DeviceNet System

Installation manual rev. 3.0

Technical characteristics

SUPPLY VOLTAGE:	24 V ± 10 %
WORKING TEMPERATURE:	0 ÷ 50 °C
PERCENTAGE OF HUMIDITY:	30 ÷ 90 % @ 25 °C
	30 ÷ 50 % @ 50 °C
MAXIMUM CONSUMPTION:	1300 mA holding
	1600 mA at the start
CONFORMS TO:	EN 61131-2
	EN 61000-6-1
	EN 61000-6-3
PROTECTION LEVEL:	IP65
MAX. NUMBER OF EXPANSIONS:	15
MAX. NUMBER OF SOLENOIDS:	32
MAX. LENGTH CONNECTIONS (worse case):	50 m

Functioning

The system is designed to operate solenoid valves according to the signals received from an external bus and to provide the diagnostic information to the system and the external bus.
The system consists of an Initial Module (slave DeviceNet device) which communicates with a Master DeviceNet by means of a bus up to 500 Kb/s (setting of the speed by means of software) to which it is possible to connect up to 15 sequential "expansion" modules.
The supply of the expansion modules activation signals of the solenoids come from the Initial Module which has an external power supply and is therefore able to communicate by means of a serial RS232 for the configuration of the system. It is also possible to connect digital input modules which communicate with the initial module through the same internal fieldbus. The input module has an external power supply. The system is able to handle up to maximum 48 inputs. In the following diagrams the main connections and the details of the different connections are shown.
For cabling of the internal fieldbus use the wired cable supplied by CAMOZZI.

Initial module

The initial module has the following functions:

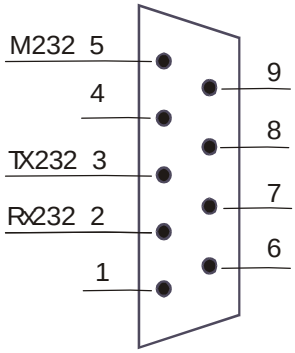
- Is supplied by a source of 24 Vdc with ground connection for the solenoids;
- Is supplied by a source of 24 Vdc with ground connection for electronics;
- 24Vdc supply from the bus for the electronics of the DeviceNet interface;
- Communicates by means of DeviceNet with the Master DeviceNet;
- Communicates by means of RS 232 with an external PC to configure the system;
- Communicates by means of the internal fieldbus (CAN bus) with the expansion modules and supplies them

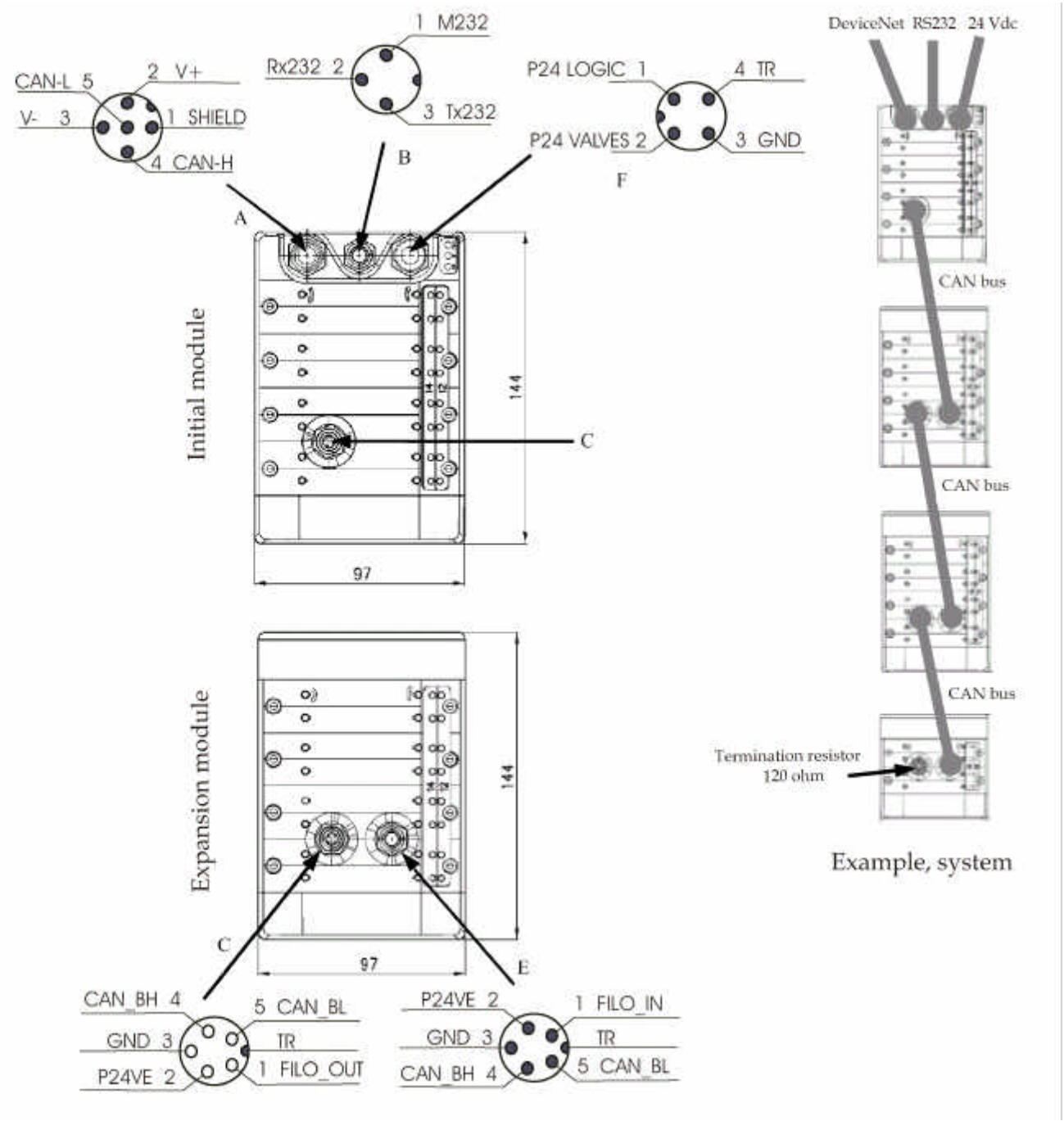
Expansion module

The expansion module (2, 4 and 8 positions) has the following functions:

- Is supplied by the Initial Module;
- Communicates by means of the internal fieldbus with the Initial Module and the eventual following expansions

Connessione seriale
lato PC



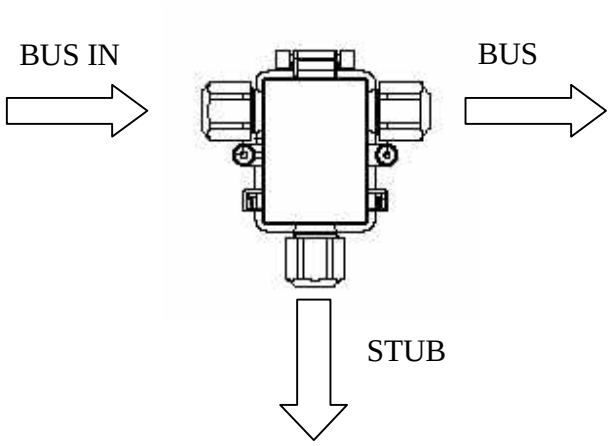


CONNECTOR A

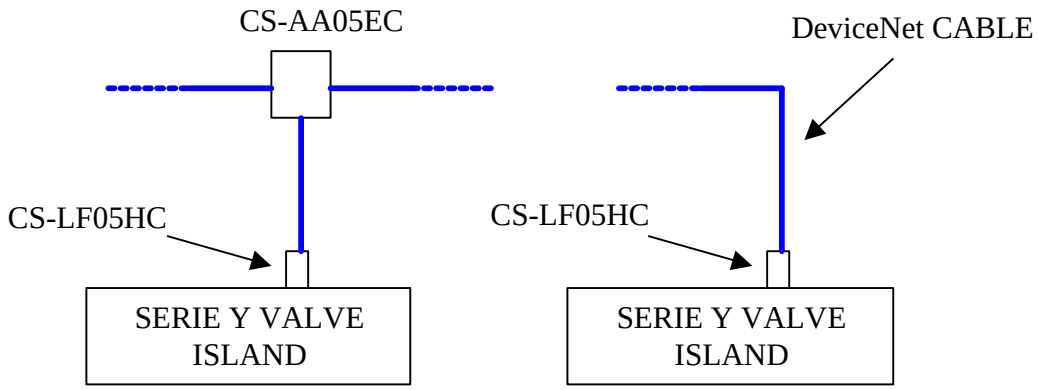
PIN 1 (SHIELD): ground. You have to connect this pin to the shield of the DeviceNet wire.
PIN 2 (V+): Positive supply voltage of the DeviceNet bus (24V).
PIN 3 (GND): Reference (0V) of the voltage on pin 2.
PIN 4 (CANH): CANH line of the DeviceNet bus.
PIN 5 (CANL): CANL line of the DeviceNet bus.

In case the valve island is the last node of the DeviceNet line, it is necessary to insert a terminal resistance of 120 ohm connected to CANH e CANL signals. The terminal resistance has to be inserted externally to the last node (inside connector A or in the T-derivation).

While in case the valve island is in an intermediate point of the DeviceNet line, a T-derivation has been realized (code CS-AA05EC) which allows to enter with the DeviceNet line from on side (BUS IN), continue the line from the opposite side (BUS OUT) and bring the DeviceNet line from the lower side up to connector A of the valve island Series Y (STUB).



The T-derivation for the DeviceNet line has to be positioned as close as possible to the valve island Series Y in order to limit the length of the stub. In order to connect the valve island to the DeviceNet network, it is necessary to use an M12, 5 female poles connector (code CS-LF05HC for the straight connector and code CS-LR05HC for the 90° connector). In particular hard applications as regards inconveniences, it is advised to use metallic connectors.
Following you will find the example scheme of a DeviceNet system with the two valve islands series Y, one mounted in an intermediate position and one at the end of the network.



CONNECTOR F:

PIN 1 (P24 LOGIC): power supply for the part which handles the DeviceNet communication of the valve island, (the electronics). You have to connect the positive pole of the supply (24V) to this pin.

PIN 2 (P24 VALVES): power supply for the operating of the solenoid valves mounted on the valve island. You have to connect the positive pole of the supply (24V) to this pin.

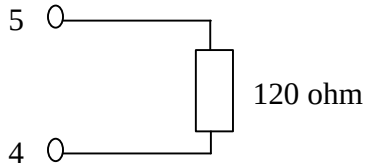
PIN 3 (GND): voltage reference on the pins 1 and 2. You have to connect the negative pole of the supply (0V) to this pin.

PIN 4 (TR): ground connection. Where present, you have to connect the ground reference of the machine to this pin. This connection is not indispensable for the function of the valve island, but it improves its performance.

If the user wants to handle the emergency phase of the machine by removing the power supply from the solenoids only, he has to connect two different power supply lines to the pins 1 and 2 of the connector F. Otherwise, it is possible to connect one supply line and just add a jumper between pin 1 and 2 inside the connector M12 4 pole female (code CS-LF04HB for the straight connector and code CS-LR04HB for the 90° connector). It is important that the user checks the total load connected to the supply of the machine, in order to avoid voltage drops, which could compromise the correct functioning of the valve island.

TERMINAL RESISTANCE FOR THE INTERNAL FIELDBUS (CAN):

In the right figure on page 2, you can see an example of a system where 3 expansion modules are connected to an initial cover. On the female connector of the last expansion (connector D) a terminal resistance is connected according to the following scheme:



An M9 connector is available with this resistance integrated (code CS-FP05H0).

Installation and connection

To install the DeviceNet system, take it out of the package and follow the operations below, referring to the schemes on the previous page.

- Place the valve island (the Initial Module) in order to receive the power supply and the connection DeviceNet from the Master DeviceNet.
- Place the Expansion Modules where needed, (within 50 m. from the initial module).
- Connect the external bus, DeviceNet, to connector **A** on the Initial Module.
- Connect the serial port RS 232 to connector **B** on the Initial Module in order to configure the valve island for the first time if needed, (setting the slave address, and baud rate).
- Connect the internal fieldbus (if the valve system has expansion modules) to connector **C** of the Initial Module.
- Connect the subsequent Expansion modules by means of the connectors **D** and **E** .
- Connect the terminal resistance (120 .) to connector **D** of the last connected expansion.
- Connect the supply wire (24 Vdc ± 10 %) to connector **F** of the Initial Module.

Once the connections are finished, it is possible to add power supply the valve island.

The initial module of the Series Y is provided with an internal non volatile memory on which the configuration of the valve island is memorized. If the configuration of the island is modified (for example with the adding of a coil), in order to make it effective, you will have to use the software "Hardware Configurator" (refer to the procedure manual) in order to memorize it on the initial module (identification procedure). If the modification is not memorized, the island will continue to act as if the modification never took place.
The identification procedure is started by means of the "Hardware Configurator" and requires that the supply is taken away from the valve island (both the logic and the power supply) and that then the island is reconnected to the supply. For a correct functioning of the identification procedure you must avoid to connect the power supply before having connected the logic supply (these can be connected at the same time). During this phase we advise to interrupt the air supply to the valve island as accidental activations of some coils could occur.
The procedure takes about 10 seconds and during this period the two red leds NS and IO continue to blink, which indicates that the system is checking its configuration. When the blinking of the two red leds NS and IO stops (in normal conditions the two leds IO and NS are green), it means that the valve island is ready to communicate with the DeviceNet master on the network. We advise to use the Hardware Configurator to make sure that all the components of the island have been identified correctly.
But if the valve island is supplied without having started the identification procedure, the power and the logic supply can be connected in any type of sequence.

If voltage is supplied to the logics only (pin 1 of connector F), the green led MS switches on, the red led IO blink and the green led NS blink. When also connecting the power supply (pin 2 of the connector F), the green led NS blink for some seconds (check of network) and after become green and, if there are no anomalies, the red led IO switch off.

If voltage is supplied to the valves part only (pin 2 of connector F), all LED's remain switched OFF. When connecting also to the logics only (pin 1 of connector F), the green MS switch ON, the green led NS start to flash and the sequence continue as described previously described.

The master DeviceNet which is present in the network starts to interrogate the valve island in order to verify its functioning. If there are no anomalies, the red NS led starts flashing indicating the trasnfer of information on the network, while if the contrary is the case, it remains switched on. The most frequent causes of anomalies on the DeviceNet network are the following:
- interruption or erroneous cabling of the DeviceNet network
- DeviceNet address of the valve island not correct (the address of the valve island should coincide with

the one present in the configuration hardware saved on the master). When the valve island indicates any anomaly through the NS led, also on the PLC there is a led which turns switched on to indicate the error and normally the master enters in a STOP state. Usually the user has the possibility to manage through the software this situation and to avoid that the master goes into the STOP state: in this way the program charged in the memory of the master could function either way, also if the valve island does not receive any command and does not send any diagnostics information.

When putting the master in the MS state, while no anomalies are indicated in the DeviceNet network, the execution of the program charged in the memory starts. In case of correct message transfer (communication) DeviceNet, the NS led turns green.
During this phase there are two conditions which could cause communication problems with the PLC:
- interruption of the DeviceNet network
- interruption of the power supply of the logics

In both cases the master indicates the state of the NS (and usually enters in the STOP mode), while the valve island indicates the anomaly only in the first case (in the second case, the valve island switches off completely and to restore the functioning correctly, you should also remove the power supply to the solenoids, pin 2 of connector F).

N.B. when the master enters in a STOP mode, the program do not restart automatically after having eliminated the cause of an error. It is necessary to restart the whole system. Furthermore, when the master enter in STOP mode, all the outlets connected to it are deactivated and consequently also all the solenoids are deactivated, except those which have the RELAX function activated. These will be activated instead, (for further information

regarding RELAX see the manual "Series Y Hardware Configurator). If the master indicates a NS situation without entering in STOP mode, it normally restarts automatically when eliminate the cause of the error.

With the master in the MS state, if the valves' supply is interrupted (pin 2 of connector F), keeping the logic one connected, there is no MS signal neither on the master nor on the valves' island: The DeviceNet network is active. The anomaly is signalled by the valves' island with the flashing of the red led IO and with the flashing of the green led MS. Furthermore the diagnostic of the valves' island signals all the coils if interrupted. The user must decide how to handle this situation through the software saved in the master (he may decide, for example, to block the program, to stop the functioning of a machine's part or to continue regularly the cycle). Through the re-connection of the valves' supply, the island start immediately it's normal working again and, if no other odd situations occur, the IO and MS LED's will turn and stay green. When the power voltage is reconnected, the island's diagnostic indicate immediately as OK the coils of Initial Module, instead the coils of eventual expansions are indicate as interrupted for some seconds and after they are indicated as OK. If on a module (initial or expansion) a coil was indicated as interrupted before of coils voltage interruption, the other coils will not indicated as interrupted and the interrupted coils indication are sustained also when the coils voltage are reconnecting.

With the master in the MS state, if the cable which connects the initial module with the different expansions is interrupted, the led IO flashes red and the diagnostic of the valves' island signals all the coils, which are present on the disconnected expansions, as interrupted, while both the initial module and the still connected expansions keep working regularly. Also in this case the user must decide how to handle this situation through the software saved in the master. Once the problems which caused the connection interruption have been solved, the error's signal through the led IO disappeared and the diagnostic signals that the coils work regularly: therefore the valves' island start again working properly. The same situation occurs in case the system registers a supply tension lower than 19,5V on any of the present expansions.

With the master in the MS state, if the valves' supply is interrupted (pin 2 of the connector F), the logic's one is connected and the valve's island structure is modified (for example by the disconnection of the cable which connects one of the eventually present expansions), the island signals the presence of an anomalous situation, even if the valves' supply is re-connected: the red led IO keeps flashing and the diagnostic of the valves' island signals that all the coils are interrupted. Also in this case the user must decide how to handle this situation through the software saved in the master

We strongly advise against connecting a new expansion to the valve island and to start the island without carrying out an identification procedure before. In fact, in this case the expansion already memorized an address inside, but which, being random, could coincide with the one of an already existing expansion on the island: at this point the two expansions would receive the same activation commands for the coils. The identification procedure allows to assign a univocal address to all connected expansions.

Programming

Format of the data

The outlets coming from the Master DeviceNet and directed to the Initial Module can be formed by a maximum of 4 bytes in the following layout:

N. coils	Byte 0								Byte 1								Byte 2								Byte 3							
	7	6	5	4	3	2	1	0	15	14	13	12	11	10	9	8	23	22	21	20	19	18	17	16	31	30	29	28	27	26	25	24

For example: bit 0 of byte 0 corresponds with the outlet 0
bit 2 of byte 1 corresponds with the outlet 10
bit 7 of byte 3 corresponds with the outlet 31

The diagnostic inlets for the Master DeviceNet can be made by a maximum of 8 bytes with the following layout:

N. coils	Byte 0								Byte 1								Byte 2								Byte 3							
	3	3	2	2	1	1	0	0	7	7	6	6	5	5	4	4	11	11	10	10	9	9	8	8	15	15	14	14	13	13	12	12

N. coils	Byte 4								Byte 5								Byte 6								Byte 7							
	19	19	18	18	17	17	16	16	23	23	22	22	21	21	20	20	27	27	26	26	25	25	24	24	31	31	30	30	29	29	28	28

For example: bits 0 and 1 of byte 0 are the diagnosis of the coil with index 0
bits 2 and 3 of byte 0 are the diagnosis of the coil with index 1
bits 6 and 7 of byte 7 are the diagnosis of the coil with index 31

The significance of these diagnosis bits relative to a coil are as follows:

0 0 correct functioning
1 0 solenoid interrupted
0 1 solenoid in short circuit

The inlets for the Master DeviceNet can be made by a maximum of 8 bytes with the following layout:

Byte 0								Byte 1								Byte 2								Byte 3							
7	6	5	4	3	2	1	0	15	14	13	12	11	10	9	8	23	22	21	20	19	18	17	16	31	30	29	28	27	26	25	24

Byte 4								Byte 5							
39	38	37	36	35	34	33	32	47	46	45	44	43	42	41	40

Byte 6								Byte 7							
55	54	53	52	51	50	49	48	63	62	61	60	59	58	57	56

The first six bytes assume the value for the state of the digital inputs.

For example: bit 0 of byte 0 corresponds to the state of the digital input 0
bit 2 of byte 1 corresponds to the state of the digital input 10
bit 7 of byte 3 corresponds to the state of the digital input 31

The significance of these bits are as follows:

0 input is OK
1 input in short circuit

File EDS

The ESD file, relative to the Initial Module, DeviceNet, is supplied by the system (name SERIEY-DEVICENET.EDS), and needs to be installed on the Master DeviceNet and allows to configure the communication between Master and Slave;

Indications

LED	COLOUR	SIGNIFICANCE LED SWITCHED ON
MS [1]	Green / Red	**Off**: there is no power present **Green non Flashing**: Module is working properly **Flashing Green**: Module is in standby **Flashing Red**: Fixable error **Red non Flashing**: Non-Fixable error **Flashing Red/Green**: LED testing (test is run after the master is turned on, the led will flash green, red, then will turn green again)
NS [1, 2]	Green / Red	**Off**: Device is not online or it's turn off **Green non Flashing**: Device is online **Flashing Green**: Device is online but is not connected to the bus **Flashing Red**: One or more I/O are in Time-Out state **Red non Flashing**: Non-fixable communication fieldbus error **Flashing Red/Green**: Communication error
IO [1, 2]	Green / Red	**Off**: All the I/O are inactive **Green non Flashing**: One or more I/O are active and without error **Flashing Green**: One or more I/O are inactive, none of the I/O are inactive or turned off because of malfunctions **Flashing Red**: One or more I/O are in error state **Red non Flashing**: One or more output are forced in a "off" state because of a critical error or the inputs are in a non-fixable error state. **Flashing Red/Green**: Communication failure
12/14	Yellow	Corresponding solenoid supplied

[1] The leds MS, NS and IO are only present on the Initial Module
[2] The flashing led's NS and IO indicate that the system is proceeding with the initial recognition.

Diagnostics

SIGNALLING	OPERATIONS TO CARRY OUT
LED MS switched off	☞ Verify the presence of power supply on the logics part of the initial module.
LED MS flashing	☞ Verify the presence of power supply on the solenoid part of the initial module.
LED NS switched on	☞ Verify DeviceNet connection ☞ Verify DeviceNet Master – Slave configuration
LED IO switched on	☞ Verify Initial Module – Expansions connections ☞ Verify state of solenoids and Expansions by means of serial

In case of a defect solenoid, the system points out the anomaly and:

- Deactivates the faulty solenoid;
- Blocks any signal directed to the faulty solenoid;
- activates the LED **DIA**;
- sets up the corresponding bits in the outlet (inlet to Master DeviceNet) to the faulty solenoid.

The user should decide how to manage this situation through the software, which is memorised in the master.

Research of defects

PROBLEM	LED MS	LED NS	LED IO	OPERATIONS TO CARRY OUT
Power supply on the logics part absent	OFF	OFF	OFF	Check the presence of supply
Power supply on the solenoid part absent	BLINK GREEN	GREEN	BLINK RED	Check the presence of supply
Supply less than the specifications	GREEN	GREEN	BLINK RED	Check the supply voltage
Disconnection DeviceNet connection	GREEN	BLINK GREEN	GREEN	Chek the CANOpen connection
Disconnection subserial connection	GREEN	GREEN	BLINK RED	Check connections Initial Module – Expansions
Length of expansion connections superior to the length allowed	GREEN	GREEN	BLINK RED	Check the length of the connections Initial Module – Expansions
Wrong communication configuration DeviceNet	GREEN	BLINK GREEN	GREEN	Check configuration CANOpen Master - Slave
Internal defect of the electric cover	OFF	OFF	OFF	Check the presence of supply
Internal defect of the electric cover	GREEN	GREEN	GREEN	Contact assistance
Solenoid defect	GREEN	GREEN	RED	Check the state of the solenoids by means of the hardware configurator program
Expansion defect	GREEN	GREEN	BLINK RED	Check the state of the expansions by means of the hardware configurator program

In case of absence of electrical supply it is possible to operate manually on each single valve by means of the corresponding manual override **G** (mechanical movement is guaranteed only in presence of compressed air).

Accessories

CS-LF04HB	CONNECTOR M12 4 POLE FEMALE (FOR SUPPLY)
CS-LR04HB	CONNECTOR M12 4 POLE FEMALE 90° (FOR SUPPLY)
CS-LF05HC	CONNECTOR M12 5 POLE FEMALE (FOR CANOPEN)
CS-LR05HC	CONNECTOR M12 5 POLE FEMALE 90° (FOR CANOPEN)
CS-FZ03AD-C500	CONNECTOR M9 3 POLE FEM+ SUB-D PLUG+CABLE 5 mt. (FOR PROGRAMMING)
CS-FW05HE-D025	CABLE WITH TWO CONNECTORS M9 5 POLE MALE + FEMALE 25 cm.(FOR EXPANS.)
CS-FW05HE-D100	CABLE WITH TWO CONNECTORS M9 5 POLE MALE + FEMALE 1mt.(FOR EXPANS.)
CS-FW05HE-D250	CAVO CON DUE CONNETTORI M9 5 POLE MALE + FEMALE 2.5 mt.(FOR EXPANS.)
CS-FW05HE-D500	CAVO CON DUE CONNETTORI M9 5 POLE MALE + FEMALE 5 mt.(FOR EXPANS.)
CS-FW05HE-DA00	CAVO CON DUE CONNETTORI M9 5 POLE MALE + FEMALE 10 mt.(FOR EXPANS.)
CS-FP05H0	CONNECTORS M9 5 POLE MALE+TERMINAL RESISTANCE (FOR EXPANS.)
CS-AA05EC	CANOPEN DATA LINE TEE

GLOSSARY

IP65	Total protection against dust. Protected against low pressure jets if water from all directions.
DeviceNet	**(Controller Area Network**) serial flexible data communication system at high speed (up to 500Kbit/sec) for the industrial automation. Its primary application area can be attributed to the field's level. There are different kinds of communication: Client/server model, producer/user and master/slave model.
MASTER	It is the device which inside a DeviceNet net has to control the data flow. There may be more DeviceNet on the same net
SLAVE	Device which communicates inside the DeviceNet net and replies to the master' s requests or generates messages in asynchronous modality. The slaves' priority is connected to their address.
NODE	Master or slave device connected to a DeviceNet network. In a DeviceNet network there may be up to 63 nodes.
FIELDBUS	Communication system which foresees the data coding in a sequence of 0 and 1 and the use of an unique transmission means. It is necessary that all the connected devices can code and decode the information.
FILE EDS	Word file which contains all the information required by the Master to communicate correctly with the slave and some information connected with the producer. This file is supplied by the slave's producer.