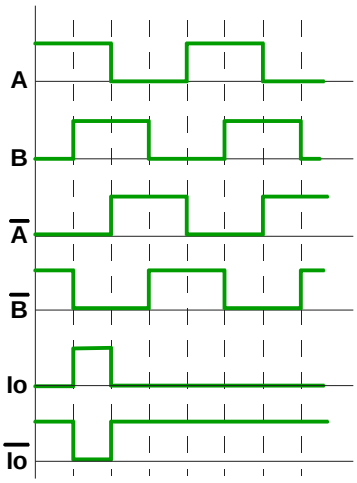
3.8 Feedback inputs. Technical characteristics and connection.

The module has 4 feedback inputs, valid for differential TTL and sinusoidal 1 Vpp signals.

Technical characteristics of the feedback inputs.

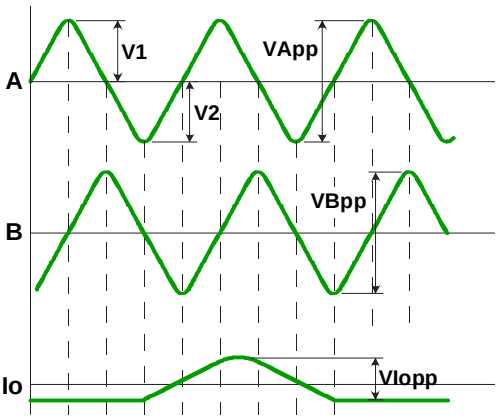
Power consumption: +5 V 1 A (250 mA per axis)

Work levels for differential TTL signal.



Maximum frequency:	1000 kHz.
Maximum gap between flanks:	460 ns.
Phase shift:	90º ± 20º.
Maximum voltage in common mode:	± 7 V.
Maximum voltage in differential mode:	± 6 V.
Hysteresis:	0.2 V.
Maximum differential input current:	3 mA.

Work levels for sinusoidal 1 Vpp signal.



Maximum frequency:	500 kHz.
A and B signals. Amplitude:	0.6 ÷ 1.2 Vpp
A and B signals. Centered:	|V1-V2| / 2 Vpp =< 6.5%
A and B signals. Ratio:	VApp / VBpp = 0.8 ÷ 1.25
A and B signals. Phase shift:	90º ± 10º
I0 signal. Amplitude:	0.2 ÷ 0.85 V
I0 signal. Width:	T-90º =< I0 =< T+180º

Feedback cable characteristics.



Fagor Automation offers a wide range of cables and extension cables to connect the feedback systems to the CNC. Refer to our catalog for further information.

The cable used must have overall shield; the rest of the characteristics of the cable, as well as its length, will depend on the type of feedback device used. Refer to our catalog.

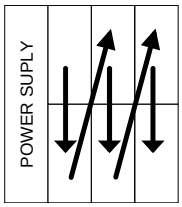
The shield of the cable being used must be connected to the connector housing at both ends. The unshielded portion of the wires of an unshielded cable cannot be longer than 75 mm.

We recommend to run the feedback cables as far away as possible from the power cables of the machine.

3.9 Numbering of the digital inputs and outputs.

Use machine parameters to set the number of digital I/O modules connected to the same CAN bus. If these parameters are not set, the CNC numbers the modules automatically according to the order of the remote groups (·ADDRESS· selector of the power supply module).

Numbering according to the order of the remote groups.



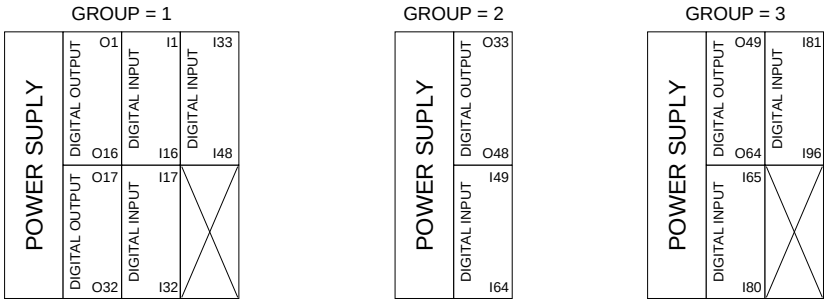
The CNC numbers the modules automatically according to the order of the remote groups (·ADDRESS· selector of the power supply module). Within each group, they are ordered from top to bottom and from left to right.

Example of configuration of the following remote modules.

Group ·1·	**Group ·2·**	**Group ·3·**
48 digital inputs.	16 digital inputs.	32 digital inputs.
32 digital outputs.	16 digital outputs.	16 digital outputs.

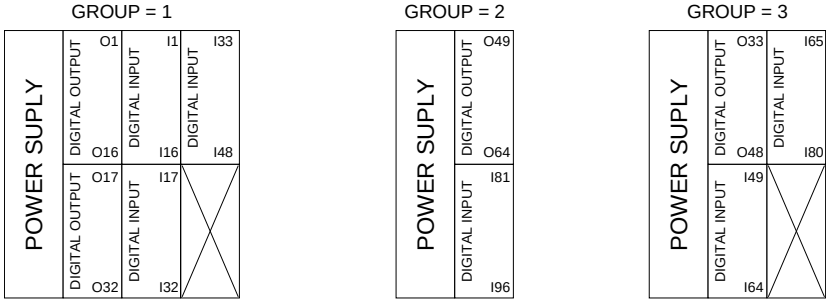
Example 1.

	Group ·1· (address = 1)	**Group ·2· (address = 2)**	**Group ·3·** (address = 3)
Digital inputs.	1 ·· 48	49 ·· 64	65 ·· 96
Digital outputs.	1 ·· 32	33 ·· 48	49 ·· 64



Example 2.

	Group ·1· (address = 1)	**Group ·2· (address = 3)**	**Group ·3·** (address = 2)
Digital inputs.	1 ·· 48	81 ·· 96	49 ·· 80
Digital outputs.	1 ·· 32	49 ·· 64	33 ·· 48

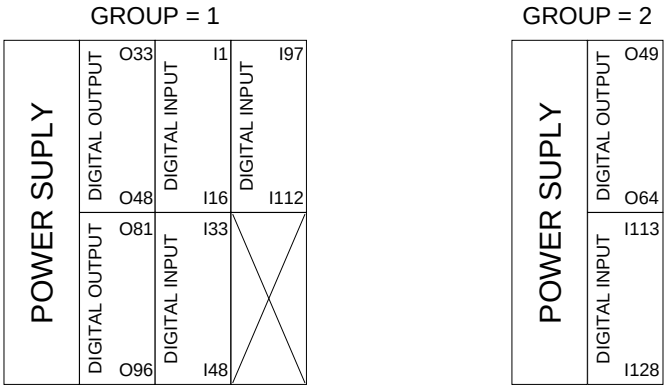


Numbering by machine parameters.

When the numbering is set by machine parameters, each module is assigned a base index and the inputs or outputs of that module are numbered after it. The values of the base index must be comply with the formula 16n+1 (i.e. 1, 17, 33, etc.). The rest of the inputs or outputs are numbered sequentially. The base indexes may follow any order, they do not have to be sequential.

When inserting a new module, the first modules will be assigned the numbering of the table and the last one will be assigned the next valid base index after the highest one assigned until then.

Examples for numbering the different modules.



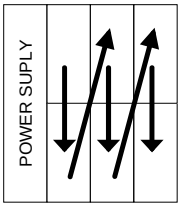
Remote group (1).

	Digital inputs.		Digital outputs.	
	Base index.	**Numbering.**	**Base index.**	**Numbering.**
Module 1.	1	1 ·· 16	33	33 ·· 48
Module 2.	33	33 ·· 48	81	81 ·· 96
Module 3.	97	97 ·· 112		

Remote group (2).

	Digital inputs.		Digital outputs.	
	Base index.	**Numbering.**	**Base index.**	**Numbering.**
Module 1.	113	113 ·· 128	49	49 ·· 64

3.10 Numbering of the analog inputs and outputs and of the feedback inputs.



The CNC numbers the modules automatically according to the order of the remote groups (·ADDRESS· selector of the power supply module). Within each group, they are ordered from top to bottom and from left to right.

Group ·1·	Group ·2·
8 analog inputs.	8 analog inputs.
4 analog inputs.	4 analog inputs.

Example.

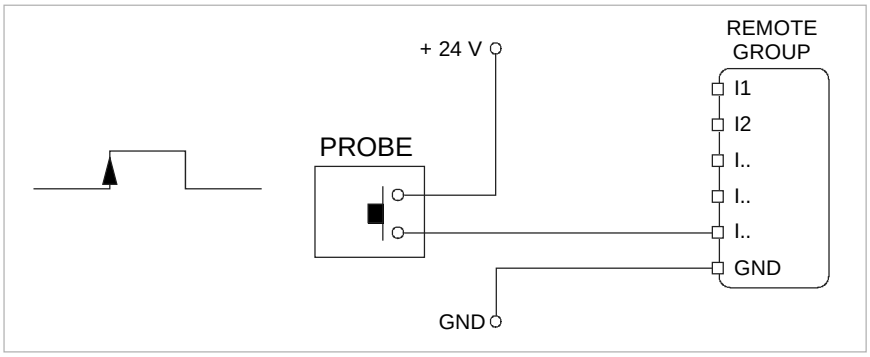
	Group ·1· (address = 1)	Group ·2· (address = 2)
Analog inputs.	1 ·· 8	9 ·· 16
Analog outputs.	1 ·· 4	5 ·· 8

3.11 Probe connection.

The digital inputs let you handle the signal of the two 24 V DC probes . Use machine parameters to define which digital input is associated with each probe and their type of pulse.

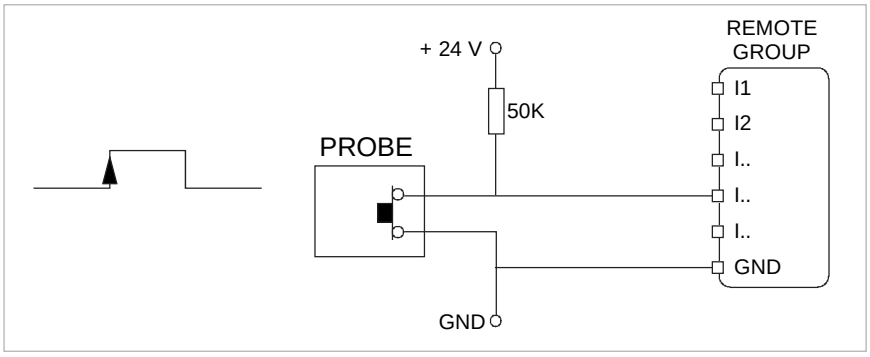
Probe whose output has a normally open contact. Connection to +24 V.

The connection acts upon the up flank (positive pulse) of the probe signal.



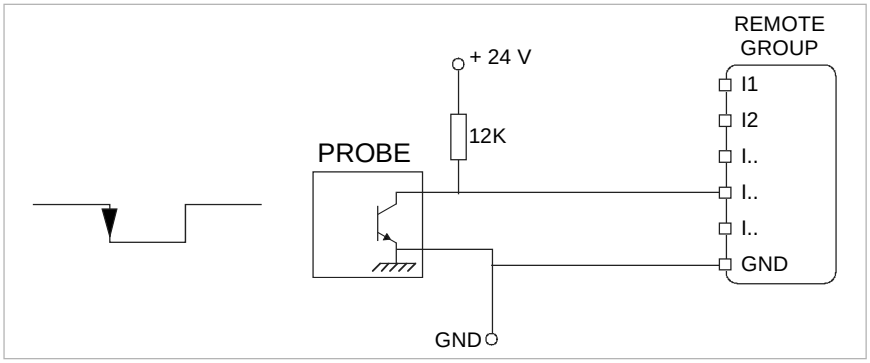
Probe whose output has a normally closed contact. Connection to +24 V.

The connection acts upon the up flank (positive pulse) of the probe signal.



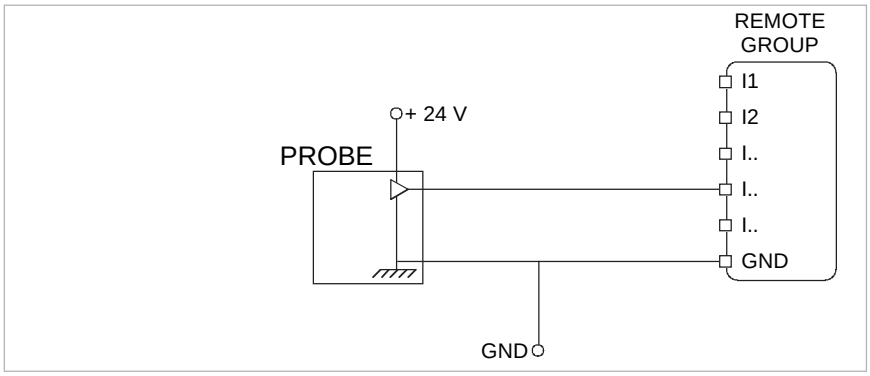
Interface with an open-collector output. Connection to +24 V.

The connection acts upon the down flank (negative pulse) of the probe signal.



Interface with a PUSH-PULL output. Connection to +24 V.

Depending on the interface being used, the connection acts upon the up flank or down flank of the probe signal.



4 RIO5 REMOTE MODULES. (CANOPEN PROTOCOL).

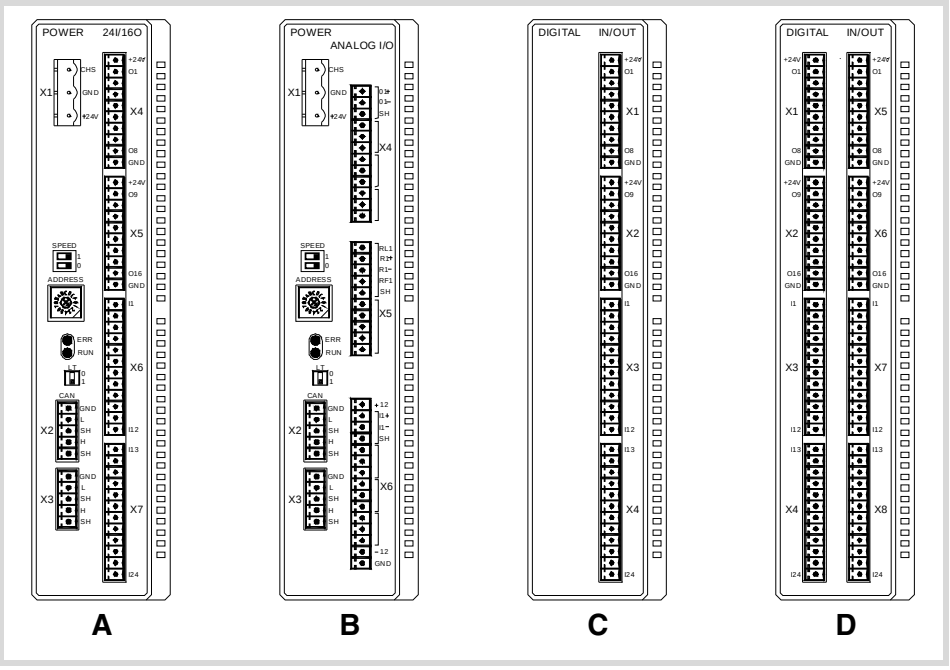
Remote modules may be used to have an additional number of digital and analog inputs and outputs (remote I/O) that, distributed at different points of the machine or mounted in the cabinet, permit controlling various devices of the machine. The remote modules are distributed by groups (nodes) and are connected to the central unit through the CAN bus that can have up to 32 nodes, including the central unit and the keyboards. The following elements may be available with RIO5 series modules.

Type of input/output	Amount.
Digital inputs.	1024
Digital outputs.	1024
General purpose analog inputs.	40
Analog outputs.	40
Analog inputs for temperature sensors.	10

When the CNC works with CANopen bus, this bus lets combine in the bus groups (nodes) formed by RIO5 and RIOW series modules; modules of both series cannot be combined in the same group.

Fagor remote modules, RIO5 series, available for CAN bus with CANopen protocol.

Each group (node) may consist of up to two of these modules.



A Power supply with 24 digital inputs and 16 digital outputs.

B Power supply with 4 analog inputs, 4 analog outputs and 2 inputs for temperature sensors.

C Digital Inputs / Outputs (single module). Each module has 24 digital inputs and 16 digital outputs.

D Digital Inputs / Outputs (double module). Each module has 48 digital inputs and 32 digital outputs.

General considerations on power supply modules.

When mounting the groups, bear in mind the following.

- One of the power supply modules must be present in each group. The power supply must be powered at 24 Vdc and connected to the CAN bus of the system.
- Two power supply modules cannot be in the same group.
- Power supplies of both models may be connected to the same CAN bus.

Fagor modules and third-party modules. Considerations about the number of analog inputs.

The CANopen bus can manage up to 60 analog inputs of any kind. The maximum number of analog inputs of each type that the bus can have depends on the type of modules installed.

CAN bus with Fagor modules.

A bus made up of only with Fagor modules can have 40 general purpose analog inputs and 10 inputs for temperature sensors. In Fagor modules, the analog inputs are pre-assigned as general-purpose inputs (four per module) or as inputs for temperature sensors (two inputs per module).

In Fagor modules of analog inputs, the CNC considers the inputs for the temperature sensor (connector X5) as analog inputs. Therefore, when numbering the inputs, the CNC considers that each module has 6 analog inputs; the four analog inputs plus the two temperature sensor inputs.

CAN bus with third-party modules.

A bus made up of only third-party modules can have 60 analog inputs of any kind. In third-party modules, it is up to the manufacturer to set the right configuration so the CNC treats these analog inputs as general purpose, for temperature sensors, etc.

CAN bus with Fagor modules and third-party modules.

A bus made up of Fagor modules and third-party modules, each Fagor modules counts as 6 analog inputs; 4 general purpose inputs and 2 inputs for temperature sensors. The inputs of third-party modules can be of any kind.

In third-party modules, it is up to the manufacturer to set the right configuration so the CNC treats these analog inputs as general purpose, for temperature sensors, etc.

Consumption of the remote modules.

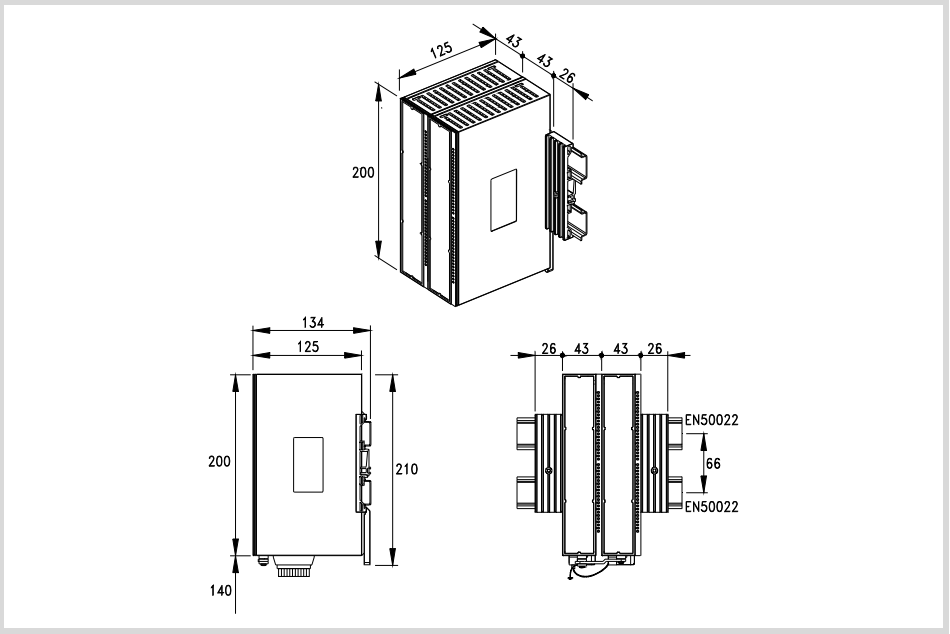
Each group consumes 1.2 A without including the consumption of the digital and analog outputs.

4.1 Dimensions and mounting of the modules.

Place the modules on 2 profiles, according to the UNE 50022 standard, with 2 securing ends, one at each end of the group; they help securing the modules besides maintaining the right gap between the profiles.

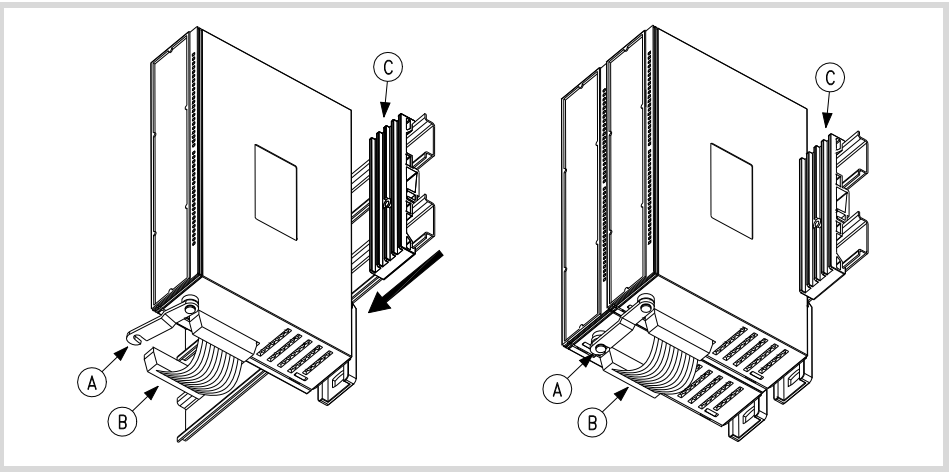
Dimensions of the modules.

Always leave a 140 mm gap under the modules for ventilation and later handling.



Connection of the modules.

The modules of the group are connected as follows:



- **A** For ground connection.
- **B** Ribbon cable to interconnect the modules.
- **C** Securing ends.

Each group is connected to the system (CPU, Keyboard, etc.) through the CAN bus as described later on.

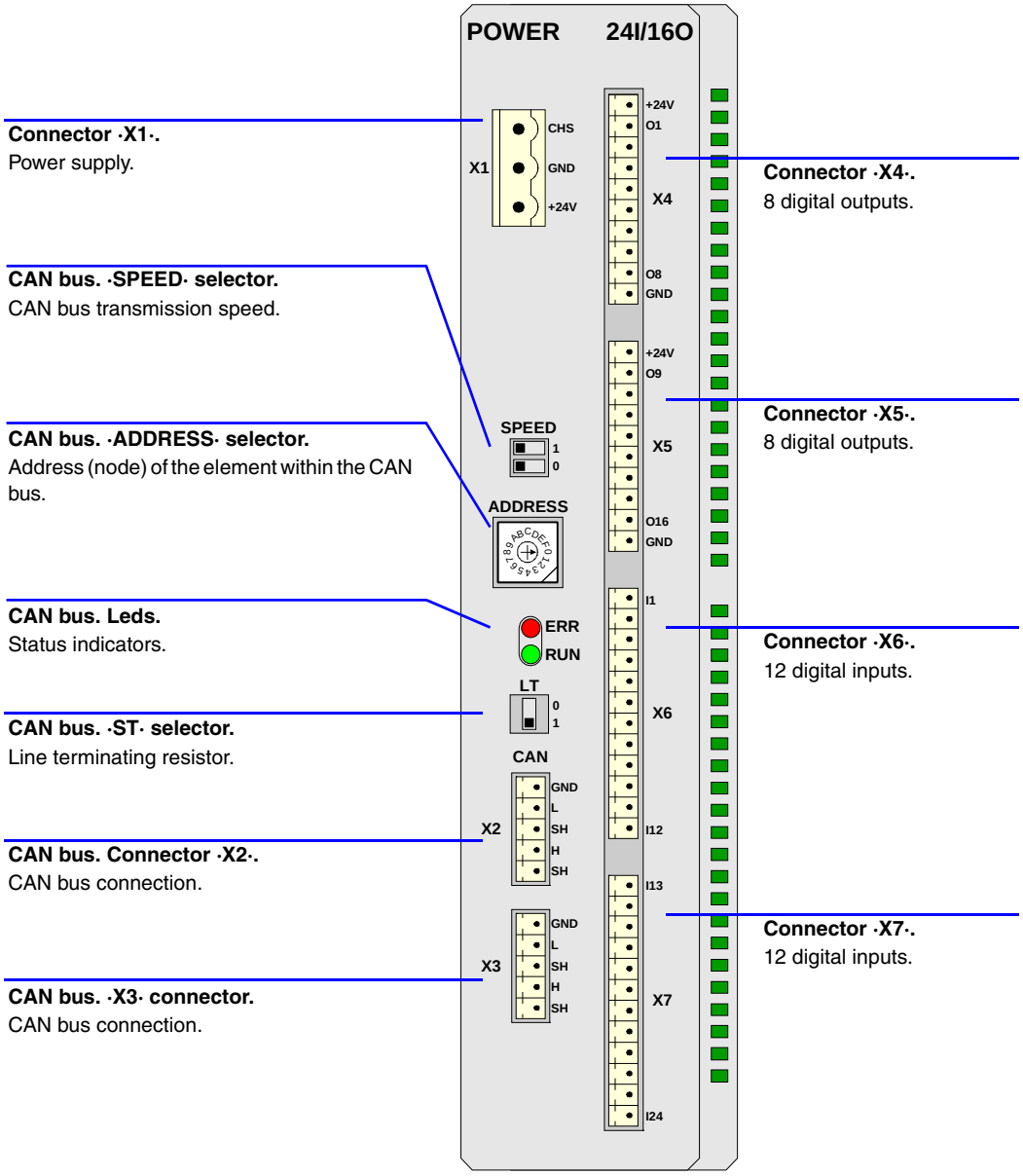
DO NOT make any connection or connect any module to the power supply while the latter is turned on. Before making any connection, ribbon cable included, turn the power supply off by unplugging the power cable.

4.2 Power supply.

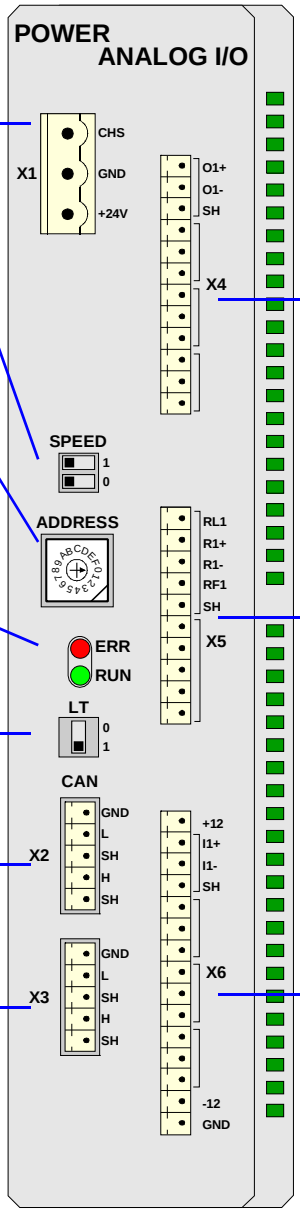
The power supply must be powered at 24 Vdc and connected to the CAN bus of the system. There are two power supply models.

- Power supply with 24 digital inputs and 16 digital outputs.
- Power supply with 4 analog inputs, 4 analog outputs and 2 inputs for temperature sensors.

Power supply with digital inputs and digital outputs.



Power supply with analog inputs and outputs.



Connector ·X1·.
Power supply.

CAN bus. ·SPEED· selector.
CAN bus transmission speed.

CAN bus. ·ADDRESS· selector.
Address (node) of the element within the CAN bus.

CAN bus. Leds.
Status indicators.

CAN bus. ·ST· selector.
Line terminating resistor.

CAN bus. Connector ·X2·.
CAN bus connection.

CAN bus. ·X3· connector.
CAN bus connection.

Connector ·X4·.
4 general purpose analog outputs.

Connector ·X5·.
2 PT100 inputs.

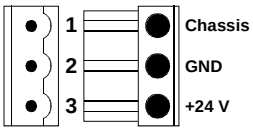
Connector ·X6·.
4 differential analog inputs.

4.2.1 Elements (connectors).

Connectors at the power supply.

Connector ·X1·. Power supply.

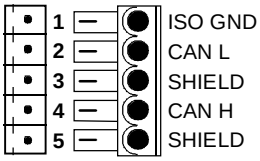
3-pin male Phoenix combicom contact (7.62 mm pitch).



Signal.	Function.
Chassis	Shield.
GND	Power supply.
+24 V	Power supply.

CAN bus. ·CAN· connector. Connector ·X2· & ·X3·.

5-pin male Phoenix minicombicon contact (3.5 mm pitch).

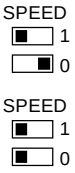


Pin.	Signal.	Function.
1	ISO GND	Ground / 0 V.
2	CAN L	(LOW) bus signal.
3	SHIELD	CAN shield.
4	CAN H	(HIGH) bus signal.
5	SHIELD	CAN shield.

CAN bus. ·SPEED· selector. Selecting the baudrate for the CANopen bus.



The transmission speed depends on the total length of the cable. Use the following approximate values. Assigning other values may cause communication errors due to signal distortion.

·CO BR·	Speed	Length of the CAN bus.
	1000 kHz	Up to 20 meters.
	800 kHz	From 20 to 40 meters.
	500 kHz	From 40 to 100 meters. Unlike at the keyboards, the communication at 250 kHz is not available at the remote modules.

In order for any change of speed to be assumed, the corresponding module must be reset; however, we recommend to change the speed while the modules and the CNC are off.

CAN bus. ·ADDRESS· selector. Address (node) of the element within the bus.



Each one of the elements integrated into the CAN bus is identified by the 16-position rotary switch (0-15) "Address" (also referred to as "Node_Select").

The CNC must always occupy position "0" and the rest of the elements of the bus will occupy consecutive positions starting with 1. In order for any change at the "Address" switch to be assumed, the CNC must be restarted and the corresponding drive must be reset, however, we recommend to change the address while the modules and the CNC are off.

The "Address" switch also sets the priority of the group within the bus; the lower the number the higher the priority. We recommend the keyboard and jog panel to be the last node of the bus.

CAN bus. ·ST· selector.



Line terminating resistor. The ·LT· switch identifies which are the elements that occupy the ends of the CAN bus; i.e. the first and last physical element in the connection.

The switch position of the terminating elements must be "1" and that of the rest of the elements "0".

·ERROR· LED. Status indicator LED.

Red LED. Its meaning depends on the blinking speed.

Type of blinking.	Meaning.
LED off.	The module works properly.
Blinking fast.	Module configuration stage.
Single blinking.	Warning. Poor transmission.
Double blinking.	There is no communication with the cpu.
LED on.	Error. Too many errors.

CAN bus. Led ·RUN·.

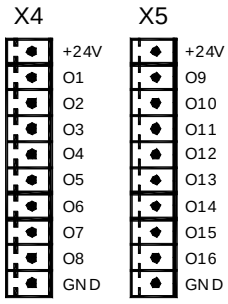
The LED is green. Its meaning depends on the blinking speed.

Type of blinking.	Meaning.
LED on.	The module works properly.
Single blinking.	Module stopped.
Blinking fast.	Module configuration stage.
Continuous blinking.	Start-up stage or error.

Connectors for the digital inputs and outputs.

Connector ·X4· & ·X5·. Digital outputs (8 outputs in each connector).

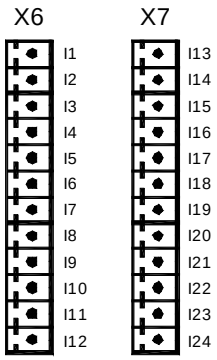
10-pin male Phoenix minicombicon contact (3.5 mm pitch). Both connectors must be powered with 24 V DC and GND.



Signal.	Function.
+ 24 V	Power supply.
O1 - O8	Digital outputs.
O9 - O16	Digital outputs.
GND	Power supply.

Connector ·X6· & ·X7·. Digital inputs (12 inputs in each connector).

12-pin male Phoenix minicombicon contact (3.5 mm pitch).

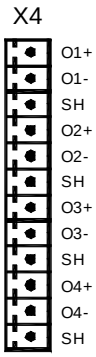


Signal.	Function.
I1 - I12	Digital inputs.
I13 - I24	Digital inputs.

Connectors for the analog inputs and outputs.

Connector ·X4·. General purpose analog outputs (4 outputs).

12-pin male Phoenix minicombicon contact (3.5 mm pitch).

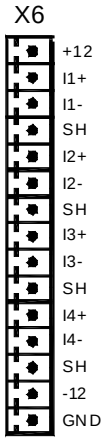


Signal.	Function.
O1+ O1-	Analog outputs.
O2+ O2-	Analog outputs.
O3+ O3-	Analog outputs.
O4+ O4-	Analog outputs.
SH	Shield connection.

Each analog output has three pins (O+, O-, SH). Use shielded cables connecting their meshes to the corresponding shield pin.

Connector ·X6·. Differential analog inputs (4 inputs).

15-pin male Phoenix minicombicon contact (3.5 mm pitch).



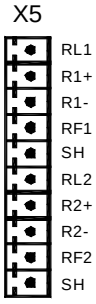
Signal.	Function.
I1+ I1-	Analog inputs.
I2+ I2-	Analog inputs.
I3+ I3-	Analog inputs.
I4+ I4-	Analog inputs.
SH	Shield connection.
+12 -12	12 V output.
GND	0 V reference signal.

Each analog input has three pins (I+, I-, SH). Use shielded cables connecting their meshes to the corresponding shield pin.

Connectors for the temperature sensors PT100.

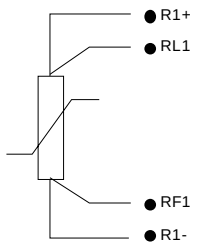
Connector ·X5·. Inputs for temperature sensors PT100 (2 inputs).

10-pin male Phoenix minicombicon contact (3.5 mm pitch).

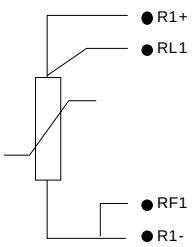


Signal.	Function.
R1+ R1- RL1 RF1	Signals of the PT100 sensor.
R2+ R2- RL2 RF2	Signals of the PT100 sensor.
SH	Shield connection.

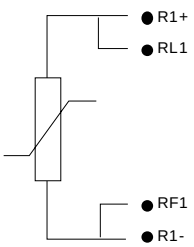
Each input has 5 pins (RL, R+, R-, RF, SH). Use shielded cables connecting their meshes to the corresponding shield pin.



4 wires.



3 wires.

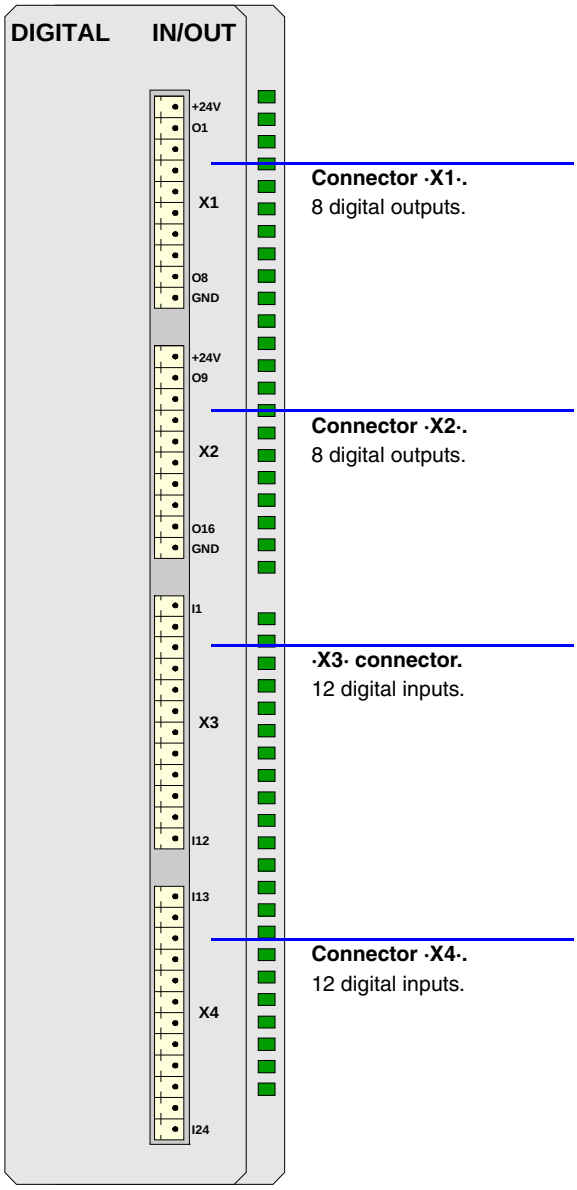


2 wires.

4.3 Digital inputs and digital outputs (single module).

This module is used to expand the digital inputs and outputs (remote I/O). Each module has 24 digital inputs and 16 digital outputs.

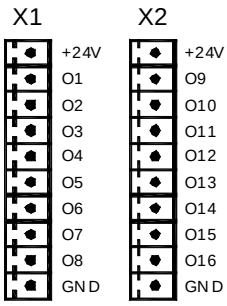
Digital inputs and digital outputs (single module).



4.3.1 Elements (connectors).

Connector ·X1· & ·X2·. Digital outputs (8 outputs in each connector).

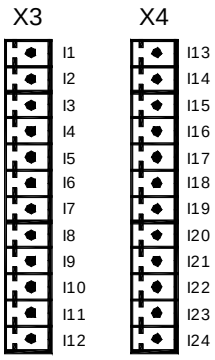
10-pin male Phoenix minicombicon contact (3.5 mm pitch). Both connectors must be powered with 24 V DC and GND.



Signal.	Function.
+ 24 V	Power supply.
O1 - O8	Digital outputs.
O9 - O16	Digital outputs.
GND	Power supply.

Connector ·X3· & ·X4·. Digital inputs (12 inputs in each connector).

12-pin male Phoenix minicombicon contact (3.5 mm pitch).

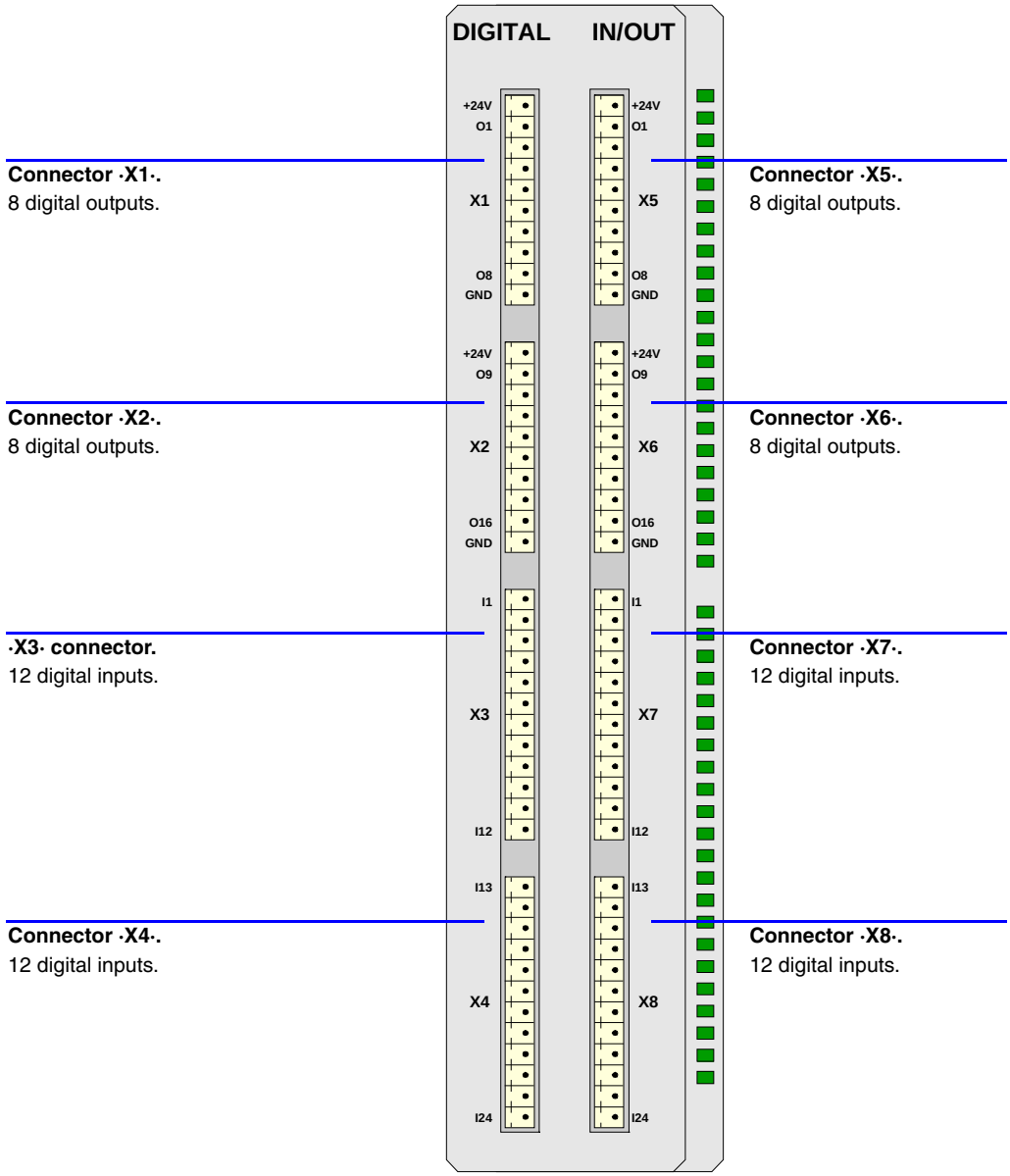


Signal.	Function.
I1 - I12	Digital inputs.
I13 - I24	Digital inputs.

4.4 Digital inputs and digital outputs (double module).

This module is used to expand the digital inputs and outputs (remote I/O). Each module has 48 digital inputs and 32 digital outputs.

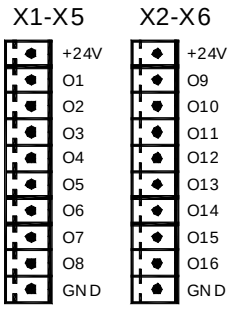
Digital inputs and digital outputs (double module).



4.4.1 Elements (connectors).

Connector ·X1· & ·X2· & ·X5· & ·X6·. Digital outputs (8 outputs in each connector).

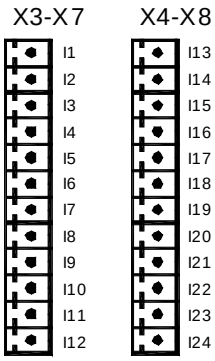
10-pin male Phoenix minicombicon contact (3.5 mm pitch). Both connectors must be powered with 24 V DC and GND.



Signal.	Function.
+ 24 V	Power supply.
O1 - O8	Digital outputs.
O9 - O16	Digital outputs.
GND	Power supply.

Connector ·X3· & ·X4· & ·X7· & ·X8·. Digital inputs (12 inputs in each connector).

12-pin male Phoenix minicombicon contact (3.5 mm pitch).



Signal.	Function.
I1 - I12	Digital inputs.
I13 - I24	Digital inputs.

4.5 Electrical characteristics of the inputs and outputs.

Digital inputs.

All digital inputs are galvanically isolated through opto-couplers. All the digital inputs have the following characteristics:

Nominal voltage.	+24 V DC (between +18 V DC and +30 V DC).
High threshold "1".	Over +18 V DC.
Low threshold "0".	Under +9 V DC.
Typical consumption of each input.	5 mA.
Maximum consumption of each input.	7 mA.

Digital outputs.

All digital outputs are galvanically isolated through opto-couplers. All the digital outputs have the following characteristics:

Nominal voltage.	+24 V DC (between +18 V DC and +30 V DC).
Output voltage.	2 V less than the supply voltage.
Maximum output current.	500 mA per output.

The digital outputs have a fuse inside for protection against over-voltage (over 33 V DC) and against reverse connection of the power supply.

Analog inputs.

Use shielded cables connecting their meshes to the corresponding shield pin. All the analog inputs have the following characteristics:

Voltage within range.	± 10 V.
Resolution.	12 bits.
Input impedance.	20 kΩ.
Maximum cable length (unshielded).	75 mm.

Analog outputs.

Use shielded cables connecting their meshes to the corresponding shield pin. All the analog outputs have the following characteristics:

Command voltage within range.	± 10 V.
Resolution.	16 bits.
Minimum impedance of the connected device.	10 kΩ.
Maximum cable length (unshielded).	75 mm.

Inputs for the temperature sensors PT100.

Use shielded cables connecting their meshes to the corresponding shield pin. The electrical characteristics of the inputs are:

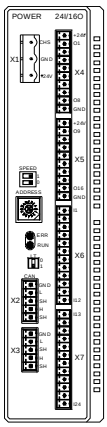
Type of sensor.	PT100
Temperature range.	Between -200 ºC (-328 ºF) and +850 ºC (1562 ºF).
Resolution.	0.1 ºC
Typical consumption of each input.	2 mA.
Maximum cable length (unshielded).	75 mm.

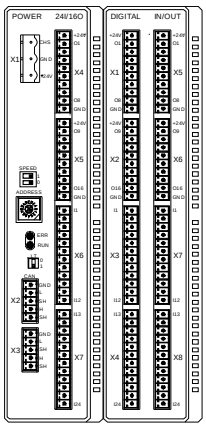
4.6 Numbering of the digital inputs and outputs.

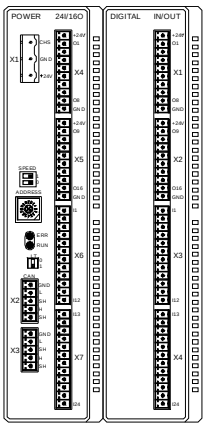
Use machine parameters to set the number of digital I/O modules connected to the same CAN bus. If these parameters are not set, the CNC numbers the modules automatically according to the order of the remote groups (·ADDRESS· selector of the power supply module).

Numbering according to the order of the remote groups.

The CNC numbers the modules automatically according to the order of the remote groups (·ADDRESS· selector of the power supply module). Within each group, they are ordered from left to right.







Group ·1·	Group ·2·	Group ·3·
24 digital inputs.	24 + 48 digital inputs.	24 + 24 digital inputs.
16 digital outputs.	16 + 32 digital outputs.	16 + 16 digital outputs.

Example 1.

	Group ·1· (address = 1)	**Group ·2· (address = 2)**	**Group ·3·** (address = 3)
Digital inputs.	1 ·· 24	25 ·· 48 49 ·· 96	97 ·· 120 121 ·· 144
Digital outputs.	1 ·· 16	17 ·· 32 33 ·· 64	65 ·· 80 81 ·· 96

Example 2.

	Group ·1· (address = 1)	**Group ·2· (address = 3)**	**Group ·3·** (address = 2)
Digital inputs.	1 ·· 24	73 ·· 96 97 ·· 144	25 ·· 48 49 ·· 72
Digital outputs.	1 ·· 16	49 ·· 64 65 ·· 96	17 ·· 32 33 ·· 48

Numbering by machine parameters.

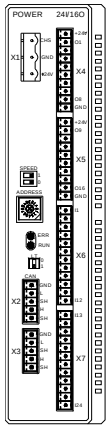
When the numbering is set by machine parameters, each module is assigned a base index and the inputs or outputs of that module are numbered after it. The double input/output module must be assigned two base indexes for the inputs and two base indexes for the outputs; one for each board;

The values of the base index must be comply with the formula "8n + 1" (i.e. 1, 9, 17, 25, etc.). The rest of the inputs or outputs are numbered sequentially. The base indexes may follow any order, they do not have to be sequential.

When inserting a new module, the first modules will be assigned the numbering of the table and the last one will be assigned the next valid base index after the highest one assigned until then.

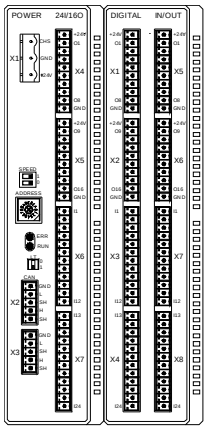
Examples for numbering the different modules.

(*) For each base index, indicate the connector and the input or output it corresponds to.



Power supply.

	Base index*	Numbering.
Digital inputs.	·1· (I1 of X6)	1 ·· 24
Digital outputs.	·1· (I1 of X4)	1 ·· 16



Power supply.

	Base index*	Numbering.
Digital inputs.	·1· (I1 of X6)	1 ·· 24
Digital outputs.	·1· (I1 of X4)	1 ·· 16

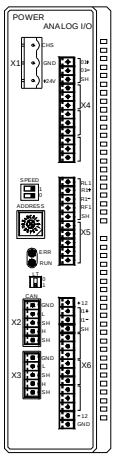
Module of digital inputs and outputs (double module).

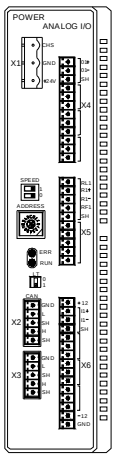
	Base index*	Numbering.
Digital inputs.	·25· (I1 of X3) ·49· (I1 of X7)	25 ·· 48 49 ·· 64
Digital outputs.	·17· (I1 of X1) ·33· (I1 of X5)	17 ·· 32 33 ·· 48

4.7 Numbering of the analog inputs and outputs and of the temperature sensor inputs.

The CNC numbers the modules automatically according to the order of the remote groups (·ADDRESS· selector of the power supply module).

When numbering the analog inputs, the CNC considers the inputs for the temperature sensor (connector X5) as analog inputs. Therefore, when numbering the inputs, the CNC considers that each module has 6 analog inputs; the four analog inputs plus the two temperature sensor inputs.





Group ·1·
4 analog inputs.
4 analog inputs.
2 PT100 inputs

Group ·2·
4 analog inputs.
4 analog inputs.
2 PT100 inputs

Example.

	Group ·1· (address = 1)	Group ·2· (address = 2)
Analog inputs. PT100 inputs.	1 ·· 4 5 ·· 6	7 ·· 10 11 ·· 12
Analog outputs.	1 ·· 4	5 ·· 8

The CNC machine parameters must be set to indicate the number of PT100 inputs and to which analog inputs they are connected. A PT100 input is active if it has one of these temperature sensors connected to it. Refer to the installation manual for further detail.

5 RIOW REMOTE MODULES. (CANOPEN PROTOCOL).

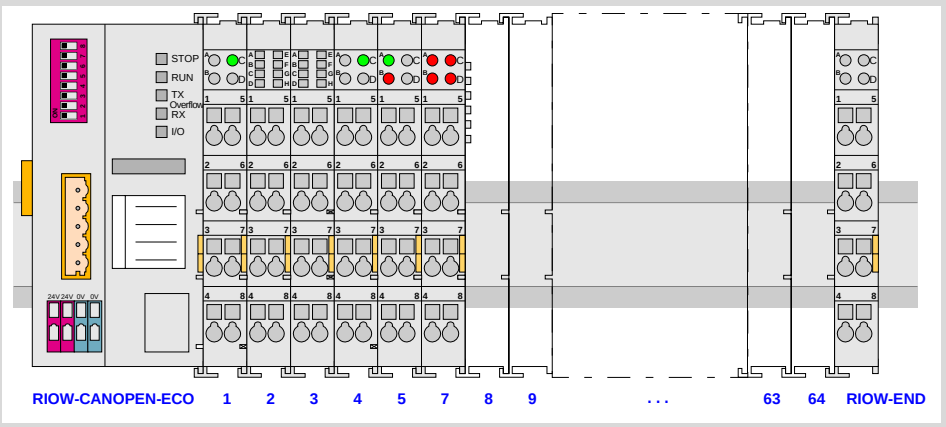
Remote modules may be used to have an additional number of digital and analog inputs and outputs (remote I/O) that, distributed at different points of the machine or mounted in the cabinet, permit controlling various devices of the machine. The remote modules are distributed by groups (nodes) and are connected to the central unit through the CAN bus that can have up to 32 nodes, including the central unit and the keyboards. The following elements may be available with RIOW series modules.

Type of input/output	Amount.
Digital inputs.	1024
Digital outputs.	1024
General purpose analog inputs.	40
Analog outputs.	40
Analog inputs for temperature sensors.	10

When the CNC works with CANopen bus, this bus lets combine in the bus groups (nodes) formed by RIO5 and RIOW series modules; modules of both series cannot be combined in the same group.

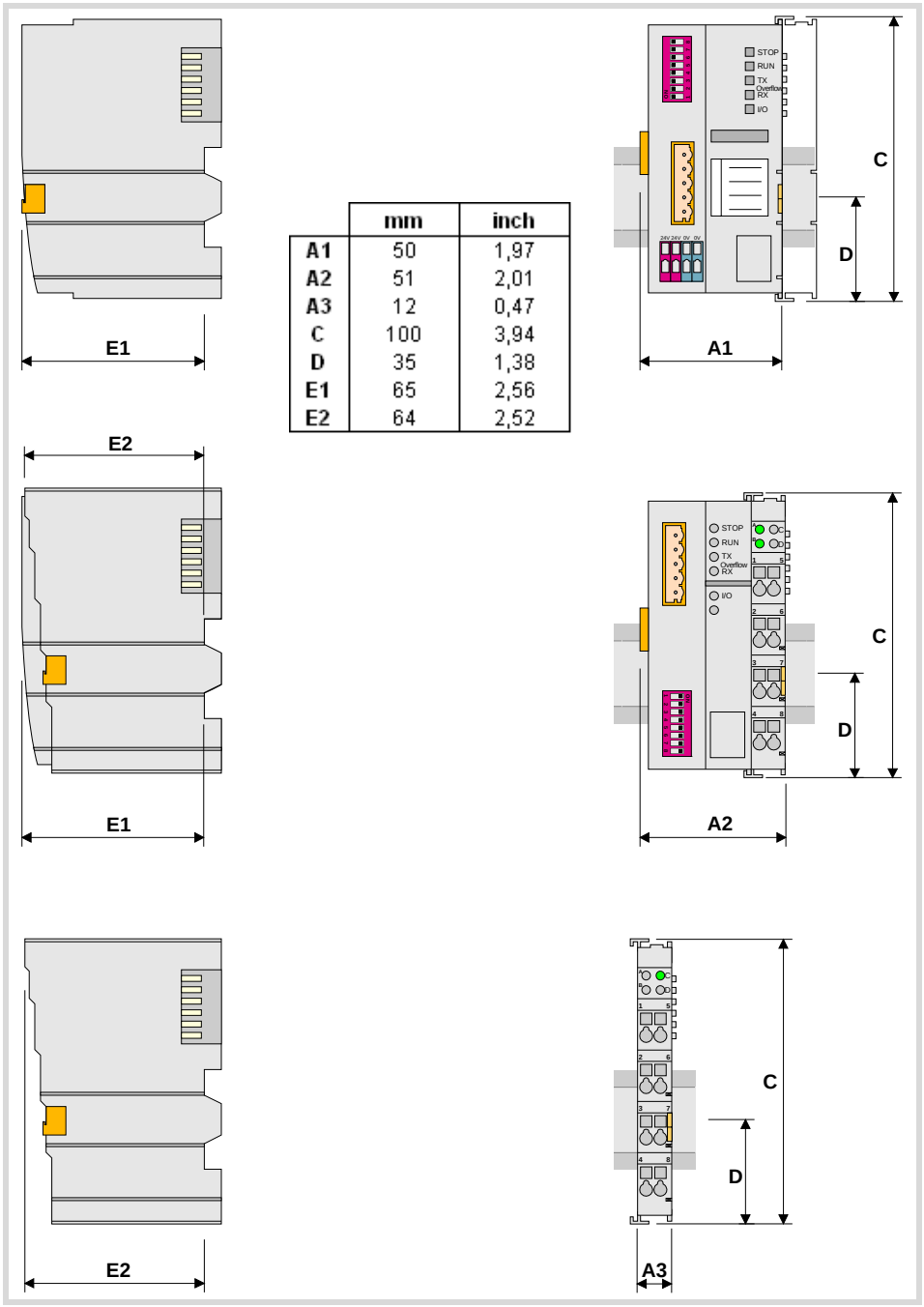
Fagor remote modules, RIOW series, available for CAN bus with CANopen protocol.

Each group (node) will consist of a leading (first) module (RIOW-CANOPEN-ECO / RIOW-CANOPEN-STAND), an end module (last) (RIOW-END) and a maximum of 64 intermediate modules for processing digital and analog inputs and outputs, etc.



Module.	Description.
RIOW-CANOPEN-ECO. RIOW-CANOPEN-STAND.	This module must be the first module of each group and it is in charge of managing the internal bus of the group and connecting the group to the CAN bus of the system.
RIOW-END.	This module must be the last module of each group and it is used to end the internal bus of the group and ensure proper data flow.
RIOW-PS24.	Power supply module. This module is in charge of supplying power to the I/O modules through the side jumpers with 24 V 10A.
RIOW-8DI.	Expansion module with eight 24V DC digital inputs.
RIOW-8DO.	Expansion module with eight 24V DC 0.5 A digital outputs.
RIOW-4AI.	Expansion module with four ±10 V DC analog inputs.
RIOW-4AO.	Expansion module with four ±10 V DC analog outputs.
RIOW-2AI-PT100.	Expansion module with 2 analog inputs for PT100 temperature sensors.

5.1 Dimensions of the modules.



	mm	inch
A1	50	1,97
A2	51	2,01
A3	12	0,47
C	100	3,94
D	35	1,38
E1	65	2,56
E2	64	2,52

5.2 Technical and electrical characteristics.

5.2.1 Technical characteristics.

Mechanical characteristics.

Vibrations (module RIOW-CANOPEN-ECO).

- Meets the IEC60068-2-6 standard.
- Sweep sine trial with a frequency step of 1 octave/minute (±10%) and 10 sweeps long per axis, on each of the three vertical axes.

10 Hz ≤ f < 57 Hz	Constant movement with an amplitude of 0.075 mm.
57 Hz ≤ f < 150 Hz	Constant 1g acceleration.

Vibrations (module RIOW-CANOPEN-STAND).

- Meets the IEC60068-2-6 standard.
- Sweep sine trial with a frequency step of 1 octave/minute (±10%) and on each of the three axes.

5 Hz ≤ f < 9 Hz	1.750 mm amplitude (constant) or 3.5 mm (short periods).
9 Hz ≤ f < 150 Hz	0.5 mm (constant acceleration) or 1g (short periods).

Choques.

- Meets the IEC60068-2-27 standard.
- Semi-sinusoidal pulses with 15g peaks for 11 ms. 3 pulses in each direction (positive and negative) of each of the three vertical axes (18 pulses in all).

Free fall.

- Meets the IEC60068-2-32 standard.
- Up to 1 m with the unit in its original packaging.

Electromagnetic compatibility.

Regulations valid for all RIOW modules.

Immunity against disturbances (regulation EN 50082-2:1996).

- Meets the EN 61000-4-2 regulation.
- Meets the EN 61000-4-3 regulation.
- Meets the EN 61000-4-4 regulation.
- Meets the EN 61000-4-6 regulation.

Regulations valid for all RIOW modules except for RIOW-CANOPEN-ECO and RIOW-CANOPEN-STAND modules.

Emission of disturbances (regulation EN 50081-1:1993).

- Meets the EN 55022 regulation.

Regulations only valid for all RIOW-CANOPEN-ECO and RIOW-CANOPEN-STAND modules.

Emission of disturbances (regulation EN 50081-2:1994).

- Meets the EN 55011 regulation.

Ambient conditions.

- Relative humidity: 5-95% without condensation.
- Work temperature: 0-55 ºC.
- Storage temperature: Between -20 ºC (77 ºF) and +85 ºC (158 ºF).
- Resistance to harmful substances: Meets standards IEC 60068-2-42 and IEC 60068-2-43.

Degree of protection.

- It meets the protection standard IP 20.

The machine manufacturer must comply with the EN 60204-1 (IEC-204-1) regulation regarding electrical shocks in case of defective input/output pins with external power supply when not plugging the connector before turning the power supply on.



Do not get into the inside of the unit. This unit MUST NOT be opened by unauthorized personnel. Only personnel authorized by Fagor Automation may manipulate the inside of this unit.

5.2.2 Electrical characteristics of the inputs and outputs.

Digital outputs.

All digital outputs have a status indicating LED that turns on when the output is active. The outputs are protected with opto-couplers and protected against short-circuits.

Technical characteristics.	
Number of outputs.	8 outputs per module.
Nominal voltage.	+24 V DC (between -15 % and +20 %).
Typical consumption.	15 mA per module plus the consumption of the elements.
Output current.	500 mA per output.

Digital inputs.

All digital inputs have a status indicating LED that turns on when the input is active. The inputs are protected by opto-couplers.

Technical characteristics.	
Number of inputs.	8 inputs per module.
Nominal voltage.	+24 V DC (between -15 % and +20 %).
Low threshold "0".	Within -3 and 5 V DC.
High threshold "1".	Within 15 and 30 V DC.
Typical consumption.	2.8 mA.

Analog inputs.

All analog inputs have a status indicating LED that turns on when there is an over-voltage or an under-voltage.

Use shielded cables connecting their meshes to the corresponding shield pin. Maximum cable length (unshielded): 75 mm.

Technical characteristics.	
Number of inputs.	4 inputs per module.
Voltage range.	± 10 V.
Maximum input voltage.	± 40 V.
Typical input impedance.	> 100 kΩ
Measuring error (25 ºC).	<± 0.1 %
Resolution.	12 bits.
Typical consumption of each input.	0.5 mA.

Analog outputs.

Each input has 2 LED's; a green one that turns on when the bus transmission is OK and a red one that turns on when there is an overload or a short-circuit to ground at any of the outputs.

Use shielded cables connecting their meshes to the corresponding shield pin. Maximum cable length (unshielded): 75 mm.

Technical characteristics.	
Number of outputs.	4 outputs per module.
Voltage range.	± 10 V.
Impedance of the connected device.	> 5 kΩ
Output filter time (typical value).	100 ms.
Measuring error (25 ºC).	<± 0.1 %
Resolution.	12 bits.
Typical consumption of each input.	0.5 mA.

Analog inputs for PT100 temperature sensors.

Each input has 2 LED's; a green one that turns on when the bus transmission is OK and a red one that turns on when there is a reading error at the inputs.

The inputs are protected by opto-couplers. Use shielded cables connecting their meshes to the corresponding shield pin. Maximum cable length (unshielded): 75 mm.

Technical characteristics.	
Number of inputs.	2 inputs per module.
Type of sensor.	PT100
Type of connection.	2-wire or 3-wire interface.
Temperature range.	Between -200 ºC (-328 ºF) and +850 ºC (1562 ºF).
Resolution.	0.1 ºC
Measuring error (25 ºC).	<± 0.2 %
Response time, from when the sensor is connected until the first correct measure is obtained.	4 s.
Typical consumption of each input.	0.5 mA.

5.3 Sizing of the remote groups.

Maximum number of modules in a group.

Each group (node) will consist of a leading (first) module, an end module (last) and a maximum of 64 intermediate modules; power supply modules, input modules, output modules, etc. In any case, a group without leading (first) module and with last module cannot be wider than 780 mm.

Module.	Width.	Maximum quantity.
Leading (first) module. • RIOW-CANOPEN-ECO. • RIOW-CANOPEN-STAND.	 50 mm 51 mm	1
Intermediate modules. • RIOW-PS24. Power supply module. • RIOW-8DI. Module of 8 digital inputs. • RIOW-8DO. Module of 8 digital outputs. • RIOW-4AI. Module of 4 analog inputs. • RIOW-4AO. Module of 4 analog outputs. • RIOW-2AI-PT100. Module of 2 inputs for PT100 sensors.	12 mm	64
Last Module. • RIOW-END.	12 mm	1

Sizing of the group depending on the consumption at the bus.

The leading module is in charge of managing and feeding the internal bus of the group.

- The RIOW-CANOPEN-ECO module supplies a voltage of 5 V DC 1 A. This module consumes 350 mA at 5 V; therefore, it can supply a maximum of 650 mA to the rest of the modules.
- The RIOW-CANOPEN-STAND module supplies a voltage of 5 V DC 2 A. This module consumes 350 mA at 5 V; therefore, it can supply a maximum of 1650 mA to the rest of the modules.

If when configuring the remote group, the consumption at the bus exceeds the maximum value that the leading module can supply, duplicate the group.

Module.	Internal consumption of the module.
RIOW-CANOPEN-ECO.	350 mA.
RIOW-CANOPEN-STAND.	350 mA.
RIOW-END.	0 mA.
RIOW-PS24.	0 mA.
RIOW-8DI.	17 mA.
RIOW-8DO.	25 mA.
RIOW-4AI.	65 mA.
RIOW-4AO.	125 mA.
RIOW-2AI-PT100.	80 mA.

Example: In a group made up of 1 RIOW-CANOPEN-ECO module, 5 RIOW-8DI modules and 10 RIOW-8DO modules, the total consumption will be 685 mA.

RIOW-CANOPEN-ECO.	350 mA.
RIOW-PS24.	0 mA.
RIOW-8DI.	5 x 17 mA
RIOW-8DO.	10 x 25 mA
RIOW-END.	0 mA.

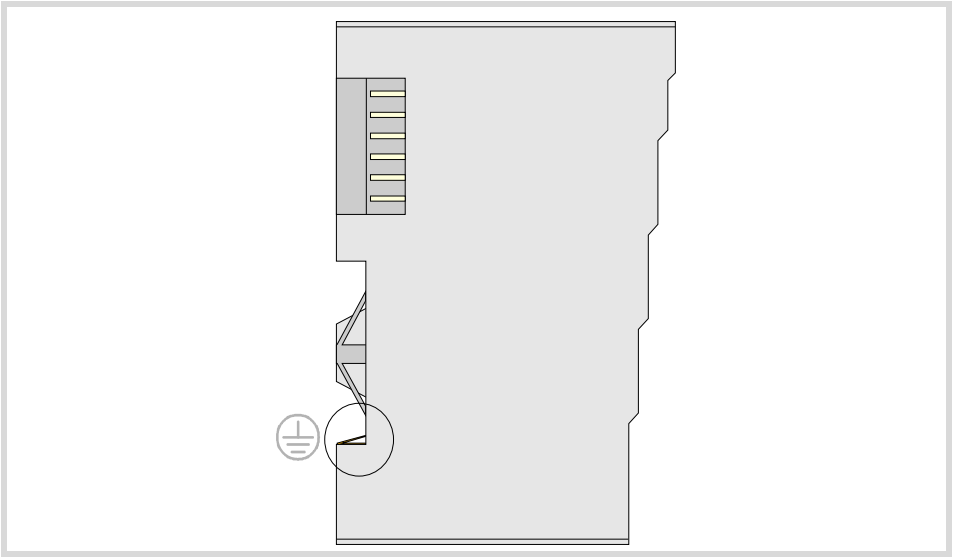
5.4 Installation of the modules.

DO NOT make any connection or connect any module or cable if the group is under power. Before making any connection, disconnect the power supply cable of the leading (first) module (RIOW-CANOPEN) and, if necessary, that of the power supply module (RIOW-PS24).

Place the modules on 1 profile, according to the European regulation EN50022 (DIN 35), with 2 securing ends, one at each end of the group to help secure the modules. RIOW series modules may be mounted horizontally or vertically; when mounting them vertically, use additional mounting blocks at the bottom to secure the modules.

Ground connection.

The profiles on which the modules are mounted must be connected to the system ground because some modules make contact with the profile to connect to ground. To connect the profiles to ground, use a cable with a minimum section of 4 mm². To ensure contact between the profile and the modules, the material of the profile must not be corrosive.



At the RIOW-PS24 module, the ground connection is done through the bottom pins of the module. The ground connection is extended to the adjacent modules through the side jumpers of the module.

Shield connection.

Proper shielding of the signal and data cables reduces interference and improves signal quality while preventing measuring and data transmission errors. The cables must be continuously shielded to ensure compliance with the technical specifications related to measuring accuracy.

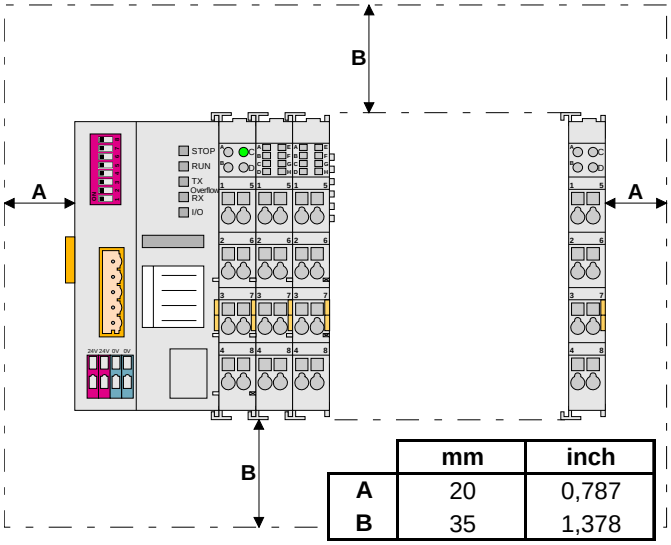
Ambient characteristics of the enclosure.

The temperature of the cabinet (enclosure) where the modules are mounted must not exceed 55 ºC (131ºF) when the modules are working. The heat dissipated by all the modules must not exceed the heating capability of the cabinet where they are installed.

Element	Dissipated power
Leading (first) module.	2.0 watts.
Rest of modules.	0.8 W per module.

Clearance recommended around a group.

It is recommended to leave a gap between the group and the adjacent elements (other groups, cable carrying channels, enclosure walls, etc.) for better ventilation and easier handling of the unit later on.

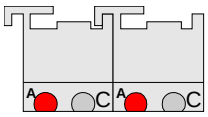


	mm	inch
A	20	0,787
B	35	1,378

How to mount and dismount the modules.

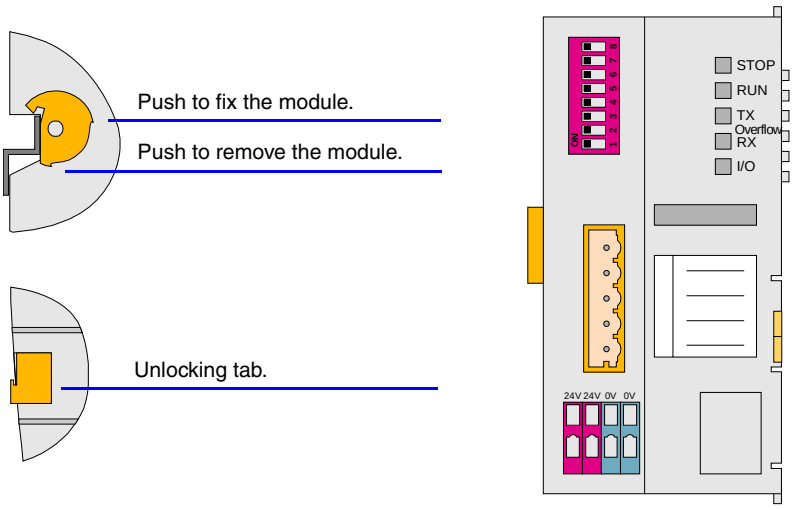
Since the communication between the modules is done through the six-pin connector on the side of the modules, they must be latched to each other.

Do not touch the side pins of the bus to avoid soiling them, damaging them and any possible electrostatic discharges that could damage the module.



To ensure that the modules are joined together, they have some tabs on top and at the bottom. To join the modules together, slide each module onto the previous one, from top to bottom, making sure that the tabs latch onto each other.

Always mount the modules from left to right beginning with the leading module and always ending the group with the end module (last). To fix the leading module, once mounted on the rail, push onto the top groove of the locking disk located on the left side of the module. To free the module and be able to remove it from the rail, push on the bottom groove of the locking disk. To help remove a module from the rail, pull the unlocking tab located on the right side of the module.



Side voltage jumpers.

Some modules, e.g. the digital inputs module, have some jumpers on the left side for receiving and sending a current of 10 A needed to supply the module.

The jumpers of a module must latch into the grooves of the previous module. It must be borne in mind that not all the modules have the same number of jumpers and grooves. Before mounting a module with jumpers, make sure that the previous module has enough grooves to receive the jumpers.



The voltage jumpers are sharp. Handle the modules carefully to prevent getting hurt.

Cable connection.



DO NOT make any connection or connect any module or cable if the group is under power. Before making any connection, disconnect the power supply cable of the leading (first) module (RIOW-CANOPEN) and, if necessary, that of the power supply module (RIOW-PS24).

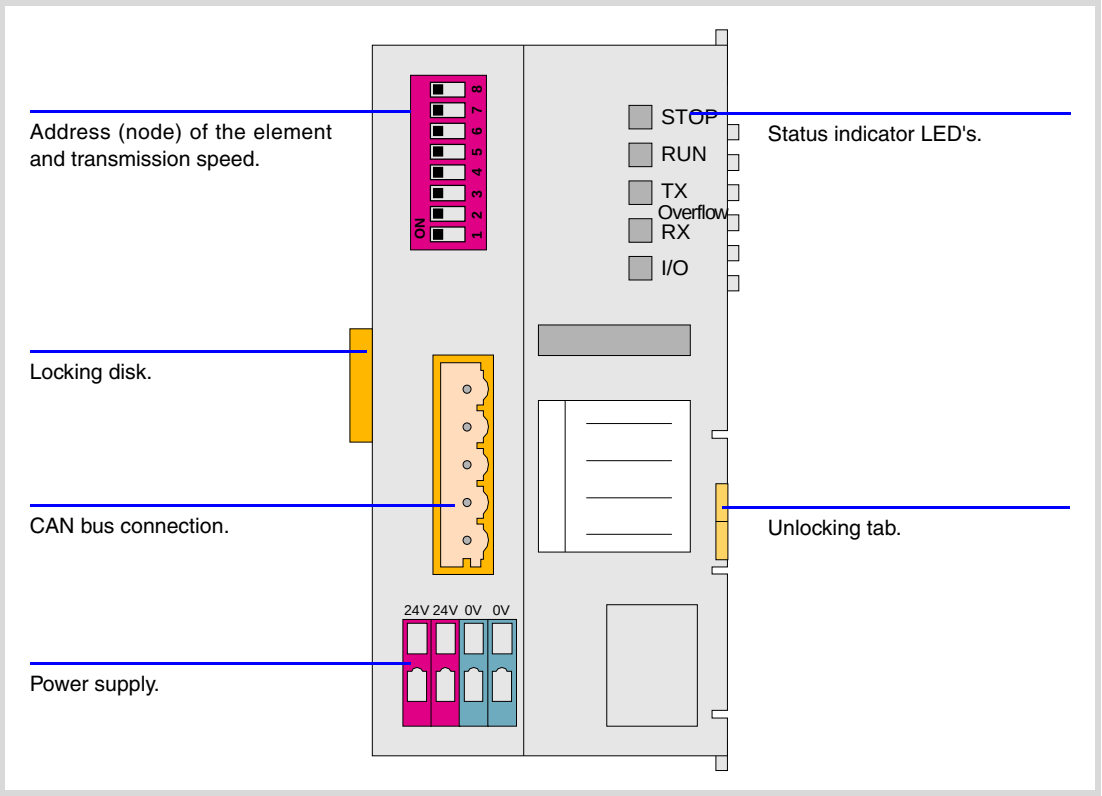
Each connector only admits one cable. To insert several cables into one connector, join the cables at a terminal and insert the terminal into the connector.

The cables are secured into the connectors by pressure. Insert a tool into the square hole located on top of the connector, this opens the connector. Insert the cable into the connector and remove the tool. After removing the tool, the cable stays fixed.

5.5 RIOW-CANOPEN-ECO module. Leading (first) module.

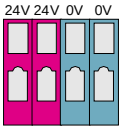
The RIOW-CANOPEN-ECO module must be present in all the groups and must be the first module of the group. This module is in charge of managing the internal bus of the group and connecting the group to the CAN bus of the system.

Power the module with an external 24V DC (between -15% and +20%) regulated power supply.

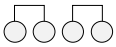


5.5.1 Elements (connectors).

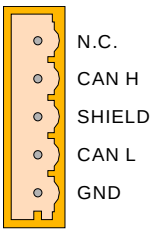
Power supply.



Signal	Function
24 V	Power supply.
0 V	Power supply.

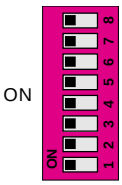


CAN bus connection.



Pin	Signal	Function
5	N.C.	Not being used.
4	CAN H	(HIGH) bus signal.
3	SHIELD	CAN shield.
2	CAN L	(LOW) bus signal.
1	GND	Ground / 0 V.

Address (node) of the element and transmission speed.



The dipswitch may be used to select the address of the node and the transmission speed. See *"5.5.2 Node configuration."* on page 77.

When using the CANopen protocol, the transmission speed at the bus is defined in each node. All the nodes must work at the same speed.

The dip-switch of the RIOW-CANOPEN-ECO and RIOW-CANOPEN-STAND modules is the same but rotated 180º, so the ·ON· position is inverted between them.

Status indicator LED's.

The module has the following LED's on top. These LED's indicate the status of the node and of the communication through the CAN bus. See *"5.5.3 Meaning of the LED's."* on page 79.

LED.	Color.	Meaning.
STOP	Red.	The node is stopped.
RUN	Green.	The node works properly.
TX overflow	Red.	Data sending error.
RX overflow	Red.	Data reception error.
I/O	Red. Green. Orange.	Status of the communication with the I/O modules.

5.5.2 Node configuration.

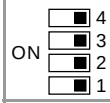
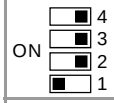
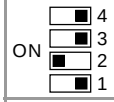
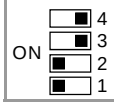
The node is configured using the dipswitches to select the node address and the transmission speed.

Configuring the node speed.

To select the speed of the node, the module must be in configuration mode (all the dipswitches in the ·off· position). After turning the module on in configuration mode, the top 4 LED's of the module blink indicating the speed selected at the module. The STOP LED corresponds to dipswitch ·1·, the RUN to dipswitch ·2·, the TX to dipswitch ·3· and the RX to dipswitch ·4·. The first time the module is configured, the TX LED blinks indicating that no valid speed has been selected.

If when turning the module on, all the dipswitches are not in the ·off· position, the position of the dipswitches will be the new address (node number) of the group.

The first 4 dipswitches are used to select the speed; the rest must be in the ·off· position. To select the speed, put the corresponding dipswitches in the ·on· position. The transmission speed depends on the total length of the cable. Use the following approximate values. Assigning other values may cause communication errors due to signal distortion.

Dipswitch	Speed	Length of the CAN bus.
	1000 kHz	Up to 20 meters.
	800 kHz	From 20 to 40 meters.
	500 kHz	From 40 to 100 meters.
	250 kHz	From 100 to 500 meters.

To save the selected speed, put dipswitch ·8· in the ·on· position. After saving the configuration, the corresponding LED's turn on to indicate the module speed. For 1 MHz, all four LED's turn on.

Once the speed has been selected, turn the module off by removing power and set dip-switch ·8· in the ·off· position. Bear in mind that the next time the module is turned on, the position of the dipswitches will indicate the address (node number) of the group.

Configuring the address (node number) of the group.

Each one of the elements integrated into the CAN bus is identified by its address or node number. The CNC must always occupy position "0" and the rest of the elements of the bus will occupy consecutive positions starting with 1.

The address (node number) of the group is selected while the module is off. Select the speed by putting the corresponding dipswitches in the ·on· position. The binary meaning of each dipswitch increases according to its number; dipswitch ·1· for address 1, dipswitch ·3· for address 4 and so on.

		
Address ·1·.	Address ·3·.	Address ·9·.

Line terminating resistor.

In the CAN bus, it is necessary to use a line terminating resistor to identify which are the elements that occupy the ends of the bus; i.e. the first and last physical element in the connection. For the central unit, the terminating resistor is factory installed because the CNC is always at one end of the bus.

The RIOW series modules do not have a factory-installed line terminating resistor. The RIOW module mounted at the end of the bus must have a 120 Ω line terminating resistor between pins CAN_H and CAN_L to avoid signal deflections (rebounds).

5.5.3 Meaning of the LED's.

While staring the module up, the LED's indicate the stage the node is in and its status.

Node status.	Meaning.
Initializing stage	After starting up or after a reset, the module goes into the initializing stage to run an autotest. During the initializing stage, the I/O LED blinks orange until it changes to red. • If the module is properly initialized, it changes to the pre-operative stage, the I/O LED changes to green and the RUN LED blinks. • If the module detects any problem in the initializing stage, it changes to the stop stage, the I/O LED blinks red and the STOP LED turns on. The blinking rate of the I/O LED indicates the detected error.
Pre-operative stage.	In this stage, the module configures the bus. During the pre-operative stage, the I/O LED turns green and the RUN LED blinks.
Operative stage.	In this stage, the module is ready to work. In the operative stage, the I/O and RUN LED's turn green.
Stop stage.	This stage indicates an error at the node. The STOP LED turns on in the stop stage.

When a module is in configuration mode (dipswitch value equal to ·0·), the LED's indicate the speed selected at the module. See *"5.5.2 Node configuration."* on page 77.

LED's STOP, RUN, TX overflow and RX overflow.

The top four LED's of the module (STOP, RUN, TX overflow and RX overflow) indicate the status of the node and of the communication through the CAN bus.

STOP	RUN	Meaning.
OFF	OFF	Module turned off or in initializing stage.
OFF	Blinking slow	Module in pre-operative stage.
OFF	ON	Module in operative stage.
ON	OFF	Module in stop stage. Node configuration error or bus error.
OFF	Blinking fast	Module in pre-operative stage. Module error.
Blinking fast	Blinking fast	Module in pre-operative stage. Module error.
Blinking fast	OFF	Module in pre-operative stage. Module error.

TX overflow	RX overflow	Meaning.
OFF	OFF	Module turned off or in initializing stage.
- - -	ON	Data reception error.
ON	- - -	Data sending error.
Blinking fast	Blinking fast	Too many errors at the node.

Led I/O.

Three-colored LED (orange/red/green) that indicates the bus status and the errors found.

Led I/O.	Meaning.
Off.	There's no data at the data bus.
Green.	The module is transmitting data.
Red.	Hardware error.

Led I/O.	Meaning.
Blinking orange.	The module is in the initializing stage.
Blinking red.	Data bus error.
Cyclic red blinking.	Error code.

Start the module up, the LED blinks orange until it changes to red. If the module is successfully initialized, the LED changes to green. If the module detects a problem the LED keeps blinking red. The module shows the error code, cyclically, by three blinking sequences.

- The first blinking sequence (10 Hz) indicates that there are errors at the node.
- After a pause, the module offers the second blinking sequence (1 Hz). The number of blinks indicates the error code.
- After a longer pause, the module offers the third blinking sequence (1 Hz). The number of blinks indicates the type of error.

Error 1: Hardware and configuration error at the node.

Type.	Description.	Solution.
1	Overflow at the internal data memory of the module.	Remove power from the node, reduce the number of modules and apply power to the node again. If the error persists, replace the leading (first) module.
2	Wrong I/O module at the node.	Replace wrong module. If the error persists, update the firmware of the leading (first) module. To locate the wrong module, repeat the following sequence as often as necessary. • Remove power from the node, place the end module in the middle of the node and apply power to the node again. • If the error persists, remove power from the node again, place the end module in the middle of the first half of the node and apply power to the node again. • If there are no errors, remove power from the node again, place the end module in the middle of the second half of the node and apply power to the node again. If there is only one I/O module left in the node, that module will be the wrong one.
3	Checksum error in EEPROM data.	Remove power from the node, replace the leading module and apply power to the node again.
4	Error while writing EEPROM.	Remove power from the node, replace the leading module and apply power to the node again.
5	Error while reading EEPROM.	Remove power from the node, replace the leading module and apply power to the node again.
6	The configuration of the I/O modules has changed after a reset.	Initialize the module by removing power and applying it again.
7	Reserved.	
8	Timeout error in the EEPROM.	Remove power from the node, replace the leading module and apply power to the node again.
9	Reserved.	

Error 2: Configuration error at the node.

Type.	Description.	Solution.
1	The image with the information on the modules is not active.	Contact Fagor Automation.
2	The image with the information on the modules is too large.	Remove power from the node, reduce the number of modules and apply power to the node again.
3	The image with the information on the modules is missing.	Contact Fagor Automation.

Error 3: Error in the protocol of the internal bus of the node.

Type.	Description.	Solution.
- - -	Communication error at the bus. Wrong module not found.	Replace wrong module. To locate the wrong module, repeat the following sequence as often as necessary. • Remove power from the node, place the end module in the middle of the node and apply power to the node again. • If the error persists, remove power from the node again, place the end module in the middle of the first half of the node and apply power to the node again. • If there are no errors, remove power from the node again, place the end module in the middle of the second half of the node and apply power to the node again. If there is only one I/O module left in the node, that module or the leading module will be the wrong one.

Error 4: Physical error in the internal bus of the node.

Type.	Description.	Solution.
- - -	Communication error at the bus or the bus is interrupted.	Replace wrong module. Place an I/O module after the leading module and check if it causes an error. If there are no errors, replace the leading (first) module. If the leading module is correct, replace the wrong I/O module. To locate the wrong module, repeat the following sequence as often as necessary. • Remove power from the node, place the end module in the middle of the node and apply power to the node again. • If the error persists, remove power from the node again, place the end module in the middle of the first half of the node and apply power to the node again. • If there are no errors, remove power from the node again, place the end module in the middle of the second half of the node and apply power to the node again. If there is only one I/O module left in the node, that module or the leading module will be the wrong one.
n	The bus is interrupted after the n-th module. The number of blinks indicates the n position of the I/O module.	Remove power from the node, replace the (n+1)th module and apply power to the node again.

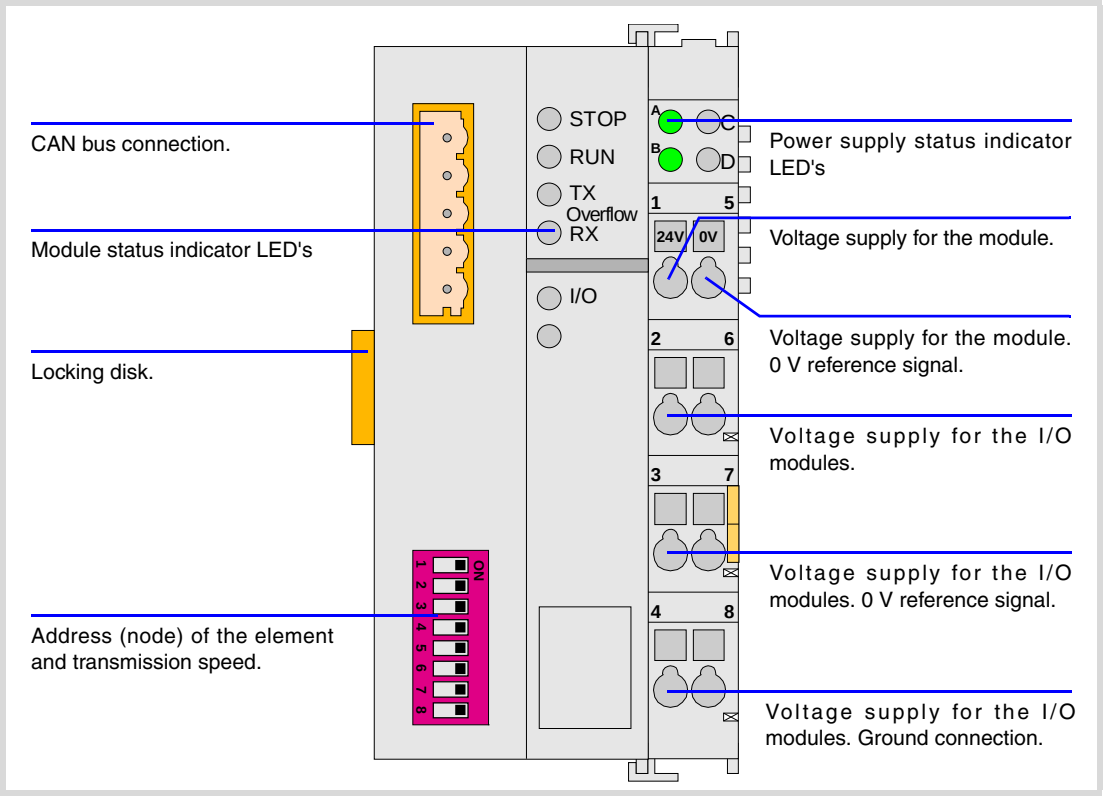
Error 5: Internal-bus initializing error.

Type.	Description.	Solution.
n	Communication error while initializing the module. The number of blinks indicates the n position of the I/O module.	Remove power from the node, replace the n-th module and apply power to the node again.

5.6 RIOW-CANOPEN-STAND module. Leading (first) module.

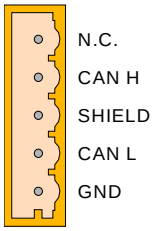
The RIOW-CANOPEN-STAND module must be present in all the groups and must be the first module of the group. This module is in charge of managing the internal bus of the group, connecting the group to the system CAN bus and supplying power to the I/O modules through the side jumpers with 24 V 10A. If when configuring the remote group, the consumption of the I/O modules is higher, additional RIOW-PS24 modules must be added.

Power the module with an external 24V DC (between -15% and +20%) regulated power supply. Using the wrong voltage may cause severe damage to the components.



5.6.1 Elements (connectors).

CAN bus connection.



Pin	Signal	Function
5	N.C.	Not being used.
4	CAN H	(HIGH) bus signal.
3	SHIELD	CAN shield.
2	CAN L	(LOW) bus signal.
1	GND	Ground / 0 V.

Address (node) of the element and transmission speed.



The dipswitch may be used to select the address of the node and the transmission speed. See *"5.6.3 Node configuration."* on page 86.

When using the CANopen protocol, the transmission speed at the bus is defined in each node. All the nodes must work at the same speed.

The dip-switch of the RIOW-CANOPEN-ECO and RIOW-CANOPEN-STAND modules is the same but rotated 180º, so the ·ON· position is inverted between them.

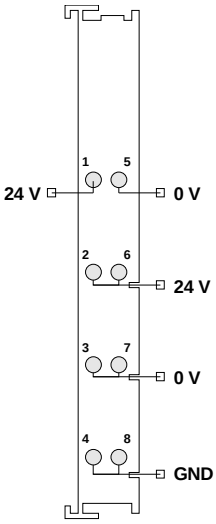
Status indicator LED's.

The module has the following LED's on top. These LED's indicate the status of the node and of the communication through the CAN bus. See *"5.6.4 Meaning of the LED's."* on page 88.

LED.	Color.	Meaning.
STOP	Red.	The node is stopped.
RUN	Green.	The node works properly.
TX overflow	Red.	Data sending error.
RX overflow	Red.	Data reception error.

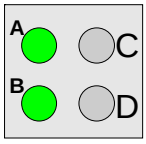
LED.	Color.	Meaning.
I/O	Green.	Status of the communication with the I/O modules.
I/O	Red.	Status of the communication with the I/O modules.

Power supply.



Pin	Function
1	Voltage supply for the module. 24V power input.
5	Voltage supply for the module. 0 V reference signal.
2 - 6	Voltage supply for the I/O modules. 24V power input.
3 - 7	Voltage supply for the I/O modules. 0 V reference signal.
4 - 8	Voltage supply for the I/O modules. Ground connection.

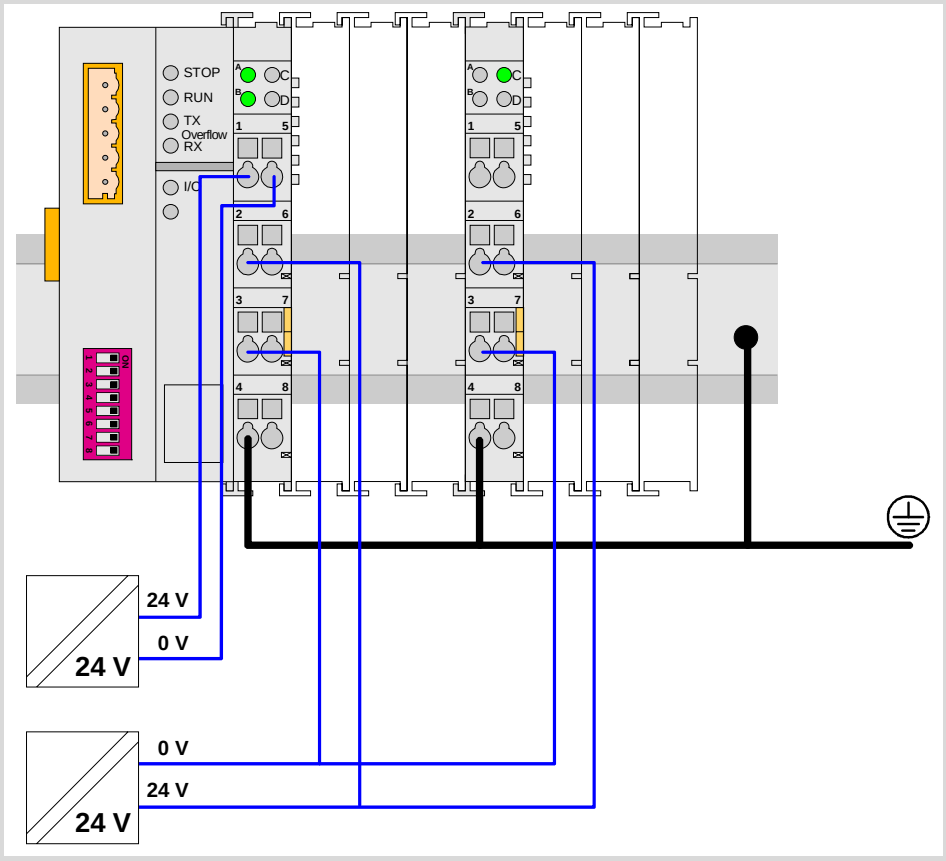
Power supply status indicator LED's



Led	Color	Function
A	Green	The LED turns on when the module is under power.
B	Green	The LED turns on if the side jumpers have 24 V.

5.6.2 Voltage supply for the module.

Power for the module and for the rest of the modules must be separated in order to ensure the operations in the bus in case of a short-circuit on the side of the actuator.



5.6.3 Node configuration.

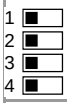
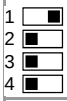
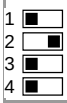
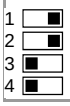
The node is configured using the dipswitches to select the node address and the transmission speed.

Configuring the node speed.

To select the speed of the node, the module must be in configuration mode (all the dipswitches in the ·off· position). After turning the module on in configuration mode, the top 4 LED's of the module blink indicating the speed selected at the module. The STOP LED corresponds to dipswitch ·1·, the RUN to dipswitch ·2·, the TX to dipswitch ·3· and the RX to dipswitch ·4·. The first time the module is configured, the TX LED blinks indicating that no valid speed has been selected.

If when turning the module on, all the dipswitches are not in the ·off· position, the position of the dipswitches will be the new address (node number) of the group.

The first 4 dipswitches are used to select the speed; the rest must be in the ·off· position. To select the speed, put the corresponding dipswitches in the ·on· position. The transmission speed depends on the total length of the cable. Use the following approximate values. Assigning other values may cause communication errors due to signal distortion.

Dipswitch	Speed	Length of the CAN bus.
	1000 kHz	Up to 20 meters.
	800 kHz	From 20 to 40 meters.
	500 kHz	From 40 to 100 meters.
	250 kHz	From 100 to 500 meters.

To save the selected speed, put dipswitch ·8· in the ·on· position. After saving the configuration, the corresponding LED's turn on to indicate the module speed. For 1 MHz, all four LED's turn on.

Once the speed has been selected, turn the module off by removing power and set dip-switch ·8· in the ·off· position. Bear in mind that the next time the module is turned on, the position of the dipswitches will indicate the address (node number) of the group.

Configuring the address (node number) of the group.

Each one of the elements integrated into the CAN bus is identified by its address or node number. The CNC must always occupy position "0" and the rest of the elements of the bus will occupy consecutive positions starting with 1.

The address (node number) of the group is selected while the module is off. Select the speed by putting the corresponding dipswitches in the ·on· position. The binary meaning of each dipswitch increases according to its number; dipswitch ·1· for address 1, dipswitch ·3· for address 4 and so on.

		
Address ·1·.	Address ·3·.	Address ·9·.

Line terminating resistor.

In the CAN bus, it is necessary to use a line terminating resistor to identify which are the elements that occupy the ends of the bus; i.e. the first and last physical element in the connection. For the central unit, the terminating resistor is factory installed because the CNC is always at one end of the bus.

The RIOW series modules do not have a factory-installed line terminating resistor. The RIOW module mounted at the end of the bus must have a 120 Ω line terminating resistor between pins CAN_H and CAN_L to avoid signal deflections (rebounds).

5.6.4 Meaning of the LED's.

While staring the module up, the LED's indicate the stage the node is in and its status.

Node status.	Meaning.
Initializing stage	After starting up or after a reset, the module goes into the initializing stage to run an autotest. During the initializing stage, the I/O LED blinks orange until it changes to red. • If the module is properly initialized, it changes to the pre-operative stage, the I/O LED changes to green and the RUN LED blinks. • If the module detects any problem in the initializing stage, it changes to the stop stage, the I/O LED blinks red and the STOP LED turns on. The blinking rate of the I/O LED indicates the detected error.
Pre-operative stage.	In this stage, the module configures the bus. During the pre-operative stage, the I/O LED turns green and the RUN LED blinks.
Operative stage.	In this stage, the module is ready to work. In the operative stage, the I/O and RUN LED's turn green.
Stop stage.	This stage indicates an error at the node. The STOP LED turns on in the stop stage.

When a module is in configuration mode (dipswitch value equal to ·0·), the LED's indicate the speed selected at the module. See *"5.6.3 Node configuration."* on page 86.

LED's STOP, RUN, TX overflow and RX overflow.

The top four LED's of the module (STOP, RUN, TX overflow and RX overflow) indicate the status of the node and of the communication through the CAN bus.

STOP	RUN	Meaning.
OFF	OFF	Module turned off or in initializing stage.
OFF	Blinking slow	Module in pre-operative stage.
OFF	ON	Module in operative stage.
ON	OFF	Module in stop stage. Node configuration error or bus error.
OFF	Blinking fast	Module in pre-operative stage. Module error.
Blinking fast	Blinking fast	Module in pre-operative stage. Module error.
Blinking fast	OFF	Module in pre-operative stage. Module error.

TX overflow	RX overflow	Meaning.
OFF	OFF	Module turned off or in initializing stage.
- - -	ON	Data reception error.
ON	- - -	Data sending error.
Blinking fast	Blinking fast	Too many errors at the node.

Led I/O.

Three-colored LED (orange/red/green) that indicates the bus status and the errors found.

Led I/O.	Meaning.
off	There's no data at the data bus
Green.	The module is transmitting data.
Red.	Hardware error.
Blinking orange.	The module is in the initializing stage.
Blinking red.	Data bus error.
Cyclic red blinking.	Error code.

Start the module up, the LED blinks orange until it changes to red. If the module is successfully initialized, the LED changes to green. If the module detects a problem the LED keeps blinking red. The module shows the error code, cyclically, by three blinking sequences.

- The first blinking sequence (10 Hz) indicates that there are errors at the node.
- After a pause, the module offers the second blinking sequence (1 Hz). The number of blinks indicates the error code.
- After a longer pause, the module offers the third blinking sequence (1 Hz). The number of blinks indicates the type of error.

Error 1: Hardware and configuration error at the node.

Type.	Description.	Solution.
- - -	Checksum error in the data.	Remove power from the node, reduce the number of I/O modules and apply power to the node again.
1	Overflow at the internal data memory of the module.	Remove power from the node, reduce the number of I/O modules and apply power to the node again. If the error persists, replace the leading (first) module.
2	Wrong I/O module at the node.	Replace wrong module. If the error persists, update the firmware of the leading (first) module. To locate the wrong module, repeat the following sequence as often as necessary. • Remove power from the node, place the end module in the middle of the node and apply power to the node again. • If the error persists, remove power from the node again, place the end module in the middle of the first half of the node and apply power to the node again. • If there are no errors, remove power from the node again, place the end module in the middle of the second half of the node and apply power to the node again. If there is only one I/O module left in the node, that module will be the wrong one.
3	The type of module stored in the flash cannot be identified or is wrong.	Remove power from the node, replace the leading module and apply power to the node again.
4	Error while writing in Flash memory.	Remove power from the node, replace the leading module and apply power to the node again.
5	Error while deleting the Flash memory.	Remove power from the node, replace the leading module and apply power to the node again.
6	The configuration of the I/O modules has changed after a reset.	Initialize the module by removing power and applying it again.
7	Error when writing EEPROM data.	Remove power from the node, replace the leading module and apply power to the node again.
8	Wrong hardware and firmware combination.	Remove power from the node, replace the leading module and apply power to the node again.
9	Checksum error in the EEPROM.	Remove power from the node, replace the leading module and apply power to the node again.
10	Error when initializing the EEPROM.	Remove power from the node, replace the leading module and apply power to the node again.
11	Timeout error when reading EEPROM data.	Remove power from the node, replace the leading module and apply power to the node again.
12	Timeout error when writing EEPROM data.	Remove power from the node, replace the leading module and apply power to the node again.
13	Reserved.	
14	Reserved.	

Error 2: Not being used.

Type.	Description.	Solution.
- - -	Not being used	- - -

Error 3: Error in the protocol of the internal bus of the node.

Type.	Description.	Solution.
- - -	Communication error at the bus. Wrong module not found.	Replace wrong module. To locate the wrong module, repeat the following sequence as often as necessary. • Remove power from the node, place the end module in the middle of the node and apply power to the node again. • If the error persists, remove power from the node again, place the end module in the middle of the first half of the node and apply power to the node again. • If there are no errors, remove power from the node again, place the end module in the middle of the second half of the node and apply power to the node again. If there is only one I/O module left in the node, that module or the leading module will be the wrong one.

Error 4: Physical error in the internal bus of the node.

Type.	Description.	Solution.
- - -	Communication error at the bus or the bus is interrupted.	Replace wrong module. Place an I/O module after the leading module and check if it causes an error. If there are no errors, replace the leading (first) module. If the leading module is correct, replace the wrong I/O module. To locate the wrong module, repeat the following sequence as often as necessary. • Remove power from the node, place the end module in the middle of the node and apply power to the node again. • If the error persists, remove power from the node again, place the end module in the middle of the first half of the node and apply power to the node again. • If there are no errors, remove power from the node again, place the end module in the middle of the second half of the node and apply power to the node again. If there is only one I/O module left in the node, that module or the leading module will be the wrong one.
n	The bus is interrupted after the n-th module. The number of blinks indicates the n position of the I/O module.	Remove power from the node, replace the (n+1)th module and apply power to the node again.

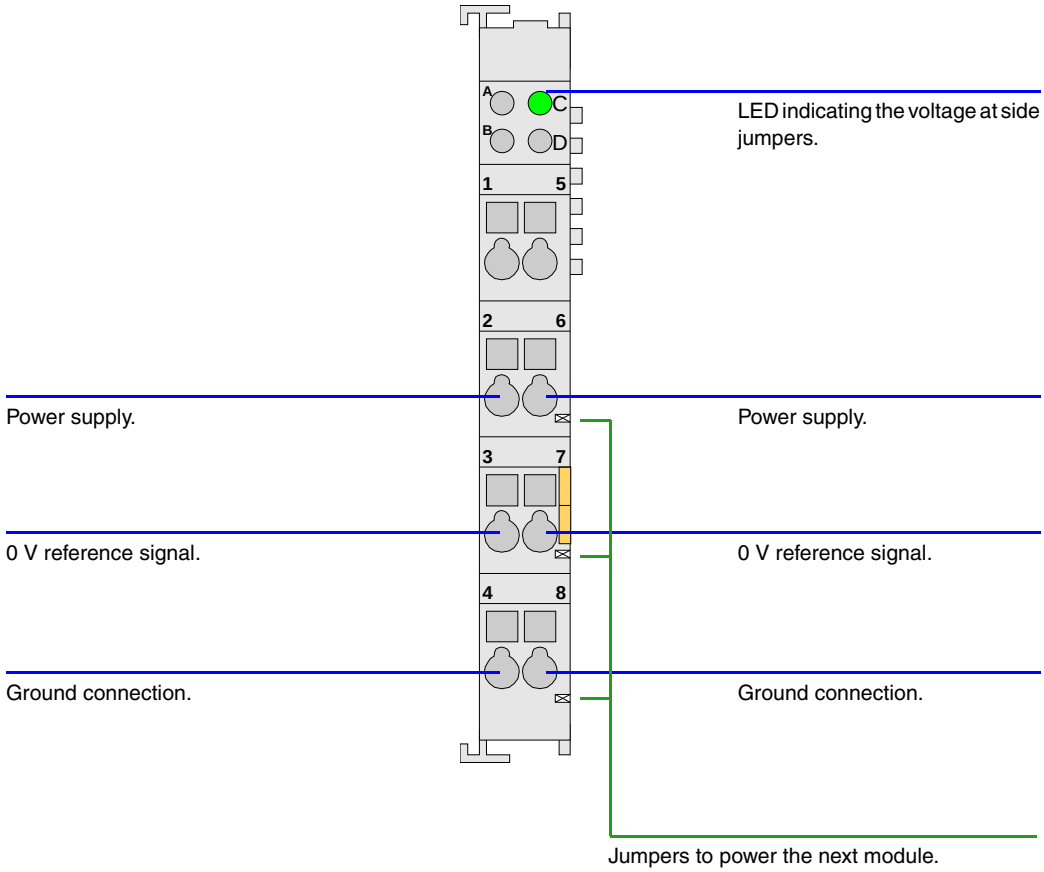
Error 5: Internal-bus initializing error.

Type.	Description.	Solution.
n	Communication error while initializing the module. The number of blinks indicates the n position of the I/O module.	Remove power from the node, replace the n-th module and apply power to the node again.

5.7 RIOW-PS24 module.

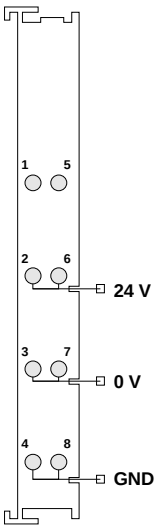
This module is in charge of supplying power to the I/O modules through the side jumpers with 24 V 10A. If when configuring the remote group, the consumption of the I/O modules is higher, additional RIOW-PS24 modules must be added.

Power the module with an external 24V DC regulated power supply.



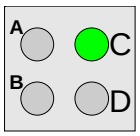
5.7.1 Elements (connectors).

Power supply.



Signal	Function
24 V	Power supply.
0 V	0 V reference signal.
GND	Ground connection.

Status indicator LED's.



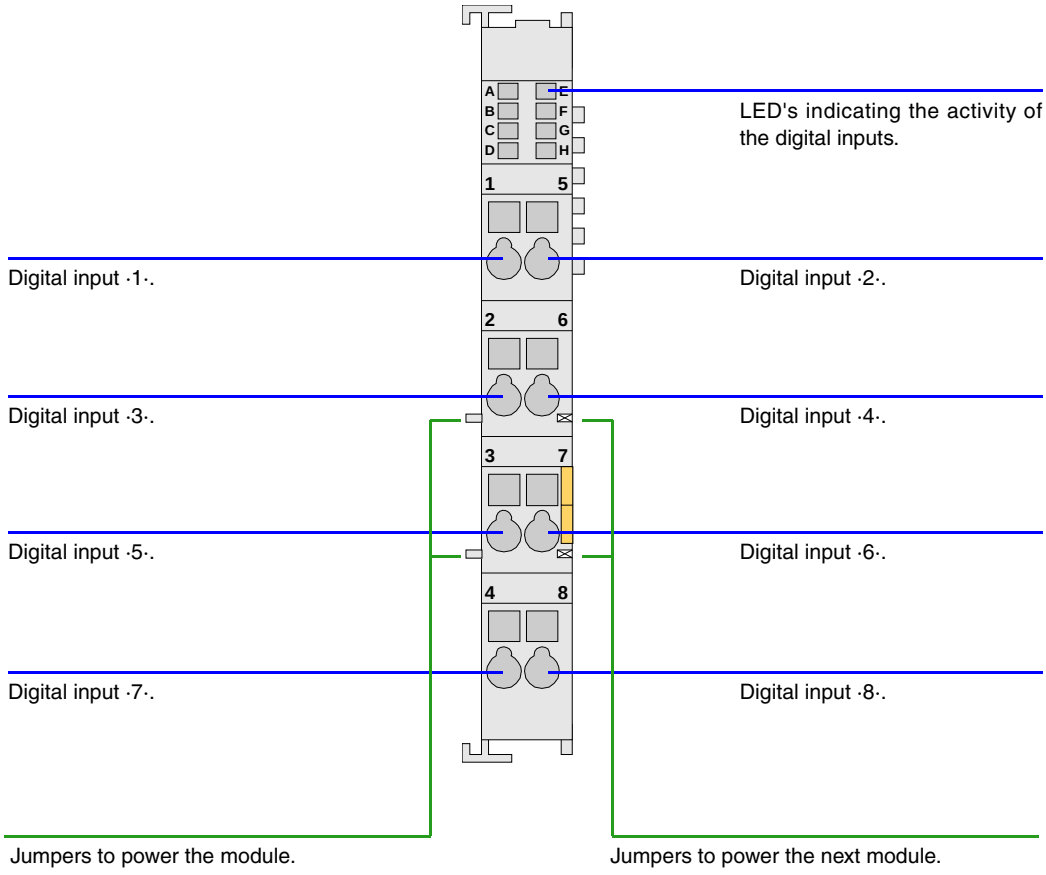
24 V

The LED is green. The LED turns on if the side jumpers have 24 V.

5.8 RIOW-8DI module. Module of 8 digital inputs.

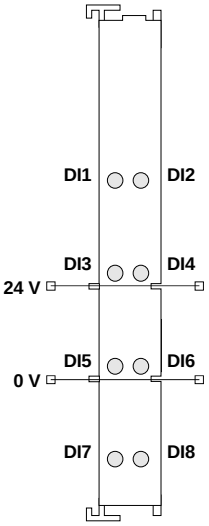
Expansion module with eight 24V DC digital inputs. The module has an LED indicating the status for each input.

The 24 V DC needed to power the module comes from the previous module (inputs, outputs module or power supply module) through the side power supplying jumpers). Likewise, this module can also power the next module through the same jumpers. This module, by itself, does not generate any voltage; it just receives the voltage generated by the previous RIOW-PS24 module and passes it on to the next module.



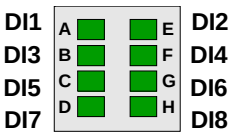
5.8.1 Elements (connectors).

Digital inputs (8 inputs).



Signal	Function
24 V	Power supply.
0 V	Power supply.
DI1 - DI8	Digital inputs.

Status indicator LED's.

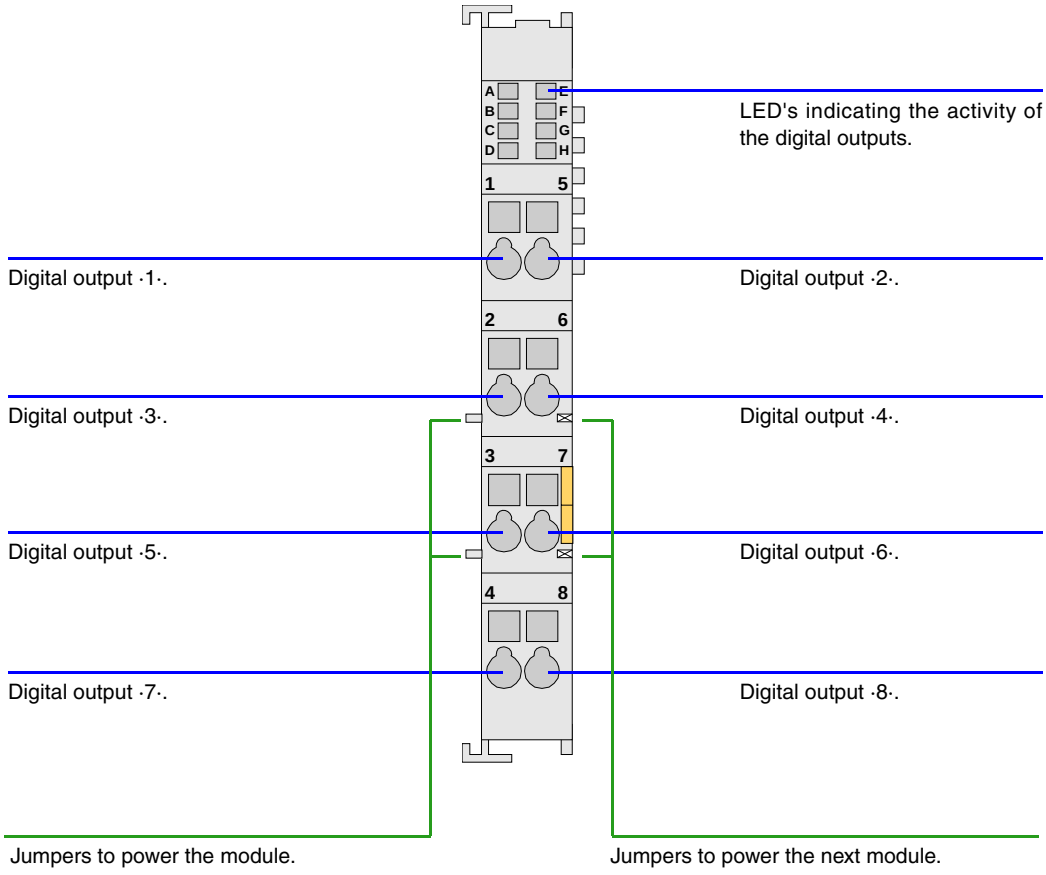


Green LED's. All digital inputs have a status indicating LED that turns on when the input is active.

5.9 RIOW-8DO module. Module of 8 digital outputs.

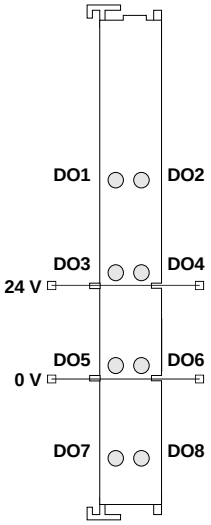
Expansion module with eight 24V DC 0,5 A digital outputs. The module has an LED indicating the status for each output.

The 24 V DC needed to power the module comes from the previous module (inputs, outputs module or power supply module) through the side power supplying jumpers). Likewise, this module can also power the next module through the same jumpers. This module, by itself, does not generate any voltage; it just receives the voltage generated by the previous RIOW-PS24 module and passes it on to the next module.



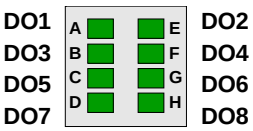
5.9.1 Elements (connectors).

Digital outputs (8 outputs).



Signal	Function
24 V	Power supply.
0 V	Power supply.
DO1 - DO8	Digital outputs.

Status indicator LED's.

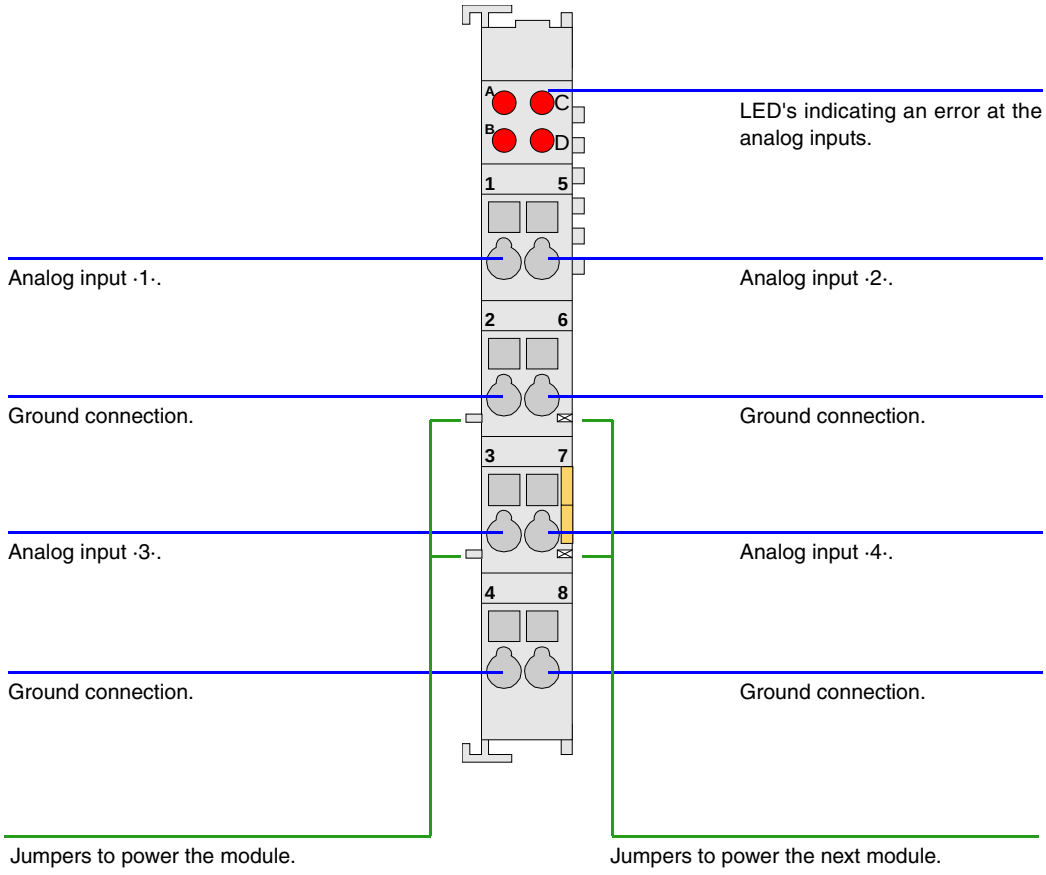


Green LED's. All digital outputs have a status indicating LED that turns on when the output is active.

5.10 RIOW-4AI module. Module of 4 analog inputs.

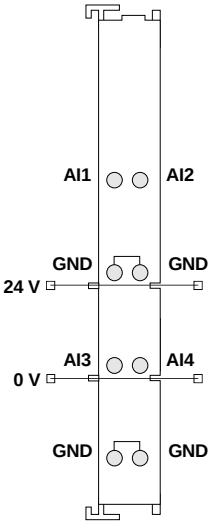
Expansion module with four ±10 V DC analog inputs. The module has an LED indicating the status for each input.

The 24 V DC needed to power the module comes from the previous module (inputs, outputs module or power supply module) through the side power supplying jumpers). Likewise, this module can also power the next module through the same jumpers. This module, by itself, does not generate any voltage; it just receives the voltage generated by the previous RIOW-PS24 module and passes it on to the next module.



5.10.1 Elements (connectors).

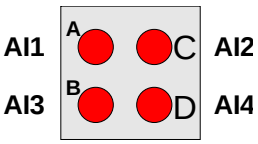
Analog inputs (4 inputs).



Signal	Function
AI1 - AI4	Analog inputs.
GND	Ground connection.
0 V	Power supply.
24 V	Power supply.

Connectors ·2· and ·6· are joined together internally.
Connectors ·4· and ·8· are joined together internally.

Status indicator LED's.

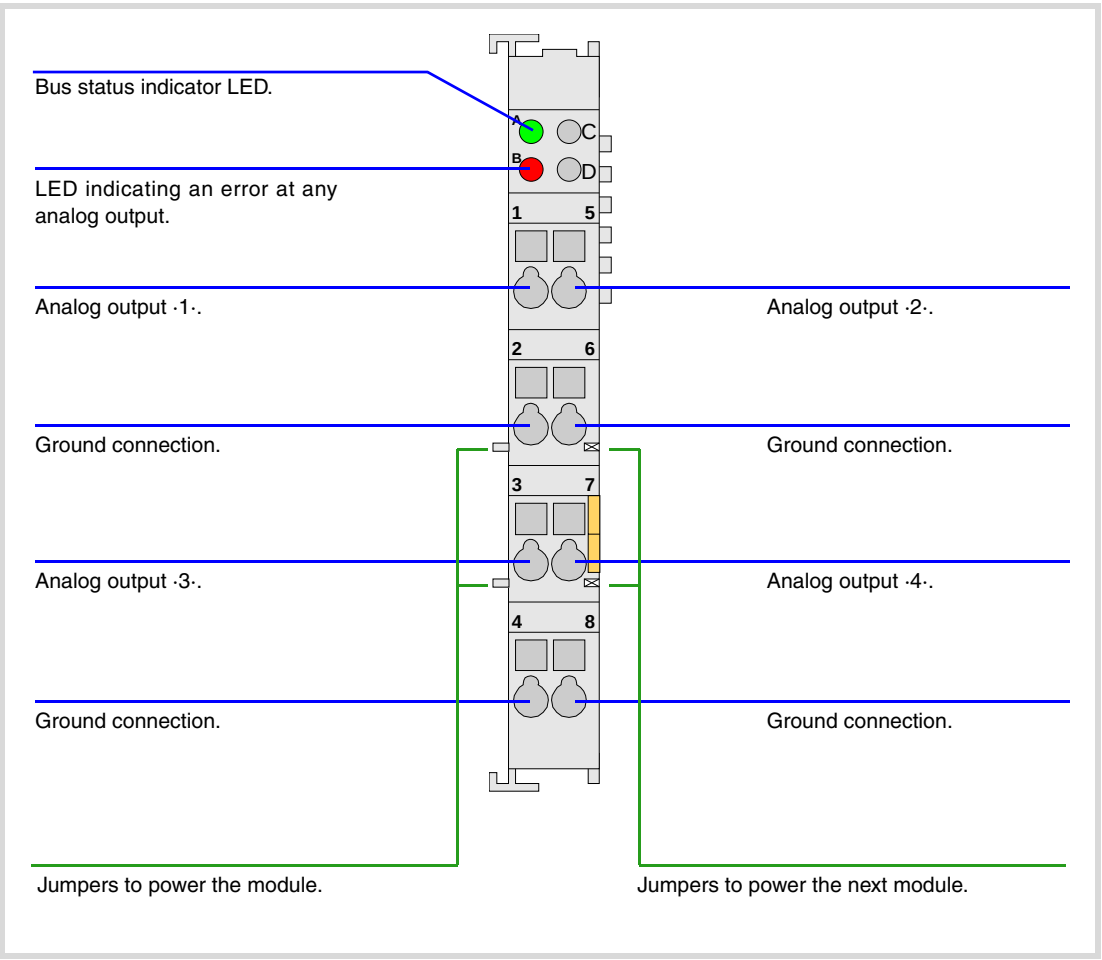


Red LED's. All analog inputs have a status indicating LED that turns on when there is an over-voltage or an under-voltage.

5.11 RIOW-4AO module. Module of 4 analog outputs.

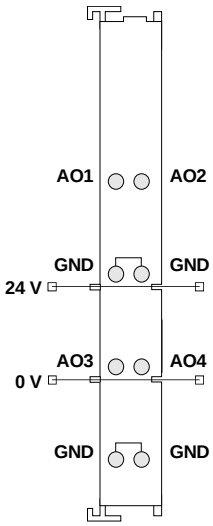
Expansion module with four ±10 V DC analog outputs. The module has an LED indicating the status of the bus an LED indicating an error at any of the outputs.

The 24 V DC needed to power the module comes from the previous module (inputs, outputs module or power supply module) through the side power supplying jumpers). Likewise, this module can also power the next module through the same jumpers. This module, by itself, does not generate any voltage; it just receives the voltage generated by the previous RIOW-PS24 module and passes it on to the next module.



5.11.1 Elements (connectors).

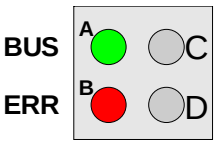
Analog outputs (4 outputs).



Signal	Function
AO1 - AO4	Analog outputs.
GND	Ground connection.
0 V	Power supply.
24 V	Power supply.

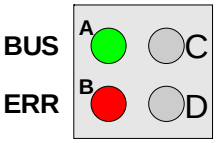
All ·GND· connectors are joined together internally.

Led ·BUS·. Data bus status.



Green LED's. The LED turns on when transmission at the bus is OK.

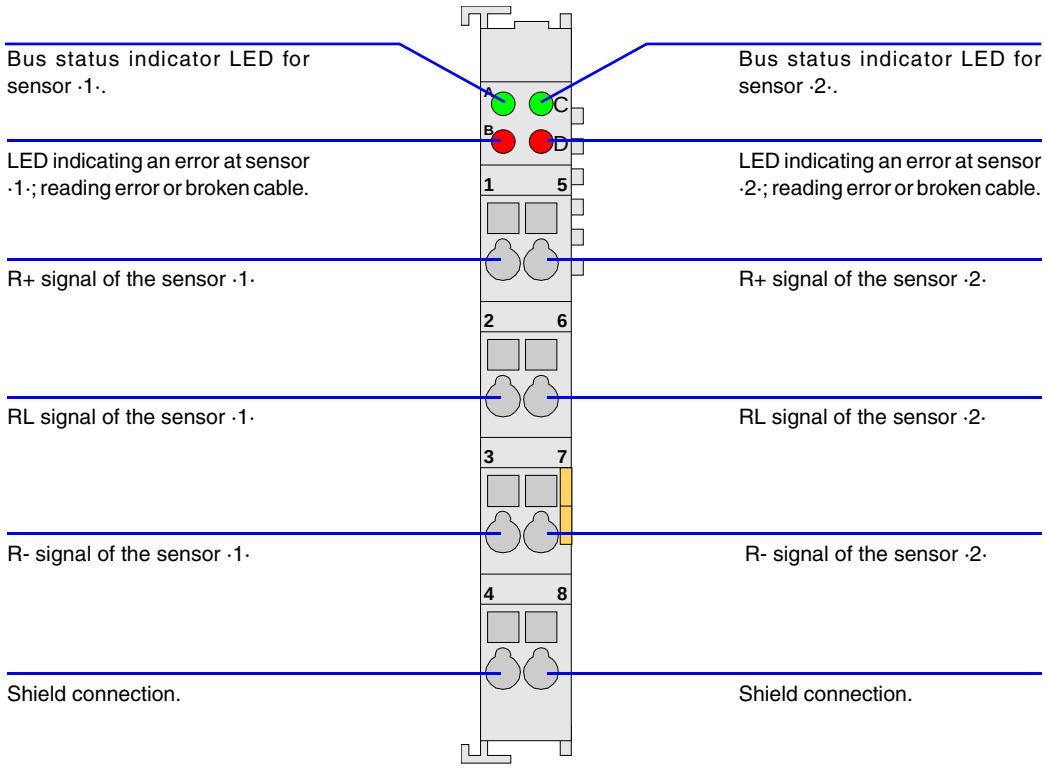
Led ·ERR·. Error at the outputs.



Red LED's. The LED turns on if there is an overload or a short-circuit to ground at any of the outputs.

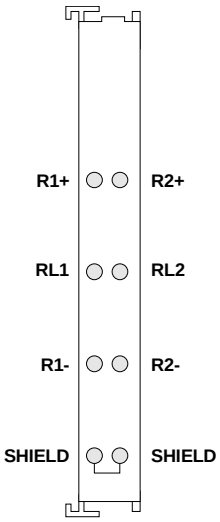
5.12 RIOW-2AI-PT100 module. Module of 2 inputs for PT100 temperature sensors.

Expansion module with 2 analog inputs for PT100 temperature sensors. Each input has an LED indicating the status of the bus an LED indicating a measuring error of the sensor.



5.12.1 Elements (connectors).

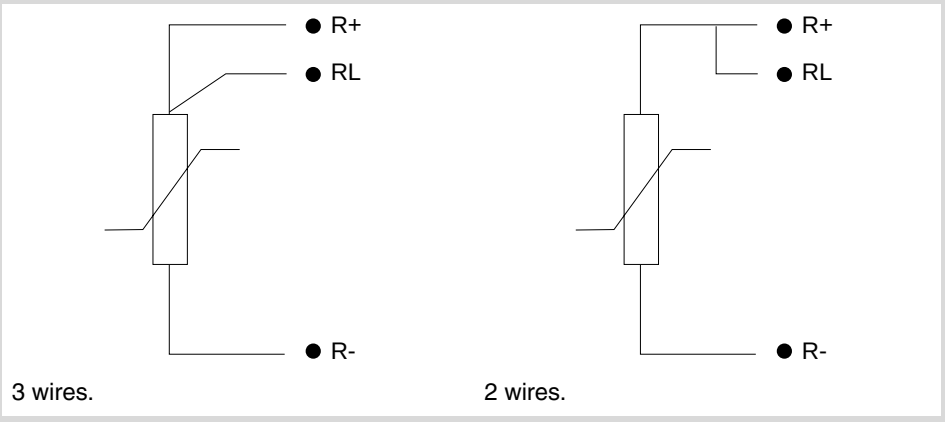
Analog inputs for PT100 temperature sensors (2 inputs).



Signal	Function
R1+ RL1 R1-	Signals of the PT100 sensor.
R2+ RL2 R2-	Signals of the PT100 sensor.
SHIELD	Grid.

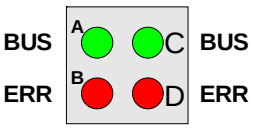
The shield connectors are internally joined together and are connected to the profile where the module is mounted

The module allows connecting sensors with a 2-wire or 3-wire interface.



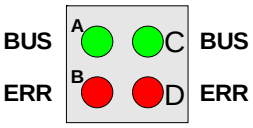
3 wires. 2 wires.

Led ·BUS·. Data bus status.



Green LED's. Both inputs have an LED that turns on when transmission at the bus is OK.

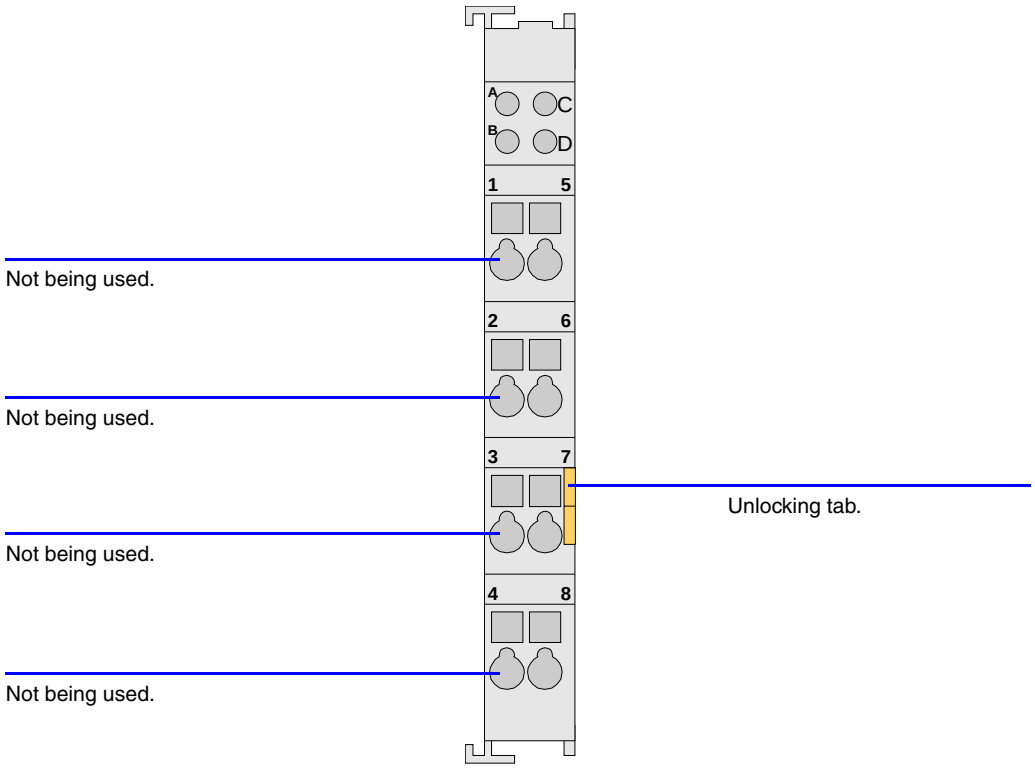
Led ·ERR·. Error at the outputs.



Red LED's. Both inputs have an LED that turns on when there is an input reading error; reading out of range or broken cable.

5.13 RIOW-END module. Last module of the group.

The RIOW-END module must be present in all the groups and must be the last module of the group. This module is used to end the internal bus of the group and ensure proper data flow.

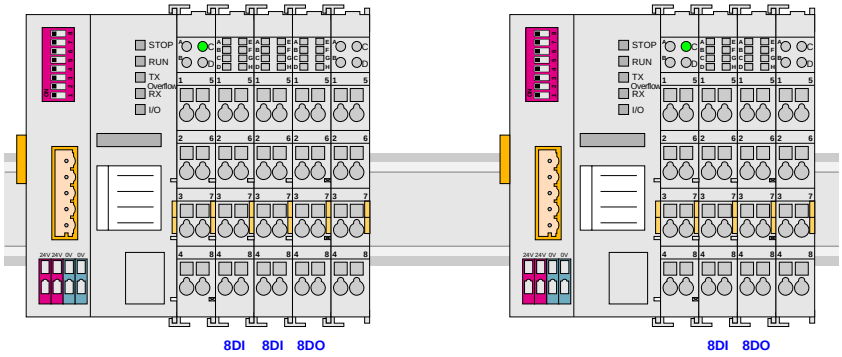


5.14 Numbering of the digital inputs and outputs.

Use machine parameters to set the number of digital I/O modules connected to the CAN bus. If these parameters are not defined, the CNC numbers the modules automatically according to the logic order of the remote groups.

Numbering according to the order of the remote groups.

The CNC numbers the modules automatically according to the logic order of the remote groups. Within each group, they are ordered from left to right.



Group ·1·	Group ·2·
8 + 8 digital inputs.	8 digital inputs.
8 digital outputs.	8 digital outputs.

Example 1.

	Group ·1· (address = 1)	Group ·2· (address = 2)
Digital inputs.	1 .. 8 9 .. 16	17 .. 24
Digital outputs.	1 .. 8	9 .. 16

Example 2.

	Group ·1· (address = 2)	Group ·2· (address = 1)
Digital inputs.	9 .. 16 17 .. 24	1 .. 8
Digital outputs.	9 .. 16	1 .. 8

Numbering by machine parameters.

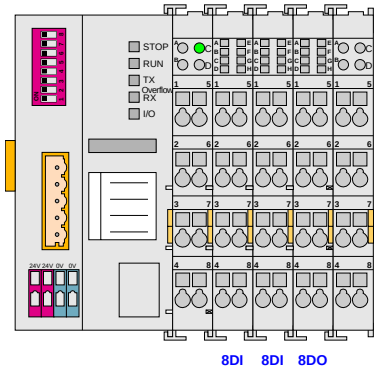
When the numbering is set by machine parameters, each module is assigned a base index and the inputs or outputs of that module are numbered after it.

The values of the base index must be comply with the formula "8n + 1" (i.e. 1, 9, 17, 25, etc.). The rest of the inputs or outputs are numbered sequentially. The base indexes may follow any order, they do not have to be sequential.

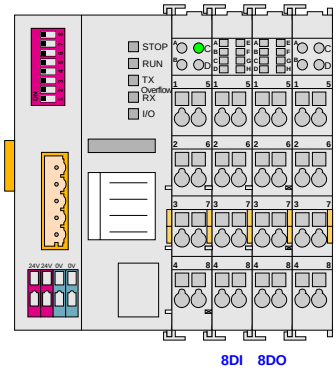
When inserting a new module, the first modules will be assigned the numbering of the table and the last one will be assigned the next valid base index after the highest one assigned until then.

Examples for numbering the different modules.

GROUP = 1



GROUP = 2



Remote group (1).

	Digital inputs		Digital inputs	
	Base index	Numbering	Base index	Numbering
module 1	1	1 ·· 8	81	81 ·· 88
module 2	33	33 ·· 40		

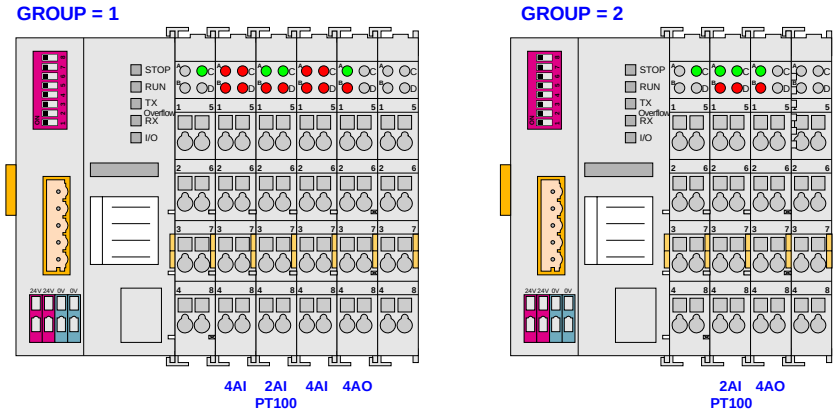
Remote group (2).

	Digital inputs		Digital inputs	
	Base index	Numbering	Base index	Numbering
module 1	113	113 ·· 120	49	49 ·· 56

5.15 Numbering of the analog inputs and outputs and of the temperature sensor inputs.

The CNC numbers the modules automatically according to the logic order of the remote groups. Within each group, they are ordered from left to right.

When numbering the analog inputs, the CNC considers the inputs for the temperature sensor as analog inputs. The CNC machine parameters must be set to indicate the number of PT100 inputs and to which analog inputs they are connected. A PT100 input is active if it has one of these temperature sensors connected to it. Refer to the installation manual for further detail.



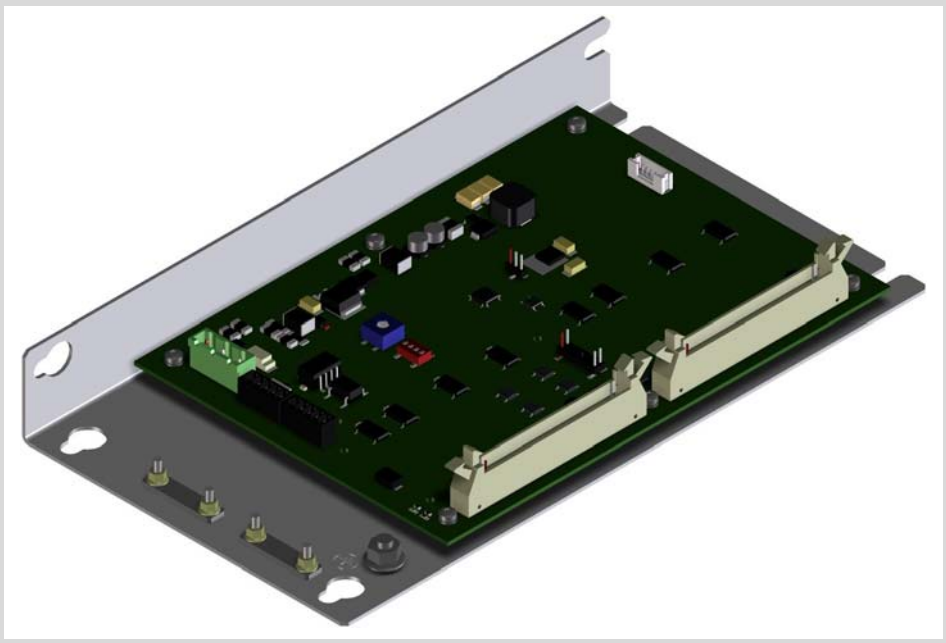
Group ·1·	Group ·2·
4 + 4 analog inputs.	4 analog inputs.
4 analog inputs.	2 PT100 inputs.
2 PT100 inputs.	

Example.

	Group ·1· (address = 1)	Group ·2· (address = 2)
Analog inputs. PT100 inputs. Analog inputs.	1 ·· 4 5 ·· 6 7 ·· 10	11 ·· 12
Analog outputs.	1 ·· 4	5 ·· 8

6 REMOTE MODULE RIOR. (CANOPEN PROTOCOL).

Remote modules may be used to have an additional number of digital and analog inputs and outputs (remote I/O) that placed in the cabinet, permit controlling various devices of the machine.



Each RIOR module offers the following elements.

Module	Descrlption.
RIOR-48DI-32DO	48 digital inputs. 32 digital outputs.

Each RIOR module constitutes a node inside the CAN bus, which may have up to 32 nodes, including the central unit and the keyboards. When the CNC works with CANopen bus, this bus lets combine in the bus groups (nodes) formed by the RIO5, RIOW and RIOR series modules; modules of different series cannot be combined in the same group. The maximum number of inputs and outputs available at the CANopen bus is the following.

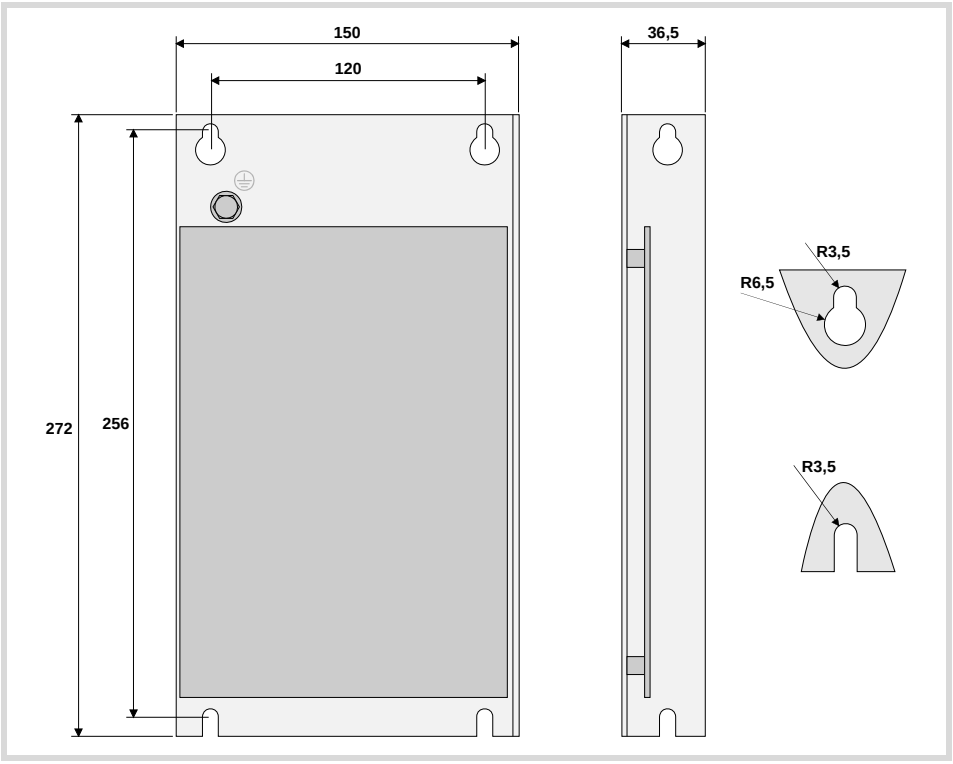
Type of input/output	Amount.
Digital inputs.	1024
Digital outputs.	1024

6.1 Dimensions and mounting of the module.

DO NOT make any connection or connect any module to the power supply while the latter is turned on. Before making any connection, turn the power supply off by unplugging the power cable.

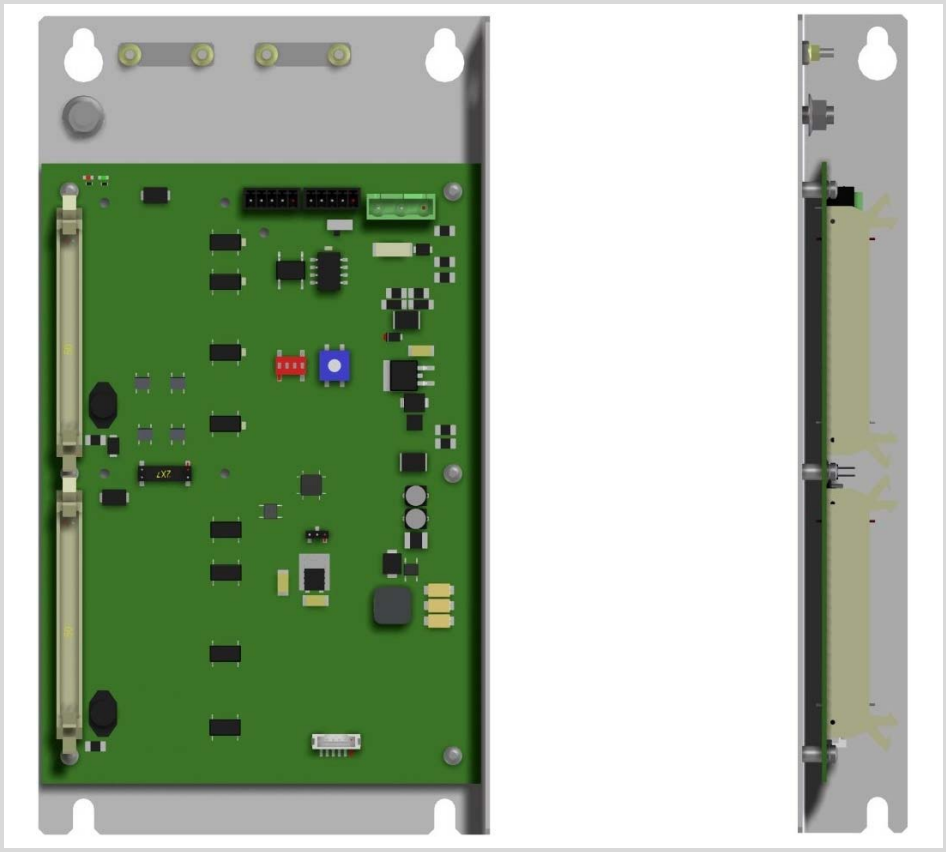
The RIOR module, meeting the standard EN 60529, corresponds to the IP00 classification, so it must be mounted inside an electrical cabinet that provides at least IP54 protection.

Module dimensions.



Mounting the module.

The RIOR module may be mounted onto the electrical cabinet in two positions; parallel to the cabinet with 4 mounting points or perpendicular to it with two mounting points. Use M6 bolts to secure the modules.



Connection of the modules.

Join the ground terminal of the module to the cabinet chassis. Each module is connected to the system (central unit, keyboard, etc.) through the CAN bus as described later on.

6.2 Powering the modules.

Power the RIOR modules with a 24 V DC class III power supply that does not exceed the limits for SELV/PELV.

Power supply requirements.



If the supply cable is longer than 10 meters, some protection element must be installed at the input of the device to protect it against voltage peaks.

The power supply must be connected to the ground/shield of the module for functionality or electromagnetic compatibility; for electromagnetic compatibility, this connection must only be done at one point.

Nominal voltage.	Meets EN 61131-2	24 V DC
	Voltage range (mean value).	Within 20.4 V DC and 28.8 V DC.
	Voltage range (dynamic).	Within 18.5 and 30.2 V DC.
	Voltage ripple peak-to-peak.	5% (unfiltered 6-pulse rectification).
	Startup time after power-up.	Any.
Non-periodic over-voltages.	Over-voltage.	≤ 35 V
	Duration of the over-voltage.	≤ 500 ms
	Recovery time.	≥ 50 s
	Events per hour.	≤ 10
Transient voltage interruptions.	Idle time.	≤ 3 ms
	Recovery time.	≥ 10 s
	Events per hour.	≤ 10

6.3 Electrical characteristics of the inputs and outputs.

Digital inputs.

The digital inputs have no galvanic isolation. Each connector has an auxiliary 24 V output protected against short-circuits, to feed the digital inputs. The digital inputs have the following characteristics.

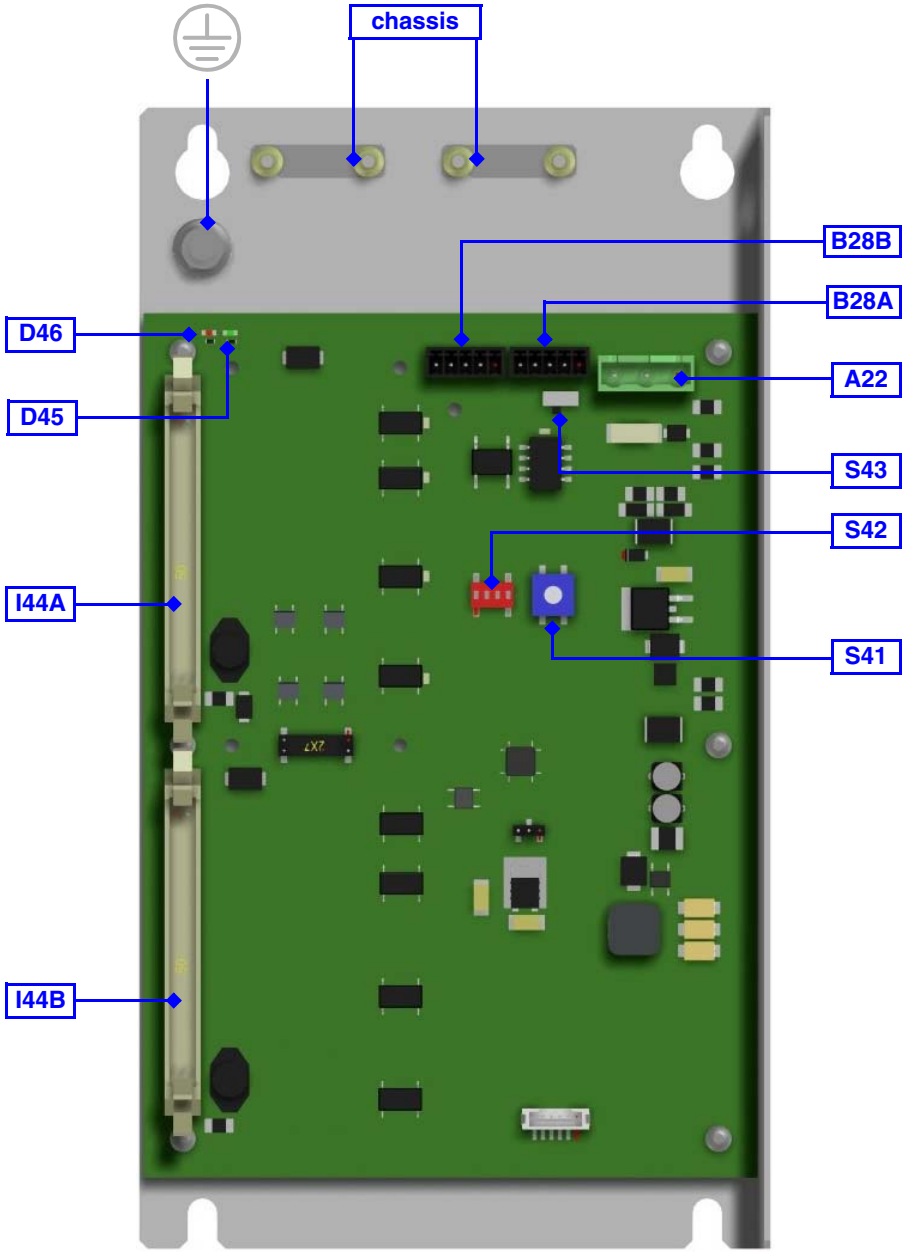
Nominal voltage.	+24 V DC (between +20 V DC and +28 V DC).
High threshold "1".	Over +20 V DC.
Low threshold "0".	Under +5 V DC.
Typical consumption of each input.	3.5 mA.
Maximum consumption of each input.	4 mA.

Digital outputs.

The digital outputs have no galvanic isolation. The digital outputs have the following characteristics.

Nominal voltage.	+24 V DC (between +20 V DC and +28 V DC).
Maximum supply voltage.	+36 V DC.
Output voltage.	1 V less than the supply voltage.
Maximum output current.	300 mA per output.
Maximum output inductance.	1 H.

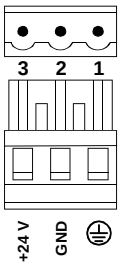
6.4 Description of connectors.



Connector.	
·A22·	24 V supply input.
·B28A· ·B28B·	CAN bus.
·D45·	RUN led, module status indicator.
·D46·	ERR led, transmission status indicator.
·I44A· ·I44B·	Digital inputs and outputs.
·S41·	CAN bus. Address (node) of the element within the bus.
·S42·	CAN bus. Address (node) of the element within the bus. CAN bus. Selecting the baudrate for the CANopen bus.
·S43·	CAN bus. Line terminating resistor.

Connector ·A22·. 24 V supply input.

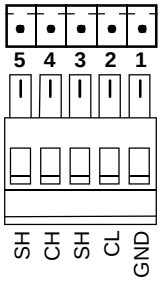
3-pin male Phoenix combicom contact (7.62 mm pitch).



Signal.	Function.
⏚	Shield
GND	0 V reference signal.
+24 V	Power supply.

Connectors ·B28A·/·B28B·. CAN bus.

5-pin male Phoenix minicombicon contact (3.5 mm pitch).



Pin.	Signal.	Function.
1	GNDa	Not connected.
2	CANL	(LOW) bus line.
3	SHIELD	Overall shield.
4	CANH	(HIGH) bus line.
5	SHIELD	Not connected.

·D45· led. RUN led, module status indicator.

The LED is green. Its meaning depends on the blinking speed.

Blinking rate.	Description.
Intermittent.	The module is in PRE-OPERATIONAL state.
Single blinking.	The module is in STOPPED state.
On.	The module is in OPERATIONAL state.

·D46· led. ERR led, transmission status indicator.

Red LED. Its meaning depends on the blinking speed.

Blinking rate.	Description.
Off.	The module is ready to run.
Intermittent.	Module configuration stage.
Single blinking.	Poor transmission. At least one of the error counters of the CAN controller has reached the alarm level.
Double blinking.	There is no communication with the cpu.
On	Error. The CAN controller is in "Bus Off" state.

·S41·. switch CAN bus. Address (node) of the element within the bus.



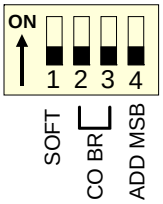
Each one of the elements integrated into the CAN bus is identified by the 16-position rotary switch (0-15) "Address" (also referred to as "Node_Select"). With the ADD MSB" switch, the positions or elements integrated in the CAN bus may be expanded up to 32.

The CNC must always occupy position "0" and the rest of the elements of the bus will occupy consecutive positions starting with 1. In order for any change at the "Address" switch to be assumed, the CNC must be restarted and the corresponding drive must be reset, however, we recommend to change the address while the modules and the CNC are off.

The "Address" switch also sets the priority of the group within the bus; the lower the number the higher the priority. We recommend the keyboard and jog panel to be the last node of the bus.

Dipswitch ·S42· Bus CAN. Address (node) of the element within the bus.

With the ·4· switch (ADD MSB), the positions or elements integrated in the CAN bus may be expanded up to 32. Positions 0-15 are selected with ADD MSB=0 and positions 16-31 with ADD MSB=1.

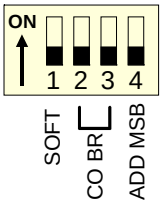


DS ·4·	Address (node) of the element.
off	Positions 0-15 within the bus.
on	Positions 16-31 within the bus.

Dipswitch ·S42·. CAN bus. Selecting the baudrate for the CANopen bus.

The transmission speed at the bus is defined in each node and they all must run at the same speed. The speed is selected with switches ·2· and ·3· (CO BR).

The transmission speed depends on the total length of the bus. Using the following illustrative values; assigning other values may cause communication errors due to signal distortion.

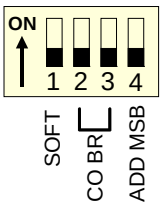


DS ·2·	DS·3·	Speed	Length of the CAN bus.
on	on	1000 kHz	Up to 20 meters.
off	on	800 kHz	From 20 to 40 meters.
on	off	500 kHz	From 40 to 100 meters.
off	off	250 kHz	From 100 to 500 meters.

In order for any change of speed to be assumed, the corresponding module must be reset; however, we recommend to change the speed while the modules and the CNC are off.

Dipswitch ·S42·. Update the software of the module.

Switch ·1· (ADD MSB) may be used to update the software of the module.



DS ·1·	Address (node) of the element.
off	Module operative (running).
on	Update the software of the module.

Switch ·1· must only be set to "on" to update the software of the module. If the module starts up while switch ·1· is in the "on" position, the CNC updates the software of the module and shows the message "the software of the ... module will now be updated...".

Dipswitch ·S43·. CAN bus. Line terminating resistor.

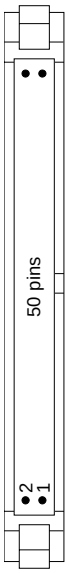


The line terminating resistor identifies which are the elements that occupy the ends of the CAN bus; i.e. the first and last physical element in the connection.

The terminating elements must have the resistor activated (position 1) but not the rest of the elements (position 0).

Connector ·I44A·. Digital inputs and outputs.

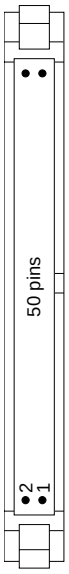
50-pin male IDC connector with a latch.



Pin.	Signal.	Description.
1	GND	0 V reference signal.
2	24V_OUT	24 V output for digital inputs.
3···26	I1 - I24	Digital inputs.
27···30	- - -	
31···46	O1 - O16	Digital outputs.
47···50	24V	24 V Ext. for digital outputs.

Connector ·I44B·. Digital inputs and outputs.

50-pin male IDC connector with a latch.



Pin.	Signal.	Description.
1	GND	0 V reference signal.
2	24V_OUT	24 V output for digital inputs.
3···26	I25 - I48	Digital inputs.
27···30	- - -	
31···46	O17 - O32	Digital outputs.
47···50	24V	24 V Ext. for digital outputs.

7 REMOTE MODULE RCS-S. (SERCOS PROTOCOL)

The "RCS-S" counter may be used to get extra feedback (counter) inputs and analog outputs (remote I/O). These modules are connected to the central unit via Sercos bus and they are just another bus within the bus. Each module offers the following elements.

Type of input/output	Amount.
Feedback inputs.	4
Analog outputs.	4

Voltage supply for the module.

Universal DC power supply. Use a 24 Vdc (±10%) 2 A power supply. The module is protected against reverse voltage at the 24V input.

Numbering of the analog outputs and of the feedback inputs.

The Sercos counter is, like the drives, a node tye of the Sercos ring. In terms of parameter setting, Sercos counters have dual identification, physical and logic, as described next.

1. Each counter must be identified by a number (Sercos ID) using the thumbwheel located on its front plate. That identifier must be unique in the ring, the number is sequential from 1 to n and without skipping any and "n" being the total number of Sercos nodes (including drives and counters).
2. The SERCOUNTID table of the general machine parameters allows linking the logic number of the Sercos counters (1..8) to the physical number set by the thumbwheel of each node (enter in each position of the Sercos ID table associated with that logic position of the counter).
3. Remote Sercos type feedback inputs (COUNTERID) and analog outputs (ANAOUTID) that may be used when setting the parameters of axes or handwheels follow the allocation criteria based on the logic numbering of the Sercos counters. The physical numbering set by the Sercos ID is irrelevant.

• SERCOUNTID1	COUNTERID (1..4)	ANAOUTID (1..4)
• SERCOUNTID2	COUNTERID (5..8)	ANAOUTID (5..8)
...	...	...
• SERCOUNTID8	COUNTERID (29..32)	ANAOUTID (29..32)

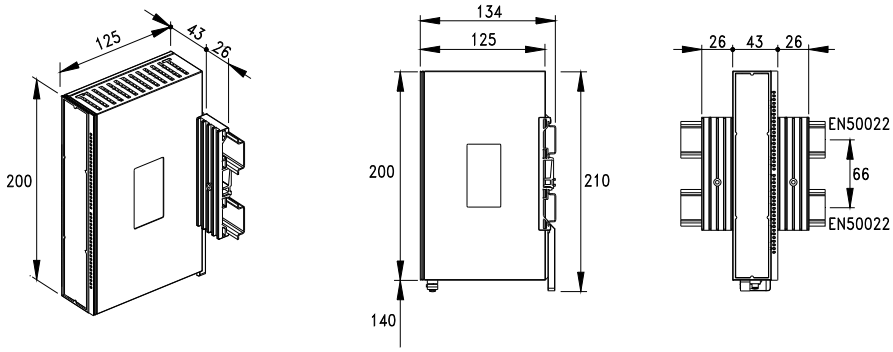
7.1 Installation of the modules.

DO NOT make any connection or connect any module or cable if the group is under power. Before connecting anything, unplug the cable from the power supply module.
DO NOT make any connection or connect any module to the power supply while the latter is turned on. Before making any connection, turn the power supply off by unplugging the power cable.

Place the modules on 2 profiles, according to the UNE 50022 standard, with 2 securing ends, one at each end of the group; they help securing the modules besides maintaining the right gap between the profiles.

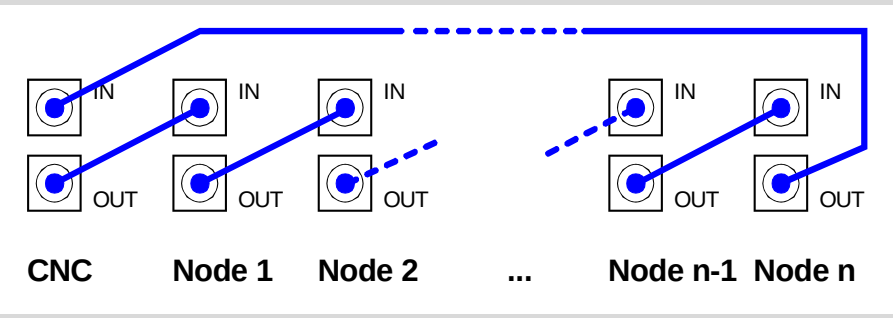
Dimensions of the modules.

Always leave a 140 mm gap under the modules for ventilation and later handling.

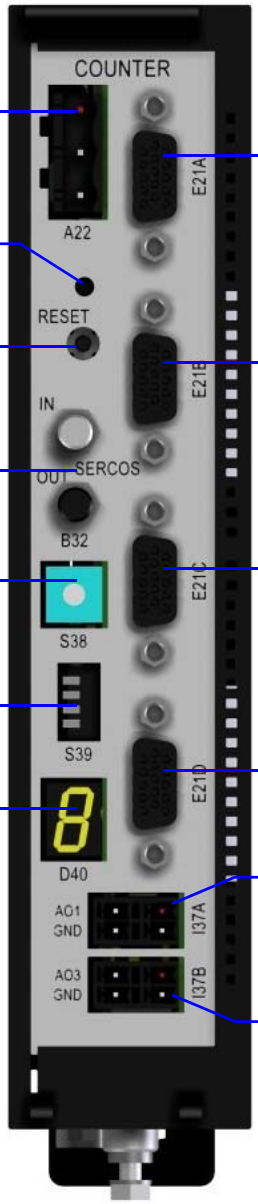


Connection of the modules.

Each module is connected to the system via the Sercos bus. The Sercos connection is carried out in a ring using fiber optic cable by joining an OUT terminal with an IN terminal.



7.2 Module description.



Connector ·A22·.
24 V supply input.

·Boot· button.

·Reset· button.

Connector ·B32·.
Sercos bus connection.

Selector ·S38·.
Address (node) of the element within the Sercos bus.

Switch ·S39·.
Switch for Sercos setting.

Display ·D40·.
Error display.

Connector ·E21A·.
Feedback input.

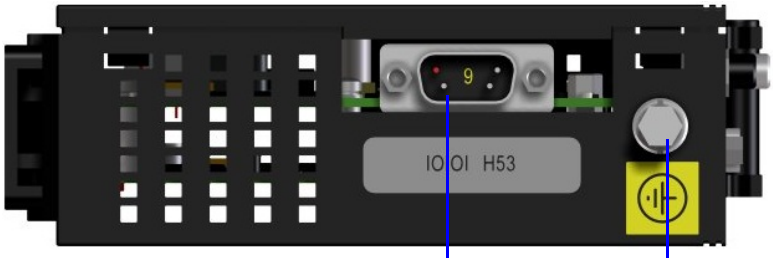
Connector ·E21B·.
Feedback input.

Connector ·E21C·.
Feedback input.

Connector ·E21D·.
Feedback input.

Connector ·I37A·.
2 general purpose analog outputs.

Connector ·I37B·.
2 general purpose analog outputs.



Bottom view.

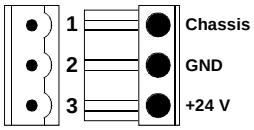
Connector ·H53·.
RS232 serial line.

Ground connection.

7.2.1 Elements (connectors).

Connector ·A22·. 24 V supply input.

3-pin male Phoenix combicom contact (7.62 mm pitch).



Signal.	Function.
Chassis	Shield.
GND	Power supply.
+24 V	Power supply.

·Boot· button.

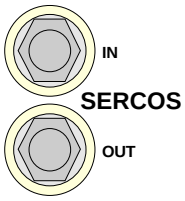
Software update.

·Reset· button.

Magazine reset.

Connector ·B32·. Sercos bus connection.

·IN· & ·OUT· connectors Honeywell emitter and receiver.



Signal.	Function.
IN	Sercos signal receiver.
OUT	Sercos signal emitter.

Selector ·S38·. Address (node) of the element within the bus.



Each one of the elements integrated into the Sercos bus is identified by the 16-position rotary switch (0-15).

The CNC must always occupy position "0" and the rest of the elements of the bus will occupy consecutive positions starting with 1. In order for any change at this switch to be assumed, the module must be reset and the CNC powered off and back on.

Switch ·S39·. Sercos setting (baudrate and optical power).



Switches ·1· and ·2· indicate the Sercos transmission speed (baudrate). Switches ·3· and ·4· set the Sercos power or the intensity of the light going through the optic fiber. Set these values with the same values used by the CNC and the drives.

·1·	·2·	Baudrate (switches ·1· and ·2·).
Off	Off	2 Mbps.
ON	Off	4 Mbps.
Off	ON	8 Mbps.
ON	ON	16 Mbps.

·3·	·4·	Optical power depending on cable length (switches ·3· and ·4·).	
Off	Off	1 to 4	Cable shorter than 15 meters. Recommended cable: SFO / SFO-FLEX
ON	Off	5 to 6	Cable between 15 and 30 meters. Recommended cable: SFO-FLEX
Off	ON	7	Cable between 30 and 40 meters. Recommended cable: SFO-FLEX
ON	ON	8	Cable longer than 40 meters. Recommended cable: SFO-V-FLEX

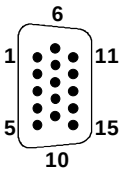
The optical power value depends on the total length of the cable being used. Assigning other optical power values, e.g. a value of 6 for a length of 3 m, can cause communication errors due to fiber optic signal distortion.

Display ·D40·. Status and error display.

7-segment display for module status and error codes.

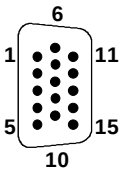
Connectors ·E21A· ·E21B· ·E21C· ·E21D·. Feedback inputs (1 per connector).

4 15-pin female SUB-D HD type connectors. The feedback signals may be incremental (TTL, differential TTL, Vpp) or communication protocols (SSI).



- Feedback signals (TTL, differential TTL, Vpp).

Pin.	Signal.	Function.
1	A	Feedback signals.
2	/A	
3	B	
4	/B	
5	I0	Reference signals.
6	/I0	
7	AL	Feedback alarm.
8	/AL	
9	+5 V DC	Voltage supply for the feedback system.
10	+5 V DC	
11	GND	0 V reference signal.
12	GND	
13	- - -	- - -
14	- - -	- - -
15	Chassis	Shield.



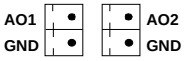
- Communication protocols (SSI).

Pin.	Signal.	Function.
1	- - -	- - -
2	- - -	- - -
3	- - -	- - -
4	- - -	- - -
5	DATA	Data line.
6	/DATA	
7	CLOCK	Clock line.
8	/CLOCK	
9	+5 V	Voltage supply for the feedback system.
10	+5_SENSE	
11	GND	Reference signal.
12	GND_SENSE	
13	- - -	- - -
14	- - -	- - -
15	- - -	- - -

- If the input is configured as TTL, differential TTL or Vpp, it will provide over-current feedback alarm (300 mA).
- If the input is configured as differential TTL, it will provide cable-breakage detection alarm.

Connector ·I37A·. 2 general purpose ±10 V analog outputs (16-bit resolution).

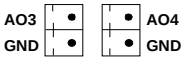
2x2 pin two-level male Phoenix minicombicon contact (3.5 mm pitch).



Signal.	Function.
AO1 AO2	Analog output.
GND GND	0 V reference signal.

Connector ·I37B·. 2 general purpose ±10 V analog outputs (16-bit resolution).

2x2 pin two-level male Phoenix minicombicon contact (3.5 mm pitch).



Signal.	Function.
AO3 AO4	Analog output.
GND GND	0 V reference signal.

Connector ·H53·. RS232 serial line.

Simple RS232 communication (only RX and TX) for updating the module.

7.3 Electrical characteristics of the analog outputs:

Use shielded cables connecting their meshes to the ground screw of the module. All the analog outputs have the following characteristics:

Command voltage within range.	±10 V.
Resolution.	16 bits.
Minimum impedance of the connected device.	10 kΩ.
Maximum cable length (unshielded).	75 mm.

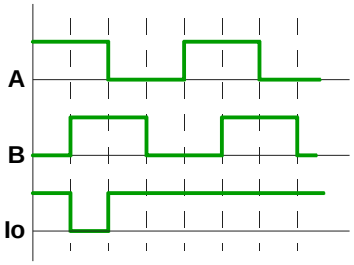
7.4 Feedback inputs. Technical characteristics and connection.

The module offers 4 feedback inputs for incremental signals (TTL, differential TTL, 1 Vpp) or communication protocols (SSI).

Technical characteristics of the feedback inputs.

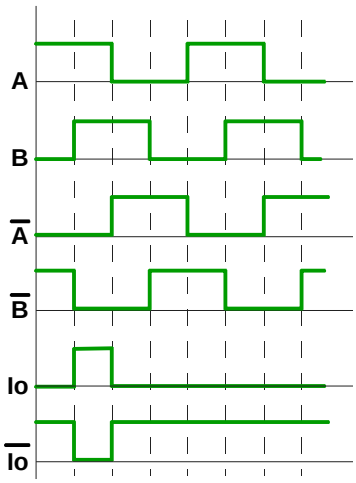
Power consumption: +5 V 1 A (250 mA per axis)

Work levels for TTL signal.



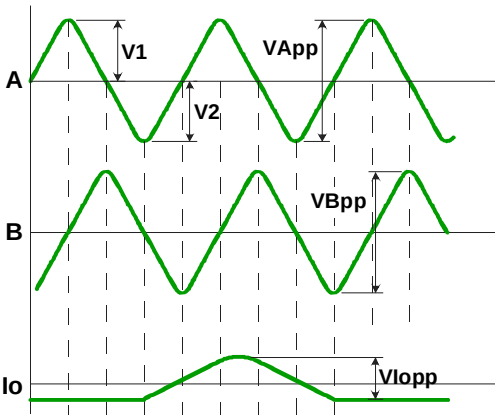
Maximum frequency:	100 kHz.
Phase shift:	90º ± 20º.
High threshold (logic level “1”) VIH:	2,2 V < VIH < 5 V.
Umbral bajo (nivel lógico “0”) VIL:	-1 V < VIL < 0,6 V.
Maximum voltage:	-1 V ÷ 7 V
Hysteresis:	1.2 V.

Work levels for differential TTL signal.



Maximum frequency:	1000 kHz.
Phase shift:	90º ± 20º.
Maximum voltage in common mode:	-1 V ÷ 7 V
Maximum voltage in differential mode:	± 6 V.
Hysteresis:	0.2 V.
Maximum differential input current:	50 mA.

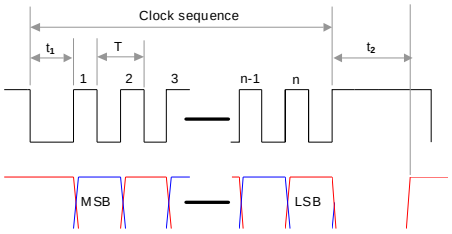
Work levels for sinusoidal 1 Vpp signal.



Maximum frequency:	500 kHz.
A and B signals. Amplitude:	0.6 ÷ 1.2 Vpp
A and B signals. Centered:	|V1-V2| / 2 Vpp =< 6,5%
A and B signals. Ratio:	VApp / VBpp = 0.8 ÷ 1.25
A and B signals. Phase shift:	90º ± 10º
I0 signal. Amplitude:	0.2 ÷ 0.85 V
I0 signal. Width:	T-90º =< I0 =< T+180º

Work levels for SSI signal.

Bidirectional 485 data line and unidirectional clock line.



Transmission:	SSI synchronous serial transfer via RS 485.
Levels:	EIA RS 485
Clock frequency:	100 kHz - 500 kHz
Maximum number of bits (n):	32 (configurable).
T:	1 µs to 10 µs
t1:	> 1 µs
t2:	20 µs to 35 µs
SSI:	Gray or binary (configurable).
Parity:	Fully configurable.

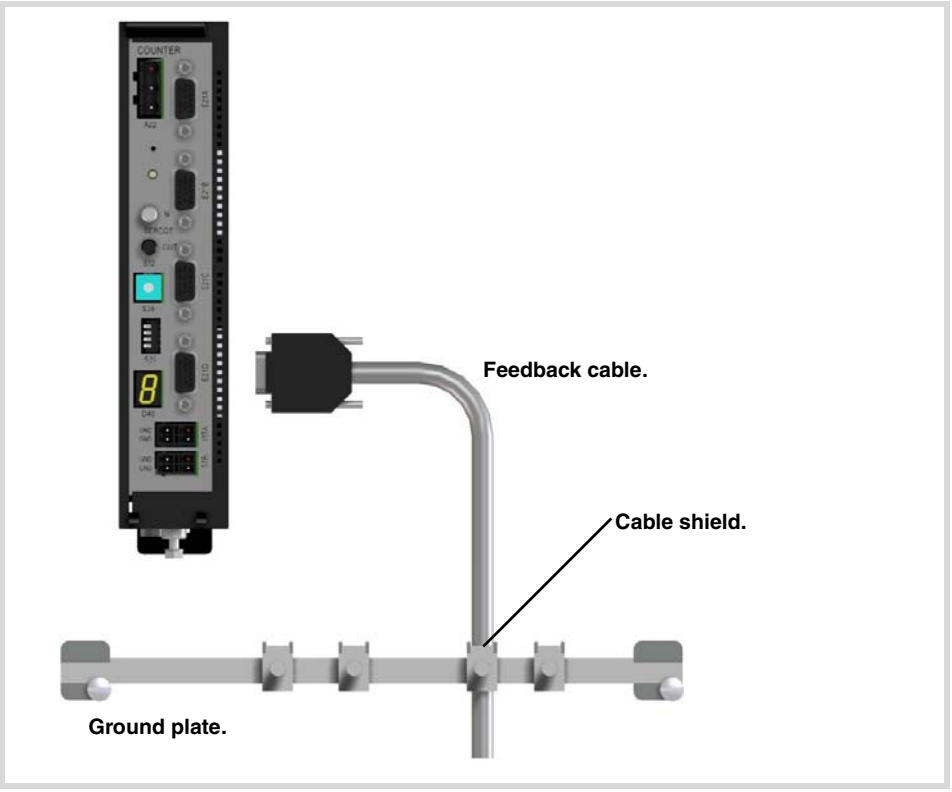
7.5 Feedback cable characteristics.

Fagor Automation offers a wide range of cables and extension cables to connect the feedback systems to the CNC. The cable characteristics , as well as its length, depend on the type of feedback being used. Refer to our catalog for further information.

We recommend to run the feedback cables as far away as possible from the power cables of the machine.

Use shielded cables connecting the shields to the ground plate inside the electrical cabinet. The unshielded portion of the wires of an unshielded cable cannot be longer than 75 mm.

Always connect the shield of the feedback cable to the ground plate of the electrical cabinet using a metallic clamp. Fagor shall not be held responsible for any system malfunction if this connection is not made.



7.6 Error codes and messages on the Sercos counter.

The activated error code is displayed on the display of the Sercos counter and on the CNC screen. The CNC can display the errors listed in this chapter as well as the error codes and texts of the Sercos communication itself.

Activating any of the errors listed in this chapter causes the following effects at the CNC.

- The CNC interrupts program execution.
- The CNC stops the movement of the axes and spindles.
- The CNC sets to zero the PLC mark /ALARM and PLC output O1. These signals are present in the PLC program which will manage that emergency without having to know which error was activated.

The system cannot be started without having eliminated all the errors detected by the Sercos counter. When using the Sercos communication interface, the errors are reset the same way as any other CNC error.

Activating any of the "resettable" or "non-resettable" errors causes a category 1 stop.

Resettable errors.

Definition. Errors that can be eliminated with a "reset" after eliminating their cause.

Non-resettable errors.

Definition. Errors that cannot be eliminated with a "reset" after eliminating their cause; in other words, the previous procedure cannot be followed to eliminate them.

Procedure. Eliminate the cause of the error and when it disappears, turn the unit off and back on.

The non-resettable errors are:

E034	E038	E039	E040	E041	E044	E045	E046	E047	E048
E083									

Errors that cancel the analog outputs.

Definition. Errors that set the analog outputs to 0V.

Procedure. Eliminate the cause of the error and when it disappears, turn the unit off and back on.

The errors that cancel the analog outputs are:

E034	E038	E039	E040	E041	E044	E045	E046	E047	E048
E083	E084	E403	E404	E405	E406	E407	E410	E411	E412
E413									

7.6.1 Error codes. Meaning and solution.

E034 Error identifying the CPU board.
Contact Fagor Automation.

E038 Code checksum error.
The loaded checksum of the program code is not correct. Load the software again. If the problem persists, the RAM, FLASH memories or the loaded code may be defective. Contact Fagor Automation.

E039 Error on the Sercos ® board .
Contact Fagor Automation.

E040 Failure of the clock of the SerCon® board.
Contact Fagor Automation.

E041 SerCon memory corrupted.
Contact Fagor Automation.

E044 Corrupted file system in flash.
Contact Fagor Automation.

E045 Error reading analog offsets.
Contact Fagor Automation.

E046 Error identifying the axis board.
Contact Fagor Automation.

E047 Unknown axis board identification.
Contact Fagor Automation.

E04 Error in FPGA code.
The FPGA code seems to be corrupted or is missing. Try reloading the software version. If the problem persists, the RAM, FLASH memories or the loaded code may be defective. Contact Fagor Automation.

E083 The FPGA could not be loaded.
Restart the counter. If the problem persists, contact Fagor Automation.

0084 Reset due to Watchdog.
The system has restarted because watchdog kicked in. If the problem is repetitive and/or persists, contact Fagor Automation.

E085 Error in power supply for the analog outputs.
Contact Fagor Automation.

E133 Broken wire, A signal of E21A feedback.
E233 Broken wire, A signal of E21B feedback.
E333 Broken wire, A signal of E21C feedback.
E433 Broken wire, A signal of E21D feedback.
For differential TTL feedback. The A and/or /A signal wire may be broken or disconnected. Check the connection. Check the level of the signals provided by the feedback device.

E134 Broken wire, B signal of E21A feedback.
E234 Broken wire, B signal of E21B feedback.
E334 Broken wire, B signal of E21C feedback.
E434 Broken wire, B signal of E21D feedback.
For differential TTL feedback. The B and/or /B signal wire may be broken or disconnected. Check the connection. Check the level of the signals provided by the feedback device.

E135 Broken wire, I0 signal of E21A feedback.
E235 Broken wire, I0 signal of E21B feedback.
E335 Broken wire, I0 signal of E21C feedback.
E435 Broken wire, I0 signal of E21D feedback.
For differential TTL feedback. The I0 and/or /I0 signal wire may be broken or disconnected. Check the connection. Check the level of the signals provided by the feedback device.

E136 Broken wire, AL signal of E21A feedback.
E236 Broken wire, AL signal of E21B feedback.
E336 Broken wire, AL signal of E21C feedback.
E436 Broken wire, AL signal of E21D feedback.
For differential TTL feedback. The AL and/or /AL signal wire may be broken or disconnected. Check the connection. Check the level of the signals provided by the feedback device.

E137 Received alarm signal at E21A feedback.
E237 Received alarm signal at E21B feedback.
E337 Received alarm signal at E21C feedback.
E437 Received alarm signal at E21D feedback.
The encoder has generated a signal alarm due to its poor performance. Check the encoder documentation to determine the source of (reason for) the alarm. It could also be a false positive due to poor connection.

E138 Amplitude alarm at E21A feedback.
E238 Amplitude alarm at E21B feedback.
E338 Amplitude alarm at E21C feedback.
E438 Amplitude alarm at E21D feedback.
Too much damping or saturation of A and/or B signals. The wiring, the feedback device or the feedback of the Sercos counter may have some problem.Check the condition (shape) of the cable, of the connection or of the feedback device. If the problem persists, contact Fagor Automation.

E140 Feedback frequency too high at E21A feedback.
E240 Feedback frequency too high at E21B feedback.
E340 Feedback frequency too high at E21C feedback.
E440 Feedback frequency too high at E21D feedback.
The axis moving speed exceeds the sampling capability of the Sercos counter hardware for this type of encoder signal. Decrease the maximum axis moving speed.

E141 Wrong distance between I0, E21A feedback.
E241 Wrong distance between I0, E21B feedback.
E341 Wrong distance between I0, E21C feedback.
E441 Wrong distance between I0, E21D feedback.
Error indicating lack of repeatability of the I0 signal in each encoder revolution. Some pulses are being lost and/or the measurement provided by the feedback device is wrong.
Resettable error. Check that the connection and the wiring are correct. Check that the number of pulses allowed as error margin is not too low. Check that the value of CNC parameter REFPULSE is correct. Contact Fagor Automation. If the error persists, it may be because the feedback device is defective.

E142 Over-current or short-circuit at E21Afeedback.
E242 Over-current or short-circuit at E21B feedback.
E342 Over-current or short-circuit at E21C feedback.
E442 Over-current or short-circuit at E21D feedback.
Either a short-circuit has occurred or the feedback device is over-supplied.
Check cables and connections.

E143 Communication error at E21A feedback. Wrong CRC.
E243 Communication error at E21B feedback. Wrong CRC.
E343 Communication error at E21C feedback. Wrong CRC.
E443 Communication error at E21D feedback. Wrong CRC.
Error reading absolute position value; wrong CRC.
Check the cable and connection of the linear or rotary encoder. Check that the parameters of the feedback device have been set correctly. If the problem persists, contact Fagor Automation.

E144 Communication error at E21A feedback. Acknowledge not received.
E244 Communication error at E21B feedback. Acknowledge not received.
E344 Communication error at E21C feedback. Acknowledge not received.
E443 Communication error at E21D feedback. Acknowledge not received.
Error reading absolute position value; acknowledge not received.
Check the cable and connection of the feedback device. The error could be due to a problem at the feedback device. If the problem persists, contact Fagor Automation.

E145 ABSIND: Synchronism error at E21A feedback.
E245 ABSIND: Synchronism error at E21B feedback.
E345 ABSIND: Synchronism error at E21C feedback.
E445 ABSIND: Synchronism error at E21D feedback.

Synchronism lost between the Sercos counter and the ABSIND module which may have caused a wrong position reading. The error may be due to wrong performance of the ABSIND moduel or to a connection problem between the ABSIND module and the Sercos counter associated with that feedback.

If the problem persists, contact Fagor Automation.

E146 ABSIND: Error reading information at E21A feedback.
E246 ABSIND: Error reading information at E21B feedback.
E346 ABSIND: Error reading information at E21C feedback.
E446 ABSIND: Error reading information at E21D feedback.

It could not read the ABSIND module identification info during system startup. The error may be due to wrong performance of the ABSIND moduel or to a connection problem between the ABSIND module and the Sercos counter associated with that feedback.

If the problem persists, contact Fagor Automation.

E183 INDUCTOSYN: INC signal too low at E21A feedback.
E283 INDUCTOSYN: INC signal too low at E21B feedback.
E383 INDUCTOSYN: INC signal too low at E21C feedback.
E483 INDUCTOSYN: INC signal too low at E21D feedback.

Incremental signal level of the inductosyn/resolver feedback device too low. Check the gain and phase values of the ABSIND module with the adjustment software. Check the cable and the connection between the ABSIND module and the inductosyn/resolver feedback device. If the error persists and cannot be changed with the previous actions, try replacing the ABSIND module and/or the cable associated with that feedback. If the error persists, contact Fagor Automation.

E184 INDUCTOSYN: INC signal too high at E21A feedback.
E284 INDUCTOSYN: INC signal too high at E21B feedback.
E384 INDUCTOSYN: INC signal too high at E21C feedback.
E484 INDUCTOSYN: INC signal too high at E21D feedback.

Incremental signal level of the inductosyn/resolver feedback device too high. Check the gain and phase values of the ABSIND module with the adjustment software. Check the cable and the connection between the ABSIND module and the inductosyn/resolver feedback device. If the error persists and cannot be changed with the previous actions, try replacing the ABSIND module and/or the cable associated with that feedback. If the error persists, contact Fagor Automation.

E185 INDUCTOSYN: GRAY signal missing at E21A feedback.
E285 INDUCTOSYN: GRAY signal missing at E21B feedback.
E385 INDUCTOSYN: GRAY signal missing at E21C feedback.
E485 INDUCTOSYN: GRAY signal missing at E21D feedback.

GRAY signal level of the inductosyn/resolver feedback device missing. Check the gain and phase values of the ABSIND module with the adjustment software. Check the cable and the connection between the ABSIND module and the inductosyn/resolver feedback device. If the error persists and cannot be changed with the previous actions, try replacing the ABSIND module and/or the cable associated with that feedback. If the error persists, contact Fagor Automation.

E186 INDUCTOSYN: Linear encoder unstable on Power-ON, E21A feedback.
E286 INDUCTOSYN: Linear encoder unstable on Power-ON, E21B feedback.
E386 INDUCTOSYN: Linear encoder unstable on Power-ON, E21C feedback.
E486 INDUCTOSYN: Linear encoder unstable on Power-ON, E21D feedback.

The position read when initializing the ABSIND module is unstable. Check that the axis is not moving while starting up or initializing. Check the cable and the connection between the ABSIND module and the inductosyn/resolver feedback device. Check the ground connections in the electrical cabinet (electrical noise on the signals). If the error persists and cannot be changed with the previous actions, try replacing the ABSIND module and/or the cable associated with that feedback. If the error persists, contact Fagor Automation.

E187 INDUCTOSYN: Wrong EEPROM checksum, E21A feedback.
E287 INDUCTOSYN: Wrong EEPROM checksum, E21B feedback.
E387 INDUCTOSYN: Wrong EEPROM checksum, E21C feedback.
E487 INDUCTOSYN: Wrong EEPROM checksum, E21D feedback.

Check the gain and phase values of the ABSIND module with the adjustment software. If the error persists and cannot be changed with the previous actions, try replacing the ABSIND module associated with that feedback. If the error persists, contact Fagor Automation.

E188 INDUCTOSYN: Unknown error at E21A feedback.
E288 INDUCTOSYN: Unknown error at E21B feedback.
E388 INDUCTOSYN: Unknown error at E21C feedback.
E488 INDUCTOSYN: Unknown error at E21D feedback.

The ABSIND module has generated an unknown error. The error is likely due to bad performance. It the error is repetitive and persistent, try replacing the ABSIND module associated with that feedback. If the error persists, contact Fagor Automation S. Coop.

E189 INDUCTOSYN: Incoherent SSITYPE parameter with feedback device type connected to E21A feedback.
E289 INDUCTOSYN: Incoherent SSITYPE parameter with feedback device type connected to E21B feedback.
E389 INDUCTOSYN: Incoherent SSITYPE parameter with feedback device type connected to E21C feedback.
E489 INDUCTOSYN: Incoherent SSITYPE parameter with feedback device type connected to E21D feedback.

Check the dipswitch S50 of the ABSIND module. The selected value must be coherent with CNC machine parameter SSITYPE and with the feedback type (inductosyn/resolver) connected to the ABSIND module.

E192 wrong REFPULSE parameter at E21A feedback.
E292 wrong REFPULSE parameter at E21B feedback.
E392 wrong REFPULSE parameter at E21C feedback.
E492 wrong REFPULSE parameter at E21D feedback.

The value of machine parameter REFPULSE is inconsistent with the type of feedback connected. Try changing its value. If the problem persists, contact Fagor Automation.

E193 Fagor digital feedback. Error on the absolute track E21A.
E293 Fagor digital feedback. Error on the absolute track E21B.
E393 Fagor digital feedback. Error on the absolute track E21C.
E493 Fagor digital feedback. Error on the absolute track E21D.

It cannot calculate the absolute position. Feedback pulses lost. The analog signal < 0.20 Vpp.
Check that the linear or rotary encoder is working at proper speed. Check mounting tolerances. Clean the glass or the steel tape of the linear encoder. If none of the previous solutions solves the error, replace the rotary encoder or reader head of the linear encoder.

E194 Fagor digital feedback. CPU error. E21A feedback.
E294 Fagor digital feedback. CPU error. E21B feedback.
E394 Fagor digital feedback. CPU error. E21C feedback.
E494 Fagor digital feedback. CPU error. E21D feedback.

Damaged rotary encoder or reader head of linear encoder. Replace the rotary encoder or the reader head of the linear encoder.

E195 Fagor digital feedback. Error at the adjustment potentiometers. E21A feedback.
E295 Fagor digital feedback. Error at the adjustment potentiometers. E21B feedback.
E395 Fagor digital feedback. Error at the adjustment potentiometers. E21C feedback.
E495 Fagor digital feedback. Error at the adjustment potentiometers. E21D feedback.

Damaged rotary encoder or reader head of linear encoder. Replace the rotary encoder or the reader head of the linear encoder.

E196 Fagor digital feedback. Image capturing sensor (CCD) error E21A feedback.
E296 Fagor digital feedback. Image capturing sensor (CCD) error E21B feedback.
E396 Fagor digital feedback. Image capturing sensor (CCD) error E21C feedback.
E496 Fagor digital feedback. Image capturing sensor (CCD) error E21D feedback.

Check mounting tolerances. Clean the glass or the steel tape of the linear encoder.
Damaged rotary encoder or reader head of the linear encoder; the CCD (Charge-Coupled Device) or the LED (Light-Emitting Diode). Replace the rotary encoder or the reader head of the linear encoder.

E197 Fagor digital feedback. Supply voltage out of range. E21A feedback.
E297 Fagor digital feedback. Supply voltage out of range. E21B feedback.
E397 Fagor digital feedback. Supply voltage out of range. E21C feedback.
E497 Fagor digital feedback. Supply voltage out of range. E21D feedback.

The supply voltage must be between 5.3 V and 4.1 V. Check that the power cable of the rotary or linear encoder is not damaged. Also check that the cable length is the right one and that the wiring connection is the right one.

E198 Fagor digital feedback. Parameter error.
E298 Fagor digital feedback. Parameter error.
E398 Fagor digital feedback. Parameter error.
E498 Fagor digital feedback. Parameter error.
Rotary or linear encoder configuration has been lost. Replace the rotary encoder or the reader head of the linear encoder.

E403 MST failure.
Communication problems through fiber optic ring. Check the ring connections and the identification of each module.

E404 MDT failure.
Communication problems through fiber optic ring. Check the ring connections and the identification of each module.

E405 Invalid phase(>4).
Communication problems through fiber optic ring. Check the ring connections and the identification of each module.

E406 Phase up-shift error.
Communication problems through fiber optic ring. Check the ring connections and the identification of each module.

E407 Phase down-shift error.
Communication problems through fiber optic ring. Check the ring connections and the identification of each module.

E410 Noise resets Sercon.
Noise gets in through the connection of the internal bus resetting the SerCon but not with the VeCon2.

E411 Error when receiving telegrams.
Communication problems through fiber optic ring. Check the ring connections and the identification of each module.

E412 Delayed synchronism message.
Communication problems through fiber optic ring. Check the ring connections and the identification of each module.

E413 Handshake error in Sercos counter.
The master element (CNC) sends a synchronism message in every cycle (usually 4ms) that synchronizes the drives. This error appears when they can't synchronize or lose synchronism.
Maybe the CNC has not sent this message or if it has, it wasn't in the precise moment. Check the transmission cable or check that there is no noise in the transmission.

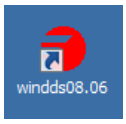
7.7 Software installation/update.

Requirements.

The software of the remote module "RCS-S" (Sercos counter) can only be installed/updated using Fagor's PC application "WinDDSSetup" with version 08.06 or later.

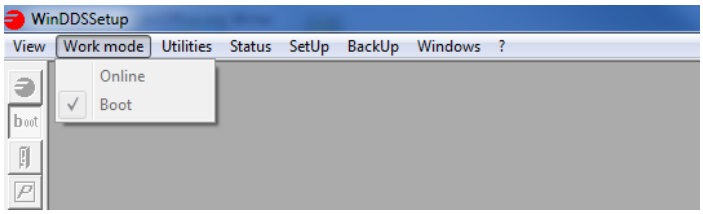
Therefore, to do that, WinDDSSetup must be previously installed at the PC and the remote module RCS-S must be connected to the PC through an RS-232 serial line cable.

Process.



Proceed as follows:

- Run the WinDDSSetup application at the PC.
- Select the label "Work mode" and check the "Boot"option of the pop-up menu.



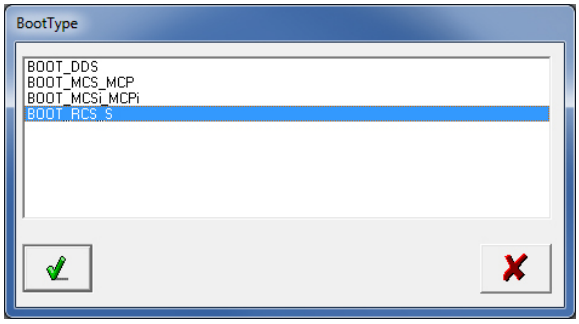
- If the "Online" option is shown, uncheck it to enable the "Boot" option. Its associated icon will also be enabled on the tool bar.



BOOT.

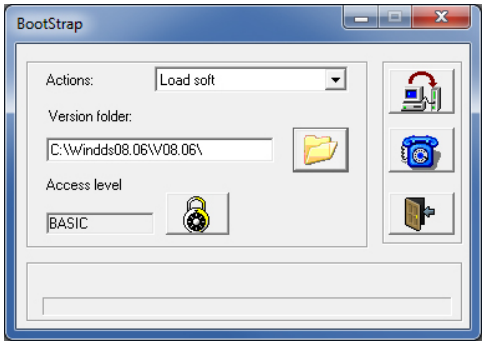


Click on the "Boot" icon of the tool bar to display the "BootType" window.





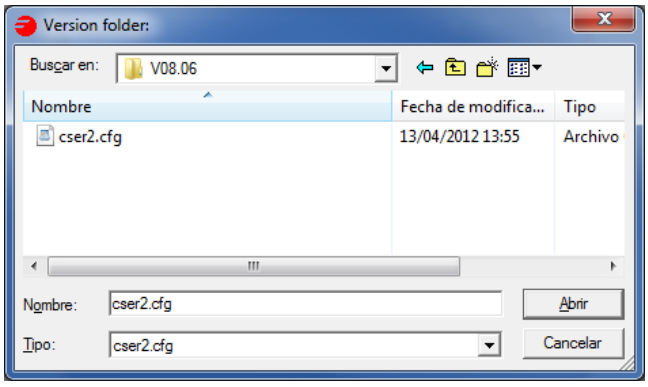
Select "BOOT_RCS_S" from the list and click on "validate". That will display the "BootStrap" window.



Find folder.



Click on this icon to go to the "Version folder" window where the version to be installed has been decompressed (expanded). Locate and select the file "cser2.cfg" in the corresponding folder and click on the Open button.

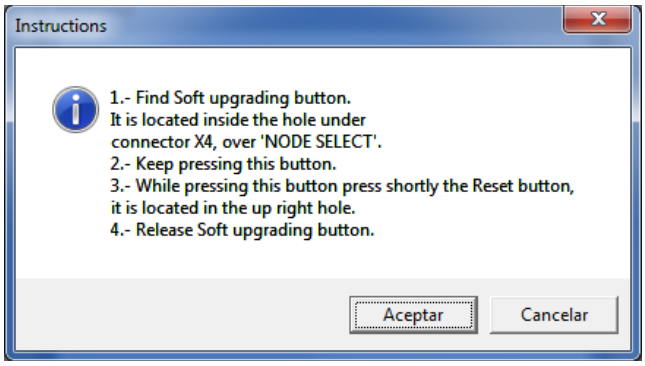


Loading software (from the PC to the remote module "RCS-S").



Click on this icon to go to the "instructions" text window. Proceed by following all the steps indicated next.

Note. The buttons mentioned by the text in this window are located on the front panel of the of the remote module "RCS-S".



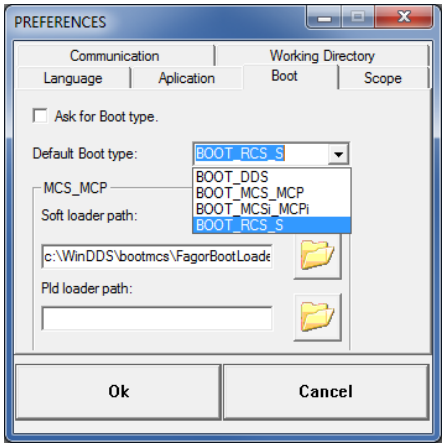
Once all the steps have been completed, click on the "OK" button to start the software loading process from the PC to the remote module "RCS-S".

CONFIGURATIONS

Default Boot.

SetUp> Preferences> Boot

Use this menu sequence to set the "Default Boot Type" and also uncheck the option "Ask for boot type".

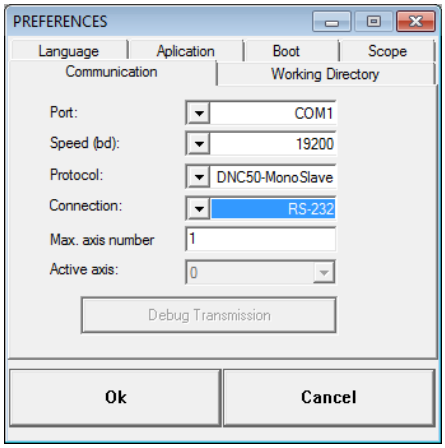


After clicking on OK, the next time the "Boot" icon of the tool bar is pressed on the home screen of WinDDSSetup, it will no longer display the "BootType" window. It will select directly, by default, the option that is selected now on the pop-up menu "Default Boot Type", which in this case is "BOOT_RCS_S" as shown in the screenshot.

Communication parameters

SetUp> Preferences> Communication

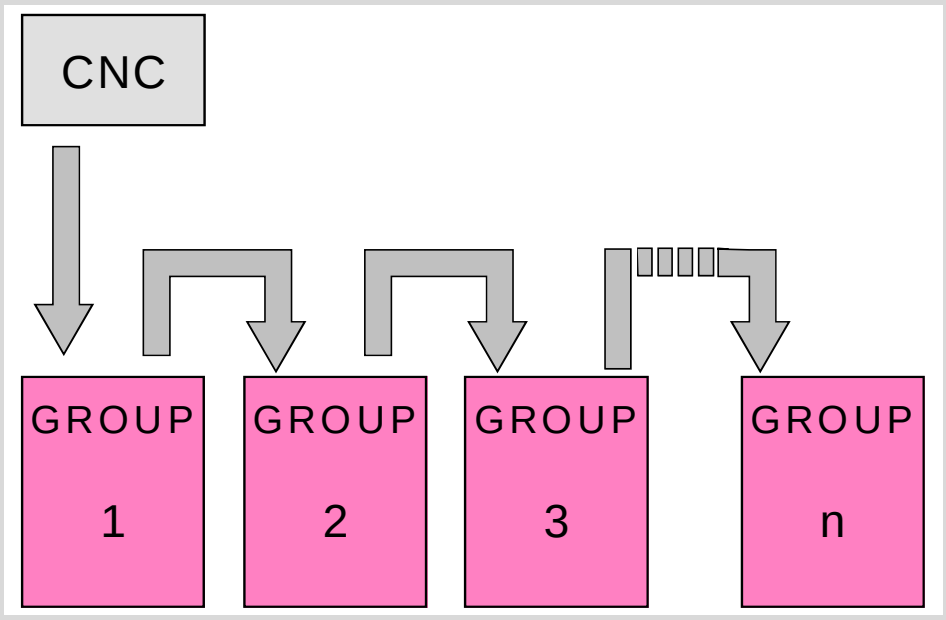
Use this menu to set the main parameters involved in the communication between the PC and the remote module "RCS-S". They stay by default when starting a new session with WinDDSSetup. Any changes made in this dialog box has an immediate effect.



Port.	Select the communication port. Options: COM1 or COM2.
Speed (bd).	Select communication speed. Options: 9600 or 19200.
Protocol.	Select communication protocol. Options: DNC50 - Monoslave, DNC50 - Multislave, MODBUS-RTU or MODBUS-ASCII.
Connection.	Select connection through RS-232 or RS-422 serial line after selecting MODBUS RTU or ASCII protocol.

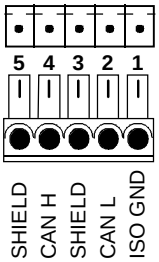
8 CAN BUS (CANFAGOR/CANOPEN PROTOCOLS).

CANfagor and CANopen are two network communication protocols based on the CAN bus system for connecting the CNC with remote modules and keyboards. The CAN connection supports up to 32 devices (nodes), including the central unit; more one than keyboard and several groups of remote modules are possible.



CAN connector.

5-pin male Phoenix minicombicon contact (3.5 mm pitch).



Pin.	Signal.	Function.
1	ISO GND	Ground / 0 V.
2	CAN L	(LOW) bus signal.
3	SHIELD	CAN shield.
4	CAN H	(HIGH) bus signal.
5	SHIELD	CAN shield.

The cable shield must be connected to the connector at both ends. The connector has two shield pins. Both pins are equivalent and the CAN shield may be connected to either one.

CAN cable characteristics.

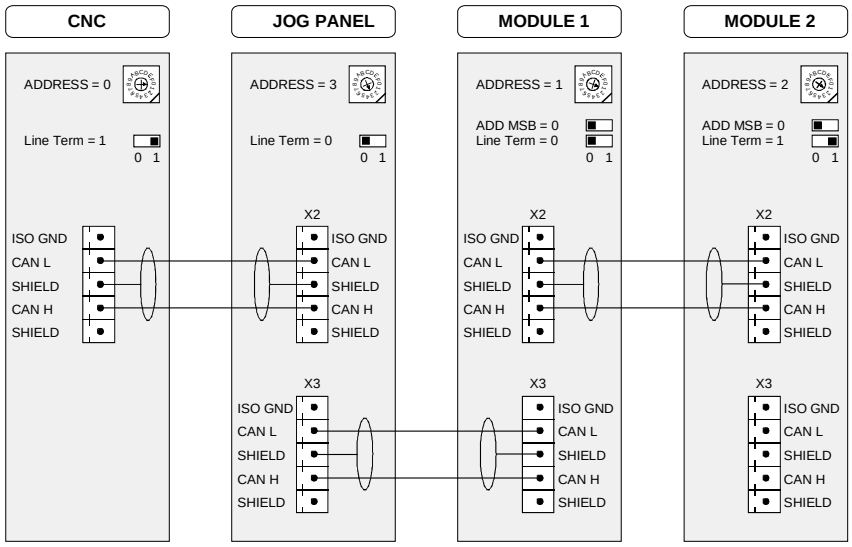
Use a specific CAN cable. The ends of all the wires and the shield must be protected by the corresponding terminal (pin). Also use the terminals (pins) to secure the cable to the connector.

General characteristics.	
Type.	Shielded. Twisted pair (1 x 2 x 0.22 mm²).
Flexibility.	Extremely flexible. Minimum bending radius, static = 50 mm and dynamic = 95 mm.
Cover.	PUR
Impedance.	Cat.5 (100 Ω - 120 Ω)

Module interconnection.

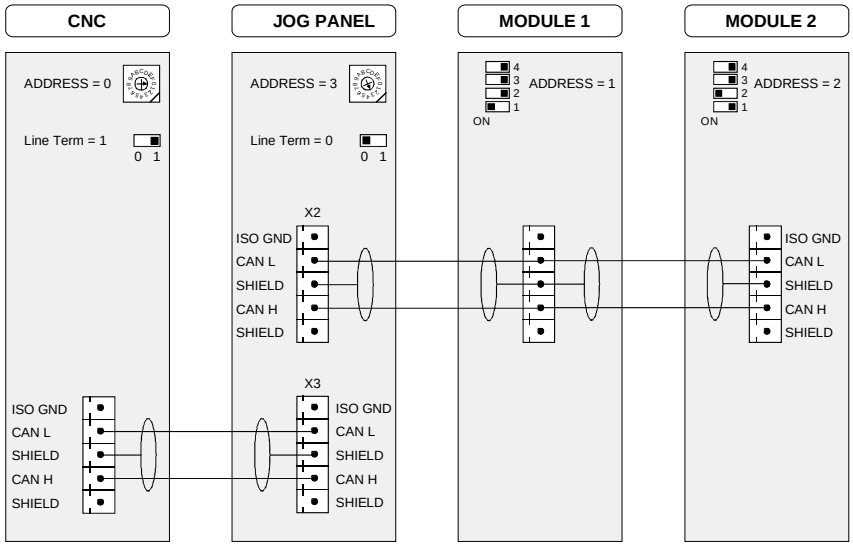
Respect the cable's minimum bending radius when connecting it. They must be connected in series; on elements having two CAN connectors, either one may be used. Once the elements have been connected, define their logic order in the bus and the transmission speed.

Remote modules of the RIO5 and RIO70 series.



The drawing shows the CAN connection between the CPU (central unit), the operator panel and 2 groups of RIO5 or RIO70 series remote modules.

RIOW series remote modules.



The drawing shows the CAN connection between the CPU (central unit), the operator panel and 2 groups of RIOW series remote modules.

8.1 Identification of the modules at the bus.

Each one of the elements integrated into the CAN bus is identified by its address or node number. The CNC must always occupy position "0" and the rest of the elements of the bus will occupy consecutive positions starting with 1.

The node address or number also sets the priority of the group within the bus; the lower the number the higher the priority. We recommend to set the priority of the groups as follows (from highest to lowest).

- The groups that have the feedback inputs.
- The groups that have analog inputs and outputs.
- The groups that have digital inputs and outputs.
- The keyboard and jog panel

Configuring the address (node number). RIO5 and RIO70 series remote modules.

·ADDRESS· selector. Address (node) of the element within the bus.



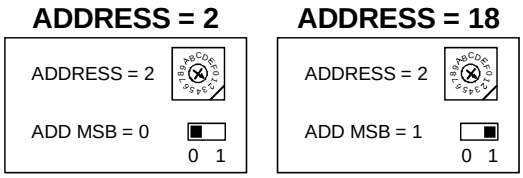
Each one of the elements integrated into the CAN bus is identified by the 16-position rotary switch (0-15) "Address" (also referred to as "Node_Select"). With the ADD MSB" switch, the positions or elements integrated in the CAN bus may be expanded up to 32.

In order for any change at the "Address" switch to be assumed, the CNC must be restarted and the corresponding drive must be reset, however, we recommend to change the address while the modules and the CNC are off.

The "Address" switch also sets the priority of the group within the bus; the lower the number the higher the priority. We recommend the keyboard and jog panel to be the last node of the bus.

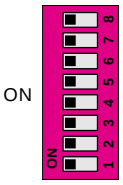
·ADD MSB· selector Address (node) of the element within the bus.

At RIO70 series modules, with the ADD MSB" switch, the positions or elements integrated in the CAN bus may be expanded up to 32. Positions 0-15 are selected with ADD MSB=0 and positions 16-31 with ADD MSB=1.



ADDRESS	0	1	2	3	···	13	14	15
ADD MSB =0	0	1	2	3	···	13	14	15
ADD MSB =1	16	17	18	19	···	29	30	31

Configuring the address (node number). RIOW series remote modules.



The dipswitch may be used to select the address of the node and the transmission speed.

The address (node number) of the group is selected while the module is off. Select the speed by putting the corresponding dipswitches in the ·on· position. The binary meaning of each dipswitch increases according to its number; dipswitch ·1· for address 1, dipswitch ·3· for address 4 and so on.

 Address ·1·.	 Address ·3·.	 Address ·9·.

Identification of the first and last elements of the bus. Line terminating resistor.

In the CAN bus, it is necessary to use a line terminating resistor to identify which are the elements that occupy the ends of the bus; i.e. the first and last physical element in the connection. For the central unit, the terminating resistor is factory installed because the CNC is always at one end of the bus.

RIO5 and RIO70 series remote modules. ·ST· selector.



The ·LT· switch identifies which are the elements that occupy the ends of the CAN bus; i.e. the first and last physical element in the connection.

The switch position of the terminating elements must be "1" and that of the rest of the elements "0". The central unit must always be at one end of the line even when not having this switch. The other end of the line will be the last physical device of the bus.

RIOW series remote modules.

The RIOW series modules do not have a factory-installed line terminating resistor. The RIOW module mounted at the end of the bus must have a 120 Ω line terminating resistor between pins CAN_H and CAN_L to avoid signal deflections (rebounds).

8.2 Type of CAN bus and baudrate.

Bus type selector: CANfagor / CANopen.

The CNC has two types CAN bus: CANfagor and CANopen. There are specific remote modules for each type of bus; at the CNC and at the operator panels, the type of active CAN bus must be selected.

Bus type selection at the CNC.

At the CNC, the type of CAN bus is selected by means of the machine parameters (parameter CANMODE),

8.3 Selecting the baudrate for the CANopen bus.

When using the CANopen protocol, the transmission speed at the bus is defined in each node and they all must run at the same speed. The transmission speed depends on the total length of the bus. Using the following illustrative values; assigning other values may cause communication errors due to signal distortion.

Speed	Length of the CAN bus.
1000 kHz	Up to 20 meters.
800 kHz	From 20 to 40 meters.
500 kHz	From 40 to 100 meters.
250 kHz	From 100 to 500 meters. The speed of 250 kHz is only available to communicate with the keyboards and RIOW series remote modules; this speed is not available at the RIO5 series remote modules.

Selecting the speed at the CNC.

The CNC detects the transmission speed (baudrate) automatically by asking the rest of the nodes connected to it.

Speed selection at RIO5 remote modules.



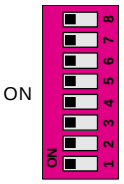
The speed is selected with the ·SPEED· switches.

In order for any change of speed to be assumed, the corresponding module must be reset; however, we recommend to change the speed while the modules and the CNC are off.

			
1000 kHz	800 kHz	500 kHz	500 kHz

The communication at 250 kHz is not available at the RIO5 series remote modules.

Speed selection at RIOW remote modules.



The dipswitch may be used to select the address of the node and the transmission speed.

The dip-switch of the previous figure corresponds to the RIOW-CANOPEN-ECO module. The dip-switch of the RIOW-CANOPEN-ECO and RIOW-CANOPEN-STAND modules is the same but rotated 180º, so the ·ON· position is inverted between them.

To select the speed of the node, the module must be in configuration mode (all the dipswitches in the ·off· position). After turning the module on in configuration mode, the top 4 LED's of the module blink indicating the speed selected at the module. The STOP LED corresponds to dipswitch ·1·, the RUN to dipswitch ·2·, the TX to dipswitch ·3· and the RX to dipswitch ·4·. The first time the module is configured, the TX LED blinks indicating that no valid speed has been selected.

If when turning the module on, all the dipswitches are not in the ·off· position, the position of the dipswitches will be the new address (node number) of the group.

The first 4 dipswitches are used to select the speed; the rest must be in the ·off· position. To select the speed, put the corresponding dipswitches in the ·on· position.

Dipswitch ·1·	Dipswitch ·2·	Dipswitch ·3·	Dipswitch ·4·	Speed
Off	Off	Off	Off	1000 kHz

Dipswitch ·1·	Dipswitch ·2·	Dipswitch ·3·	Dipswitch ·4·	Speed
ON	Off	Off	Off	800 kHz
Off	ON	Off	Off	500 kHz
ON	ON	Off	Off	250 kHz

To save the selected speed, put dipswitch ·8· in the ·on· position. After saving the configuration, the corresponding LED's turn on to indicate the module speed. For 1 MHz, all four LED's turn on.

Once the speed has been selected, turn the module off by removing power and set dip-switch ·8· in the ·off· position. Bear in mind that the next time the module is turned on, the position of the dipswitches will indicate the address (node number) of the group.

8.4 Selecting the speed for the CANfagor bus.

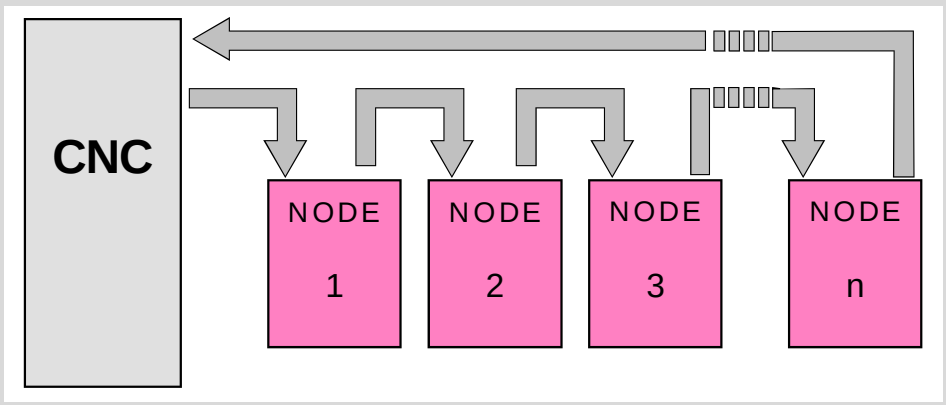
When using the CANfagor protocol, the transmission speed at the bus is defined at the CNC (parameter CANLENGTH). The transmission speed depends on the total length of the cable. Use the following approximate values. Assigning other values may cause communication errors due to signal distortion.

Length (m)	Speed (KHz)
20	1000
30	888
40	800
50	727
60	666
70	615
80	571

Length (m)	Speed (KHz)
90	533
100	500
110	480
120	430
130	400
> 130	250

9 SERCOS BUS.

The Sercos interface is a communications standard designed especially for the machine-tool world and that allows a simple interconnection between the CNC, drives and RCS-S modules. All the data and commands are transmitted in digital format through fiber optic lines that make up a ring (the Sercos ring) that connects all the elements of the bus (CNC and drives) to each other. Using the Sercos interface considerably minimizes the necessary hardware, makes cabling simpler and grants greater reliability to the system making it immune to electrical interference (noise).



Sercos cable characteristics.

Fagor Automation supplies the fiber optic cables needed for Sercos communication. There are several types of cable depending on their length and their dynamic and static installation characteristics.

- Fiber optic cable with polymer core (SFO, SFO-FLEX) for up to 40 meters. If the fiber optic cable is going to withstand dynamic conditions (moving), always use the SFO-FLEX cable If the fiber optic cable is going to withstand static conditions (not moving), always use the SFO cable
- Fiber optic cable with glass core (SFO-V-FLEX) for over 40 meters.

Mechanical cable characteristics.

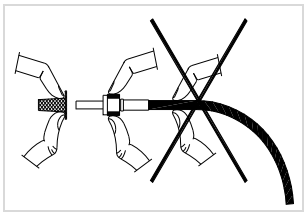
SFO cable.	
Flexibility.	Normal. Minimum bending radius of 30 mm. Only to be used in static systems (not moving).
Cover.	PUR. Polyurethane resistant to chemicals used in machines.
Temperature.	Working: -20 ºC / 80 ºC (-4 ºF / 176 ºF). Storage: -35 ºC / 85 ºC (-31 ºF / 158 ºF).

SFO-FLEX cable.	
Flexibility.	High. Minimum bending radius, static = 50 mm and dynamic = 70 mm. Special cable to be used in cable chains.
Cover.	PUR. Polyurethane resistant to chemicals used in machines.
Temperature.	Working: -20 ºC / 70 ºC (-4 ºF / 158 ºF). Storage: -40 ºC / 80 ºC (-40 ºF / 176 ºF).

SFO-V-FLEX cable.	
Flexibility.	Minimum bending radius, static = 45 mm and dynamic = 60 mm.
Cover.	PUR. Polyurethane resistant to chemicals used in machines.
Temperature.	Working: -40 ºC / 80 ºC (-40 ºF / 176 ºF). Storage: -40 ºC / 80 ºC (-40 ºF / 176 ºF).

Cable handling.

The cable provided by Fagor has its pins protected with a hood. Before connecting the cable, remove the protecting hood.



Both for removing the pins protecting hood for the pins and for plugging and unplugging the cable, hold the cable by its pin, never pull at the cable while holding it by its plastic part because it could make it useless.

9.1 Module identification and connection

Node identification.

Nodes are identified with the 16-position rotary switch (thumbwheel) "Address" (also called "Node_Select") and for the RCS-S modules also with parameter SERCOUUNTID. This switch selects the address (node) occupied by each of the elements integrated into the Sercos connection. The CNC does not have the switch; this CNC is pre-configured to always occupy position ·0· at the bus.

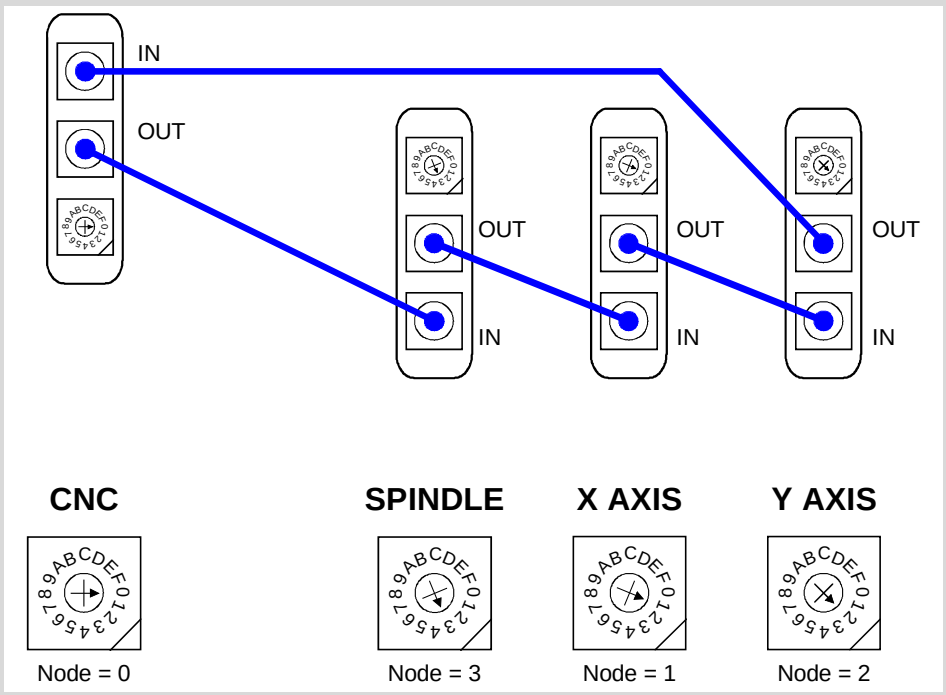
The CNC must always occupy position 0 and the nodes will occupy consecutive positions starting with 1. In order for any change at the "Address" switch to be assumed, the corresponding node must be reset and the CNC powered off and back on.

Whether the drive identified with number 1 (for example) corresponds to the X axis, to the Y axis or to another one is irrelevant. However, it is a good idea, for clarity sake, that the machine axes X, Y, Z, U, V, W, A, B and C be assigned consecutive numbers in that order.

Then set certain CNC machine parameters to configure the connection.

Module interconnection.

The Sercos connection is carried out in a ring using fiber optic cable by joining an OUT terminal with an IN terminal. The drawing shows the Sercos connection of the CNC with Fagor spindle drives and the X, Y axes.



9.2 Data exchange via Sercos.

The data exchange between the CNC and the drives takes place in each position loop. The more data is exchanged, the more overloaded the Sercos transmission will be. These registers should be limited leaving only the ones absolutely necessary after the setup.

There is data that must necessarily be transmitted in every position loop (velocity commands, feedback, etc.) and other data that may be transmitted in several loops (monitoring, etc.). Since the CNC must know the priority of those transmissions, there must be two separate transmission channels.

Cyclic channel (fast).

The data is transmitted in every position loop. It contains velocity commands, feedback, etc. Each variable that is read or written at the drive is included in this data pack. In order not to overload the interface, you must limit the number of drive variables involved to the minimum necessary.

Indicate the type of data to be transmitted. The data to be sent to the drives must be placed in certain particular registers of the PLC and the data to be read from the drives is received in other registers of the PLC.

Service channel (slow).

The data is transmitted in several position loops. It contains monitoring data, etc.

This channel can only be accessed through high-level blocks in the part-program or from the PLC channel.



