9602

Technical Manual

V2.3

Viscosity and temperature processor

Setting for up to 8 products

IMPORTANT

THE <u>OFFSET ADJUSTMENT IN THE AIR</u> MUST BE THE FIRST TASK COMPLETED.

Offset adjustment procedure is detailed in § 1.5.1

1.   CLEAN AND DRY THE SENSOR ROD.

2.   BE SURE THE PROCESS IS EMPTY. THE ROD MUST BE VIBRATING IN THE AIR.

3.   INSTALL THE SENSOR ON THE PROCESS AND FIX IT WITH ITS 4 SCREWS.

4.   REACH THE OFFSET ADJUSTMENT FUNCTION BY ENTERING INTO THE MENU AND CHOOSING THE FUNCTION NUMBER 1 (OFFSET). PRESS "OK".

5.   FOLLOW THE INSTRUCTIONS DISPLAYED ON THE ELECTRONICS SCREEN.

6.   PRESS "OK" TO ADJUST THE OFFSET. IT MEANS THE RAW SIGNAL IS SHIFTED TO THE VOLTAGE REFERENCE DEFINED IN THE FACTORY CALIBRATION STAGE.
     A MESSAGE SAYING THE OPERATION WAS SUCCESSFUL APPEARS.

PRACTICAL ADVICES AND IMPORTANT WARNINGS ARE ALSO LISTED IN **§ 1.6** AND **§ 3.12.**

TABLE OF CONTENT

1 General Presentation

The measuring chain is composed of two inseparable elements: the sensor and the electronic processor.

1.1 The sensor

Each sensor is matched with its own electronics. Before switching on, be sure that serial numbers at the sensor and the electronics identification plates are corresponding.

The operation principle of the equipment makes that the provided viscosity information is relative: in the same fluid, at the same conditions the information is the same. But for 2 rheologically different fluids the response can be different (despite it is perfectly repeatable).

The sensor active part is protected by an stainless tube which must not be removed.

The sensor is fixed upon its mounting flange by means of the provided 4 long screws.

See the detailed leaflet, § 2.

1.2 The processor

Its functions:

- powers the sensor,
- processes the sensor's information,
- displays and transmits the process information : viscosity, temperature, sensor's frequency, outputs and relays states….

The processor is composed of two modes:

1.2.1 Utilisation mode

The "UTILISATION" Mode makes it possible to visualize in different forms viscosity and temperature values.

- Visualization with bargraphs, acquisition graph
- Access to the sensor identification data
- Access to the "ADAPTATION" Mode blocks starting from the principal menu

1.2.2 Adaptation mode

The "ADAPTATION" Mode makes it possible to adapt the displayed data, parameters, settings and configuration of the processor according to the using conditions.

- Display block: makes it possible to display outputs and relays states, rough data, to choose viscosity and temperature units and to choose the viscosity correction to active.

- Settings block: makes it possible to set current outputs, alarms, bargraphs and graph scales, to choose and set the modalities parameters of kinematic viscosity calculation, to proceed to the mounting offset adjustment, to activate and define viscosity filter and to change the Pt100 status.

- Parameters block: makes it possible to parameter viscosity corrections, to read and modify the compensation table, to modify security codes and to set the density coefficient.

- Configuration block: makes it possible to SOFRASER to configure the processor with the manufacturing data (thermal drift, calibration) and to define the viscosity adjustment data.

1.3   Checking the equipment at the receipt

a)   At first, check the supply conformity with the ordered equipment, mainly the presence of the parts necessary for the equipment mounting. Those to be used at the process will be given to the concerned department, for the installation preparation.

b)   Place the sensor on a soft foam plate, connect it to processor (see §3.10) and switch on. The vibration appears at the rod, the viscosity indication is close to zero (or close to the minimal required current value of the analog output). When touching the rod, the information has to increase.

In case of subnormal operation *a)* or *b)*, check as follows:

⚠   Power supply, connections, cables

⚠   The good condition of the vibrating rod (no bending on knock damages)

1.4   Checking the equipment when placed at the process

Before filling the network check that the viscosity information is stable (vibrating rod in air). If not, check the strength of the sensor fitting, then rotate the sensor of 90° (4 possible positions). Choose the position where the information is the most stable.

Locate this position, in order to restore it when the sensor is removed – put in place.

Adjust the mounting offset, at room temperature. The rod is vibrating in air.

When possible, note the viscosity information when a cleaning or rinsing solution is flowing.

If the original calibration is convenient, one of the 2 above mentioned values can be taken as reference for periodic control of the equipment operation each time that the same conditions will occur (rod in air, or in the cleaning solution). Such an operation can be assimilated to a self-checking.

If the original calibration has been modified the reference values will be of course those obtained with the new calibration.

1.5   Periodic checking

Conformity to regulations relative to Quality Insurance implicates a periodic control of the measuring equipment used in the manufacturing operations, taking in consideration (or correcting) their drift in time.

It is proved that this equipment drift is negligible. However, it is good to check their aspect and their response once a year, at the same time as the other process equipment.

A fast test is many times available, when the sensor active part is in air, or immersed in a cleaning or rinsing solution. As long as these values stay similar, we can say that the sensor operation is right among its whole range (if no intermediate re-programming occurred).

1.5.1 Offset adjustment in air

The clean and dry rod is vibrating in air when the offset adjustment is carried out.
The amplitude, corrected with an offset, Vbrut, must be shift to the reference of 900 mV.

1.5.2 Modification of the previous calibration

The device has been programmed in order to answer to your needs. These features are noted on the factory specification pages at the end of this document.

At first, be sure that the modification is necessary, and not consecutive of a non coherent comparative information (different measuring conditions, bad standards, inaccurate or wrong laboratory measurements,…).

The calibration parameters are protected and can only be modified with the security code.

For modifications of calibration, contact your distributor.

1.6 Directives and Standards

1.6.1 European Pressure Equipment Directive

Up to 60 bars, MIVI sensors are in agreement with the article 3.3 of the PED 97/23/EC. In case of higher pressure, sensors are certified one by one.
The mounting flange is an accessory to be welded on the process line. It means it can not be individually certified but with the whole process line.

1.6.2 EMC and low voltage directive

The processor 9601 is in agreement with EMC specifications detailed into 89/336/EEC (modified by 92/31/EEC and 93/68/EEC).
Processors 9601 are supplied by 24 VDC. So they are not subjected to the Directive Low tension 73/23/CEEC (modified by 93/68/CEE).

MIVI sensors have been designed and manufactured according to the electrical safety rules.

1.6.3 Ex-proof certifications

MIVI sensors are in agreement with 94/9/EC directive (ATEX) and with FMRC-3615 class (FM) for equipments installed in explosive gas atmospheres or in presence of combustible dust:

⟨Ex⟩ II 2G (gas) or ⟨Ex⟩ II 2D (dust)   ◇FM APPROVED◇   MIVI FM

| Ex d IIC T1 to T6 | : | gas | Class I, Div. 1, Groups A, B, C & D   T4A |
| Ex tD A21 IP67 T75°C to T300°C | : | dust | ambient temp. range: from -20°C to 100°C |

Be sure the sensor's certification is in accordance with the security level required on your process location: area classification, equipments group, protection method, gas type, temperature codes…
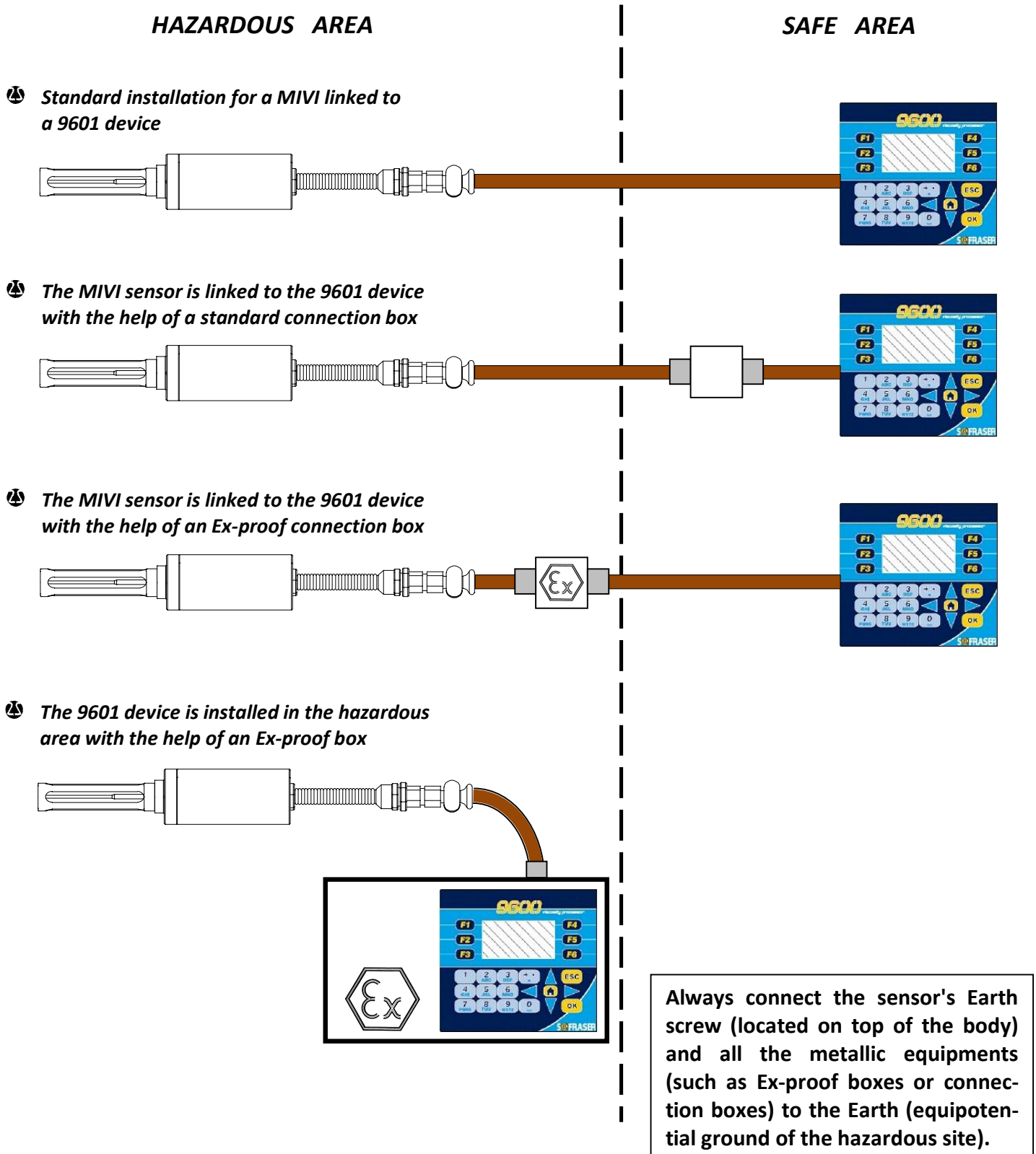Area classification and equipments installation rules are detailed into IEC 7910 and EN 60 079 standards for gas or EN 61 241 standards for dust.

To always keep the maximum security level, do not open it. We moreover recommend installing the sensor in a horizontal position or with the cable gland oriented to the ground.

Check as often as possible that the information indicated on the sensor's identification plate is still visible.

1.6.4   Installation in hazardous area

Here are the possible ways to install the MIVI 9601 sensors in a hazardous area.

HAZARDOUS AREA   *SAFE AREA*

⚖ *Standard installation for a MIVI linked to a 9601 device*

⚖ *The MIVI sensor is linked to the 9601 device with the help of a standard connection box*

⚖ *The MIVI sensor is linked to the 9601 device with the help of an Ex-proof connection box*

⚖ *The 9601 device is installed in the hazardous area with the help of an Ex-proof box*

Always connect the sensor's Earth screw (located on top of the body) and all the metallic equipments (such as Ex-proof boxes or connection boxes) to the Earth (equipotential ground of the hazardous site).

1.6.5 Special design and recommendations for the FM sensors

For the FM sensors, it is necessary to add a protection in accordance to the area's risks level. As long as the cable is in a hazardous area, it should be protected as recommended in the 2011 NEC code digest, appendix IV.

Our sensors are certified until the end of the flexible conduit, where we connected a NPT joint. For connecting the sensor in agreement with the class, the installer should follow the instructions given in the 2011 NEC code digest, appendix IV.

This means a conduit seal has to be connected to our NPT joint, according to the examples you have hereunder.
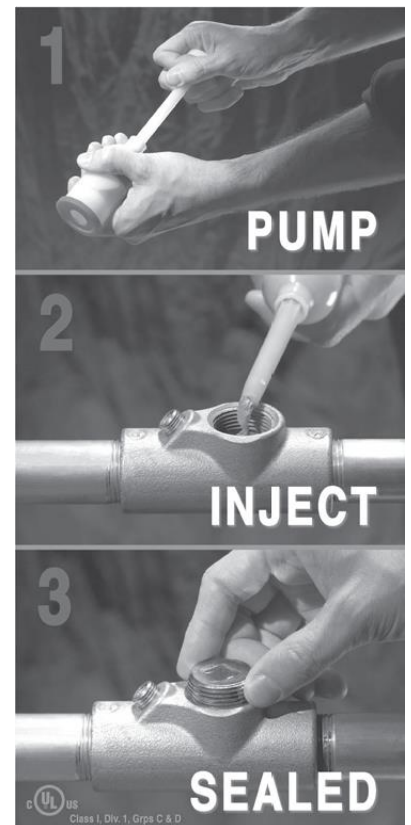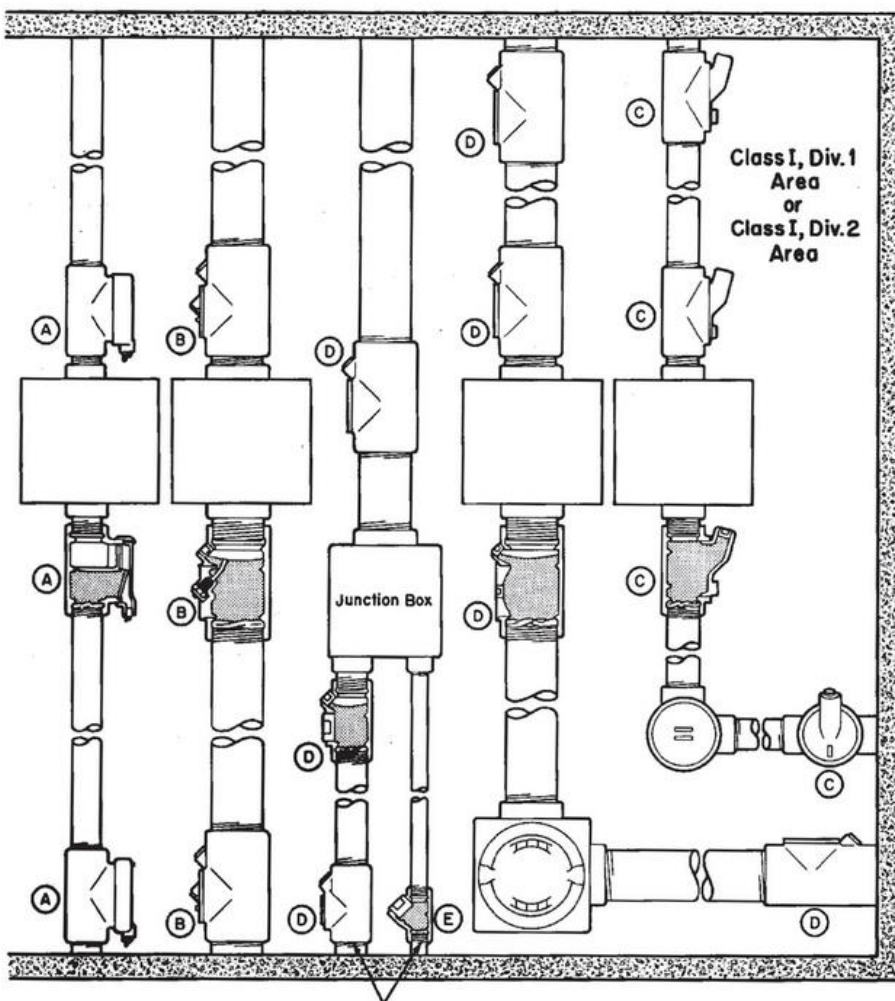
This equipment is not provided by SOFRASER.

Note: In order to protect the inner part of the sensor (body + flexible conduit) during transportation, we use a black silicone tape to cover the NPT joint's end. This has nothing to do with a FM approved protection and shall be removed while being installed on site.

Hereunder are some features of the conduit seals to be installed.

EYS and EZS sealing fittings:

⚖   restrict the passage of gases, vapors, or flames from one portion of the electrical installation to another at atmospheric pressure and normal ambient temperatures.

⚖   limit explosions to the sealed-off enclosure.

⚖   prevent precompression or "pressure piling" in conduit systems.

While not an *NEC* requirement, many engineers consider it good practice to sectionalize long conduit runs by inserting seals not more than 50 to 100 feet apart, depending on the conduit size, to minimize the effects of "pressure piling."

Sealing fittings are required:

⚖   at each entrance to an enclosure housing an arcing or sparking device when used in Class I, Division 1 and 2 hazardous locations. To be located as close as practicable and, in no case, more than 18" from such enclosures. The enclosure's installation instructions may specify a distance less than 18".

⚖   at each entrance of 2" size or larger to an enclosure or fitting housing terminals, splices, or taps when used in Class I, Division 1 hazardous locations. To be located as close as practicable and, in no case, more than 18" from such enclosures.

⚖   in conduit systems when leaving the Class I, Division 1 or Division 2 hazardous locations.

⚖   where cables terminate at enclosures that are required to be explosionproof.

⚖   where cables leave Class I, Division 1 locations and where they leave a Class I, Division 2 location if they are attached to process equipment that may cause a pressure of over 6 in. of water to be exerted ona cable end.

2 The MIVI sensor

2.1   Various models

- ⚖ General-purpose sensors.

- ⚖ Sanitary sensors.

- ⚖ Ex-proof sensors (ATEX, FM, JIS).

- ⚖ High pressure sensors (up to 150 bars).

- ⚖ Special models, according to the requirements (material and design).

- ⚖ When required, a temperature probe can be incorporated to the MIVI sensor.

2.2   Sensor installation

It operates at any position, even upside down. Its active part has to be permanently immersed in the fluid (low part of the network or reactor). If the fluid temperature varies widely and fast, choose the upside down or horizontal position, in order to allow a convenient air convection among the sensor body.

It is screwed to its mounting flange by means of 4 screws M6X100 (or 8 screws M8 for high pressures). The mounting flange has to be welded close to the device generating the viscosity variations (heater, mixer, reactor, etc…). Retention, high flow velocities, strong vibrations and high magnetic fields have to be avoided.

According to the application the mounting flange material can be:

- ⚖ Stainless steel Z3CND 17/11-02 (316L).

- ⚖ Carbon steel XC38.

- ⚖ Other materials, according to the requirement.

2.2.1   Elbow mounting

The flange is welded on a right angle tee as indicated in figure 1.

The minimal pipe diameter is of 32 mm.

The flange and the pipe axes have to be superjacent.

The flow direction is as indicated on figure 1 (unless for fibrous fluids where the flow is inverted and the rod protector removed. (see §2.2.5).

A free area of at least 150 mm length is necessary.

<u>Advice:</u> Choose a sensor position in order to assure a permanent fluid renewal and to avoid the existence of "dead zones".
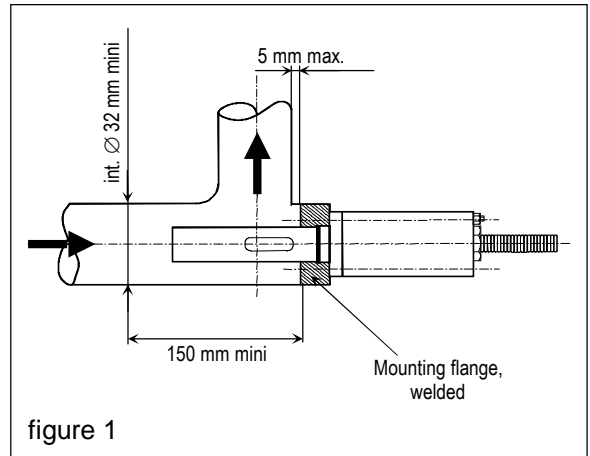
2.2.2   Plane side mounting

The flange is welded on a metal plate as indicated on figure 2.

The free area around the vibrating rod has to be at least ∅ 40, 150 mm length.

In order to avoid parasitic vibrations, the plate where the flange is welded must be thicker than 5 mm.

<u>Advice:</u> Preferably choose a horizontal position for the rod placement with all the liquid flows turned to the top in order to avoid the apparition of bubbles.
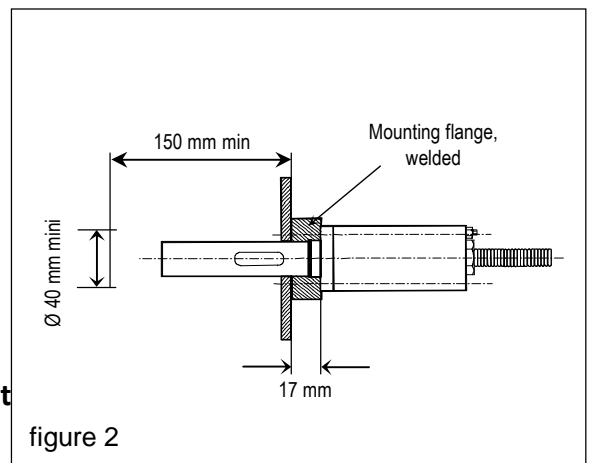
2.2.3   Pot mounting, for small flow rates, or pilot plant

see example on figure 3

2.2.4   Special mountings

The small sensor size allows many different mounting features according to the user's requirements. Consult your distributor.

2.2.5   Replacement cap

Each mounting flange is provided with an obturation kit:
-   cap and O-ring
-   4 fixing screws CHC M6 (or 8 fixing screws M8 for high pressure sensor)
It allows the installation working when the sensor has to be removed.

figure 1

figure 2

on circulation pot

figure 3

2.3 Practical advices

Torque at the mounting screws: 9 N.m ± 1 at the M6×100 screws, or 22 N.m ± 1 at the M8 screws (for the high pressure design).

Tightness is assured by a O-ring (2 for sanitary model). The grounds for the sensor and the electronic devices must be at the same voltage level.
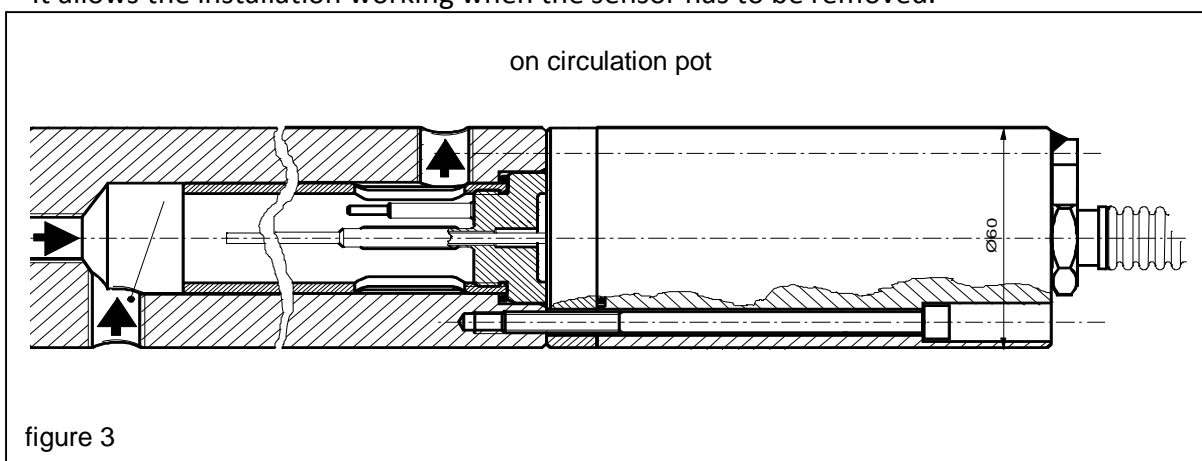
Warning :

Each sensor is equipped with a guard tube in order to protect the vibrating rod. This protector must be left on the sensor at the time of the assembly on the mounting flange. The fluid renewal is done through the slits of the protector. He has not to be removed unless when the sensor is used in particular conditions : on pot mounting, sanitary use, very viscous and fibrous fluids.

WARNING !

In this case, the mounting / removing of the sensor must be made with precaution, in order to avoid to bend the vibrating rod.

A ring, with the same dimensions of the protector's base, must be placed on the head of the sensor in order to maintain the O-ring.

IMPORTANT:
- *As soon as the sensor is removed, screw immediately its protection tube.*
- *IP 67 rightness is only obtained when firmly screwing either the cable connectors, their replacing caps, and the cable gland.*
- *The minimal bending radius at the flexible pipe (electric outlet) is of 100 mm. Less radius can generate leakage, then failure.*

2.4 Checking

In case of subnormal operation, check the following points:
- Electrical connections (connectors, cables, power supply…)
- Remove the sensor from the process and clean it
- Check that the vibrating rod is not bent.

When powered on, check with the finger there is a vibration at the end of the rod. At this moment, the viscosity information (displayed on the electronic device) has to increase.

2.5 Sensor wires colors

wire	*color*
A	blue
B	brown
C	transparent
D	black
E	red
F	yellow
G	green

2.6   Models and dimensions

standard sensors
(until 01/01/2012)
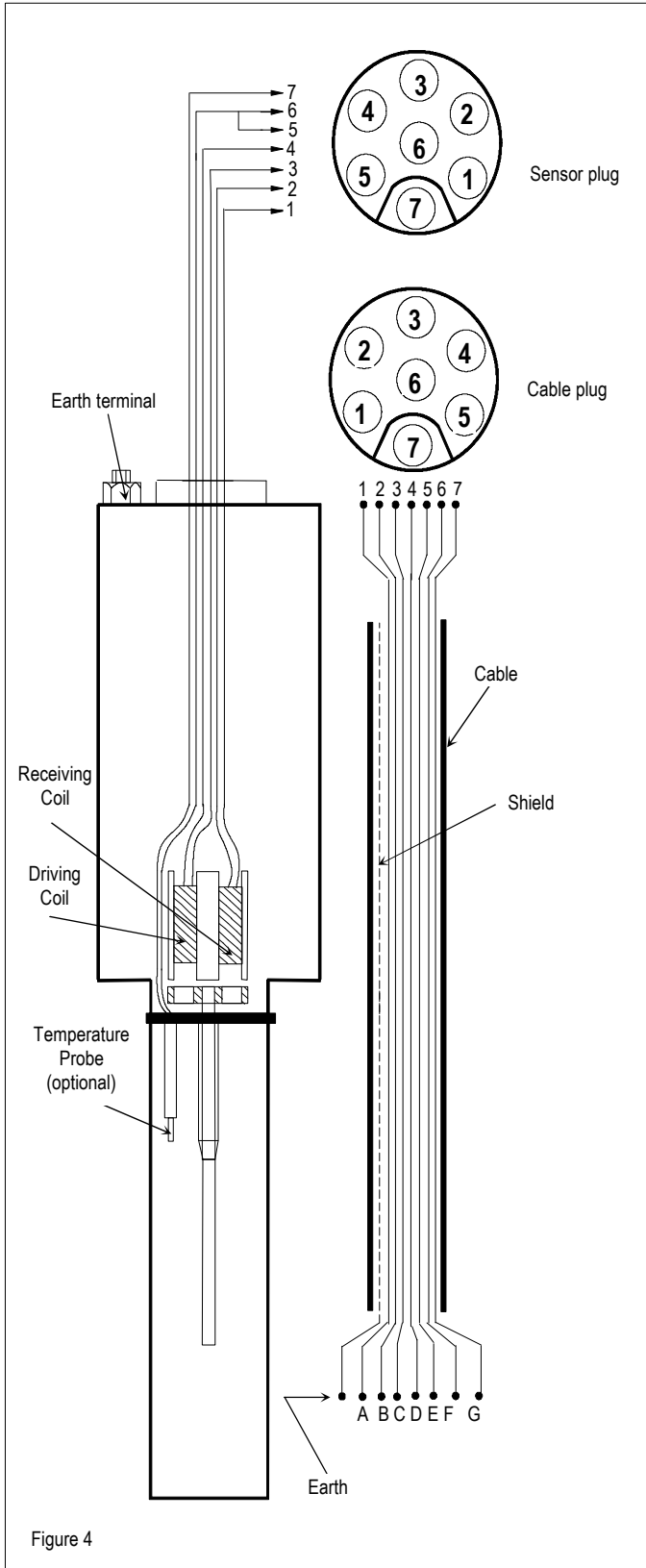
standard and Ex-proof sensors
(since 01/01/2012)
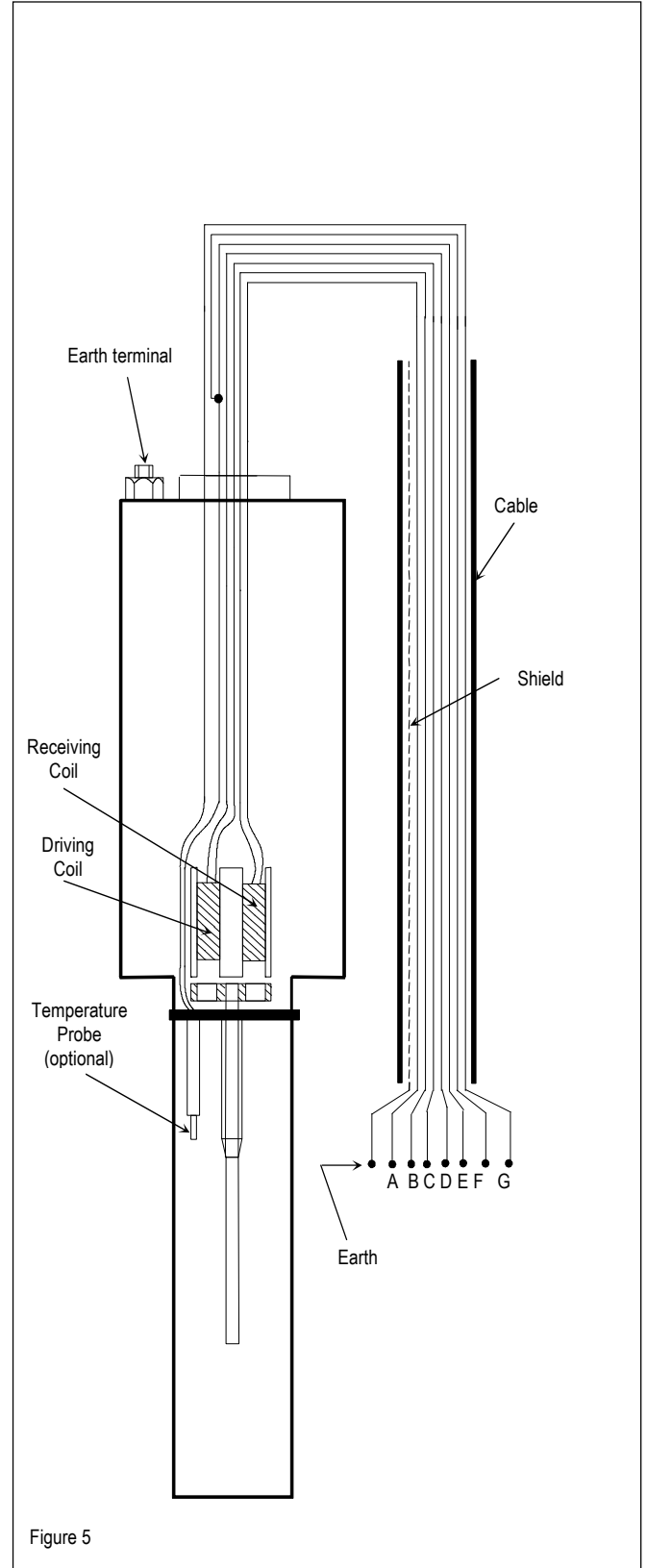
Figure 4

Figure 5

2.7 Various mountings

low pressure

high pressure

Ø 60

Ø 76

Ø 99

mounting flange

sanitary low pressure

sanitary high pressure

Ø 70

mounting flange

standard
replacement ring

sanitary
replacement ring

Ex-proof MIVI
on a ¼ gas pot

high temperature
Ex-proof MIVI
on a ¼ gas pot

2.8 Watertightness

17

Ø 76 or 79

① oqring Ø 29,82 * 2,62

15

Ø 70 or 99

② oqring Ø 21,95 * 1,78
③ oqring Ø 30,00 * 2,00
④ oqring Ø 30,00 * 2,50
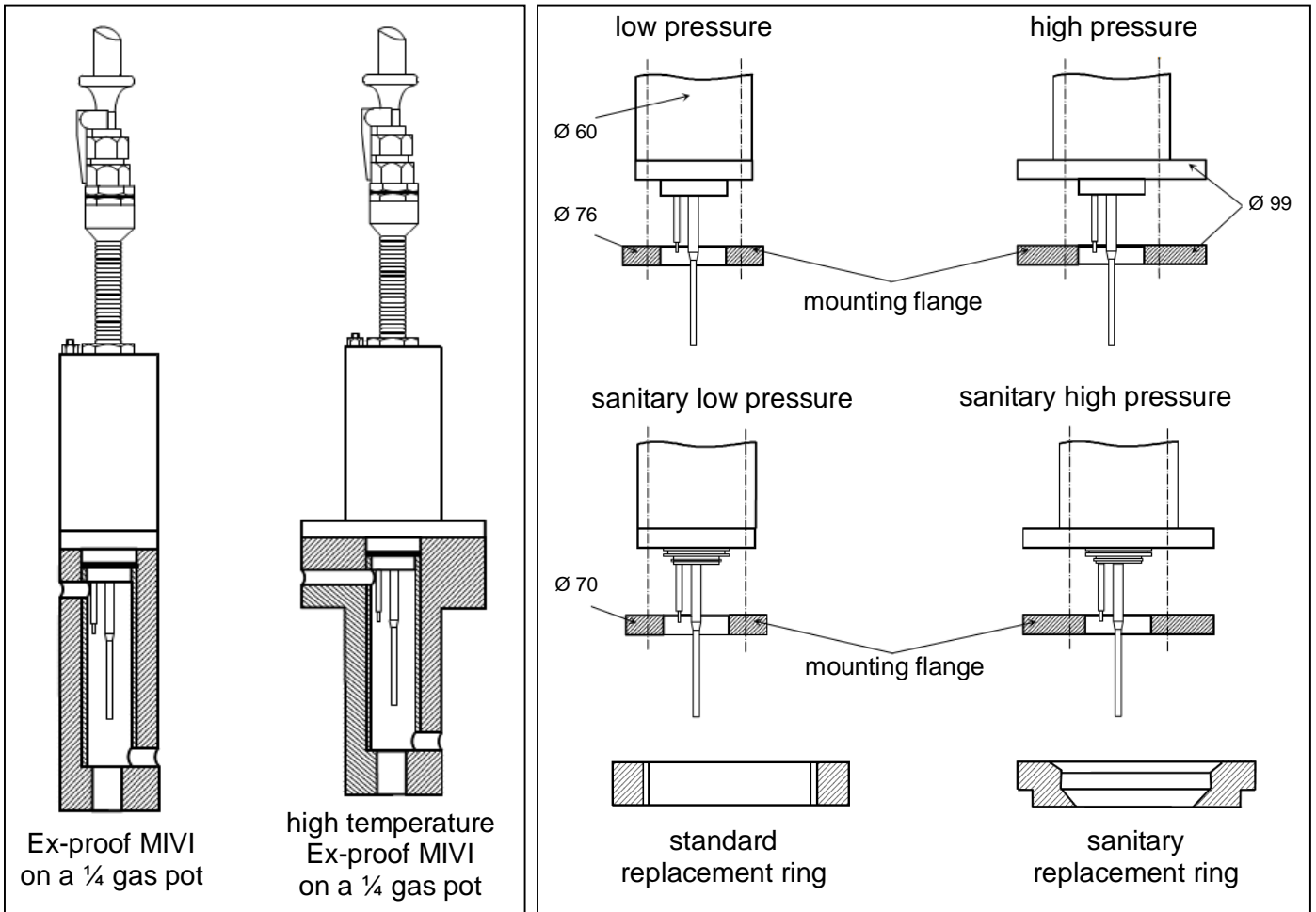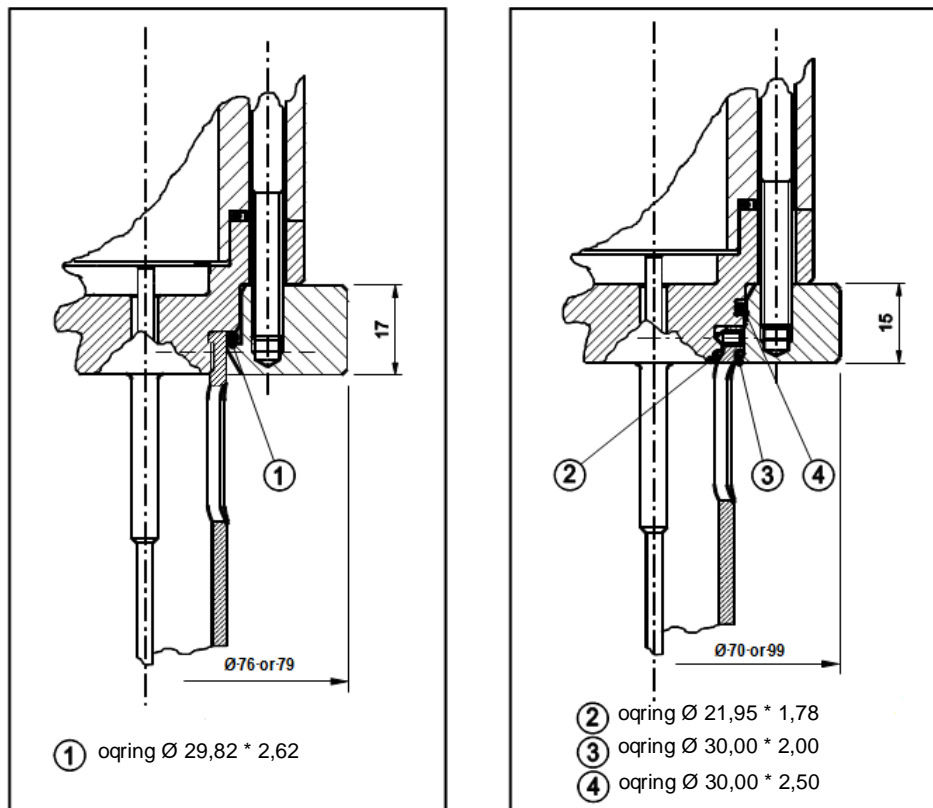
3 Processor technical characteristics

3.1 Mechanical characteristics

Dimensions behind the collar: 138 x 123 x 106.4 mm
Collar dimensions: 184 x 155 x 6.7 mm
Case transducer dimensions : 66.2 x 67.1 x 28.2 mm
Cut-out for assembly on panel: 141 x 126 mm. Thickness ≤ 5mm.
Weight: about 515 g.
Tightness: IP 65 with panel mounting and IP20 on rear panel.
Operational temperature: 0°C to 45°C.

Screw for bright-
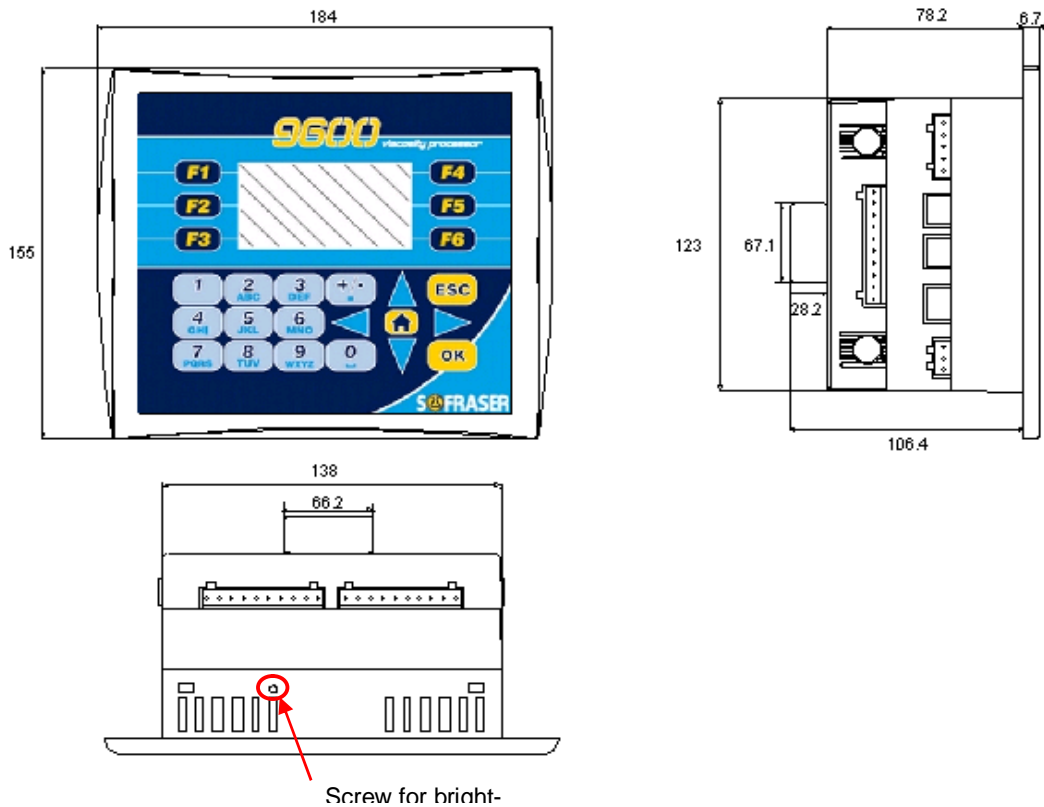
3.2 Display

Display type : STN LCD
Illumination backlight : LED yellow
Display resolution : 128 x 64 pixels

The brightness can be adjusted using the screw on the top panel.

3.3 Keyboard

24 keys : alphanumeric keys and function keys.

3.4 Battery

The battery lifespan is 7 years at 25°C.

3.5 Consumption

The processor requires a 24 VDC (± 2.4 V) power supply (not provided by SOFRASER).
Typical power consumption: 7,2W maximum.

3.6 Connection blocks

On the processor back module, various categories are identified (example: DIGITAL INPUTS, ANALOG OUTPUTS…).

We will call these categories "connection blocks". The diagram below identifies the various connection blocks. The colours codes used and the name of these connection blocks are taken again for each connection diagram.
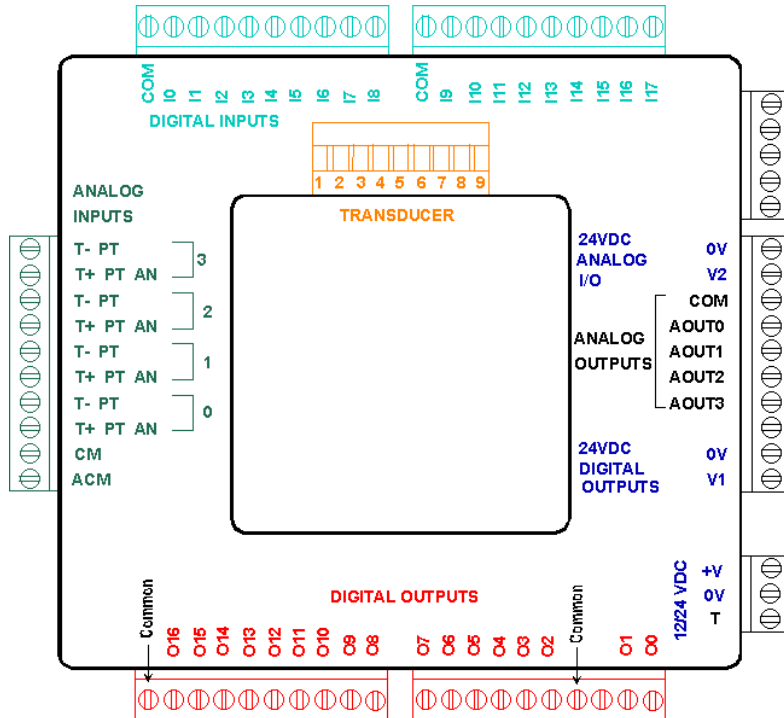
3.7 Connections made by Sofraser

All the connections in the following table are already wired when the equipment is delivered.

12/24 VDC	24 VDC DIGITAL OUTPUTS	24 VDC ANALOG I/O	DIGITAL INPUTS	TRANSDUCER
0V	0V	0V		8
+V	V1	V2	COM	(1) 9
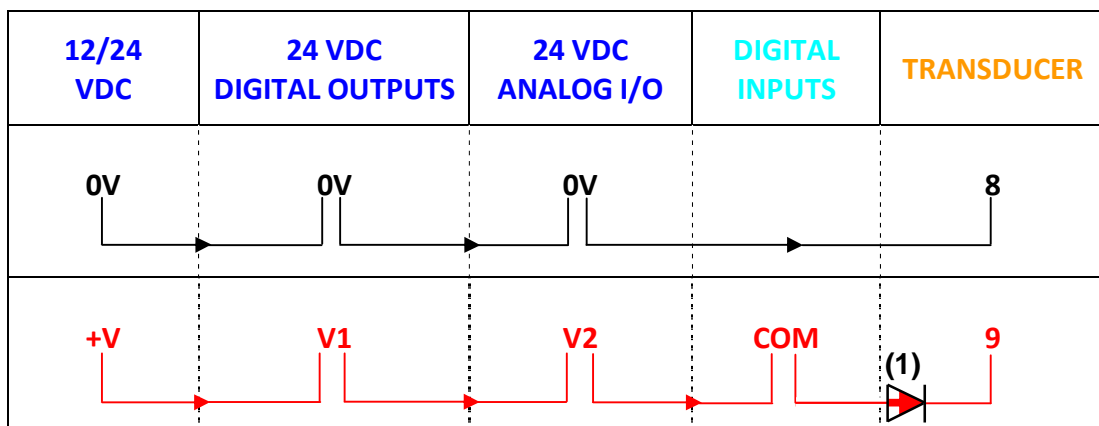
A 1N4007-type diode **(1)** is cabled between the digital inputs block and the transducer in order to protect the transducer from the unexpected power supply inversion.

3.8 Connections to be done by the customer

All the wires and terminal blocks at stake here are already numbered and pre-cabled.

Equipment		12/24 VDC	Transducer	Analog Inputs	Digital Inputs
POWER SUPPLY	0V → 0V				
	24V (2) → +V				
	Shielding bread → T				
MIVI	A → 1				
	B, C → 2				
	D → 3				
	E → T- PT				
	F → T+ PT			(0)	
	G → CM				
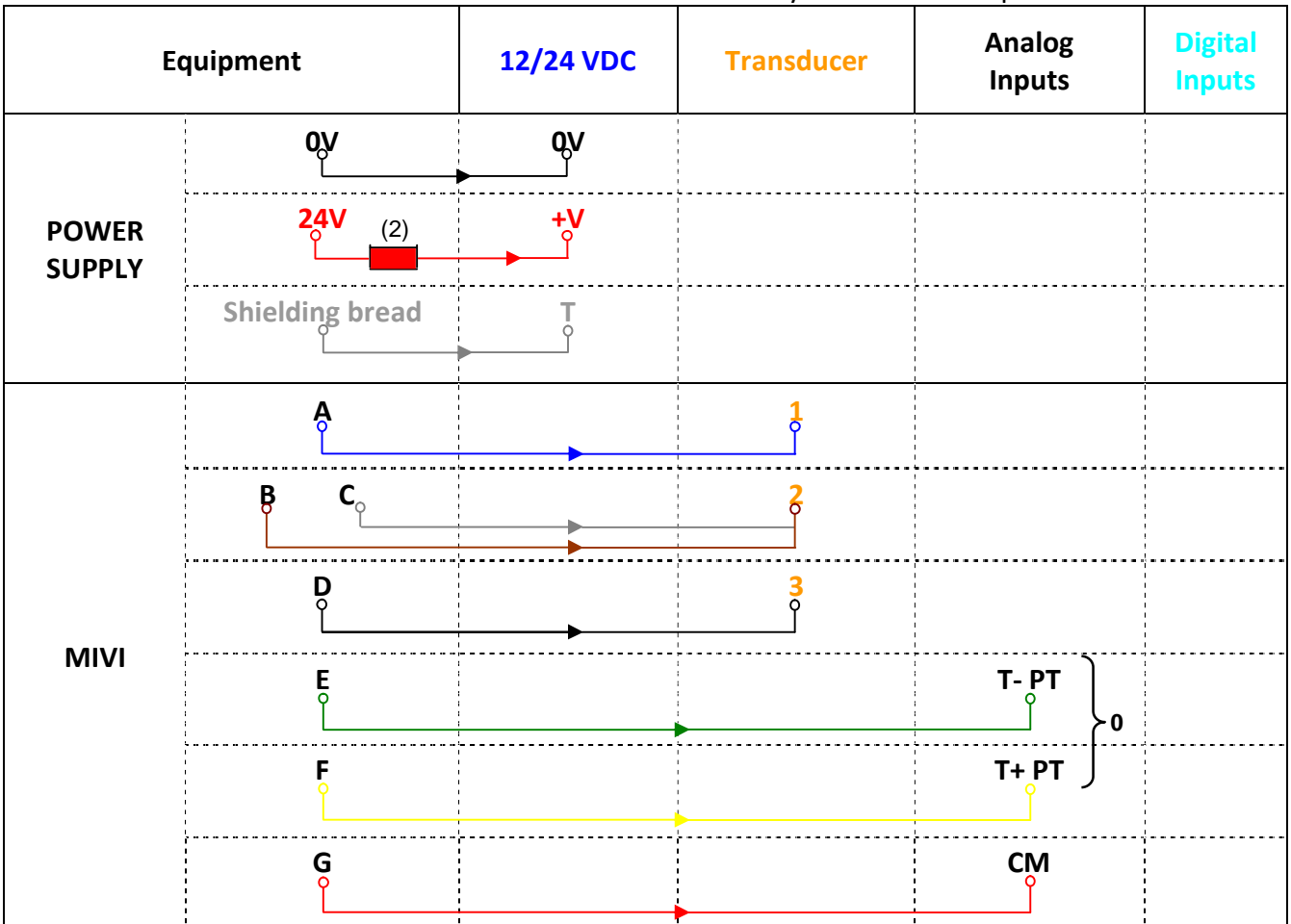
If there is no incorporated pt100 probe, there are no E, F and G wires to connect. In the case of a non-provided by SOFRASER external probe, be sure this is a 3-wires one.

An external circuit protection device (such as a fuse) is recommended as shown in **(2)**.

3.9 Digital Inputs TOR

18 TOR inputs are available including 2 inputs which can be used as high speed counter, shaft encoder or for frequency measurement.

In our configuration, we only use one input (for the frequency): I0 (see §3.10).

3.10 Analog Inputs

4 analog inputs are available. Their resolution is 14 bits.

Analog inputs type: voltage 0-10 V, current 0/4-20 mA. These inputs can be used with thermo-couple or a Pt100 probe.

On the 9601 processor, these inputs are used as follows:

Physical value	Input type	Scale
amplitude	voltage	0-10V
coil	voltage	0-10V
temperature (optional)	Pt100 Ω – 3-wires mode	-50°C to 200°C
	external probe	-200°C to 600°C
density (optional)	current	4-20 mA

Transducer	Analog Inputs	Digital Inputs
5	T- PT } 2	
	T+ PT	
4	T- PT } 1	
	T+ PT	
7		IO
6	ACM	
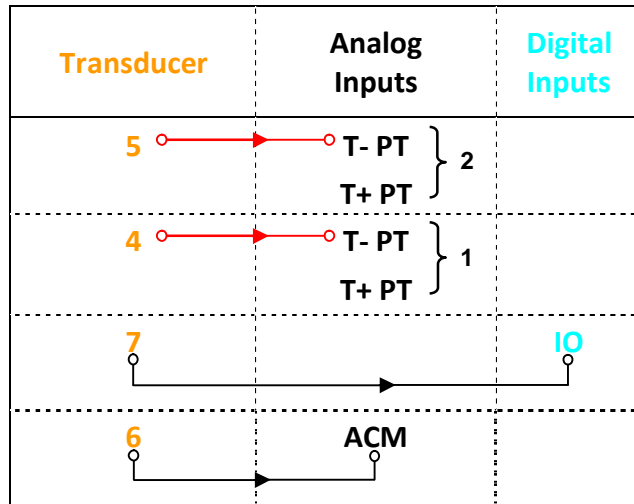
Note: These connections are also made by SOFRASER.

3.11 Densimeter (optional)

In the case of SOFRASER provides its densimeter, this is the way to connect it to the device.

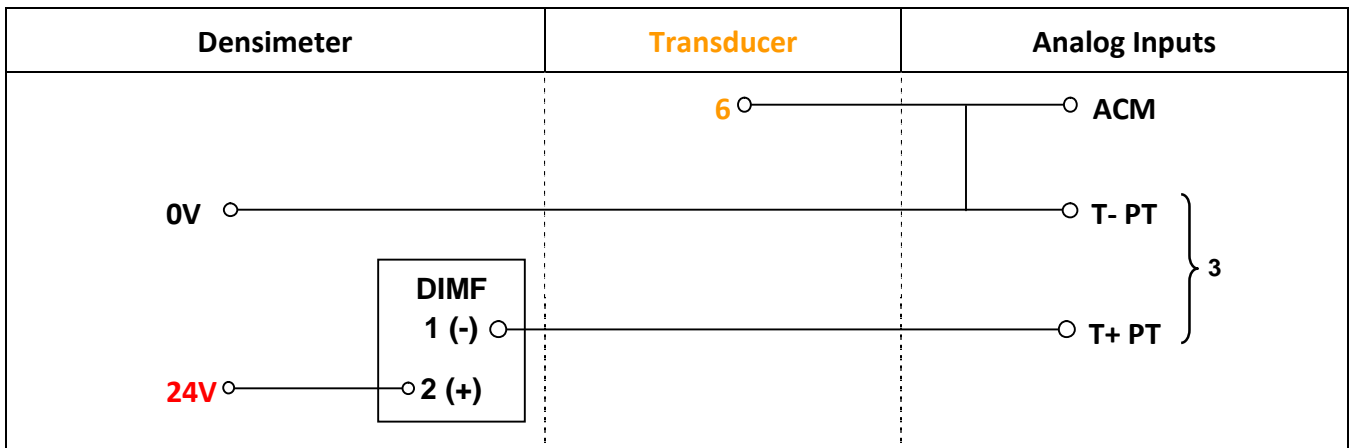| Densimeter	Transducer	Analog Inputs
	6	ACM
0V		T- PT }
DIMF 1 (-)		T+ PT } 3
24V 2 (+)		

3.12 Safety considerations

- Do not touch wires while the processor is ON.
- A non-isolated power supply can be used provided that the 0V is connected to the frame.
- In the event of mounting on a metal panel, standard safety considerations require that the power supply should be earthed to avoid electrocution.
- Do not connect either the "Neutral" or "Line" signal of the 110/220VAC to the device's 0V pin.
- In the event of voltage fluctuations or non-conformity to voltage power supply specifications, connect the device to a regulated power supply.
- Double-check all wiring before turning on the power supply.
- Do not use tin on the stripped wire that might cause the strand to break.
- Install at maximum distance from high-voltage cables and power equipment.
- To avoid damaging the wire, do not exceed a maximum torque of 0,5 Nm (0,05 kgf.m).
- We recommend using crimp terminals for wiring. Use 26-14 AWG wire for all wiring purposes.
- To maximize the system performances, avoid electromagnetic interferences by mounting the processor on a metal panel and earthing the power supply.

Note: The wire used to earth the power supply must not exceed 8 cm in length. If your conditions do not permit this, do not earth the power supply (cf. step 2 § 4.1).

3.13 General scheme of the electronic device
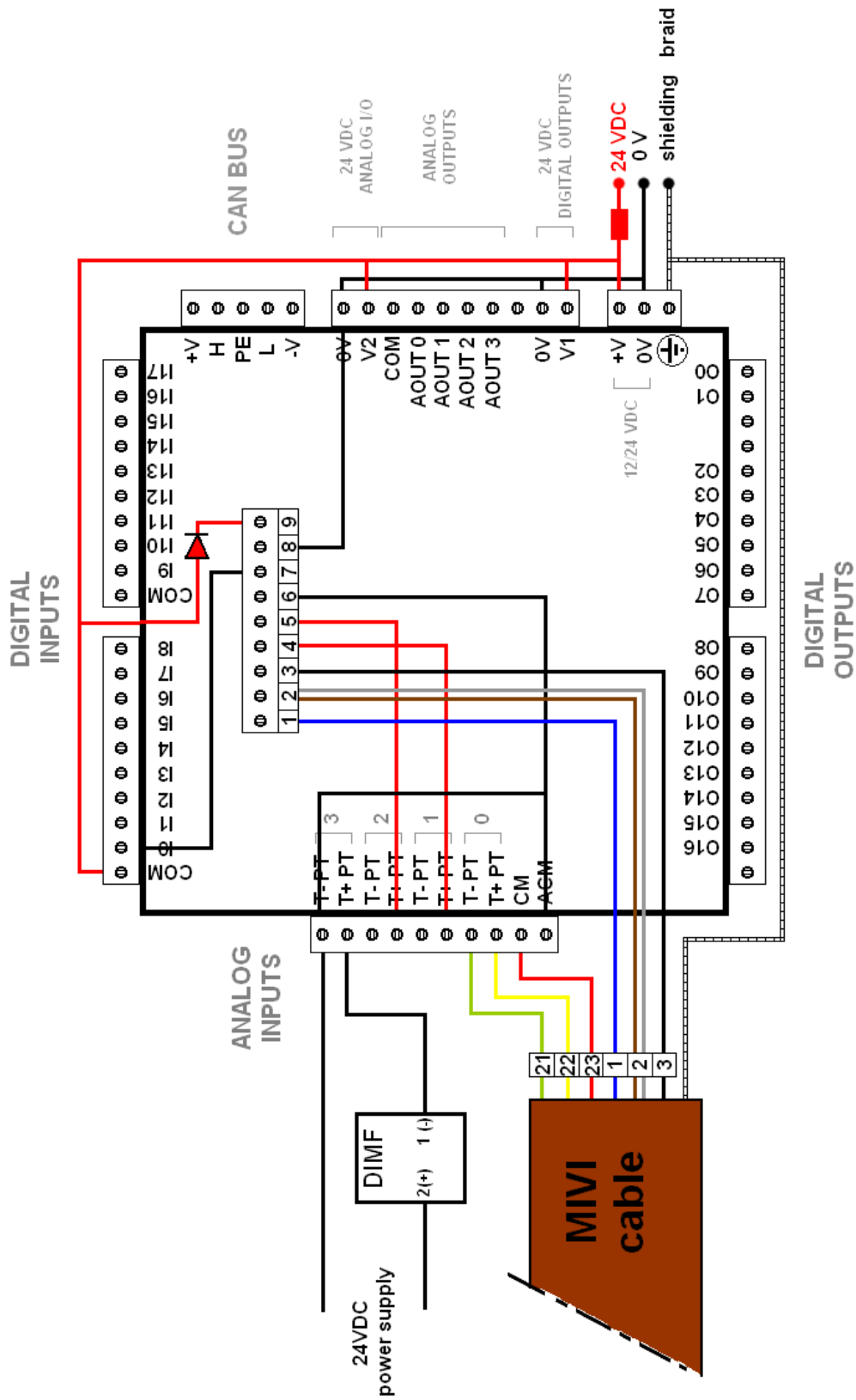
3.14 Relay outputs

15 relay outputs are available.

In our configuration, 9 relay outputs are used as follows:

Physical value	Relays
Viscosity	1 NO relay for LOW threshold
	1 NO relay for HIGH threshold
Compensated Viscosity	1 NO relay for LOW threshold
	1 NO relay for HIGH threshold
Temperature	1 NO relay for LOW threshold
	1 NO relay for HIGH threshold
Density	1 NO relay for LOW threshold
	1 NO relay for HIGH threshold
Diagnosis - Dysfunction	1 NO relay

- *Normal functioning:*

The coils of the relay are under tension and the contact is closed.

- *In case of anomaly:*

The coils are not under tension and the contact is opened: measurements out of set point, processor power supply is turn off…

- *Power cut-out:*

Relays O2 to O7 and relays O8 to O15:   3 A maximum per relay, 250VAC or 30VDC
Common: 8 A maximum
                                        Common is not located, refer to the plugging chart

Minimal charge: 1mA for 5VDC
Relays lifespan: 100 000 operations at the maximum charge
Response time: 10 ms

If these relays are used to commute some inductive charge, we advise you to add some RC networks to the charge terminals (preferably) or to the contacts terminals. They will then lessen the electro-magnetical phenomena.

3.15 Analog outputs

4 analog outputs are available. Their resolution is 12 bits.

Analog outputs type: current output 4-20 mA or voltage output 0-10 V.

In our configuration, analog outputs are used as follows:

Physical value	Output type	Scale
viscosity	current	4-20 mA
temperature	current	4-20 mA
compensated viscosity	current	4-20 mA
density	current	4-20 mA

3.16 Outputs wiring

<table>
<tr><th colspan="2">Analog outputs</th><th colspan="2">Digital outputs</th></tr>
<tr><td>COM</td><td>Common outputs 4/20mA</td><td>O16</td><td>NO relay - diagnosis</td></tr>
<tr><td>AOUT0</td><td>4/20mA viscosity output</td><td>O15</td><td>NO relay HIGH - density</td></tr>
<tr><td>AOUT1</td><td>4/20mA temperature output</td><td>O14</td><td>NO relay LOW - density</td></tr>
<tr><td>AOUT2</td><td>4/20mA compensated viscosity output</td><td>O13</td><td>NO relay HIGH - comp. viscosity</td></tr>
<tr><td>AOUT3</td><td>4/20mA density output</td><td>O12</td><td>NO relay LOW - comp. viscosity</td></tr>
<tr><td></td><td></td><td>O11</td><td>NO relay HIGH - temperature</td></tr>
<tr><td></td><td></td><td>O10</td><td>NO relay LOW - temperature</td></tr>
<tr><td></td><td></td><td>O9</td><td>NO relay HIGH - viscosity</td></tr>
<tr><td></td><td></td><td>O8</td><td>NO relay LOW - viscosity</td></tr>
</table>

3.17 General information

List of the device generic standards:

Low Voltage Directive	EN 61131-2	Power supply 24 VDC-not submitted
CEM Immunity	EN 61000-6-2	Electro-statical discharges Radio-frequency Burst quick transients
CEM Emission	EN 61000-6-3 EN 61000-6-4	Radio-frequency
Process variable	CEI 751	Pt100
Protection	CEI 529	IP 65 on front panel and IP 20 on rear panel
Size	CEI 473	Front panel : 184 * 155 mm Cut-out : 141 * 126 mm
Climatic conditions	Storage	-20 to 60°C 5 to 90% HR non-condensing
	Work	0 to 45°C 5 to 90% HR non-condensing

3.18 Wastes handling

Within the framework of the directive 2002/96-CE application, commonly named directive DEEE, relating to the wastes of electric and electronic equipments, SOFRASER envisages to take in charge the equipments arriving at the end of the lifetime.
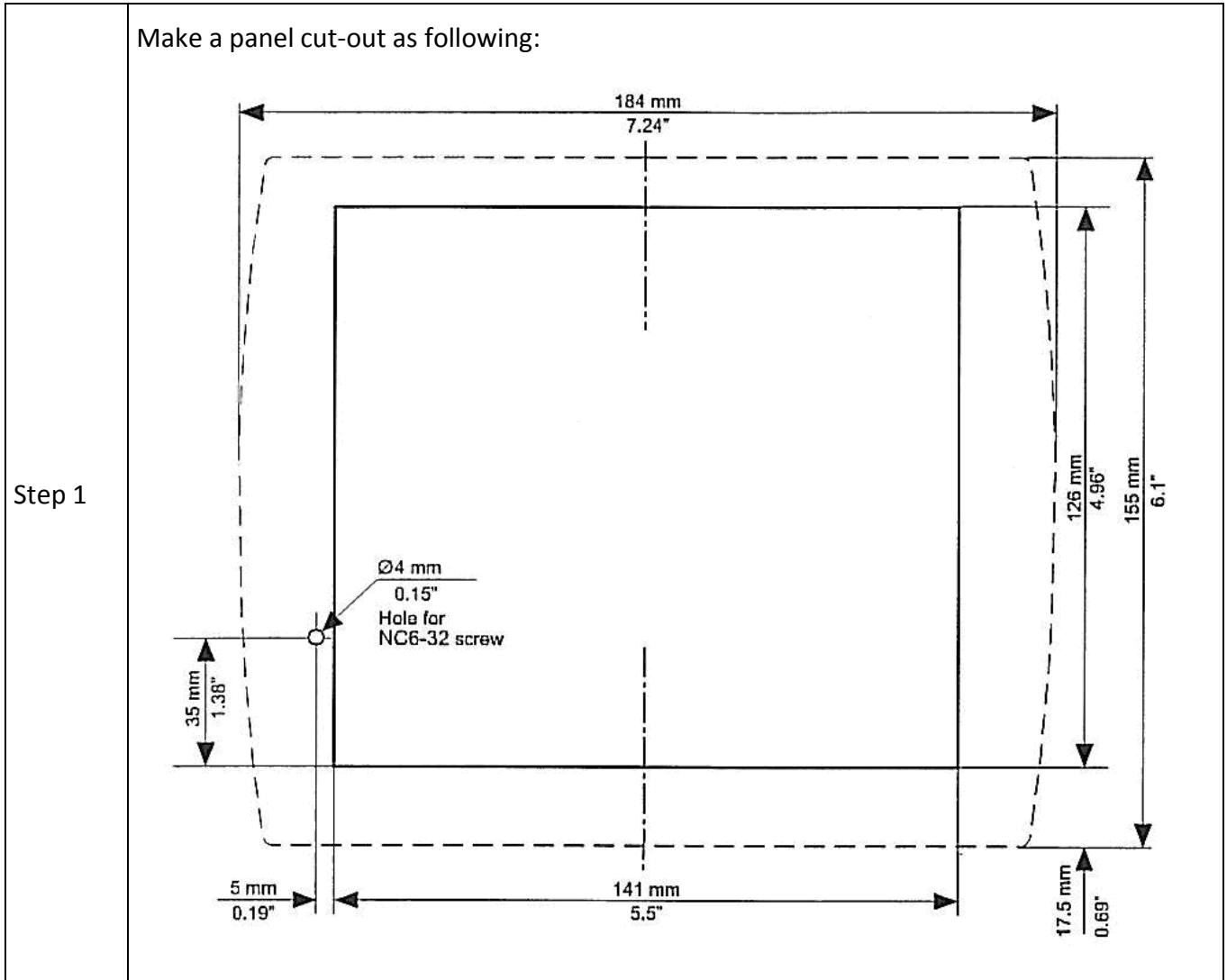
Do not throw the equipments to the dustbin. If the user does not have the means to take in charge the wastes of our electronic equipments, he should returned these equipments to our factory with a signed letter confirming that it is an equipment that has to be destroyed/recycled.

4 Processor mounting-installation

4.1   Panel mounting

Warning:

The mounting panel should not be more than 5 mm thick.

Step 1	Make a panel cut-out as following: 184 mm / 7.24" 126 mm / 4.96" 155 mm / 6.1" Ø4 mm / 0.15" Hole for NC6-32 screw 35 mm / 1.38" 5 mm / 0.19" 141 mm / 5.5" 17.5 mm / 0.69"

Step 2	Earth the power supply - Bore a hole of Ø4 mm that suits the NC6-32 screw supplied. - Scrape the panel paint away from the contact area to ensure a conductive connection. - Drive the screw into the hole and place the following hardware in this order : washer, ring cable shoe, second washer, spring and nut. Note: The wire used to earth the power supply must not exceed 8 cm in length. If your conditions do not permit this, do not earth the power supply.
Step 3	Slide the processor into the cut-out, ensuring that the rubber seal is in place.
Step 4	Push the 4 mounting brackets into their slots on the processor sides as shown as following:
Step 5	Tighten the bracket screws against the panel. Hold the mounting brackets firmly against the processor during the screws tightening.
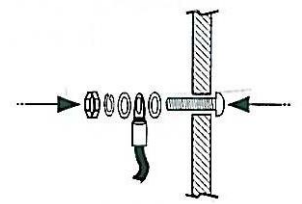
5 Communication

5.1   Serial interface

2 RS ports are available. One is a RS232 (PORT 1), the other one can be either a RS232 or a RS485 (PORT 2). They are located on one side of the processor.
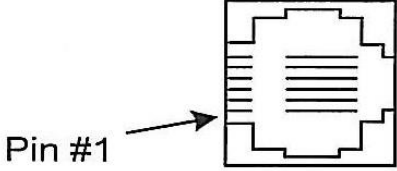
Serial ports type : RJ-11.

⚠ Caution:

- Turn off power before making communication connections.
- Do not connect the controller directly to a telephone or a telephone line.
- Use shielded, twisted pair cables.
- Minimize the length of the connection cables. The length should not exceed 1200 m.
- Do not cross A and B signals: positive terminals must be wired to +, and negative terminals to -.
- The RS232 port is not isolated.
- The RS485 serial port is not isolated. If the controller is used with a non-isolated external device, avoid potential voltage that exceeds ± 10V.To avoid damaging the system, all non-isolated device ports should relate to the same ground signal.
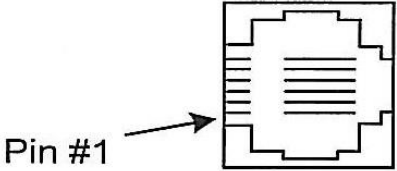- Signals are linked to the processor's ground, this is the same ground used by the power supply.

⚠   RS232 characteristics:

Baud rates	PORT 1	PORT 2	Voltage limits
	300 to 57600 bps	300 to 115 200 bps	-20V to 20V

Pin number	Function
1	DTR signal
2	0V reference
3	TxD signal - Transmission
4	RxD signal - Reception
5	0V reference
6	DSR signal

⚠   RS485 characteristics:

Baud rates	Nodes	Voltage limits
300 to 115 200 bps	Up to 32 processors	-7V to 12V

Pin number	Function
1	A signal (+)
2	*
3	*
4	*
5	*
6	B signal (-)

* pins 2 to 5 are not used for RS485 communication.

5.2 Modbus communication protocol

Goal: read amplitude, coil, viscosity and Pt100 values using RS-485 communication

S: send from the console to the board

R: response from the board to the console

Amplitude: signal read before correction, offset and without linearization

Coil: signal which is an image of the sensor inner temperature

Viscosity: viscosity calculated in cP

Pt100: value in Celsius degrees of the temperature read by the probe (if there is one)

COM port characteristics

Speed: 9600 bits/s	Number of bits: 8	Parity: none	Stop bit: 1

Generic frame format

S = SN 3 XX XX YY YY <CRC>

R = SN 3 AA {DATA} <CRC>

SN: slave number   **3**: reading function

XX XX: starting point for the addresses to be read **YY YY**: number of words to be read

AA: read bytes number   **DATA**: content of all the asked addresses

<CRC>: checksum (automatic)

List of addresses

Viscosity	0x143C	4 bytes
Temperature	0x0021	2 bytes
Compensated viscosity	0x144C	4 bytes
Density	0x001F	2 bytes
Frequency	0x000D	2 bytes
Amplitude	0x001C	2 bytes
Coil	0x0007	2 bytes
Offset	0x001B	2 bytes

Example

S = 11 3 14 3C 00 02 <CRC>
R = 11 3 04 00 08 8D F3 <CRC>

11: slave number   3: reading function
14 3C: viscosity address   00 02: number of words
04: number of bytes read   00 08 8D F3: viscosity value (0x88DF3 = 560,627 mPa.s)
<CRC>: checksum