

SV SISTEMI DI SICUREZZA

ITALY



EXFIRE360

EX2GSI TECHNICAL SPECIFICATION

TECHNICAL SPECIFICATION

REVISION 09 OF 20/08/2019

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NOTE

EX2GSI installed in MINI-EXFIRE360 control panels must be connected only to FIRE ALARM signals.

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1 GENERAL INFORMATION

1.1 CODES AND STANDARDS

Design of hardware and software have been developed according to the following reference standards.

Directive 2014/34/EU of the European Parliament and of the Council of 26 February 2014 *“on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres”*

EN 60079-0

“Explosive atmospheres - Equipment - General requirements”

EN 60079-29-1

“Explosive atmospheres - Gas detectors - Performance requirements of detectors for flammable gases”

Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 *“laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC”*.

EN 54-2

“Fire detection and fire alarm systems - Part 2: Control and indicating equipment”

EN 54-4

“Fire detection and fire alarm systems - Part 4: Power supply equipment”

1.2 TERMS AND DEFINITIONS

The following definitions given in EN 60079 standards apply to the present document and provide the appropriate terminology for dissertating on flammable gas detection.

Ambient air

Normal atmosphere surrounding the apparatus.

Clean air

Air that is free of flammable gases and interfering or contaminating substances.

Explosive gas atmosphere

Mixture with air, under normal atmospheric conditions, of flammable substances in the form of gas or vapour, in which, after ignition, self-sustaining flame propagation.

Flammable gas

Gas or vapour which, when mixed with air in a certain proportion, will form an explosive atmosphere.

Lower flammable limit (LFL)

Volume fraction of flammable gas or vapour in air below, which an explosive gas atmosphere does not form, expressed as a percentage. This is also known as lower explosive limit (LEL).

Potentially explosive atmosphere

Atmosphere that could become explosive (the danger is a potential one).

Upper flammable limit (UFL)

Volume fraction of flammable gas or vapour in air above, which an explosive gas atmosphere does not form, expressed as a percentage. This is also known as upper explosive limit (UEL).

Volume fraction (v/v)

Quotient of the volume of a specified component and the sum of the volumes of all components of a gas mixture before mixing, all volumes referring to the pressure and the temperature of the gas mixture.

Continuous duty apparatus

Apparatus that is powered for long periods of time, but may have either continuous or intermittent sensing.

Fixed apparatus

Apparatus that is intended to have all parts permanently installed.

Group I apparatus

Apparatus for mines susceptible to firedamp.

Group II apparatus

Apparatus for places with a potentially explosive atmosphere, other than mines susceptible to firedamp.

Stand-alone gas detection apparatus

Fixed gas detection apparatus that provide a conditioned electronic signal or output indication to a generally accepted industry standard (such as 4-20 mA or 3-15 psi), intended to be utilized with stand-alone control units or signal processing data acquisition, central monitoring and similar systems, which typically process information from various locations and sources including, but not limited to gas detection apparatus.

Stand-alone control unit

Fixed gas detection control units intended to provide meter indication, alarm functions, output contacts and/or alarm signal outputs when utilized with stand-alone gas detection apparatus.

Remote sensor

Sensor that is not integral to the main body of the apparatus.

Sensor

Assembly in which the sensing element is housed and that may also contain associated circuit components.

Alarm set point

Fixed or adjustable setting of the apparatus that is intended to preset the level of concentration at which the apparatus will automatically initiate an indication, alarm or other output function.

Fault signal

Audible, visible or other type of output, different from the alarm signal, permitting, directly or indirectly, a warning or indication that the apparatus is not working satisfactorily.

Latching alarm

Alarm that, once activated, requires deliberate action to be deactivated.

Special state

All states of the apparatus other than those in which monitoring of gas concentration takes place, for example warm-up, calibration mode or fault condition.

Drift

Variation in the apparatus indication with time at any fixed gas volume fraction (including clean air) under constant ambient conditions.

Final indication

Indication given by the apparatus after stabilisation.

Stabilisation

State when three successive readings of an apparatus, taken at 2 min intervals, indicates no changes greater than $\pm 1\%$ of the measuring range.

Time of response $t(x)$

Time interval, with the apparatus in a warmed-up condition, between the time when an instantaneous change between clean air and the standard test gas, or vice versa, is produced at the apparatus inlet, and the time when the response reaches a stated percentage (x) of the stabilised signal on the standard test gas

Warm-up time

Time interval, with the apparatus in a stated atmosphere, between the time when the apparatus is switched on and the time when the indication reaches and remains within the stated tolerances.

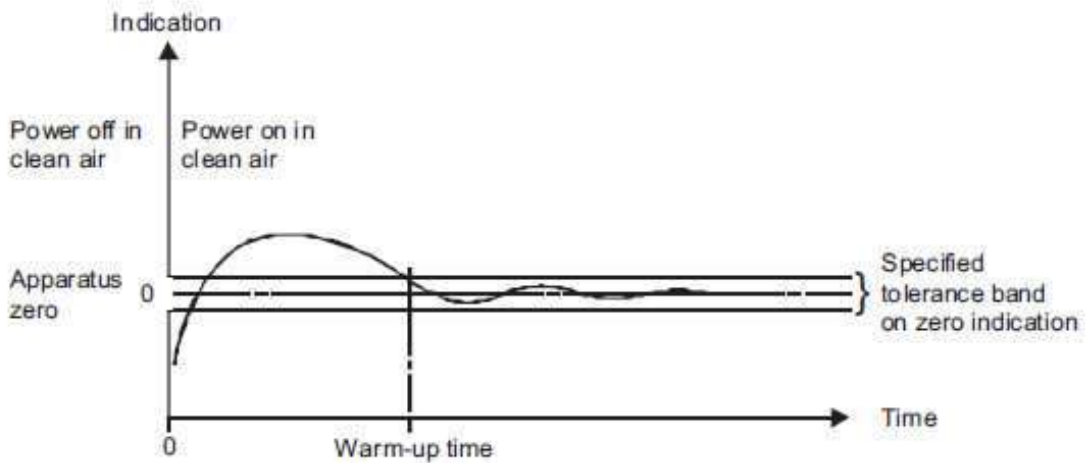


Fig.1: Warm-up time in clean air (from EN 60079-29-1)

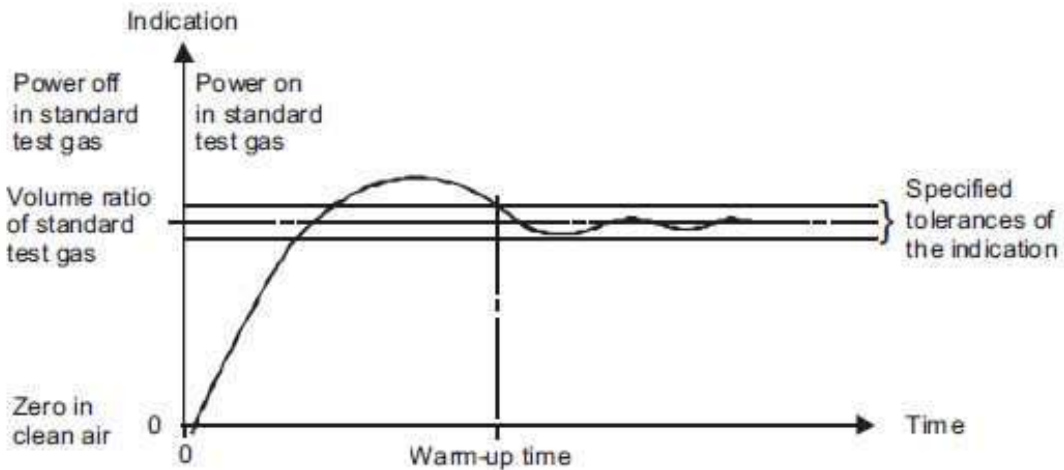


Fig.2: Warm-up time in standard test gas (from EN 60079-29-1)

2 EX2GSI PRESENTATION

In the EXFIRE360 fire alarm panel, EX2GSI is the independent control unit for the detection of flammable gases, toxic gases or oxygen. It can be also utilized in fire alarm systems to monitor analog detectors (e.g. flame detectors with 4-20 mA proportional output), as described in Chapter 6. Regarding the flammable gas detection, EX2GSI card refers to standard EN 60079-29-1; when used for fire detection, EN 54-2 requirements must be met.

EX2GSI is equipped with two 4-20 mA analog inputs (with internally redundant channels and configurable pre-alarm/alarm thresholds), two supervised outputs (rated 24 Vdc, 2 A max, for shut-off valves, notification appliances, etc.), two volt-free relays (rated 24 Vdc, 2 A max) and seven Open Collector outputs that can be associated to pre-alarm, alarm or fault conditions of both inputs. The card must be connected to continuous duty apparatus that can provide a 4-20 mA analog output, fully monitored while operating.

EX2GSI has a standard Eurocard format (160 mm x 100 mm) with a rear plug connector to 19" rack and it's integrated in the communication bus of the panel, as reported in the following figure.

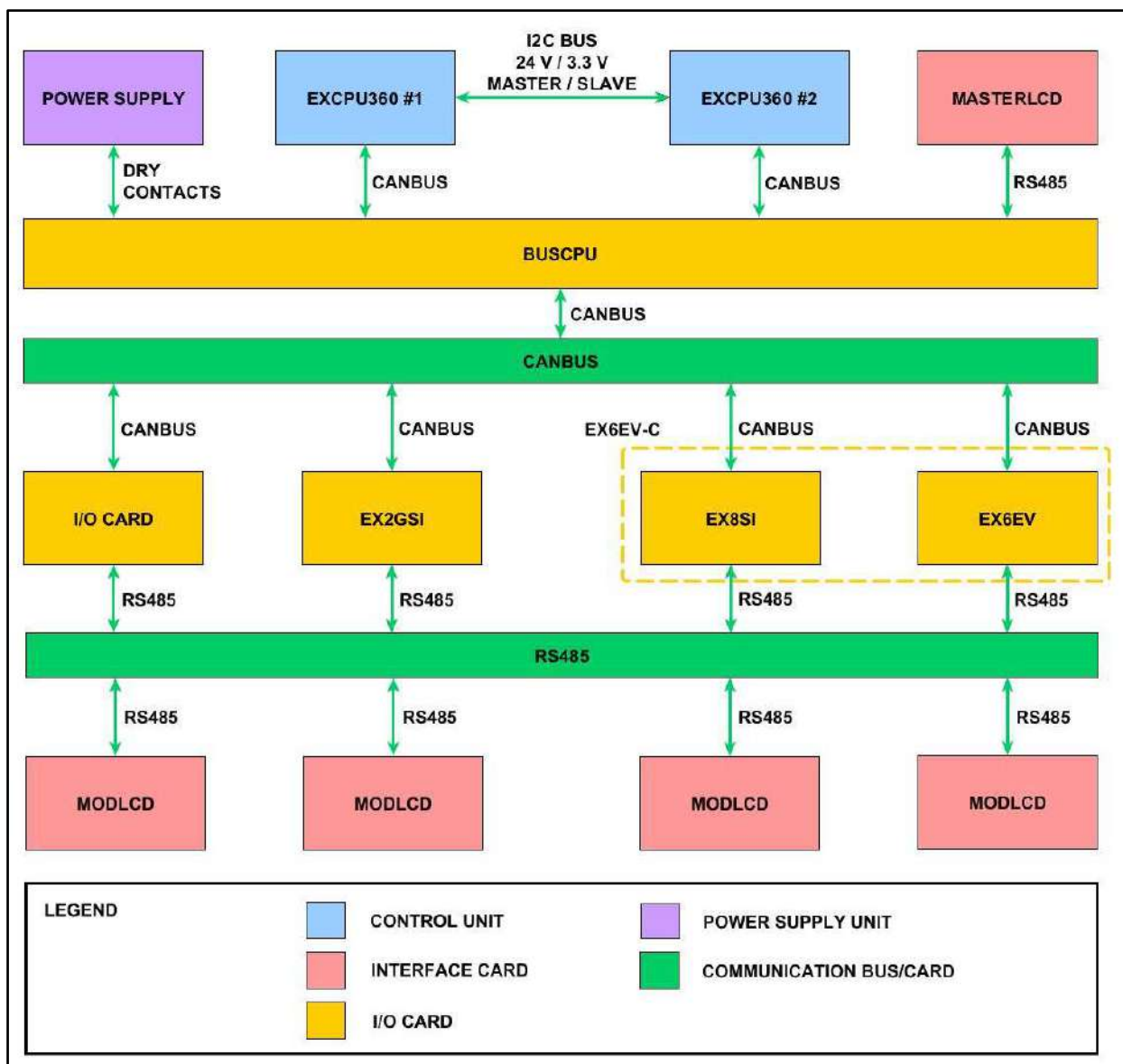
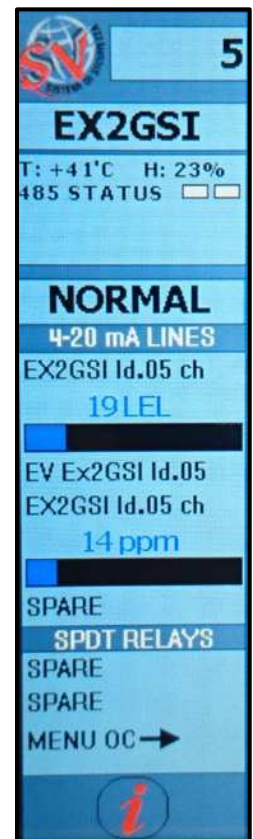


Fig. 3: EXFIRE360 architecture

The card is powered by the panel supply unit (EN 54-4 certified) and back-up batteries (sized as requested by the reference design standards).

2.1 TECHNICAL FEATURES

- “hot-swap” insertion in a CANBUS slot;
- automatic card addressing;
- execution of diagnostic functions;
- supervision of two 4-20 mA analog input channels against line open and short conditions;
- internal channel redundancy, automatic exchanged in case of fault conditions;
- pre-alarm and alarm threshold programmable with SV Protection;
- supervision of two outputs (24 Vdc, 2 A max) against line open and short;
- control of two volt-free relays (2 A max);
- control of seven Open Collectors (max. 500 mA);
- current value (of each supervised channel) available on MODLCD;
- monitoring of card temperature;
- monitoring of card humidity;
- monitoring of CANbus communication;
- monitoring of supply voltages (24 Vdc/ 5 Vdc / 3.3 Vdc);
- supply voltage: 21÷30 Vdc;
- standby current consumption (4 mA on input channels, no activation of supervised outputs, relay and OC): 160 mA;
- alarm current consumption (Overcurrent condition on both inputs, no activation of supervised outputs, relay and OC): 130 mA;
- standby current consumption with both relays activated: 145 mA;
- standby current consumption with activation of 2 OC outputs: 165 mA;
- working temperature: -5 to +40°C;
- storage temperature: -25 to +60°C: **Note:** such conditions are valid for the storage of the panel, as requested by EN 60079-29-1:2016 ([§ 5.4.2](#)). Back-up batteries (Fiamm 12FGL series) must be stored and moved apart from the panel, because the admitted range of the storage temperature is [-10°C to +50°C](#).
- humidity range (UR): <= 95% non-condensing.



2.2 DETECTABLE GASES

EX2GSI monitors and represents the concentration levels of the following types of gas:

- combustible gases with levels of concentration between 0 and 100% LEL;
- oxygen with concentration between 0 and 25 % v/v;
- toxic gases with the following ranges:
 - 0-2 % v/v (e.g. carbon dioxide);
 - 0-5 % v/v (e.g. carbon dioxide);
 - 0-30 % v/v (e.g. carbon dioxide);
 - 0 - 20 ppm (e.g. sulfur dioxide);
 - 0 - 50 ppm (e.g. hydrogen sulfide);
 - 0 - 100 ppm (e.g. nitrogen monoxide);
 - 0 - 200 ppm (e.g. ammonia);
 - 0 - 500 ppm (e.g. carbon monoxide);
 - 0 - 1000 ppm (e.g. ammonia);
 - 0 - 5000 ppm (e.g. carbon dioxide).

The configuration of the type of gas and the values of pre-alarm and alarm threshold can be set up in the programming software SV Protection. Please refer to “TM-0006 Programming manual” for further details.

3 INSTALLATION

3.1 INSTALLATION INSTRUCTION

Mounting instructions for EXFIRE360 control panel and electronic cards (including EX2GSI) are reported in the “TM-0012 Installation manual”. Please refer to this documents when assembling the panel and its components.

3.2 WIRING INSTRUCTIONS

EX2GSI must be connected to gas detectors equipped with active, non-isolated 4-20 mA output. A 3-wires connection is needed: two wires for detector power (with voltage variable between 21 to 28 Vdc), one for analog signal (4-20 mA, sinking type).

Input/output signals must be connected to CANBUS terminals, as shown in Figure 4. CANBUS terminals is power-limited, in order to ensure the absence of hazardous situations in case of line shorts, causing over-heating conditions.

Here below the technical specification of the CANBUS terminal board:

- Angle of cable entry: horizontal;
- Maximum operational temperature: 110° C;
- Admitted sections of the wire: AWG 12, 14, 16, 18, 20, 22, 24 – mm² 0.05 - 2.50;
- Maximum admitted current: 17,5A;
- Maximum admitted voltage: 300V.

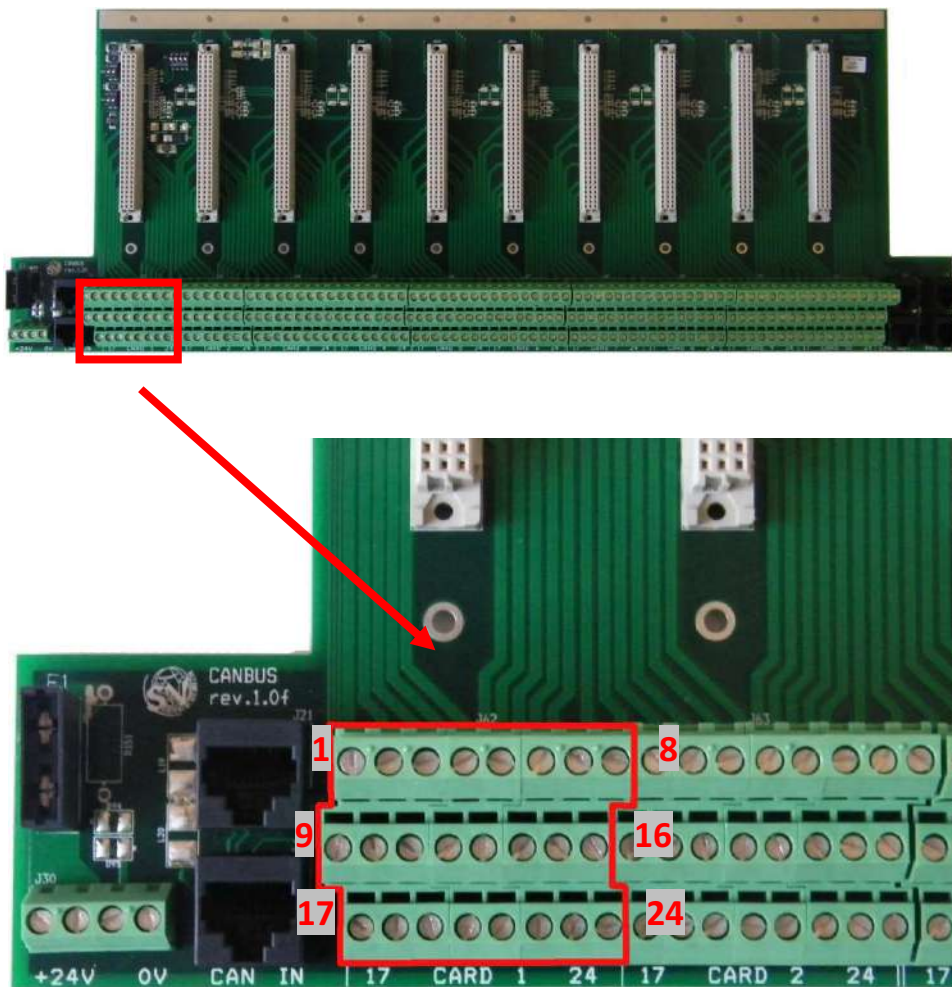


Fig. 4: CANBUS terminal board

Input/output devices must be connected as explained in Table 1.

The cable must be selected according to the application and the requirements of the manufacturer of gas detectors. Please refer to the following design criteria:

1. Utilization of double shielded cables (e.g. Al/Pet tape with coverage (Kf) = 100% and copper braid with coverage (Kf) > 70%), equipped with a fire sheath not propagating the fire (CEI 20-22 II);
2. Wire sections smaller than 0.75 mm² are not recommended. Anyhow it's advisable to calculate the maximum length of the cable based on the electrical characteristics of the detector (current consumption, minimum working voltage), to define accurately the type of cable to be used. For example, consider a gas detector with a maximum current consumption of 200 mA e a minimum working voltage of 20 Vdc. Utilization of a multi-core cable with 1 mm² wire section results in an electrical resistance equal to 19 Ω/km. The maximum cable length (l) will be equal to:

$$l = \frac{(24 - 20)V}{0,2 A} \times \frac{1}{19 \Omega/km} \times \frac{1}{2} \times 1000 m/km = 526 m$$

Terminal	Signal description Inputs / outputs
1	24 Vdc – positive (600 mA max)
2	Analog input 1
3	24 Vdc – positive (600 mA max)
4	Analog input 2
5	Horn/strobe 1 - positive
6	Horn/strobe 2 - positive
7	Relay 1 - common
8	Relay 1 - common
9	0 Vdc – negative
10	Analog output 1
11	0 Vdc – negative
12	Analog output 2

Terminal	Signal description Inputs / outputs
13	Horn/strobe 1 - negative
14	Horn/strobe 2 - negative
15	Relay 1 – NO / NC
16	Relay 2 – NO / NC
17	OC input 1 alarm
18	OC input 1 pre-alarm
19	OC input 1 line open fault
20	OC input 2 alarm
21	OC input 2 pre-alarm
22	OC input 2 line open fault
23	OC HVAC shutdown
24	OC common

Tab. 1: terminals for the connection of input/output signals on EX2GSI

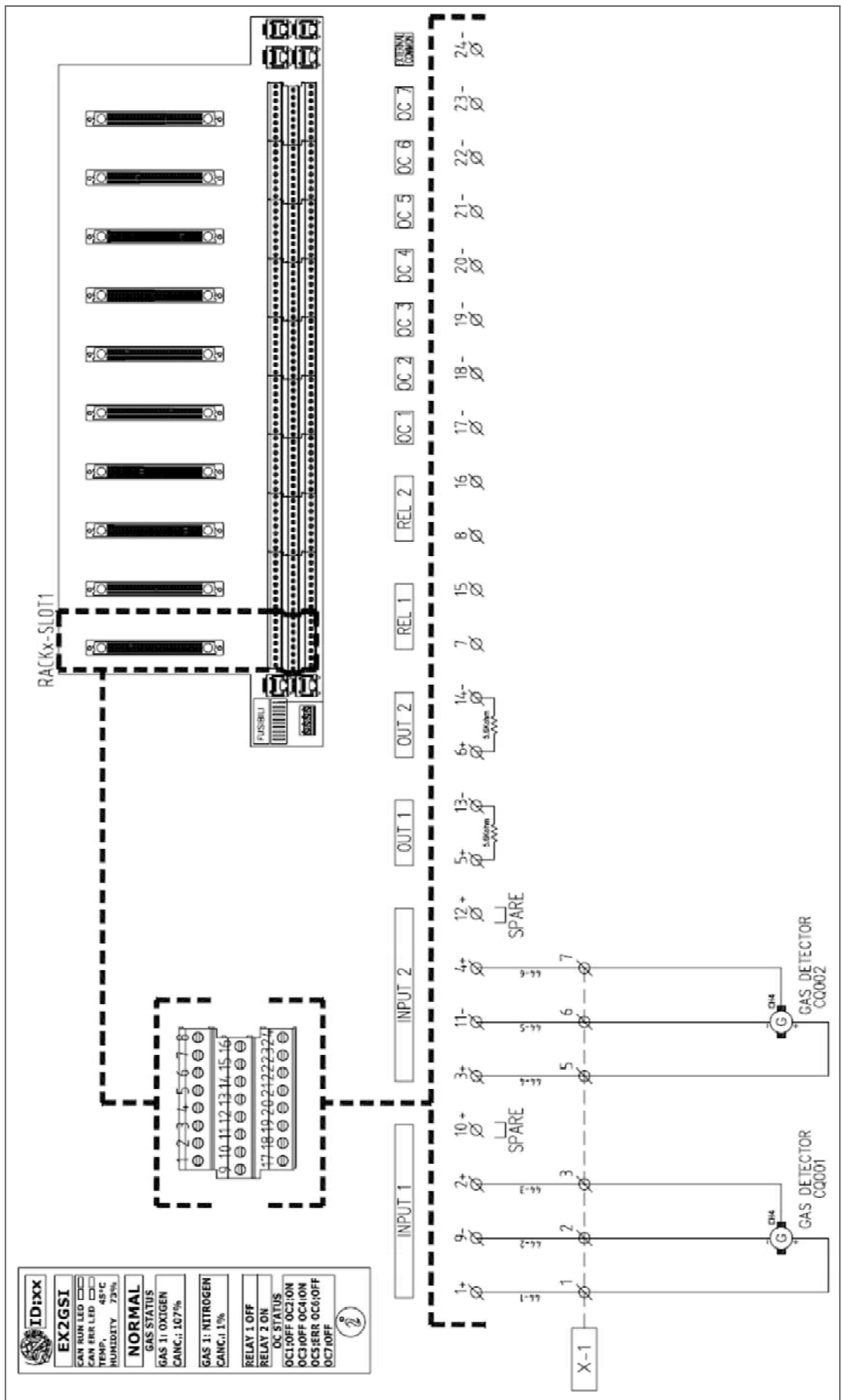


Fig. 5: connection of two gas detectors

4 OPERATION

Similarly to all the I/O units of the EXFIRE360 control panel, EX2GSI communicates with a touch screen LCD (MODLCD) displaying information about alarms, faults, activations and working status of the card; it also shows graphical pages representing the electrical parameters of input/output lines and the status of the internal diagnostics.

Alarm, fault and activate conditions are reported on the main display (MASTERLCD), while pre-alarm, alarm and fault are even signalled by LEDs next to the main display (Fig. 6). Indications colour complies with the requirements of the EN 60079-29-1 standard (red for alarm conditions, yellow for faults, green for power indications).

Display can be accessed with manual operations at access level 1 or 2. Visible indications are clearly identified at access level 1 for their specific function.

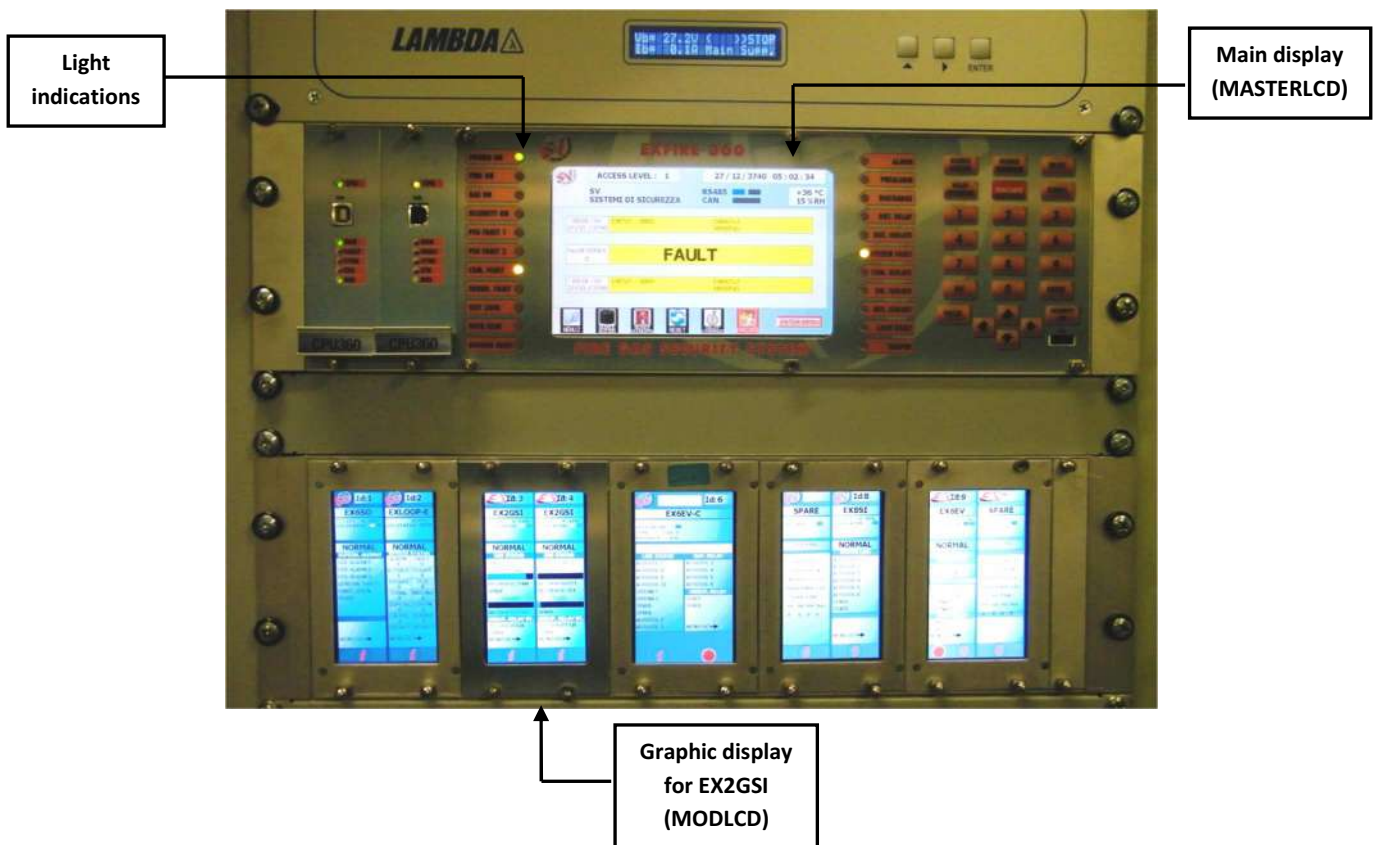


Fig. 6: representation of alarm/fault/working conditions of the gas detection unit

Manual controls are clearly identified for their specific function. The graphic display of the card shows a key that gives access to the menu; it reports information about the current of the channels and card diagnostics.

A representation of the sub-menus is reported in Fig. 7.

4.1 CARD POWER-UP

When panel is powered up, indications are inhibited for 45 seconds to allow the channel currents to stabilize (Fig. 8). In this phase the card is auto-addressed depending by the slot position where inserted on the CANBUS board and by the rack address; then EX2GSI sends a boot message to the CPU (EXCPU360) that, in case of "hot-swap" insertion, replies sending the configuration data.

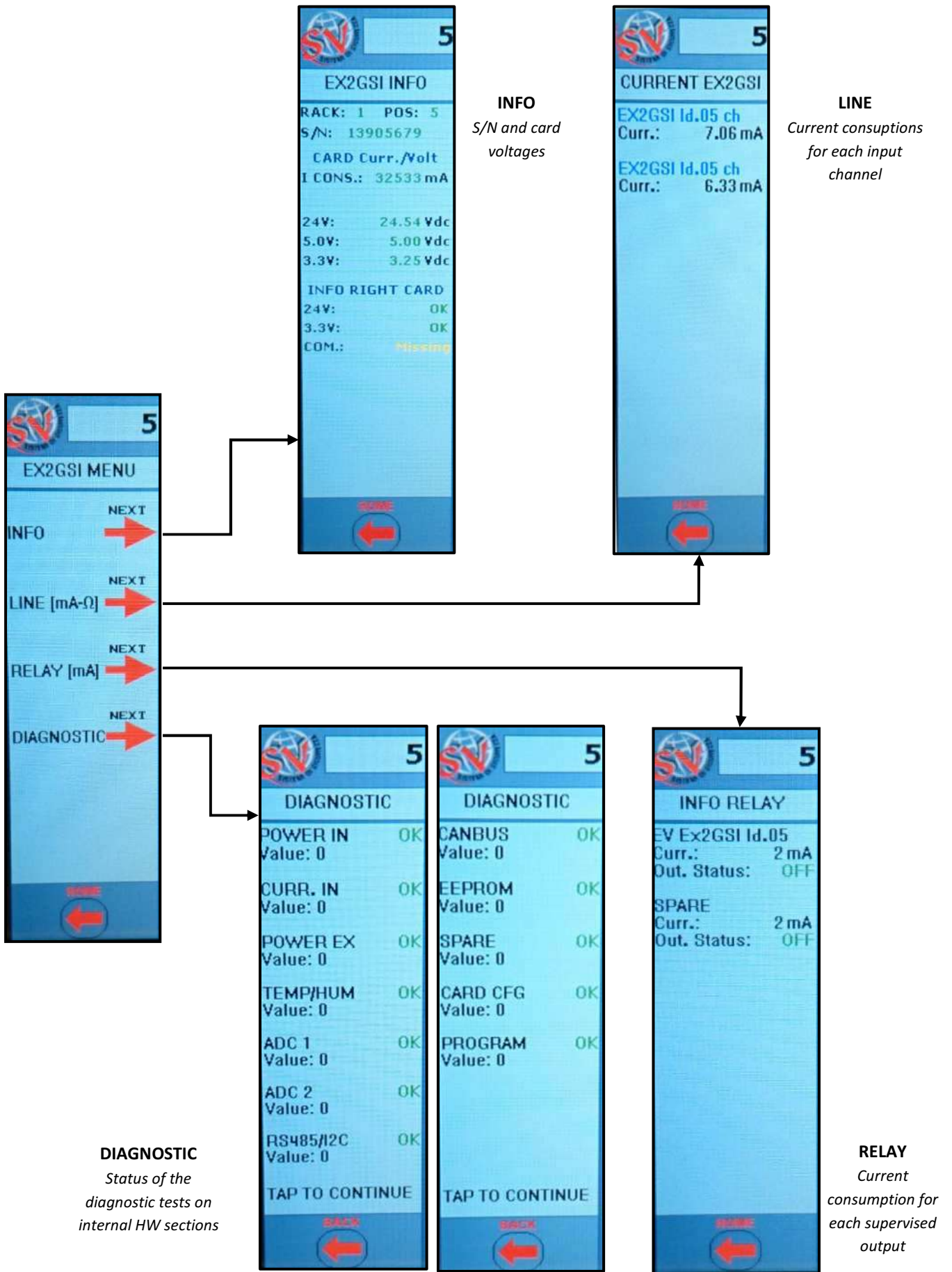


Fig. 7: menu of EX2GSI graphic display

In the same initialization phase, EX2GSI receives the configuration messages from EXCPU360 and updates the operating parameters of input and output channels (alarm and pre-alarm thresholds; continuous, periodic or pulsed output, etc.). When all the configuration messages have been received, then card is ready to operate, otherwise it's considered as disabled and transmission on CAN bus is inhibited.



Fig. 8: scheda EX2GSI in fase di inizializzazione (in progressione temporale da sinistra a destra)

The period of the initialization phase (warm-up time) depends by the dimensions of the configuration file. It can be variable from two to three minutes for the maximum configuration of the panel (60 I/O cards).

Once operating, card can assume the following states:

- normal;
- alarm (and pre-alarm);
- fault;
- isolate;
- test.

4.2 NORMAL CONDITION

The NORMAL condition of the card is represented in Fig. 9. In this situation display reports:

- card address and type;
- CAN bus status;
- card temperature;
- card humidity;
- status of analog inputs;
- status of supervised outputs;
- graphic key for accessing to the OC menu;
- graphic key for accessing to the "Info" menu.



Fig. 9: EX2GSI normal condition

In NORMAL conditions, card executes the following operations:

- via CAN bus receives messages from the EXCPU360 (commands to input/output channels);
- replies to the polling requests from EXCPU360;
- monitors both 4-20 mA input channels;
- measures the current on input channels;
- generates an analog 4-20 mA current, repeating the input signals;
- monitors the supervised outputs against open and short line conditions;
- performs test on internal HW sections (for any fault condition sends a message to EXCPU360 through the CAN bus and to the adjacent card through I2C bus);
- sends to MODLCD information about the status of the card, input and output channels, current and voltage values;
- monitors the connection with MODLCD on RS485 line;
- monitors the connection with the Master unit on the serial line (first slot of each rack), transmitting a "RS485 fault" message to EXCPU360 when necessary;
- via I2C bus receives messages regarding the status of the adjacent card, in case of abnormal conditions sends a message to EXCPU360;
- executes the test of integrity of the program memory, verifying the absence of any data corruption with a CRC16 check;
- transmits to the EXCPU360 a message with the FW revision, to be shown on MASTERLCD.

Transition from normal to any other condition is represented in Fig. 10.

4.3 ALARM CONDITION

Though EN 60079-29-1 standard allows to configure the pre-alarm condition as non-latched, EX2GSI treats both pre-alarm and alarm conditions as latched.

Thresholds are configurable via programming software SV Protection. Refer to “TM-0006 Programming manual” for details about parameterization of these values.

When input signal goes over pre-alarm or alarm thresholds, the correspondent light indication next to the main display (gas pre-alarm or alarm) is switched on and a visual indication is represented on main (MASTERLCD) and local (MODLCD) displays.

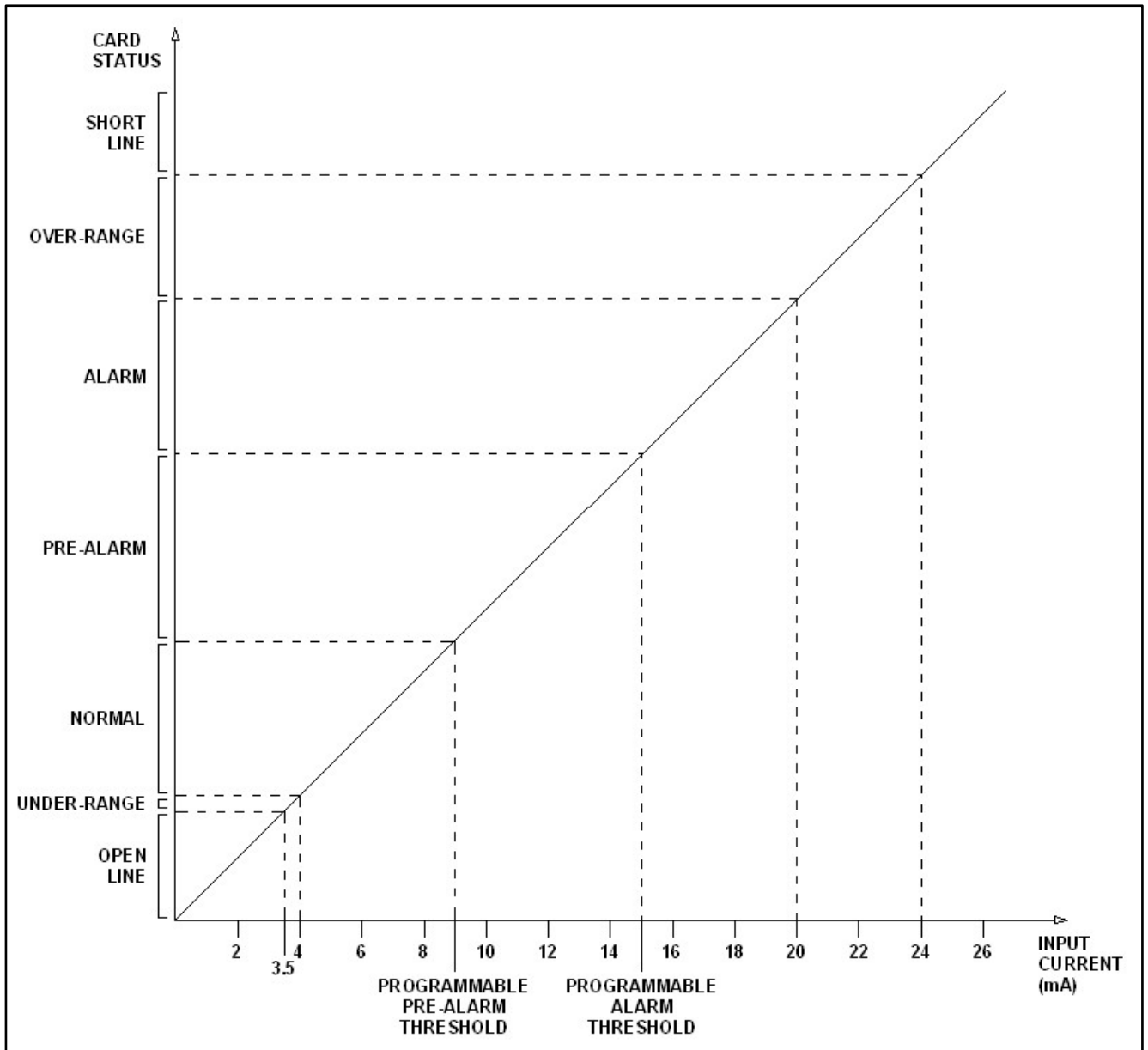


Fig. 10: transitions of card status related to the input signal

Under pre-alarm or alarm conditions, EX2GSI card reports:

- Indication of alarm or pre-alarm status;
- Indication of the channel in alarm and identification tag of the detector. If the second channel is in normal condition, this is not highlighted in red colour and the gas concentration is displayed;
- Indication of the gas concentration of the line in alarm (highlighted in red colour);
- Indication of the outputs that have been activated (supervised or unsupervised);
- Indication of the OC outputs that have been activated (accessing to the appropriate menu);
- the status of temperature and humidity measured by the card.

Fig. 11 shows the EX2GSI local display with a single line in alarm condition.



Fig. 11: EX2GSI in alarm condition

When both the input lines go over the alarm threshold, the local display MODLCD reports the status of the single input/output lines, with a general indication of the card status with a decreasing priority for over-range, alarm, pre-alarm conditions (latched).

Anyhow the indication of the events is reported on the main display of the panel, as described in the "TM-0001 Operator manual".

4.4 FAULT CONDITION

The fault condition is associated to the following situations:

- under-range current;
- open or short condition on an input line;
- open or short condition on a supervised output;
- CAN bus fault;
- abnormal value of card temperature;
- abnormal value of card humidity;
- abnormal value of 24 Vdc, 5 Vdc and 3,3 Vdc voltage;
- fault condition of a HW section (see par. 4.7).

Under-range condition, typically related to an erroneous calibration of the detector, can be distinguished in two cases:

- a) an input signal between 3.75 mA and 4 mA. The 0.25 mA margin can be considered as the tolerance of the analog measure, so no fault indication is raised;
- b) an input signal between 3.25 and 3.75 mA. In this case the detector is out of the calibration range, so an "Under-range" condition is indicated to the operator.

When the current is lower than 3.5 mA, the card display reports a blinking fault condition (open line), as indicated in Fig. 12.



Fig. 12: EX2GSI fault for open line condition on a input channel

4.5 ISOLATE CONDITION

In this condition, that can be set on the main display at access level 2, single I/O channels can be put in "out of service" state, without removing them.

Card display reports:

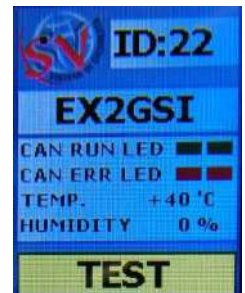
- card general status;
- isolated input lines with the identification tag;
- isolated input lines with the identification tag.



4.6 TEST CONDITION

While in test condition operator is able to execute the maintenance procedures on the gas detection system, because of the inhibition of the output channels.

This condition can be set at access level 4 and is related to an entire detection zone. So it's appropriate to divide correctly the system in detection zones, in order to guarantee the execution of the maintenance procedures without compromising the functionality of the detectors.



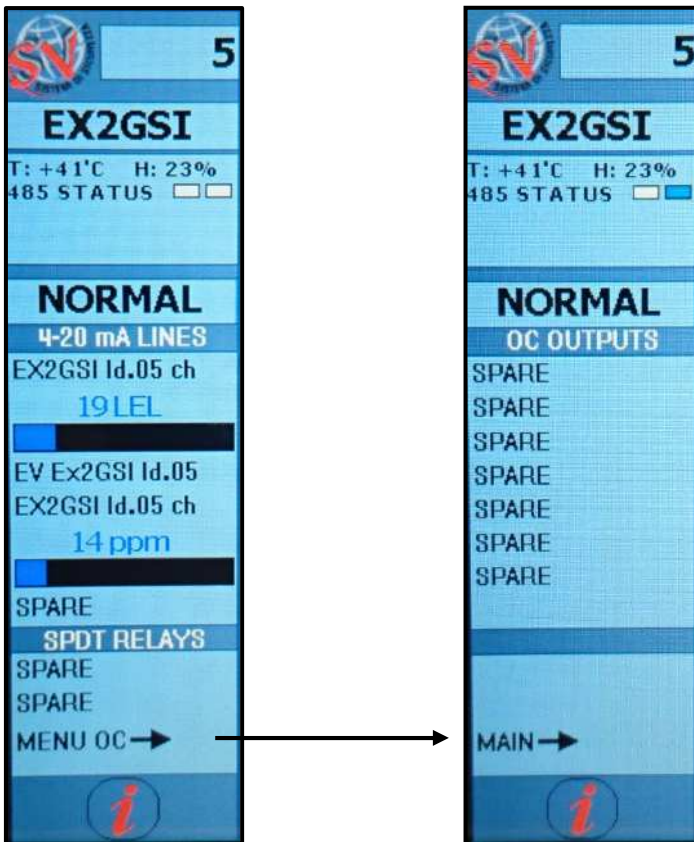
4.7 DIAGNOSTICS

In the "Diagnostic" menu, accessible on the local display (MODLCD), the status of diagnostic tests on HW section is reported. Here below the monitored functions:

- POWER IN: status of supply voltages;
- CURR.IN: status of supply currents;
- POWER EX: status of supply voltages of the adjacent card;
- TEMP/HUM: status of temperature and humidity;
- ADC 1: status of ADC converter 1;
- ADC 2: status of ADC converter 2;
- RS 485/I2C: status of communication RS485 and I2C buses;
- CANBUS: status of communication CAN bus;
- EEPROM: status of EEPROM memory;
- CARD CFG: status of the card configuration;
- PROGRAM: status of integrity test on program memory.

4.8 OPEN COLLECTORS MENU

As showed in the figure below, the "OC OUTPUTS" menu indicates the status of the Open Collector outputs, when activated they are highlighted in red or white colour.



5 MAINTENANCE

EX2GSI can be connected or disconnected when desired; in case of removal, panel will display the message “CARD XXX MISSING”. Please wait 30 seconds before inserting the card again, to let the card electronic discharge completely. Once the card will be connected anew the panel will cancel the fault indication.

6 UTILIZATION OF EX2GSI FOR FIRE DETECTION

When the EX2GSI is utilized in a fire detection and alarm system to connect devices equipped with a proportional 4-20 mA analog output, EN 54-2 requirements must be met as described in the paragraphs below.

6.1 SUPERVISED INPUTS

SENSOR 1	Analog 4-20 mA channel
SENSOR 2	Analog 4-20 mA channel

6.2 SUPERVISED OUTPUT

Supervised outputs **HAVE NOT TO** be used for connecting fire alarm or fault routing equipment (type E and J) or automatic fire protection equipment (type G).

SUPERVISED OUT 1	Supervised output (rev. polarity or current sup.) 24 Vdc, max 2 A
SUPERVISED OUT 2	Supervised output (rev. polarity or current sup.) 24 Vdc, max 2 A

6.3 VOLT-FREE RELAY

Volt-free relays **HAVE NOT TO** be used for connecting fire alarm sounders (type C), fire alarm or fault routing equipment (type E and J) or automatic fire protection equipment (type G).

Volt-free relays **MUST** be connected to SELV circuits.

RELAY 1	Volt-free relay (NO or NC, configurable as energized o de-energ.)
RELAY 2	Volt-free relay (NO or NC, configurable as energized o de-energ.)

6.4 OPEN COLLECTORS

Open Collectors **HAVE NOT TO** be used for connecting fire alarm sounders (type C), fire alarm or fault routing equipment (type E and J) or automatic fire protection equipment (type G).

OPEN COLLECTOR 1	Digital output max. 500 mA
OPEN COLLECTOR 2	Digital output max. 500 mA
OPEN COLLECTOR 3	Digital output max. 500 mA
OPEN COLLECTOR 4	Digital output max. 500 mA
OPEN COLLECTOR 5	Digital output max. 500 mA
OPEN COLLECTOR 6	Digital output max. 500 mA
OPEN COLLECTOR 7	Digital output max. 500 mA