Profibus-DP System

Installation manual rev.3.0

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 continui 1600 mA di spunto
MAXIMUM CONSUMPTION::	EN 61326-1 EN 61010-1
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 Profibus-DP device) which communicates with a Master Profibus-DP by means of a bus up to 12 Mb/s (automatic setting of the speed) to which it is possible to connect up to 15 sequential "expansion" modules by means of an internal fieldbus.
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, (3 input modules, each containing 16 digital 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:

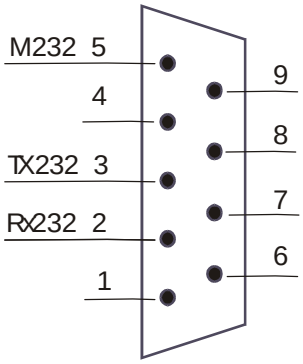
- Is supplied by a source of 24 Vdc with ground connection for the solenoids;
- Is supplied by a source of 24 Vdc with ground connection for electronics;
- Communicates by means of Profibus with the Master Profibus-DP;
- Communicates by means of RS 232 with an external PC to configure the system;
- Communicates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

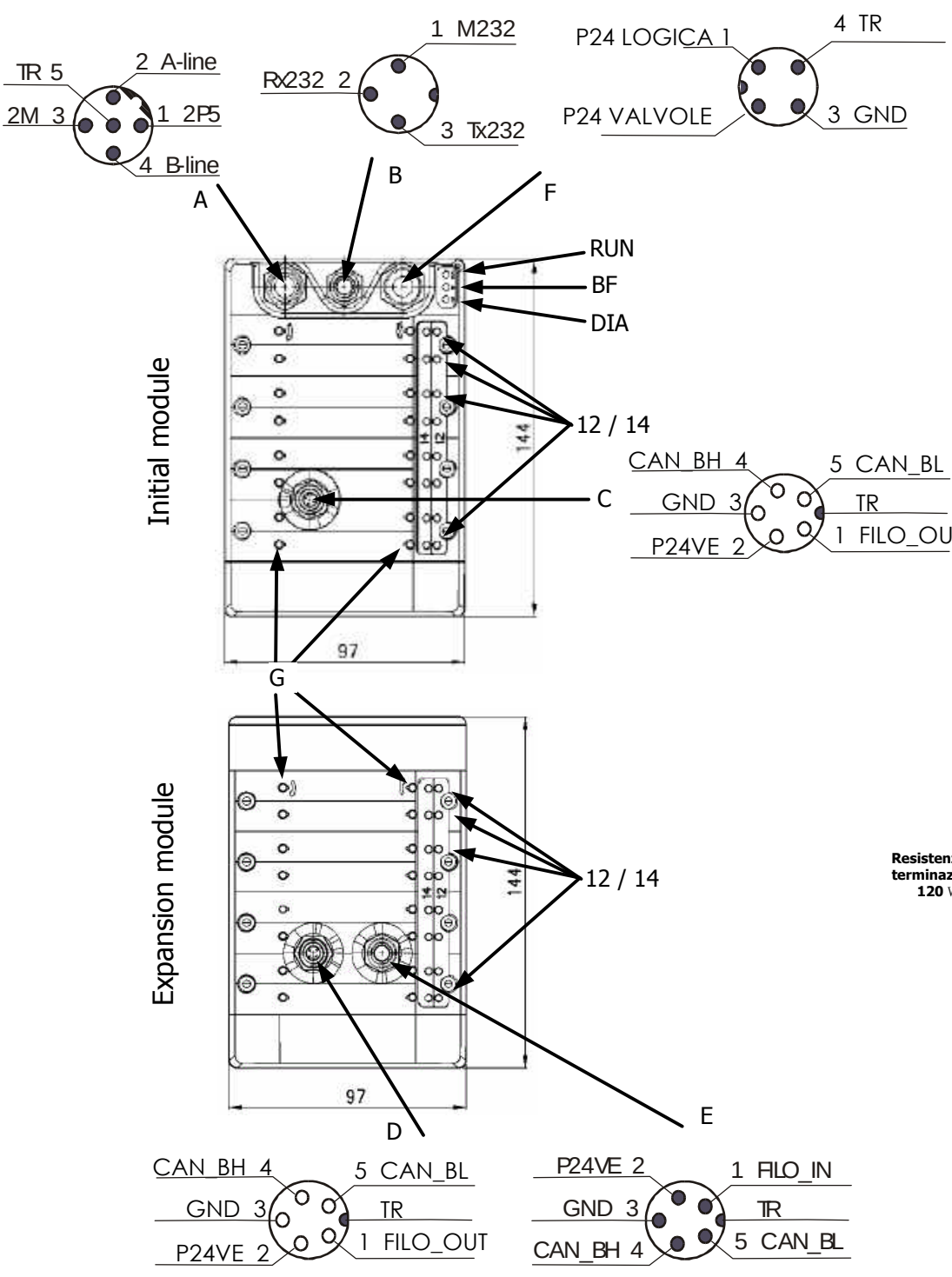
Expansion module

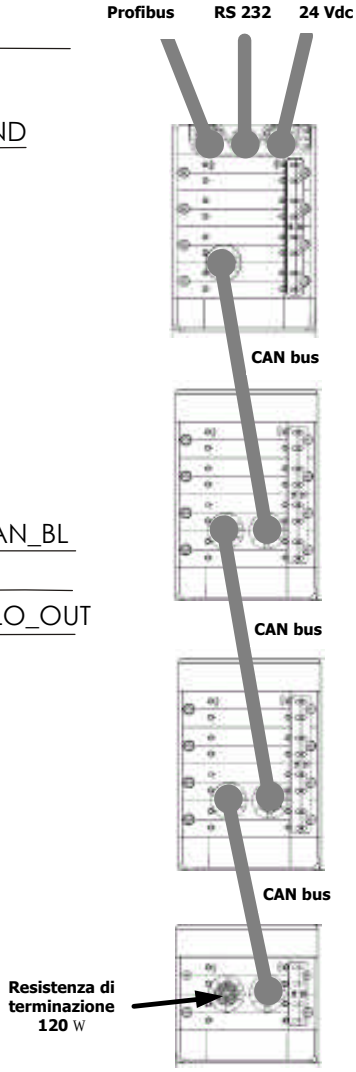
The expansion module (2, 4 and 8 positions) has the following functions:

- 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





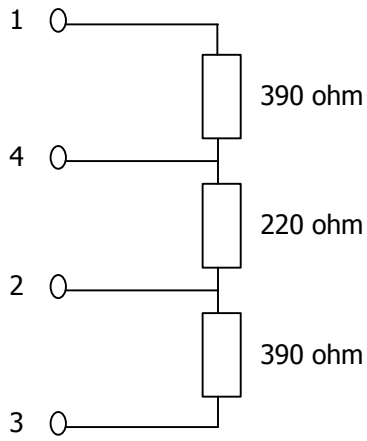


system example

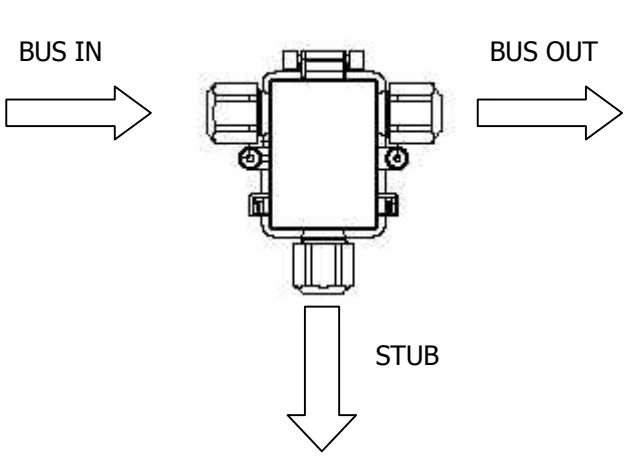
CONNECTOR A

PIN 1 (2P5): 5V tension provide from the board.
PIN 2 (A-line): line A of the Profibus line. You have to connect this pin to the green wire of the Profibus wire.
PIN 3 (2M): reference (GND) of the voltage of 5V on pin 1.
PIN 4 (B-line): line B of the Profibus line. You have to connect this pin to the red wire of the Profibus wire.
PIN 5 (TR): ground. You have to connect this pin to the shield of the Profibus wire.

In case the valve island is the last node of the Profibus line, the Profibus specifications recommend to use a terminal resistance: for the valve islands Series Y the possibility to insert this terminal resistance through the software program "Configurator Hardware" (for details see the relative manual). Here below you can find the scheme of the connection of this resistance (the numbers on the left indicate the number of the pin of connector A):

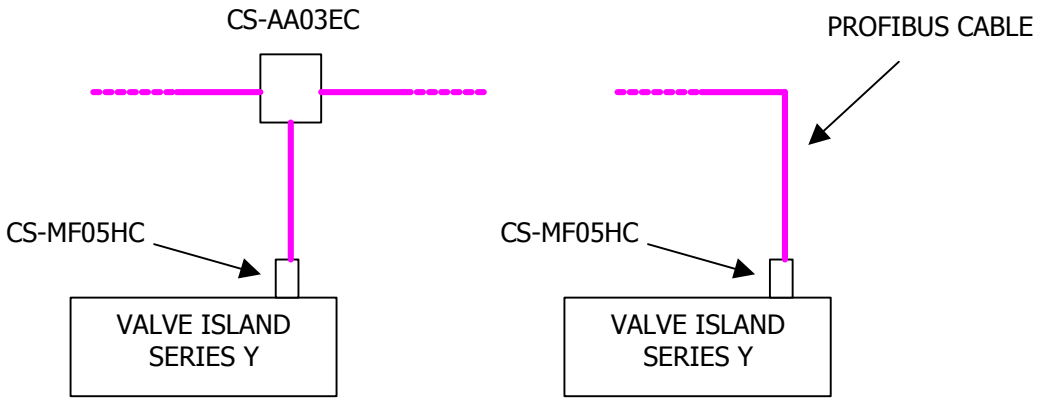


While in case the valve island is in an intermediate point of the Profibus line, a T-derivation has been realized (code CS-AA03EC) which allows to enter with the Profibus line from on side (BUS IN), continue the line from the opposite side (BUS OUT) and bring the Profibus line from the lower side up to connector A of the valve island Series Y (STUB).



The T-derivation for the Profibus 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 Profibus network, it is necessary to use an M12B (reverse key) 5 pole female connector (code CS-MF05HC). In particular hard applications as regards inconveniences, it is advised to use metallic connectors.

Following you will find the example scheme of a Profibus system with the two valve islands series Y, one mounted in an intermediate position and one at the end of the Profibus network.



CONNECTOR F:

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

PIN 2 (P24 VALVE): 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.

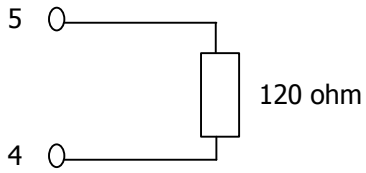
PIN 3 (GND): voltage reference on the pins 1 and 2. You have to connect the negative pole of the supply (0V) to this pin.

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, (keeping the logics still operative during emergency stop) 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). 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 Profibus 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 Profibus from the Master Profibus-DP.
- Place the Expansion Modules where needed
- Connect the external bus, Profibus-DP, 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 Ω) 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 BF and DIA continue to blink, which indicates that the system is checking its configuration. When the blinking of the two red leds BF and DIA stops (in normal conditions the two leds DIA and BF are switched off), it means that the valve island is ready to communicate with the Profibus 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 RUN switches on and the red led DIA switches on. When also connecting the power supply (pin 2 of the connector F), if there are no anomalies, the red led DIA 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 (pin 1 of connector F), the green LED switch ON, and the sequence continue as described previously.

The master Profibus which is present in the network starts to interrogate the valve island in order to verify its functioning: during this phase the red led BF remains switched on. If there are no anomalies, the re led BF turns switched off, while if the contrary is the case, it remains switched on.
The most frequent causes of anomalies on the Profibus network are the following:

- interruption or erroneous cabling of the Profibus network
- Profibus 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 BF led, also on the PLC the BF led turns switched on and normally the master enters in a STOP state. 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 (in case of the Siemens PLC, it is necessary to manage the l'OB86).

When putting the master in the RUN state, while no anomalies are indicated in the Profibus network, the execution of the program charged in the memory starts. During this phase there are two conditions which could cause communication problems with the PLC:
- interruption of the Profibus network
- interruption of the power supply of the logics

In both cases the master indicates the state of the BF (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).

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 BF situation without entering in STOP mode, it normally restarts automatically when eliminate the cause of the error.

With the master in the RUN state, if the valves' supply is interrupted (pin 1 of connector F), keeping the logic one connected, there is no BF signal neither on the master nor on the valves' island: The Profibus network is active. The anomaly is signaled by the valves' island with the flashing of the red led DIA and with the flashing of the green led RUN. 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 red led DIA goes off and the green led RUN lights up constantly. 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 RUN state, if the cable which connects the initial module with the different expansions is interrupted, the led DIA lights up 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 DIA 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 RUN 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 DIA 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 Profibus-DP and directed to the Initial Module can be formed by max. 4 bytes disposed as follows:

	Byte 0								Byte 1								Byte 2								Byte 3							
N. coils	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 PROFIBUS 0 (A0.0)
bit 2 of byte 1 corresponds with the outlet PROFIBUS 10 (A1.2)
bit 7 of byte 3 corresponds with the outlet PROFIBUS 31 (A3.7)

The inlets for the Master Profibus-DP (diagnosis of the system generated by the Initial Module) can be formed by a maximum of 8 bytes disposed as follows:

	Byte 0								Byte 1								Byte 2								Byte 3							
N. coils	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

	Byte 4								Byte 5								Byte 6								Byte 7							
N. coils	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 PROFIBUS 0 (E0.0, E0.1)
bits 2 and 3 of byte 0 are the diagnosis of the coil with index PROFIBUS 1 (E0.2, E0.3)
bits 6 and 7 of byte 7 are the diagnosis of the coil with index PROFIBUS 31 (E7.6, E7.7)

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 Profibus can be formed by a maximum of 8 bytes disposed as follows:

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 circuit open
1 input circuit closed

The seventh byte (byte 6) is not used while the first six bits of the last byte (byte 7) indicates the state of the whole circuit (module).

For example: bit 0 of byte 7 correspond to the state of the first input module
bit 2 of byte 7 correspond to the state of the third input module

(bit 6 and 7 of byte 7 are not used)

The significance of these bits are as follows:

0 the module is functioning OK
1 the module does not communicate

File GDS

The GSD file, relative to the Initial Module, Slave Profibus-DP, is supplied by the system (name CCC07BA.gsd), and needs to be installed on the Master Profibus-DP and allows to:

- configure the communication between Master and Slave;
- set up the format of the output– input frames based upon the number of solenoid valves to command and the number of inputs to read. From the following configurations is possible to select a maximum of 2 "blocks", one for the outputs (from number 1 to 4) and one for the inputs (from number 5 to 7)

1) 8 EV + DIA EV (1 byte OUT + 2 byte IN)
2) 16 EV + DIA EV (2 byte OUT + 4 byte IN)
3) 24 EV + DIA EV (3 byte OUT + 6 byte IN)
4) 32 EV + DIA EV (4 byte OUT + 8 byte IN)
5) 2 Byte Input + DIA IN (4 byte IN)
6) 4 Byte Input + DIA IN (6 byte IN)
7) 6 Byte Input + DIA IN (8 byte IN)

Indications

LED	COLOUR	SIGNIFICANCE LED SWITCHED ON
RUN [1]	Green	Flashing: Power supply present on the logics part of the Initial Module ON: Power supply present on the logics part and valves of the Initial Module
BF [1, 2]	Red	communication error with Profibus-DP
DIA [1, 2]	Red	Communication error on the internal fieldbus or anomaly of the expansions or of the solenoids
12/14	Yellow	Corresponding solenoid activated

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

Diagnostics

SIGNALLING	OPERATIONS TO CARRY OUT
LED RUN switched off	☞ Verify the presence of power supply on the logics part of the initial module
LED RUN flashing	☞ Verify the presence of power supply on the solenoid part of the initial module.
LED BF switched on	☞ Verify Profibus connection ☞ Verify Profibus-DP Master – Slave connection
LED DIA switched on	☞ Verify Initial Module – Expansions connections ☞ Verify state of solenoids and Espansions 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 Profibus-DP) to the faulty solenoid.
The user should decide how to manage this situation through the software, which is memorised in the master.

Trouble shooting

PROBLEM	Led RUN	Led BF	Led DIA	OPERATIONS TO CARRY OUT
Power supply on the logics part absent	OFF	OFF	OFF	Check the presence of power supply
Power supply on the solenoid part absent	BLINK	OFF	OFF	Check the presence of power supply
Supply less than the specifications	ON	OFF	ON	Check the supply voltage
Disconnection Profibus connection	ON	ON	OFF	Chek the Profibus connection
Disconnection internal fieldbus connection	ON	OFF	ON	Check connections Initial Module – Expansions
Length of expansion connections superior to the length allowed	ON	OFF	ON	Check the length of the connections Initial Module – Expansions
Wrong communication configuration Profibus	ON	ON	OFF	Check configuration Profibus-DP Master - Slave
Internal defect of the electric cover	OFF	OFF	OFF	Check the presence of supply
Internal defect of the electric cover	ON	ON	OFF	Contact assistance
Solenoid defect	ON	OFF	ON	Check the state of the solenoids by means of the hardware configurator program
Expansion defect	ON	OFF	ON	Check the state of the expansions by means of the hardware configurator program

In case of absence of electrical power supply it is possible to manually operate 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-MF05HC	CONNECTOR M12B 5 POLE FEMALE (FOR PROFIBUS)
CS-MR05HC	CONNECTOR M12B 5 POLE FEMALE 90° (FOR PROFIBUS)
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

SUMMARY

IP65	Total protection against dust. Protected against low pressure jets if water from all directions.
PROFIBUS DP	**(D**ecentralized **P**eriphery) serial flexible data communication system at high speed for the industrial automation. Its primary application area ca be attributed to the field's level, where reaction times are required from hundreds of µs to some hundreds of ms. The communication is type Master-Slave with a cyclical data exchange.
MASTER	It is the (only) device which inside a Profibus net has to control the data flow.
SLAVE	Device which communicates inside the Profibus net only if interrogated by the Master device. The possibility to have two slaves which communicate directly between each other is not foreseen. All the Profibus slaves have the same priority.
NODE	Master or slave device connected to a Profibus network. In a Profibus network there may be up to 32 nodes without the use of repeaters, up to 126 nodes with the use of repeaters.
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.
FREEZE	This (optional) command used by the master generates the freezing of the inlets on one or more slaves. Used frequently for synchronization. EXAMPLE: - The master transmits a FREEZE command to the selected slave group. Such a command makes the directed slaves freeze their inputs. - During the successive date cycle, the slaves transmit their frozen inlets of the selected group to the master. - After this procedure, the master transmits an UNFREEZE command to the relative group. The bus systems returns again in the normal mode of data exchange and during each data cycle all the changes of the inlets are transmitted.
SYNC	This (optional) command of the master is used so that the slave, or group of slaves, to which the command is being sent, 'maintains' the outputs. Used frequently for synchronization. EXAMPLE: When the data frozen by a FREEZE command are elaborated in the master, the master reacts by sending a SYNC command to the slave group to obtain the outputs. During the successive data cycle , the master supplies to the slave group the data to put in the outlet and concludes the cycle with a UNSYNC command in the successive data cycle. The UNSYNC command make the slaves transfer their outlets in a precise moment.
FILE GSD	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.