EsiWelma® s.r.l.

TW1-M and TW1nA-M
Computer Head User Guide
CNG Version (Methane)

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1. TECHNICAL DESCRIPTION

TW1 electronic computing head is designed to operate on one-nozzle fuel dispensers, using one or two-sided display systems. It can communicate with a Host sending data concerning the refuelling during the process and/or at the time of the device.

1.1. Structural specifications

The computing head is composed of:

- One ***CPU board*** of a supplier and communication interface. Each assembly is settled into a metallic box to be protected both mechanically and against EMI interferences;
- One **board for set-up/price changing** settled into a plastic box. This assembly can be put by the customer in the most comfortable place or inserted by convenience;
- One or two **display boards**, optionally settled in a metallic box.

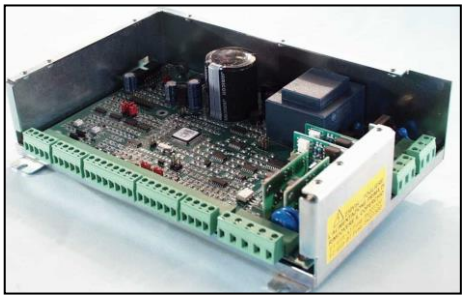

Photo 1: *CPU*

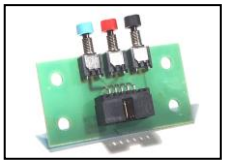

Photo 2: *Set-up / Price Changing*

Photo 3: *Display*

1.2. Technical data

- *Power supply:* 230Vac ± 10%
- *Power consumption:* 10VA
- *Temperature:* min. –40°C max 70°C
- *Humidity (no dew):* 95%
- *Max flow rate:* 3.5Kg/s or 3.5Sm³/s (see Setup)
- *Measure:* 1dag or 10dm³ (see Setup)
- *Solenoid valve control:* N.O. max 270Vca/3A Standard /1A Atex **(*)**
- *Measuring device inlet:*
  - Pulses → one channel: 1 pulse = 10g
  - *Serial → ModBus:* A-B channel
- *Protection grade* IP20(**)
- *Total counter depending on version:*
  - Electromechanical not resetable (7 numbers): 1 counting unit = 1Kg/Smc (see Setup)
  - Electronic not resetable (10 numbers): 1 counting unit = 1Kg/Smc (see Setup)
- *Computing Head CPU Dimensions:* (230 x 154 x 66)mm
- *Computing Head CPU Weight:* 1950g
- *Computing Head Display Dimensions:* (225 x 250 x 50)mm
- *Computing Head Display Weight:* 960g

(*) Outputs device depending:
Relays for TW1-M "Standard", or Solid State relays for TW1nA-M "ATEX".

(**) The declared protection degree is referred to the metallic box. The devices enclosed by the dotted line in **Figure 1** must be installed in a cabinet with at least protection degree IP54, compliant to standard EN60079-15 of ATEX directive.

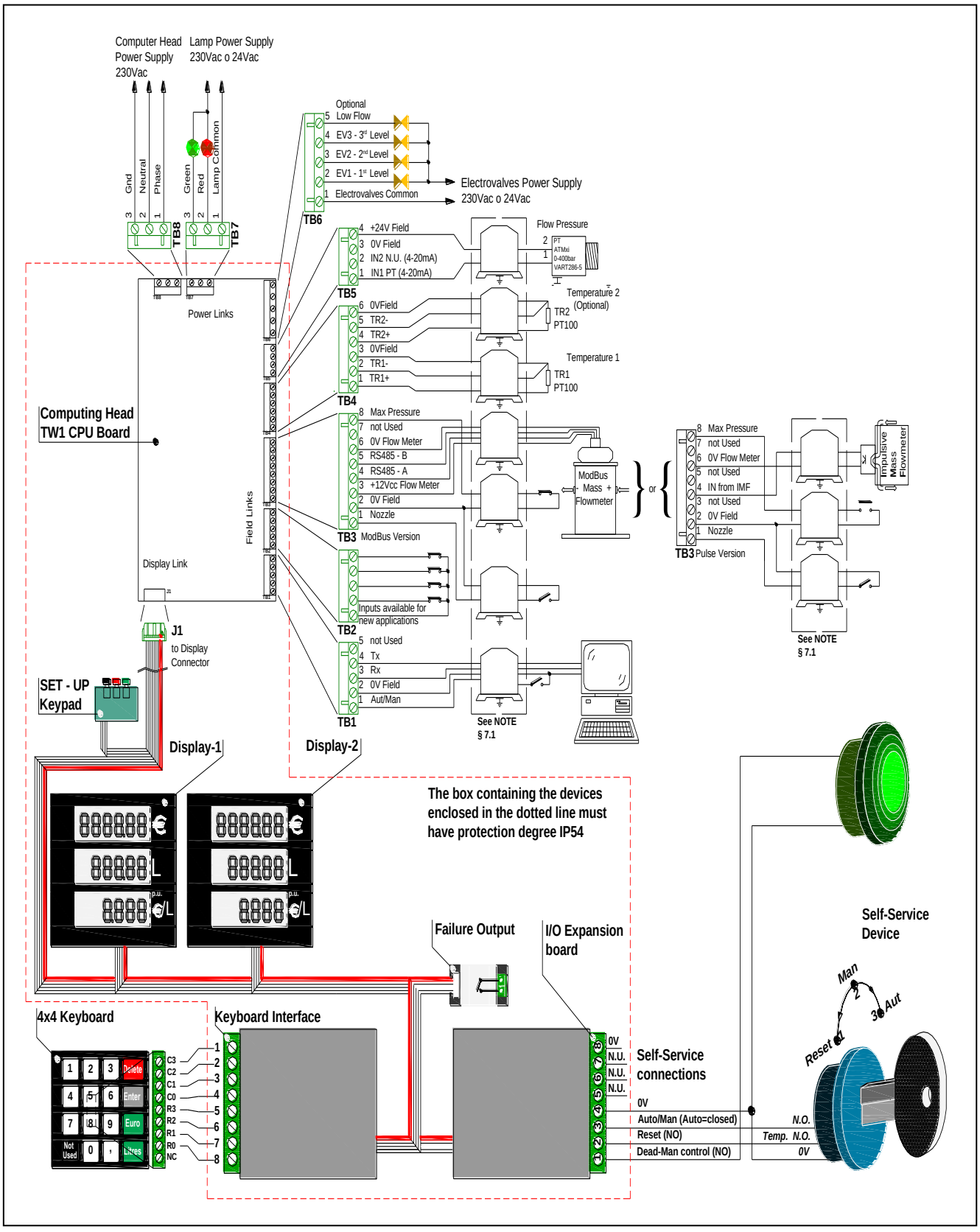

Figure 1: Summary electric connections

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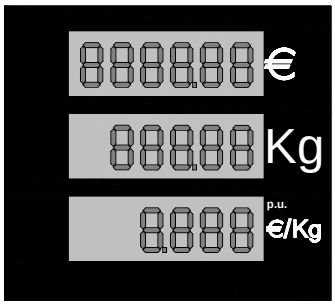
2. FUNCTIONAL DESCRIPTION

2.1. Data display

TW1 computing head can be combined with one-nozzle fuel dispensers, data are always visualised on a 6-digit display for the amount to be paid, a 5-digit display for delivered fuel and a 4-digit display for unit price.



TOTAL AMOUNT

DELIVERED FUEL

UNIT PRICE

Figure 2: Max data display

25mm high back lighted LCDs made up the display bars. The backlighting system is made up of a printed circuit with a led matrix welded on. It is settled on the backside of the metal box and gives out a green light. As an alternative it is possible to use the dispenser's own light.

2.2. Operating sequence description

Once initialised, the computing head carries out some checks:

- EPROM - it checks the EPROM CRC and compares it to the data reported on the program.
- RAM - it checks the writing and reading ability of data RAM.
- EEROM - it checks the congruence of the data reported in EEROM.
- DISPLAY - it checks the connection status of the display.
- RX-TX - presence of active connection with Host.
- DATA COMPLIANCE - compliance of the data used by RAM with the originals in E^2ROM.
- UNIT PRICE - it checks that the unit price is not zeroed.
- ANALOG INPUTS - it checks the presence of pressure and temperature transmitters.
- MEASUREMENT - it checks that the mass flow meter (in case of MODBUS system) is present and communicating.
- MAX. PRESSURE - it checks that pressure does not exceed the maximum functioning pressure of the plant.

If the above mentioned checks give a positive result, display temporarily shows the program code and the data about the last delivery, then it switches-off. In case of anomalies display shows the relevant error code (See further, "Anomalies management" §3).

When the dispenser is in stop-mode , the computing head performs continuously the same controls described above.

The refuelling operation begins by turning the switch to START

If the dispenser is available and nozzle is connected to the refuelling receptacle on the vehicle, it's possible to actuate the "START" switch, activating the delivering sequence of the computing head, which will perform the following controls:

- The same as described above - see §2.2
- PULSER - in case of a pulse measuring device, the presence of pulses is verified in time compliance.
- TOTAL COUNTER - verifies the presence of the electromechanical total counter
- HF - verifies that the compressed natural gas flow does not exceed the set value, so that in case of a gas loss due to the cut of a nozzle connected to the vehicle, flow can be immediately stopped.

If the above mentioned checks give a positive result, the refuelling procedure can start with a visual control by display and a subsequent activation of the solenoid valves.

- Display - All digits show 8, then blank and at last 0.00 Euro and 0.00 kg. Each phase takes about 1 second: in this way user can verify immediately the good working of each step.

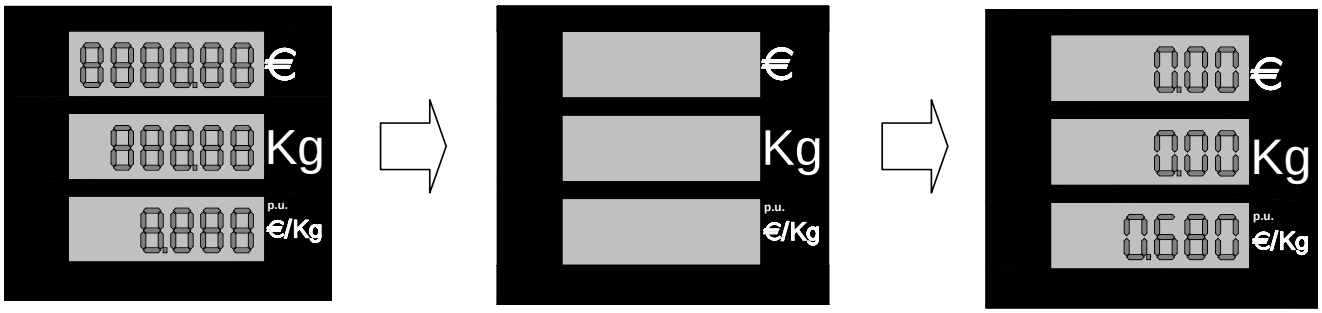


Figure 3: Refuelling start sequence; CNG metric counting version

During the refuelling process the computing head executes the following functions:

- Activation of the command modules of the following devices: solenoid valves and operating lights.
- As defined during the set-up:
  - Pulse acquisition coming from the transducer Every pulse is equivalent to 10g.
  - Acquisition of the delivered quantity through communication with the mass flow meter.
- Calculation and visualization of the delivered quantity and the relevant amount.
- Control of the validity of the visualized data (implicit with the control of Ram and Eprom).
- Functional control of the single or both displays.
- Presence control of the electro mechanical total counter and managing of both electro mechanical and/or electronic total counter.

Delivery ends because of:

- Opening of the “start” switch.
- Reaching of a pressure in the vehicle cylinder that makes the flow tend to zero.
- Reaching of the maximum allowed pressure value in the vehicle cylinder.
- Reaching of the maximum amount or of the maximum delivered quantity.
- Anomalies (see §3).
- Blocking order by Host.

…If delivery is stops due to anomalies:

display shows, if possible, the relevant error code. (see troubleshooting §3.).

2.2.1 *Manual delivery*

Operator decides the beginning of the delivering process, acting on the “START” switch and ends the refuelling by acting on the “START” switch again, when the desired quantity is reached or when the tank in completely filled.

2.2.2 *Pre-set value delivery*

The computing head provides to stop delivery once the pre-set value is reached, both in case of programming by pre-set buttons and in case of Host programming.

The requested quantity is shown as follows:

- Unit price display - always active
- Amount display - if pre-setting is in Euro, display shows the requested value, otherwise it is shaded.
- Quantity delivered display - if pre-setting is in litres, display shows the requested value, otherwise it is shaded.

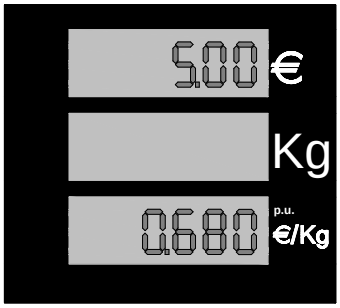


Figure 4: Example of a 5.00€ Amount pre-setting

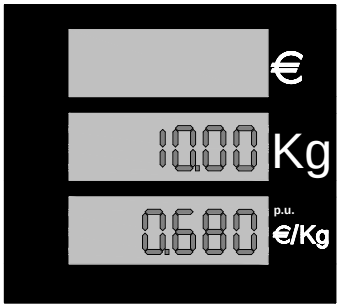


Figure 5: Example of a 10Kg delivered quantity pre-setting

2.2.3 *Programming by Host*

Every time the computing head is connected to a Host with Post-pay function, it can receive an order of price change, by sending a new unit price, or an order of delivering stop.

Metrological parameter settings cannot be modified by Host.
Unit price cannot be modified during the delivery.

2.2.4 *Programming by a 16-key keyboard*

When computing head switches on, it makes a presence control of the keyboard. If this test is positive, the computing head manages the keyboard to pre-set a quantity or an amount to be delivered.

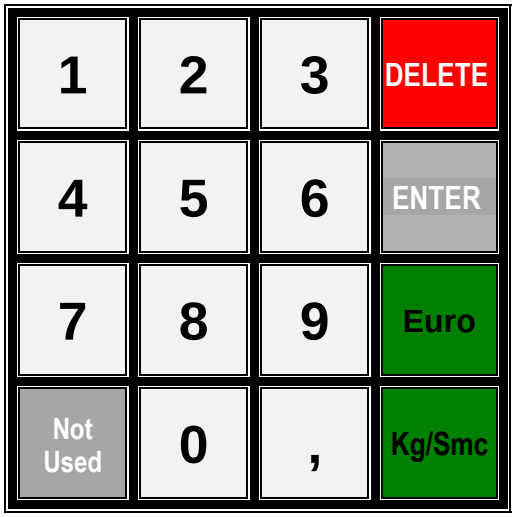


Figure 6: 16-key Keyboard

With nozzles in place, keyboard works and can be used as follows:

1. Choose Euro or Liter pre-set by pressing the corresponding button.
2. Press number buttons (with comma, if necessary) to pre-set value.
3. Press « ENTER». Now the display of the computing head shows on the LCD the amount (upper line) or the quantity delivered (central line).
4. If the value is correct, delivery can start. If an error occurs, press «DELETE» and repeat steps 1÷3.

During the delivery, keyboard doesn't work.
When operator puts the nozzle back in place another operation is possible.

2.2.5 *Automatic stop sequence*

Automatic stop occurs in two phases:

- Flow rate reduction by controlling an optional solenoid valve. The point of intervention can be varied by set-up (bP parameter) following the procedure described below.
- Motor and solenoid valve stop.

2.2.6 *Supply voltage blackout management*

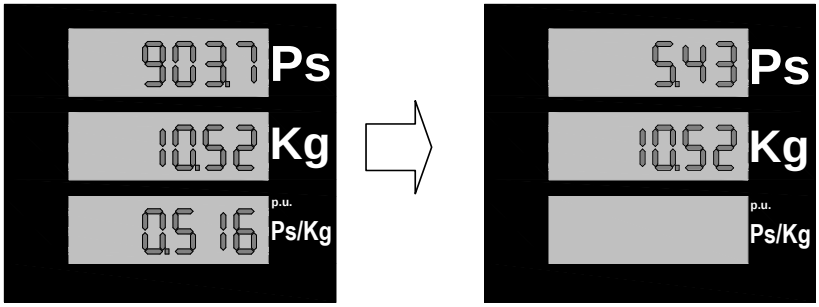
If during normal operation a supply voltage black out or even a blackout occurs, both when nozzle is inserted and during delivery, the computing head enters a procedure called PWF which allows to memorise: amount, quantity delivered and absolute totalizer. The data display is maintained for about 30 minutes from the moment the network shortage occurred. The power supply lack is visualized writing “OFF” on the unit price display. The network shortage state is displayed by writing OFF on the unit price bar. When power supply is restored, data related to interrupted delivery are read by the memory and visualised on the display and send to the Host, if present.

2.3. Connection to Host

This computing head as its standard can be connected by “Pumalan” 3 wire current loop TX, RX, Gnd. Different connections are possible by adding an adapter. To use and implement different protocols, a license released by manufacturer is needed.
Pumalan is a registered mark of GILBARCO (LOGITRON).

2.4. Euro €

The standard computing head connection is foreseen with three cables, TX, RX, Gnd.
The computing head, by its set-up, can work with different foreign currencies: operator can set the decimal digits in the unit price and in the amount. In any case operator can choose quickly the Euro set by setting jumper J3: while starting, the computer head will set the correct decimal digits.



Further, as requested from the standard, in those countries, which are approaching to the Euro, after the refuelling process shown in local currency, it’s possible to visualize the amount converted in Euro by temporarily pushing an appropriate button.

Figure 7: Temporary amount conversion to Euro

The standard rate DGII-C-4(99) is used as conversion factor.

By pushing the button for a second time, the visualization will switch back to the local currency value. If another refuelling process should be started, the computing head switches in any case to the normal visualization.

2.5. Delivery in Self-Service mode

In accordance with the Decree dated 11 September 2008, amendments and supplements to Decree of Minister dated 24th May 2002 about the rules for fire prevention and planning, construction and operation of distribution systems of natural gas for vehicles. (*GU n. 232 del 3-10-2008*)

The computing head can work in Self Service mode following the procedures required and described below:

2.5.1 Electrical devices involved

In addition to the lights (red and green) the following devices will be installed on board of the dispenser: a “deadman’s break” push button (mushroom head, no block, normally open) , an emergency push button (with block interrupting the power supply to distributor) and a 3-position key selector (1 unstable and 2 stable).

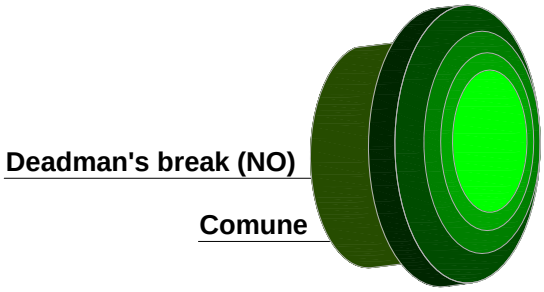


Figure 8: “deadman’s break” push button

Aloof (safe zone), a button (normally closed) to disable the delivery to the user by the operator (connected in series with the dead man's button).
The computing head manages these devices by the following digital inputs.

- **1** Input « deadman’s break » temporary voltage free contact, normally open
- **2** Input «Reset deadman’s break » temporary contact of the 3-position key selector
- **3** Input selector «Self (AUT) / Served (MAN)» bistable contact of the 3-position key selector, contact closed in position Served.

2.5.2 Sequence of delivery

The 3-position key selector allows the operator to choose the operating mode of the dispenser: Manual (SERVED) or Automatic (SELF-SERVICE).

The positions of the selector are:

- **1** **Deadman’s break Reset** (counterclockwise rotation) temporary, return to central position
- **2** **Automatic** Self-Service (central position) close stable contact.
- **3** **Manual** Served (clockwise rotation), open stable contact.

The key can be removed only in positions 2 and 3

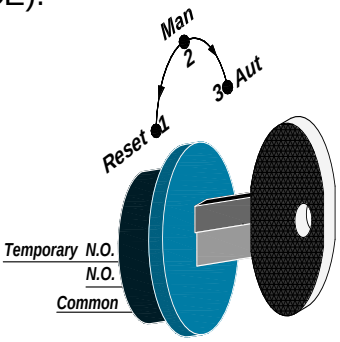


Figure 9: Activation Key of Self-Service/Served mode

Manual (Served) mode works as described in §2.2.

In addition to what already explained, operator can stop and restart the flow of gas without resetting the current delivery. By the “deadman’s break” push button in the manual mode, the delivery starts and stops alternately every time it is pushed.

This function can be repeated several times consecutively without resetting the counting. The delivery definitely finishes when the user puts the nozze back in place or when the condition of low flow (full bottle) is reached.

Automatic mode (Self-Service) is almost the same but during the delivery the “deadman’s break” push button must be always pushed. If this push button is released before the refuelling finishes, delivery stops and has to be locally rehabilitated by operator using the key selector in reset position, then the user can re-start the delivery by pushing (and keeping) the “deadman’s break” push button.
In remote, by the button "Single Block" (Normally Closed), located in series with the " deadman’s break" device, the operator may at any time stop the current delivery , which can be rehabilitated only locally using the key selector in reset position.

According to the standard or the Self-Service mode, the cumputing head works automatically, detecting the presence of the I / O Expansion switch board.

The card connection on the flat I²C Bus, is described and shown below. See wiring B.T. § 7.1

2.5.3 Warning light management

To allow operators to follow in remote the operations, each possibile status of the dispenser is coupled with a unique code as shown in the table below:

Status of the dispenser	Green Light	Red Light
Dispenser off	Off	Off
Dispenser Ready	On	Off
Nozzle off	Flashing	Off
In delivery	Off	On
End of delivery (for low flow or Stop by HOST in Auto)	Off	Flashing
End of delivery (Nozzle in) ≡ Dispenser Ready	On	Off
Deadman’s break (push button released)	Flashing	Flashing
Computing head error (Dispenser not available)	On	On
Computing head set-up (Dispenser not available)	On	On

3. TROUBLESHOOTING

During its normal working the computing head controls the internal data flow and the correspondence of data coming from outside. Possible anomalies are managed in different ways according to the damage they may cause to data.
The recognized errors can be subdivided in *fatal* and *non fatal* errors as described as follows.
In any case the computing head stops the current refuelling, visualizes the memorized recognized error code and, if connected to a Host, communicates the state of error using a proper error code.

3.1. Fatal errors

Fatal errors are normally due to malfunctioning which may cause data loss. In such a case the computing head stops the delivery, displays the relevant code and does not re-start. To start again it must be reset by switching off power supply for some second.

- Data congruence
- EPROM Error
- RAM Error
- EEROM Error
- Presence of totalizer Error
- Presence of optional I/O (Self-Service)
- Pulser or communication with mass flow meter

3.2. Non fatal errors

Belong to such a category all blocks due to an anomalous status of the field, and all temporary blocks occurring due to an anomalous working process, caused by a secondary situation such as the lack of unit price, or occasionally, for example because of an incorrect data due to a disturbance. In that case the error will be automatically deleted as soon as the anomalous status that created it ends.
The computing head tries three times to restart; at the fourth unsuccessful attempt, the error turns into fatal.

- Display 1 and 2
- Communication with Host
- Set-up data loss
- Maximum system pressure
- Maximum delivering flow
- Temperature transducer presence
- Pressure transducer presence
- Pulser disconnection

3.3. Error review table

Errors review table							
Non fatal errors				**Fatal errors**			
Display Code	**Protocol Code [E+][E-]**		**Description**	**Display Code**	**Protocol Code [E+][E-]**		**Description**
	Hex	**Ascii**			**Hex**	**Ascii**	
				FECd	[0x33][0x30]	[3][0]	Data congruence
				FEEP	[0x31][0x31]	[1][1]	EPROM error
				FErA	[0x31][0x30]	[1][0]	Ram error
				FEEE	[0x31][0x35]	[1][5]	Eerom error
				FEto	[0x32][0x32]	[2][2]	Totalizer Error
				FEin	[0x34][0x37]	[4][7]	Spare Inputs
				FEMF	[0x34][0x32]	[4][2]	Mass flow meter control (also for impulsive type)
Erd1	[0x37][0x30]	[7][0]	Display 1	FEPd	[0x47][0x30]	[G][0]	Display 1 after 3 errors NF
Erd2	[0x37][0x30]	[7][0]	Display 2	FEPd	[0x47][0x30]	[G][0]	Display 2 after 3 errors NF
ErLn	[0x38][0x30]	[8][0]	Communication				
ErSU	[0x34][0x31]	[4][1]	Set-up data missing				
ErHP	[0x34][0x34]	[4][4]	Maximum pressure	FEHP	[0x44][0x34]	[D][4]	Maximum pressure error after 3 errors NF
ErHF	[0x37][0x37]	[7][7]	High flow rate	FEHF	[0x47][0x37]	[G][7]	High flow rate error after 3 NF errors
ErSt	[0x34][0x36]	[4][6]	Presence Temperature sensor	FESt	[0x44][0x36]	[D][6]	Temperature sensor. after 3 NF errors
ErSP	[0x34][0x35]	[4][5]	Presence Pressure sensor	FESP	[0x44][0x35]	[D][5]	Pressure sensor after 3 NF errors
ErPU	[0x37][0x31]	[7][1]	Pulser Output not connected	FEPU	[0x47][0x31]	[G][1]	Pulser Output not connected after 3 NF errors

Description of anomalies:

- Display

  LCD single bar presence control, with identification of the absent line

  Error Code: **Erd1 o Erd2**

- Communication with Host

  The computing head verifies the existence of polling from Host every 5 seconds at least. If there is no polling, it stops the delivery

  Error Code: **ErLn**

- Set-up data missing

  If there are no Set-up data or they are not conformable, the computing head does not deliver and operator must input these data

  Error Code: **ErSU**

- Maximum system pressure error

  Verifies the status of the pressure sensor (or pressure sensor switch) and in case of exceeded pressure delivering procedure will be blocked.

  Error Code: **ErHP**

- High flow rate error

  Verifies the outgoing flow rate and if the maximum value is exceeded, delivering procedure will be stopped.

  Error Code: **ErHF**

- Presence of temperature sensor

  Verifies that the signal coming from the temperature sensor Pt100, respects the functioning range (-60°C ÷ +60°C)

  Error Code: **ErSt**

- Presence of pressure sensor

  Verifies that the signal coming from the pressure sensor respects the functioning range (4÷ 20mA)

  Error Code: **ErSP**

- Pulser output not connected

  Verifies that, from the beginning of the delivering process (solenoid valve start), the relevant pulses arrive within 6s.

  Error Code: **ErPU**

- **Data congruence**

  Data correspondence control. The computing head checks, even during the delivery, both EPROM and RAM data. In case an error occurs, it finally stops the delivery.

  Error Code: **FECd**

- **EPROM error**

  When nozzle hangs on, the computing head checks the EPROM checksum. If something is wrong, it doesn't allow the delivery.

  Error Code: **FEEP**

- **RAM Error**

  When nozzle hangs on, the computing head checks RAM. If something is wrong, it doesn't allow the delivery.

  Error Code: **FErA**

- **EEROM Error**

  When nozzle hangs on, the computing head checks the E²rom checksum. If something is wrong, it doesn't allow the delivery.

  Error Code: **FEEE**

- **Totalizer Error**

  The computing head checks the totalizer presence. In case an error occurs, it finally stops the delivery.

  Error Code: **Feto**

- **Optional Inputs/Outputs**

  The computing head verifies the presence of device dedicated to Self Service and other applications.

  Error Code: **FEin**

- **Mass flow meter control**

  The computing head verifies the communi-cation and/or of the reset procedure of the mass flow meter; In case an error occurs it finally stops the delivery.

  Error Code: **FEMF**

  (also in the case of impulsive type mass flow)

3.4. Operating modes

For fitting different field operating modes, the computing head can work in different ways, that can be subdivided in two principal categories:

1. system adaptation (to implant)
2. dispenser adaptation

3.4.1 *System adaptation*

The management of the solenoid valves is adaptable to the type of system where the dispenser is installed:

- Single level for the implants that have only one compression system installed
- Cascade 2 levels for the implants that have a 2-level compression system installed
- Cascade 3 levels for the implants that have a 3-level compression system installed

3.4.2 *CNG dispenser adaptation*

The management of the solenoid valves is adaptable on the type of dispenser installed:

- EV1 active only during the first level phase
- EV1 always active until the end of refuelling
- High pressure control determinate with a pressure switch
- High pressure control determinate with a pressure transmitter

3.5. Types of refuelling

The computing head can be adapted to different national standards, allowing to modify the way of refuelling as follows:

- No control:
  - Free delivery up to the maximum available pressure.
- Compensated:
  - It modifies the end of the refuelling in function of the pressure value related to the ambient temperature (so that at 25°C the pressure can not exceed the specific value inserted during the set-up by **PCON** parameter).

4. PROCEDURES

Further the normal refuelling, there are three different possible procedures:

- Reading from the absolute total counter
- Computing head set-up (changing the configuration parameters), price change
- Metrical office (anomaly simulation)

To start a procedure, operator has to push one of the push-buttons on the set-up board; display will show the following notice:

Push on one of the set-up buttons, to activate the relevant procedure; push-buttons are available on the printed circuit connected to the same cable of the display:

Figure 10: Visualization "waiting procedure selecting"

Procedure black «t» reading absolute **totalizer**

Procedure red «S» **Set-up computing head:** Parameters changing

Procedure green «U» **Metrical office:** anomaly simulation

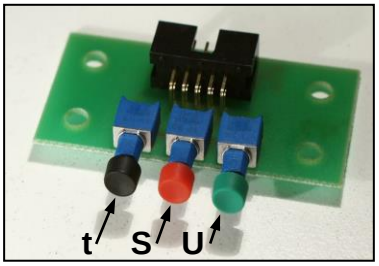
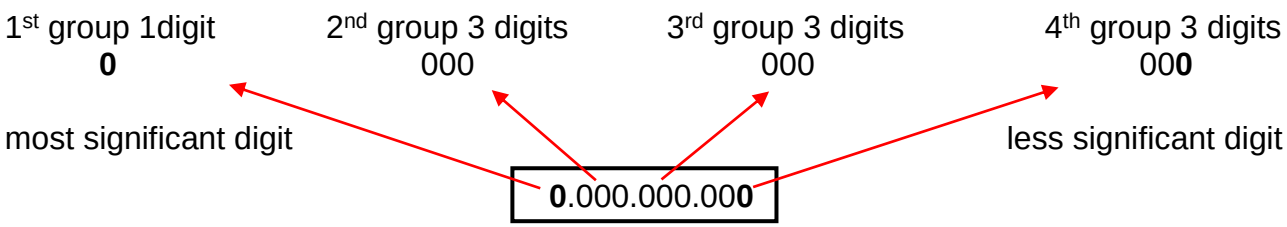


Figure 11: Set-up buttons

4.1. Reading from the absolute totalizer

The absolute totalizer is a counter which cannot be reset (to zero) and allows to store and display the quantity delivered in Kg or Smc on 10 digits. Since it is not possible to dispose of such an extended display, digits are subdivided into groups and visualised as follows:



By pushing the black button «t», the computing head shows the first group of digits; to visualize the second, third and fourth group, advance by pushing the green button «U» once each time.

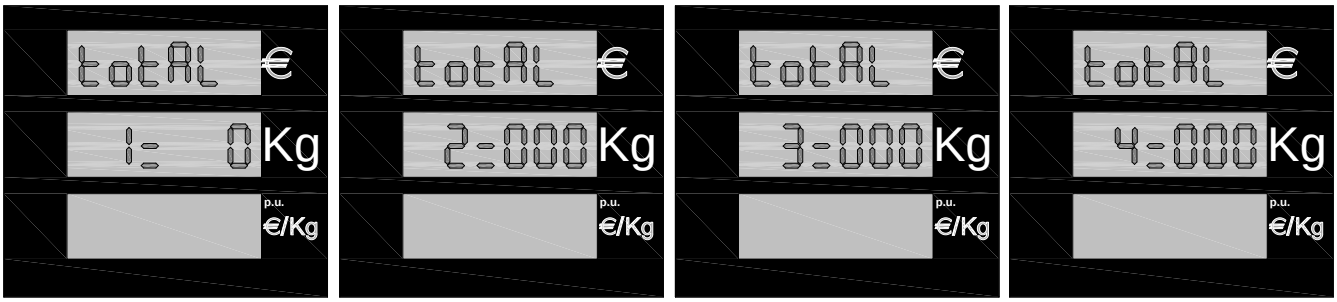


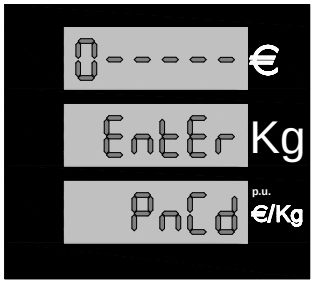
Figure 12: Display absolute total counter Kg

Further, a non annullable electro mechanical total counter that can show 7 digits can be installed on the display. This counter is electronically controlled and in case of failure, the computing head stops the occurring refuelling process and visualizes the error code: FEto.

4.2. Computing head set-up

After entering in set-up mode by pushing the red button «S», the computing head requires a password; if nothing has been previously changed, the default password is “20000”. To insert the correct code follow this procedure:

To enter the SETUP procedure, operator has to set JP2 Jumper “closed”.
SETUP can’t be done if JP2 Jumper is “open”.



- Set Jumper J2
- Push the black button «t» until the value of the first digit has been reached
- Push the red button «S» to switch to the next digit
- Once the correct value has been inserted also for the last digit, push the red «S» button again to enter the set-up.

Figure 13: Enter password

If the password is not correct, the computing head immediately breaks down the set-up procedure and turns.
If the password is correct, it’s possible to proceed with the upgrade of the values of the parameters.
If jumper J2 has not been inserted already, the computing head indicates that it is required for the set-up to insert the jumper now with the shown message: Set JP2

Figure 14: Notice insert jumper JP2

The following table shows all the available parameters:

Computing head set-up parameters						
Code	**Imprint**	**Signification**	**Range**	**Step**	**Default**	**Units**
01	**LF**	Functioning level	1-3	1	2	----
02	**St**	Functionality Electro valve 1	0-3	1	0	----
03	**Mt**	Meter type	0-3	1	3	----
04	**Sb**	ModBus communication baud rate	0-3	1	0	----
05	**L0**	Low flow rate 1st...2nd level (stop for mono-level)	1-16	1	2	10g
06	**t0**	Acquisition delay for L0	0-15	1	8	s
07	**L1**	Low flow rate 2nd…3rd level (stop for bi-level)	1-16	1	1	10g
08	**t1**	Acquisition delay for L1	0-15	1	12	s
09	**L2**	Low flow rate 3rd level (stop delivery)	1-16	1	1	10g
10	**t2**	Acquisition delay for L2	0-15	1	12	s
11	**AL**	LAN address	1-32	1	1	----
12	**HF**	High flow rate	1-299	1	150	10g/s
13	**AP**	Enables the pressure switch	0-15	1	12	----
14	**AC**	Enables the pressure compensation	0-1	1	0	----
15	**HP**	Pressure switch intervening values	200-299	1	235	barg
16	**Pcon**	Compensation pressure	150-250	1	207	barg
17	**tC**	Compesation temperature	0 – 50	1	21	°C
18	**Ot**	Temperature offset	± 20	1	10	°C
19	**tF**	Duration of the first puff	2-60	1	4	s
20	**tS**	Duration of the second puff	1-30	1	10	s
21	**dr**	Awaiting reading	1-40	1	10	s
22	**Po**	POS option	0-2	1	0	----
23	**Pr**	Kind of preset	0-2	1	0	----
24	**bP**	Slowdown (low flow)	0-90	10	50	10g
25	**cA**	Early closure of the solenid valve	0-11	1	6	10g
26	**cM**	Hose compensation in preset mode	0-10	1	5	10g
27	**tP**	Nozzle switch acquisition time	0-10	1	1	s
28	**FC**	Holding time of the count beyond the stop	0-40	5	30	0.1s
29	**PL**	Protocol Level	1-4	1	4	----
30	**PC**	Pressure switch contact polarity	0-1	1	0	----
31	**Ar**	Amount approximation	0-3	1	3	----
32	**DP**	Unit price decimal digits	0-3	1	3	----
33	**DI**	Amount decimal digits	0-3	1	2	----
34	**Ct**	Passage to round digit	1-3	1	1	----
35	**nd**	Number of connected displays	1-2	1	1	----
36	**CE**	Number of delivered display digits	5-6	1	5	----
37	**bL**	Delivery stop for LAN error	0-1	1	0	----
38	**MC**	Flow meter zero setting procedure	0-1	1	0	----
39	**PS**	Specific weight	255-9999	1	7000	----
40	**P1**	Preset value push button 1	0-9/dig	1	10	€
41	**P2**	Preset value push button 2	0-9/dig	1	5	€
42	**CF**	Conversion factor currency / €	0.1-9.99999	1	6.55957	----

Set-up parameters meaning:

- **LF** Functioning level - Allows to change the functioning mode:
  - 1 single level computing head
  - 2 cascade 2 levels computing head
  - 3 cascade 3 levels computing head
- **St** Functionality Electro valve1 - Allows to change the intervention mode of the EV1:
  - 0 Electro valve active only during phase 1
  - 1 Electro valve active during the whole refuelling process
  - 2 Equal to 0 but with EVs closed
  - 3 Equal to 1 but with EVs closed
- **Mt** Meter type - Allows to inform the CPU about the type of used flow meter:
  - 0 Impulsive type
  - 1 Modbus Krohne type
  - 2 Modbus MicroMotion type
  - 3 Modbus Endress+Hauser
- **Sb** Baud-rate Modbus comm's - Select baud rate of mass flow communication port.
  - 0 Baud-rate Automatico
  - 1 38400 bps
  - 2 19200 bps
  - 3 9600 bps
- **L0** Low flow rate 1st...2nd level - Represents the delivering value in dag/s, under this value the computing head switch on the next level (or stop the delivery if mono-level)
- **t0** Acquisition delay L0 - Represents the time between the acquisition of the L0 status and the start of the next level (or refuelling ending procedure if mono-level)
- **L1** Low flow rate 2nd…3rd level - Represents the delivering value in dag/s, below than that the computing head switch on the next level (or stop the delivery if bi-level)
- **t1** Acquisition delay L1 - Represents the time between the acquisition of the L1 and the start of the next level (or refuelling ending procedure if bi-level)
- **L2** Low flow rate for 3rd level - Represents the delivering value in dag/s, below than that the computing head considers to be in minimum delivering condition at the end of 3rd level, and stop the delivery
- **t2** Acquisition delay L2 - Represents the time that must elapse between the acquisition of the status of L2 and the start of the ending delivery procedure.

- **AL** LAN IP
  - It's the address that the computing head assumes when connected to a Host Computer.
- **HF** High flow rate
  - It's the value over which the computing head blocks the refuelling procedure charging the exceeded flow rate to a possible mechanical fault.
- **AP** Pressure switch function
  - When the pressure switch function is carried out by the pressure transmitter:
    - 0 not enabled
    - 1 enable, switch on @ +10bar & EV closed, 1 s
    - 2 enable, switch on @ +20bar & EV closed, 1 s
    - 3 enable, switch on @ +30bar & EV closed, 1 s
    - 4 enable, switch on @ +40bar & EV closed, 1 s
    - 5 enable, switch on @ +50bar & EV closed, 1 s
    - 6 enable, switch on @ +60bar & EV closed, 1 s
    - 7 enable, switch on @ +70bar & EV closed, 1 s
    - 8 enable, switch on @ 0bar & EV closed, 2 s
    - 9 enable, switch on @ +10bar & EV closed, 2 s
    - 10 enable, switch on @ +20bar & EV closed, 2 s
    - 11 enable, switch on @ +30bar & EV closed, 2 s
    - 12 enable, switch on @ +40bar & EV closed, 2 s
    - 13 enable, switch on @ +50bar & EV closed, 2 s
    - 14 enable, switch on @ +60bar & EV closed, 2 s
    - 15 enable, switch on @ +70bar & EV closed, 2 s
- **AC** Pressure compensation
  - The computing head performs the pressure compensation in function of the temperature:
    - 0 does not compensate
    - 1 compensates (see curve § 4.2.2.)
- **HP** Pressure switch
  - Pressure value that activates the protection and intervening switches off the computing head. With AP>0 & EV closed, the HP value is increased from 10 to 70bar triggered in 1 or 2 seconds.
    The hysteresis is fixed @ -10bar.
    (**the parameter is visible only when AP>0**)
- **Pcon** compensation pressure
  - When a CNG bottle is filled with gas at ambient temperature and reaches a compensation temperature TC, it reaches the so called compensation pressure.
    (**the parameter is visible only when AC=1**)
- **tC** Compensation temp.
  - Reference temperature of the tank when car is parked in the garage.
    (**the parameter is visible only when AC=1**)
- **Ot** Temperature offset
  - This parameter allows operator to change the ambient temperature value measured by 1°C rates.
    (**the parameter is visible only when AC=1**)

- **tF** duration of the first puff
  - To measure the CNG pressure at the beginning of the delivery, it is necessary to fill the gas pipeline. **tF** is the time assigned to this activity. **(the parameter is visible only when AC=1)**
- **tS** duration of the second puff
  - To calculate the quantity to be delivered it is necessary to measure the bottle pressure after its partial filling up. **tS** is the time assigned to this second activity. **(the parameter is visible only when AC=1)**
- **dr** awaiting reading
  - Before reading the pressure values it is necessary waiting that variations damp. **dr** is the time assigned to this activity. **(the parameter is visible only when AC=1)**
- **Po** POS Option
  - The computing head changes the amount sent in the following way:
    - 0 amount X 1 (not scaled value)
    - 1 amount X 10 (one digit left scaled value)
    - 2 amount / 10 (one digit right scaled value)
- **Pr** Kind of preset
  - Depending on this parameter, the computing head can deliver (see also **P1** and **P2** parameters):
    - 0 no preset
    - 1 preset in Kg or Smc
    - 2 preset in currency
- **bP** Low flow
  - It shows how many dag the optional solenoid valve for high flow switches off before reaching the preset value.
- **cA** Advance end of delivery
  - It shows how many dag the solenoid valve for delivery switches off before reaching the preset value (Automatically calculated); in particular:
    - 0 pre-stop disable
    - 1 pre.stop calculation enable with -5dag
    - 2 pre.stop calculation enable with -4dag
    - 3 pre.stop calculation enable with -3dag
    - 4 pre.stop calculation enable with -2dag
    - 5 pre.stop calculation enable with -1dag
    - 6 pre.stop calculation enable with 0dag
    - 7 pre.stop calculation enable with +1dag
    - 8 pre.stop calculation enable with +2dag
    - 9 pre.stop calculation enable with +3dag
    - 10 pre.stop calculation enable with +4dag
    - 11 pre.stop calculation enable with +5dag

- **cM** Hose compensation - It shows how many dag are inside the hose @ normalized pressure of 220bar, in preset mode. cM=0 disable this compensation.
- **tP** Nozzle acquisition time - Determines how many seconds the head has to wait for gun contact validation, before assuming the ON state in order to avoid improper starts
- **FC** Time of end counting - It sets how many seconds the head keeps on querying the meter (ModBus type only) after the solenoid valve for delivery switches off.
- **PL** Protocol Level - It sets the Protocol Level used for communication:
  - 1 Pumalan standard
  - 2 Pumalan (mono + multiproduct + mix)
  - 3 Pumalan esteso (mono + multiproduct + mix)
  - 4 Pumalan like 3 with the totals and data counting
- **PC** Polarity contact - Indicates the polarity of the contact of the maximum pressure switch:
  - 0 closes by max pressure
  - 1 opens by max pressure
- **Ar** Amount rounding - It specifies how the rounding shall be performed:
  - 0 no rounding on the last digit
  - 1 if uc≥5 last digit exceeds rounding 10
    if uc<5 last digit defects rounding 0
  - 2 if uc>0 e ≤5 last digit exceeds rounding 5
    if uc>5 e ≤9 last digit exceeds rounding 10
  - 3 if cp ≥ 5 last digit exceeds rounding 10
    if cp < 5 last digit defects rounding 0
    where: uc = last visualized digit
    cp = foregoing digit
- **DP** Unit price decimals - It specifies the number of digits on the right of the comma in the unit price.
- **DI** Amount decimals - It specifies the number of digits on the right of the comma in the amount.
- **Ct** passage to Round number - It specifies the type of passage to a round number:
  - 1 no passage to round digit
  - 2 passage to hundreds (100, 200, etc.)
  - 3 passage to thousands (1000, 2000, etc.)
- **nD** Number of displays - It specifies the number of connected displays.
- **CE** Nr. of delivered display digits - It specifies the number of digit on the delivered display.
  - 5 digit available – max supplied 990.00
  - 6 digit available – max supplied 9990.00
- **bL** Delivery Stop for Lan Error - Stop the delivery for a Lan Error.

- **MC** Meter zero setting
  - This procedure allows to set the mass flow meter to zero. By placing the MC parameter to 1, the computing head automatically provides, at the end of the set-up, to perform the zero setting of the mass flow meter. At the end of the procedure it resets the parameter to 0.
- **PS** Specific weight
  - This value must be inserted to convert from Kg to Smc. The value does not include the initial 0. (e.g.: For a weight of 0,7174 insert only 7174) (**The parameter is visible only if the Jumper JP1, that allows the delivery in Smc, has been set**)
- **P1** Preset value push button 1
  - Preset value used by the computing head when button 1 is pressed. It can be programmed in € or local currency for the amounts. Delivered fuel value is however 1Kg o Smc.
- **P2** Preset value push button 2
  - Preset value used by the computing head when button 2 is pressed. It can be programmed in € or local currency for the amounts. Delivered fuel value is however 10Kg o Smc.
- **CF** Conversion rate currency/€
  - Value to be inserted to convert the amount visualization from local currency to Euro. The conversion rate is modifiable only when the computing head is switched on.

To exit the SETUP procedure, operator has to set JP2 Jumper "open".
Delivery is not possible if JP2 Jumper is "closed" in SETUP.

4.2.1 *Simple parameters*

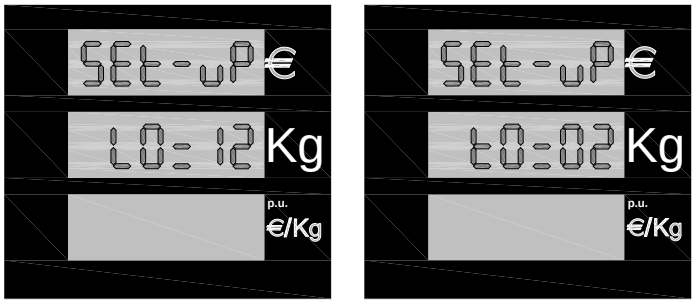


Figure 15: Visualization of some set-up parameters.

- Choose the parameter to be modified (push the green button «U» to change the parameter).
- Push the black «t» button to increase the current parameter value.
- Push the red «S» button to annul or to decrease the current parameter value.
- Push the green «U» button to switch to the next parameter.

For the measuring devices provided for a zero setting procedure, it can be automatically started by the computing head. This procedure allows the mass flow meter to adapt measurement to the actual operating conditions.

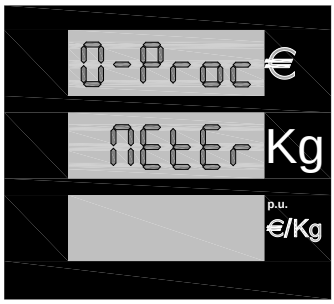


Figure 16: Zeroing Massmeter procedure

It means the procedure has to be started only after the mechanical and electrical installation of the whole dispenser on the refuelling station. The whole sequence is automatic; when it stops, parameter is set to zero and the computing head is ready to deliver. In case a black out occurs during this procedure, parameter is set to zero and operator has to start the procedure again.

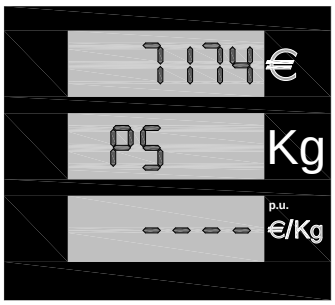
4.2.2 *Parameters for temperature compensation*

Temperature compensation is a procedure which allows to increase the quantity delivered to the maximum considering that the pressure inside the tank doesn't exceed a "compensated" pressure (when tank itself is at a "compensated" temperature).
For this reason, the following parameters are necessary to define the working point of the:

- **tC** and **PCON** allow to define pressure and temperature compensation.
- **t** and **dr** allow to fit the reading mode to the mechanical specifications of the dispenser.
- **tF** and **tS** set the duration of the puff which is necessary to calculate the quantity to be delivered in order to reach the requested compensation point.

4.2.3 *Complex parameters*

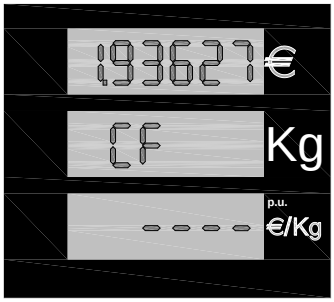
Some parameters are characterized by a higher number of digits; to modify this number it's necessary to use a different procedure and visualization:



- **PS parameter:** specific weight of the delivered product, used to convert the visualization of the delivered from **Kg** to **Smc.**

  The setting sequence is to push «t» button to increase the digit flashing value; push red «S» button to pass to the next digit; once all the digits correspond to the right, press green «U» button to exit the procedure.

Figure 17: Specific weight setting



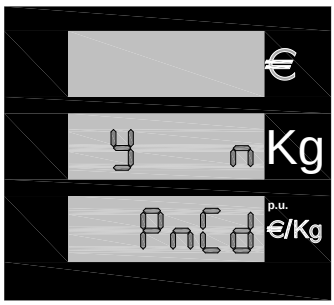
- **CF parameter**

  The conversion rate from local currency to Euro is composed of 1 unit and 5 decimals; for example in the case of the old French franc value is 6.55957. CF values are determined by DGII-C-4(99) standards.

  For the setting sequence press black «t» button to increase the flashing digit value; press red «S» button to switch to the next digit; when all digits have been set properly, press green «U» button to exit the procedure.

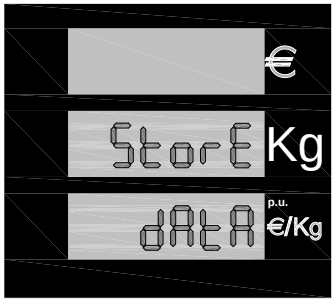
Figure 18: Visualization of the conversion rate Currency/Euro

4.2.4 *Password*



At the end of set-up the computing head asks if the password should be changed and waits for an answer; **Y**es or **N**o.
Push black button to change password.
Push green button to exit without changing password.

Figura 19: Changing password request



In case of negative answer, the procedure ends by saving of the entered data.

Figure 20: Visualization saving data

In case of affirmative answer, it's possible to modify the password with a similar procedure as already described before.

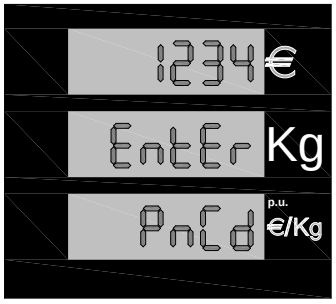
Password is structured as follows:

Manager password value: **1XXXX**
It exclusively allows to change price. The first value is always 1 and identifies the codes reserved to the manager plant.
Its starting value is 10000

Maintainer password value: ***2XXXX***
It allows to modify all the parameters that are foreseen in the computing head set-up procedure. The first value is always 2 and indicates the codes reserved to the maintenance company.
Its starting value is 20000

Importer password value: **3XXXX**
It only allows to reset previous passwords.
The starting value is internally connected to the firmware and communicated to the customer at the moment of sales; it cannot be changed.

Password is made up of 5 digits. The first digit indicates the access level: Importer, maintainer, manager plant. At the moment of the changing procedure, the first digit is not modifiable (it indicates the access level), and for this reason it will not be visualized; the other four digits are at the discretion of the operator.

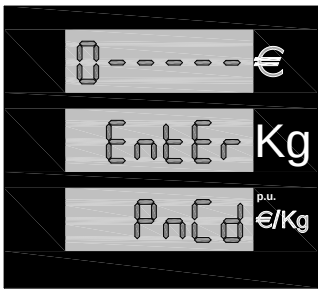


- Press black button until the requested value for the first digit is obtained.
- Press red button to pass to the next digit.
- Once inserted the correct value also for the last digit, press green button to confirm.

Figure 21: Changing Password

To exit the SETUP procedure, operator has to set JP2 Jumper "open".
Delivery is not possible if JP2 Jumper is "closed" in SETUP.

4.2.5 *Price change*



After pressing red «S» button and entering the set-up, the computing head asks for password; if it has not been previously modified, its default value is 10000. To enter the exact code, follow the procedure below:

- Push black «t» button until the correct value of the first digitis reached
- Press red «S» button to pass to the next digit.
- Once inserted the correct value also for the last digit, press red «S» button again to enter set-up.

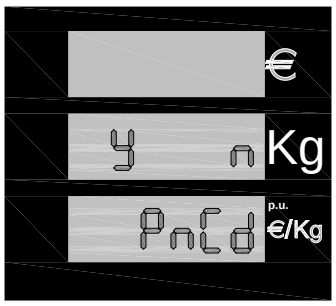
Figure 22: Inserting Password

*It is not necessary to set the Jumper J2 to enter the **Price changing** procedure, because the operation is not considered metrically relevant.*

If password is not correct the computing head immediately exits the set-up procedure and returns to stand-by mode.
If password is correct, the unit price can be updated. The operating sequence is similar to the already described above:

- Push red «S» button to select the digit to modify
- Push black «t» button until the desired value is obtained
- Push green «U» button to exit the price changing procedure.

At the end of set-up the computing head asks if the password should be changed and waits for an answer: **y**es o **n**o.

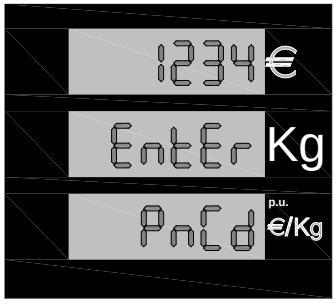


Push black button to confirm the password changing intention.
Push green button to exit without modifying the password.

Figure 23: Password changing request

In case of negative answer the procedure will end with the saving of the new unit price.

Figure 24: Visualization saving unit price



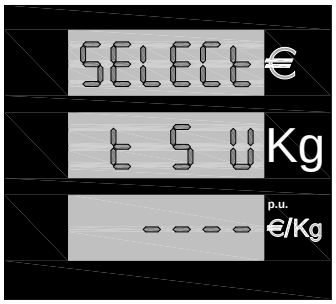
In case of affirmative answer, it's possible to change the password with a similar procedure as already seen:

- Press black button until the desired value for the first digit is obtained.
- Press red button to pass to the next digit.
- Once inserted the correct value also for the last digit, press green button to confirm.

Figure 25: Entering Password

4.3. Metrical check procedure

This procedure is reserved for the metrical check; it allows to simulate an error sequence and to verify that the computing head interrupts the delivering procedure, indicating the relevant error. Press green «U» button to enter the procedure.



The simulated errors are the following reported in the ERROR CODES (see §3.3.). To evidence the occurring simulation status, the computing head switches on all the available points on the unit price display line and the two of the left side of the delivered counter display line.
From now on, every time that the nozzle hangs off its holder, the computing head starts a delivering process, simulates an error and consequently control device blocks the delivering process as soon as the error is recognized. The failure code visualization appers on the unitary price.

Figure 26: Confirm of anomaly simulation procedure

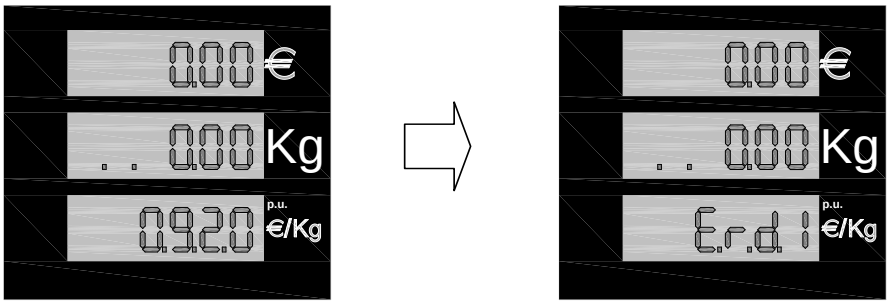


Figure 27: Passage from delivery to block during an "anomaly simulation" phase.

5. HARDWARE PERSONALIZATION

On the CPU 3 selectors (JP) are available. They are placed in the case protected by the metrical seal and allow to modify the functionality of the computing head as follows::

- JP1 Delivered quantity expressed in Kg or in Smc
  - Open **Kg**
  - Close **Smc**
- JP2 Enables and performs Set-up operations
  - Open **normal** delivering
  - Close **set-up** enabled
- JP3 Forces the head to use the parameters in congruence with the Euro, unbounded from the current set-up:
  - Open utilizes **Set-up values**
  - Close utilizes values in congruence to **Euro**

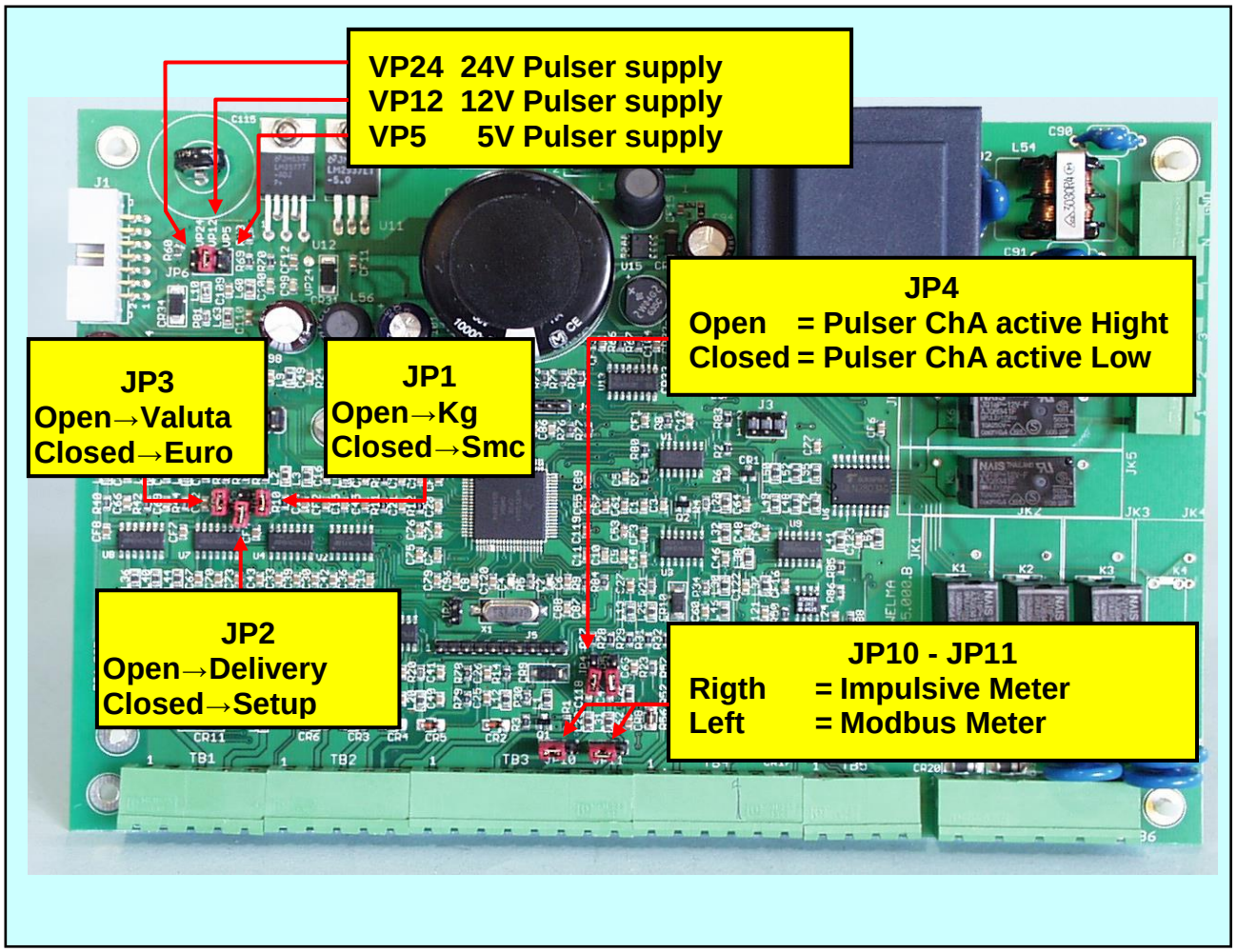


Photo 4: *Set-up jumper on CPU*

The mass flow meter can be configured in function of the following operating parameters:

- Type of mass flow meter:
  - Modbus – Krohne, MicroMotion, Endress+Hauser JP10, JP11 on the left
  - Impulsive – Rheonik, MicroMotion, Endress+Hauser JP10, JP11 on the right
- Rating:
  - 5V 200mA (MAX) insert the Jumper in VP5 position
  - 12V 100mA (MAX) insert the Jumper in VP12 position
  - 24V 50mA (MAX) insert the Jumper in VP24 position

  } mutual exclusive
- Exit channels (in case of an impulsive meter):
  - Active low channel JP4 jumper opened
  - Active high channel JP4 jumper closed

The connection terminals of the mass flow meter must be used exclusively to connect the mass flow meter itself. It is not possible to use the power supply terminal for other purposes than the foreseen.

6. OPTIONS

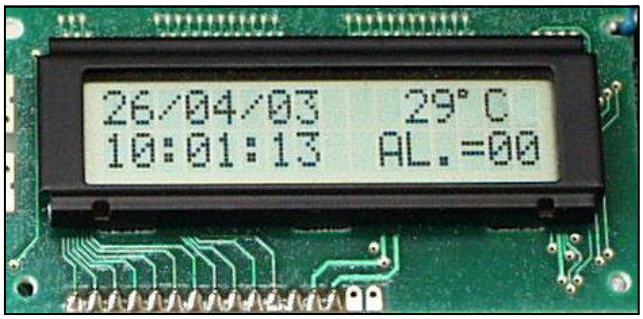
6.1. External 4x4 keyboard

A 16-key keyboard could be necessary. Both language and functions of this keyboard can be adjusted on customer's demand.
With an external keyboard operator can choose Euro or litre pre-set.

Photo 5: *Pre-set keyboard adjustement on customer's demand*

6.2. 16-digit-on-2-line Display (to be implemented)

If necessary a second small display can be installed near the keyboard: this display works even for complex procedures such as automatic payment, inserting a password, kilometers covered etc.



In this case display shows:

Date…….Temperature
Time ……Alarm condition

Photo 6: *Second Display*

6.3. Anomaly signalling device

If a detected anomaly has to be shown in remote, a simple device can be used: it is connected to the same flat cable used for display and allows to activate a free voltage contact by whom a lamp or any other signalling device can be supplied.

Le caratteristiche elettriche sono le seguenti:

- Max mains 270Vca or 350Vdc
- Output voltage depending on the device used:
  - 3A → Relay (Standard)
  - 1A → Solid State devices (Atex non sparking)

Photo 7: *Anomaly remote signalling device*

Mechanical specifications:

- Fixing method: DIN rail
- Overhall sizes: 90x35x58mm
- Weight: 60g

6.4. I/O expansion device

When the application requires to control non-standard equipment, you can use an expansion device I/O.
This is particularly effective in case of personalization for self-service systems in which, according to current rules, controlling a greater number of field devices is necessary.
This device can read 6 Inputs and drive 6 Outputs. Inputs are available on the terminal. The outputs, open collector type, may be connected to its implementation through flat cable.

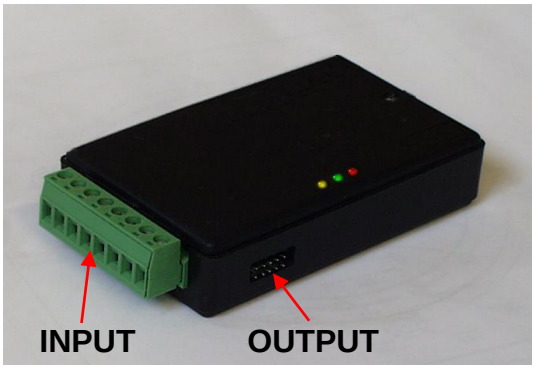


Photo 8: *I/O expansion device*

The electrical characteristics are as follows:

INPUT	Maximum voltage	+5Vdc	open clamp
	Maximum current	1mA	clamp closed at 0V
OUTPUT	Maximum voltage	+24Vdc	ad uscita non attiva
	Maximum current	10mA	active output

To use the outputs in a dangerous environment, to the I/O expansion device can be connected through a flat cable a field interface similar to the one described above (Anomaly) with the following characteristics:

- Maximum voltage: 270Vca o 350Vdc
- Output current: Depending on the device used:
  - 3A → Relay (Standard)
  - 1A → Solid State Devices (Atex non sparking)

7. ELECTRICAL CONNECTIONS

7.1. Low voltage connections

Usually all the performed controls with micro switches and buttons are normally open and must close on 0V when used. Particularly:

- Start contact ---------- open in stand-by, closed during delivering
- High pressure contact ---------- N.O. o N.C. modifiable through set-up
- Predetermination buttons ---------- normally open, closed when activated
- Foreseen mass flow meter: ----------

Impulsive type:

Current per channel:	50mA
Output:	active low
Impulses:	100 x Kg/Smc

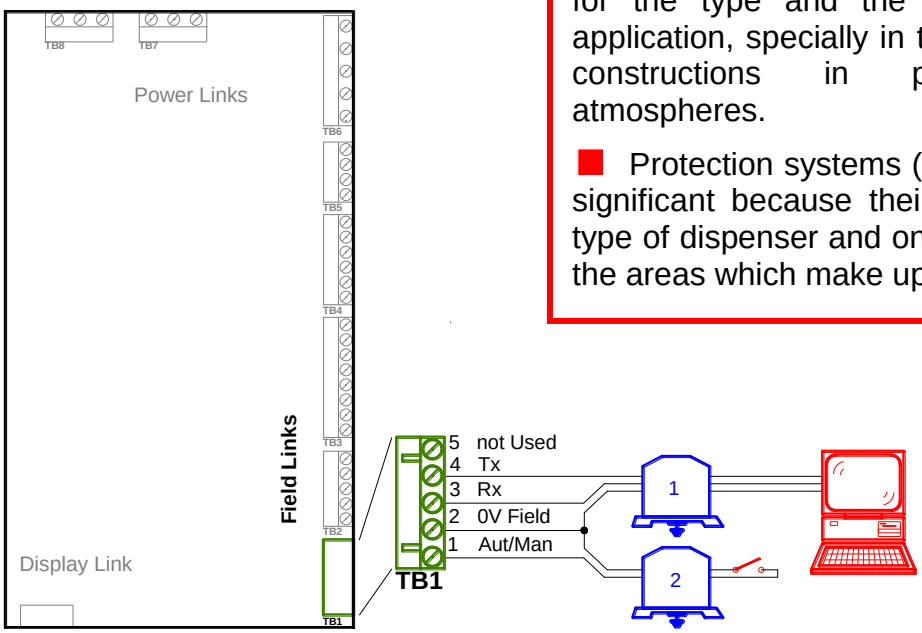
Serial type:

Power supply tension:	5V, 12V, 24V
Power sup. curr.(MAX):	200mA, 100mA, 50mA
Serial line	RS485 Standard ModBus

WARNING:

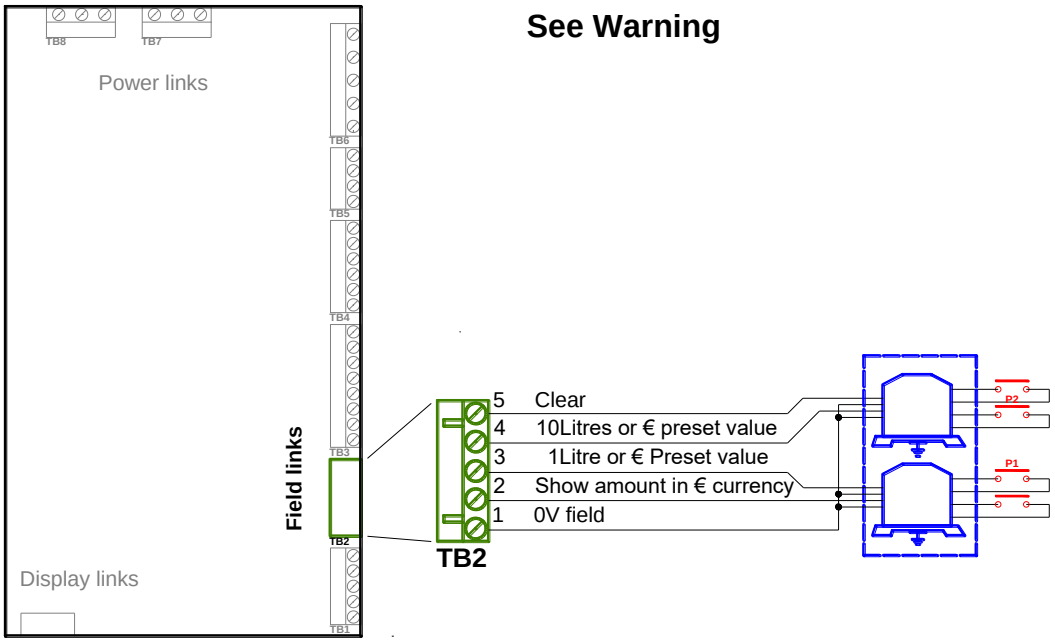
- The below reported electrical connection schemes do not absolve the installer from respecting the standards of the country where the installation is going to be performed, and the respect of the foreseen security standards for the type and the characteristics of the application, specially in the context of electrical constructions in potentially explosive atmospheres.
- Protection systems (e.g. zener barriers) are significant because their use depends on the type of dispenser and on the classification of all the areas which make up the dispenser itself.

Terminal Board TB1

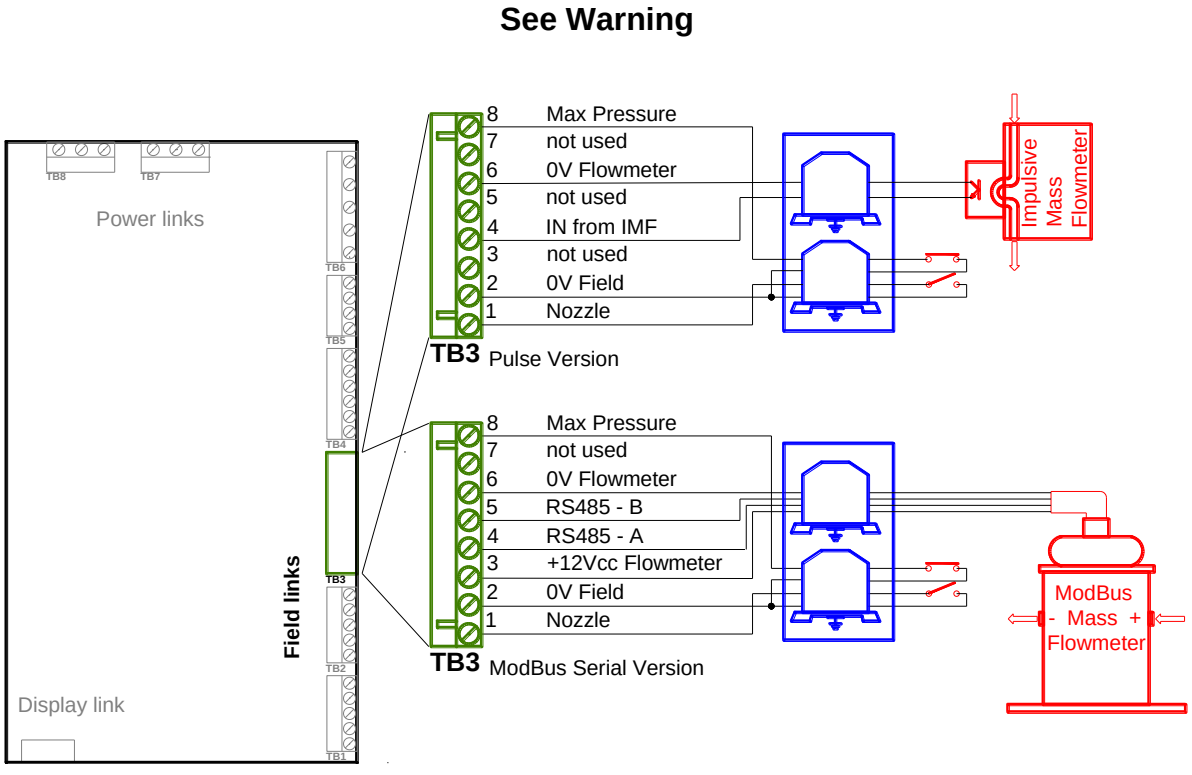


See Warning

Terminal Board TB2

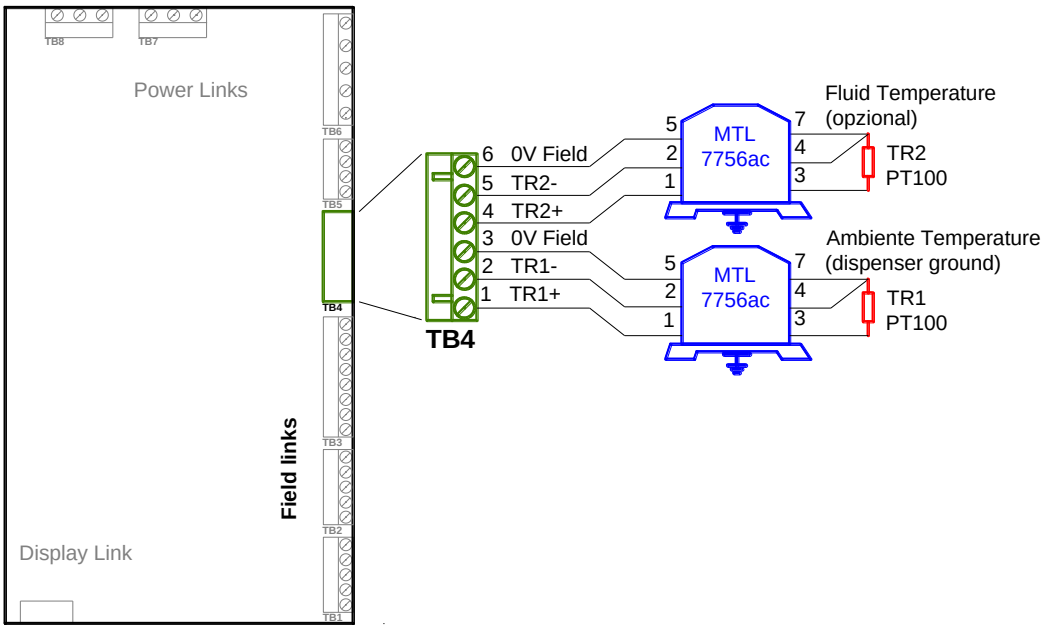


Terminal Board TB3



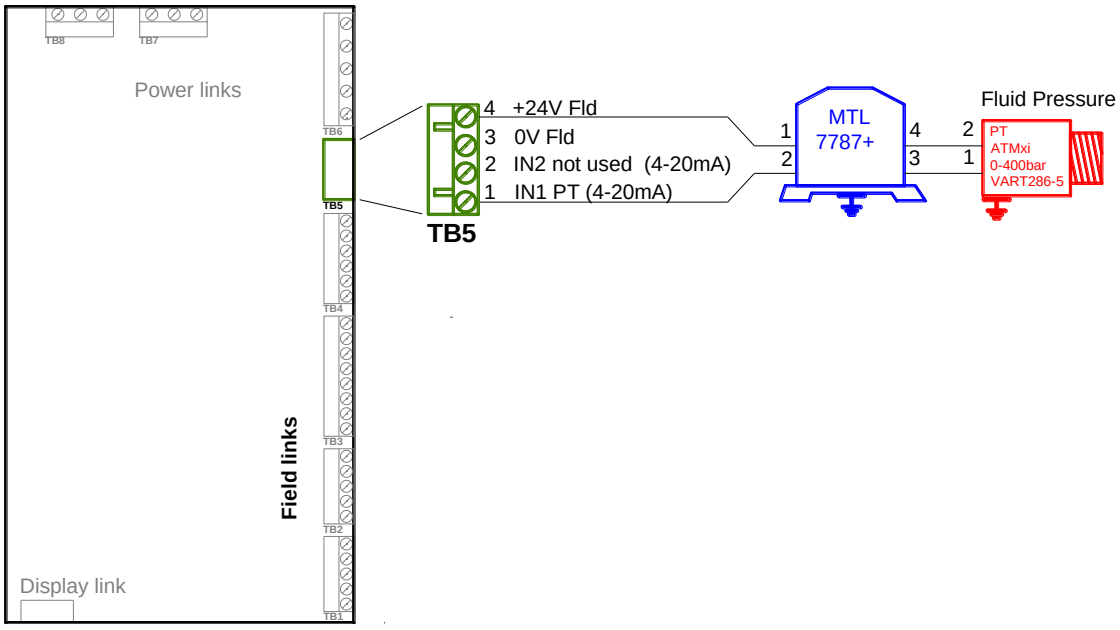
Terminal Board TB4

See Warning

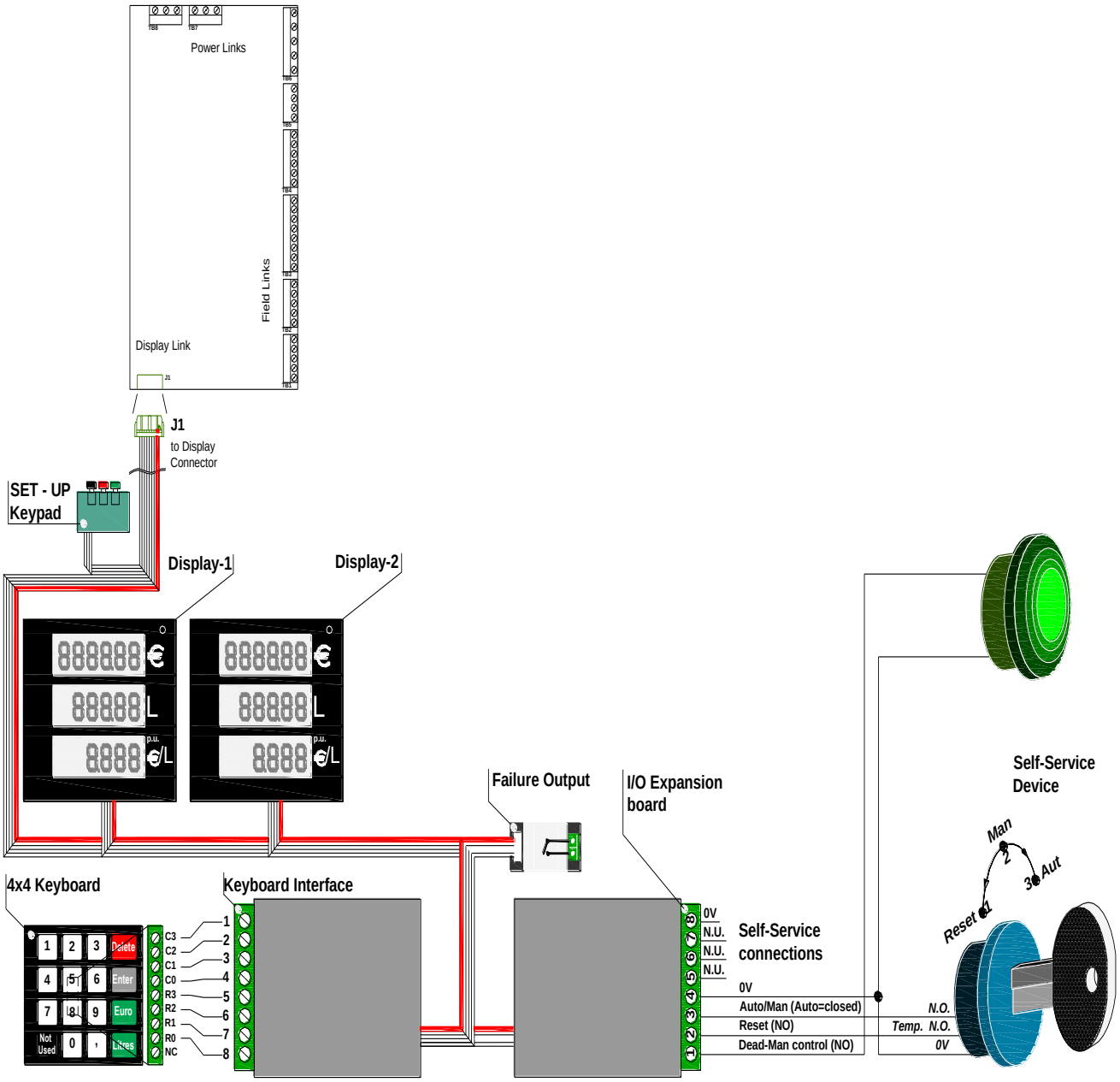


Terminal Board TB5

See Warning



Connector J1

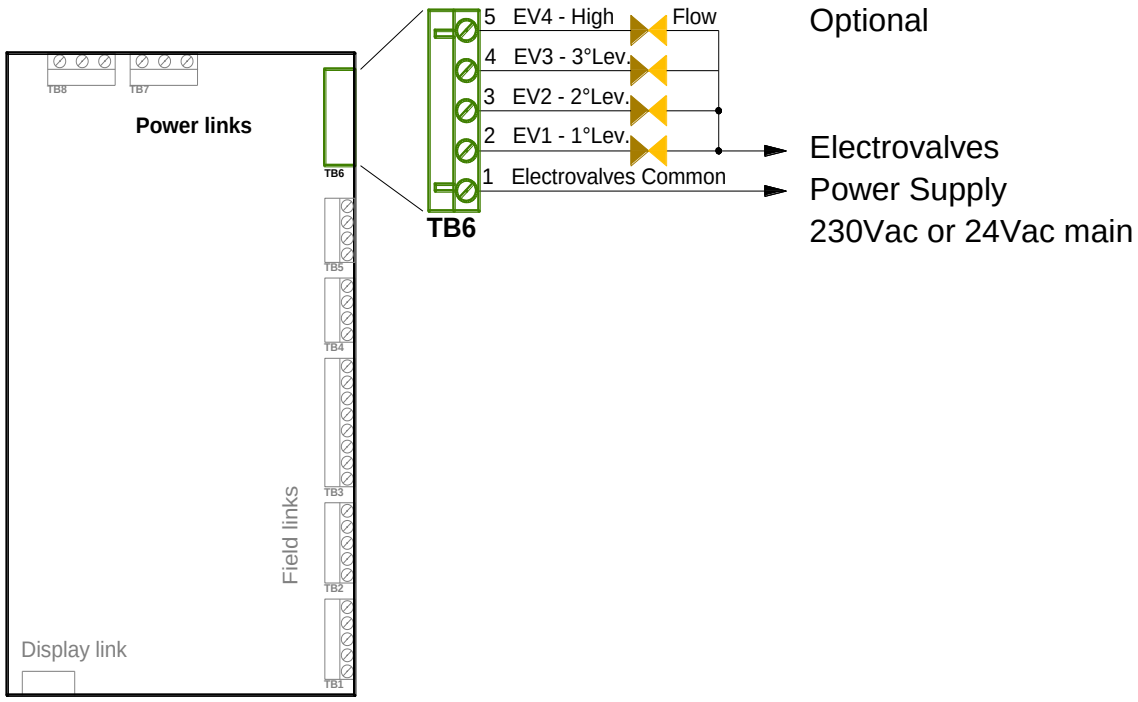


7.2. High voltage connections

The computing head provides voltage free contacts, able to pilot resistive and/or inductive loads with the following characteristics:

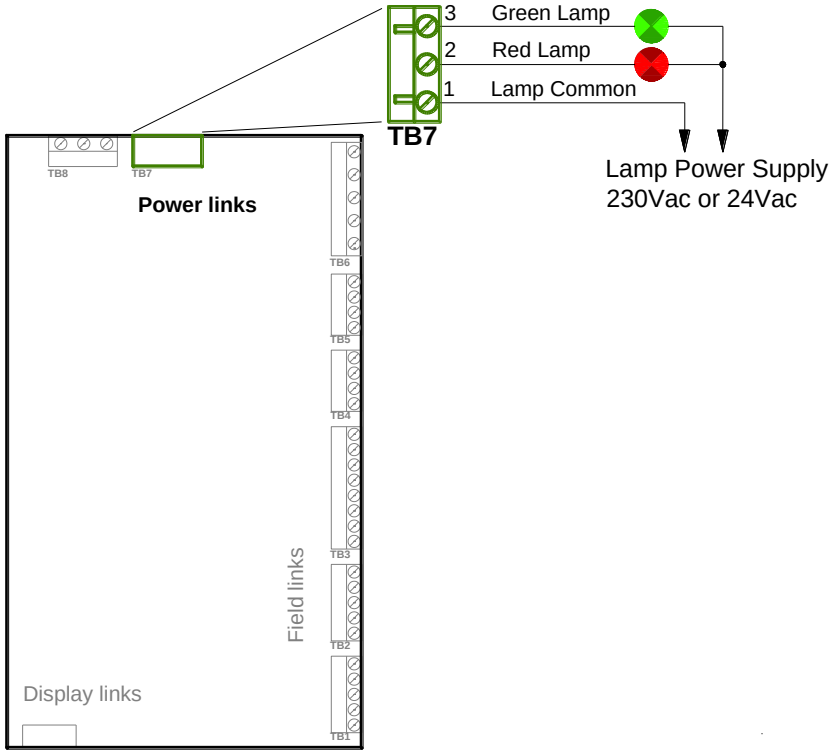
- Voltage max 270Vca
- Depending on the output device used:
  - Relè (Standard) → Current max 3A[1]
  - Solid State Device (Atex) → Current max 1A

Terminal Board TB6

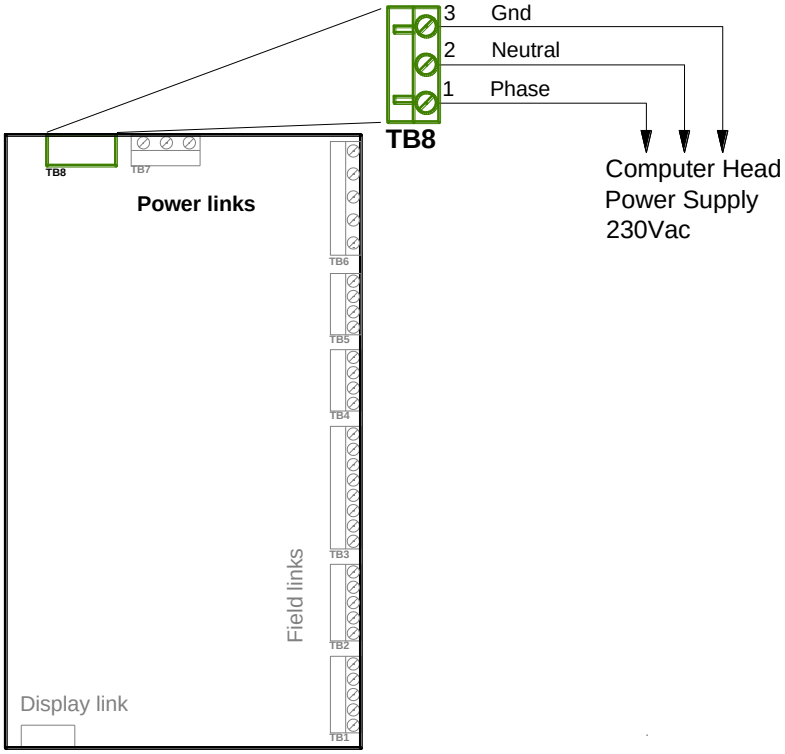


[1] 1A Limited for TB6 output EV1 – 1st Lev in order to circuit integrity control

Terminal Board TB7



Terminal Board TB8



8. IDENTIFICATION OF COMPUTING HEAD TW1

In the respect of the standards in force, an identification plate of the product is applied as shown in the figure:

EsiWelma s.r.l.
Via F.lli Canepa 134D-E 16010 Serra Riccò
GENOVA (Italia)

Type Examination Certificate: N° LNE - 15430 rév. 1 Dtd: 26-08-09	
Calculator:	TW1 - M
Style:	Standard
S/n:	Dtd: .....
Power supply:	230Vac / 50mA
Unit:	Kg/Smc
Temperature:	-40°C+70°C Umidity: 90%
Mechanical condition:	CLASS M2
Electromagnetic condition:	CLASS E2

Figure 28: TW1-M; "Standard" Identification plate

EsiWelma s.r.l.
Via F.lli Canepa 134D-E 16010 Serra Riccò
GENOVA (Italia)

Type Examination Certificate: N° LNE - 15430 rév. 1 Dtd: 26-08-09	
Calculator:	TW1nA - M
Style:	Ex II 3G Ex nA IIC T4 X
S/n:	Dtd: .....
Power supply:	230Vac / 50mA
Unit:	Kg/Smc
Temperature:	-40°C+70°C Umidity: 90%
Mechanical condition:	CLASS M2
Electromagnetic condition:	CLASS E2

Figure 29: TW1nA-M; "Atex" (1) Identification plate

On the plate the following data are shown:

- Device manufacturer.
- Address.
- CET (Type Examination Certificate).
- Device type.
- Application Area.
- Device identifying S/n and date.
- Power supply tension (voltage) and Current consumption.
- Measure Unit.
- Environmental Condition.
- Mechanical Condition.
- Electromagnetic Condition.

(1) Symbol "X" indicated in the *Style* field of the Identification plate denote that computing head and accessories have to be installed in a box with degree of protection ≥ IP54.

Photo 9: *Identification plate of the electronic computing head TW1*

9. MECHANICAL CLAMPING

The CPU of the computing head is settled into a metallic box which can be clamped in a vertical as well as a horizontal position.
Some tangs assure a correct clamping:

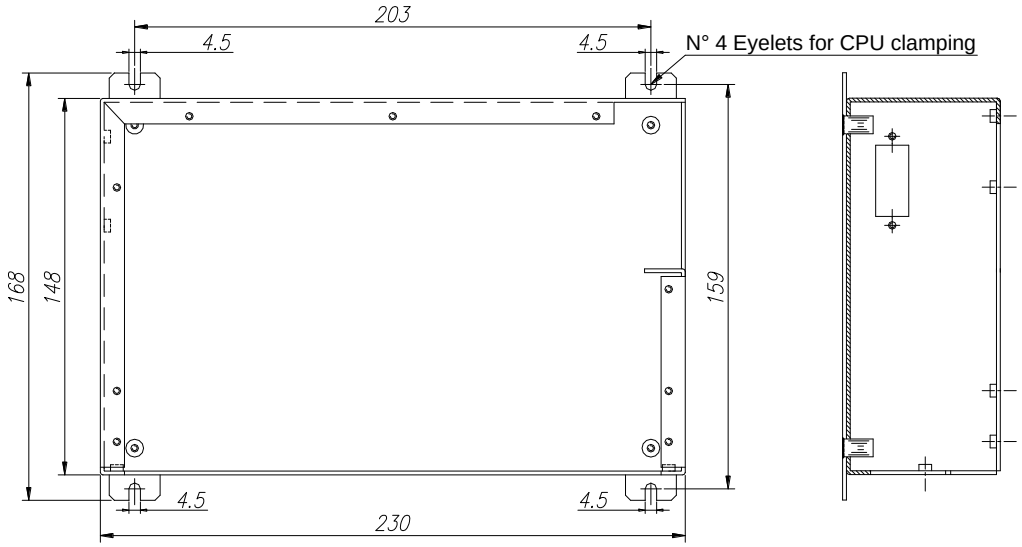


Figure 30: Clamping of the CPU box

There are some clamping points also for displays. The tangs settled in the centre are not clamping points, but eyelets for legalizing leads.

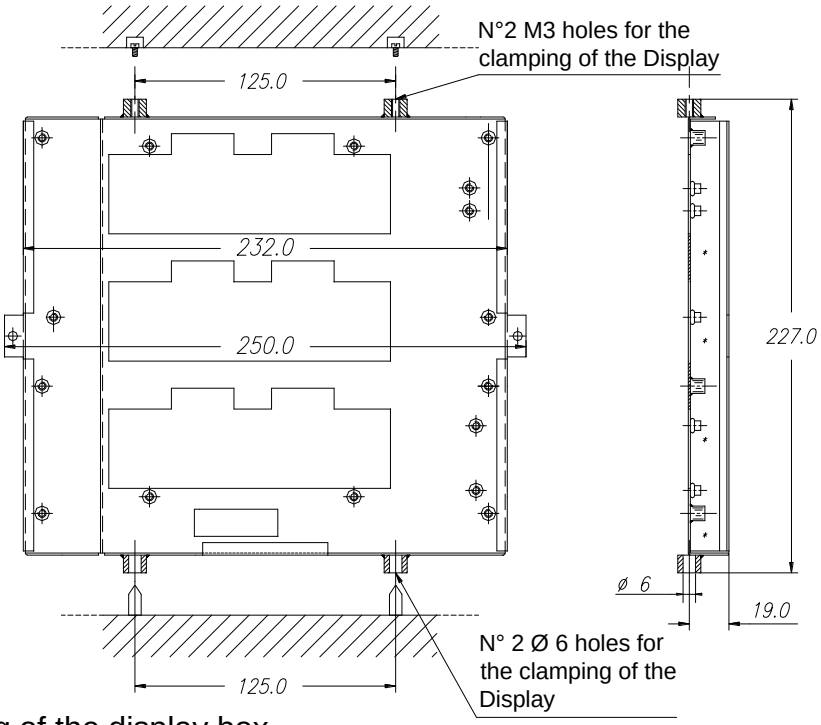


Figure 31: Clamping of the display box

10. LEGALIZING PROCEDURE OF THE COMPUTING HEAD TW1

10.1. Legalizing procedure of CPU

The lead (seal) prevents the CPUs case removing and the access to the computing head.

Lead that prevents from removing the display connection cable.

Lead that prevents from removing the connections to the field.

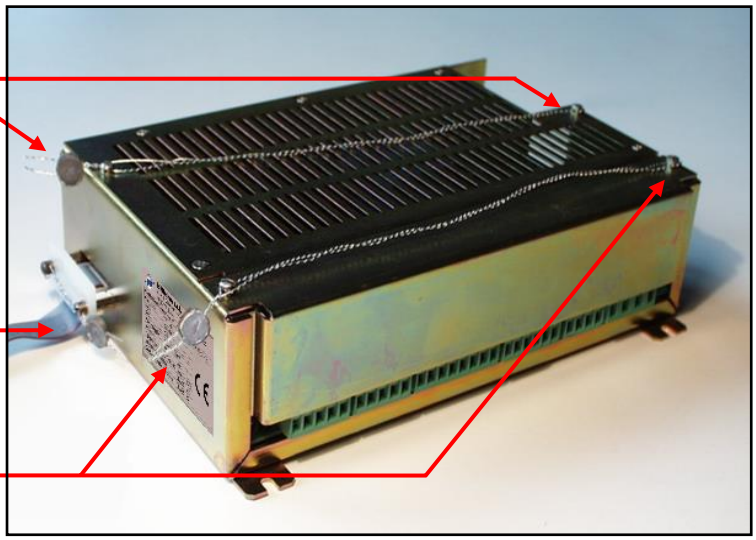


Photo 10: *Computing head TW1 CPU*

10.2. Legalizing procedure of display

Lead that prevents from removing the display.

Lead that prevents from access the display plate.

Photo 11: *Computing Head TW1-M and TW1nA-M Display front view*

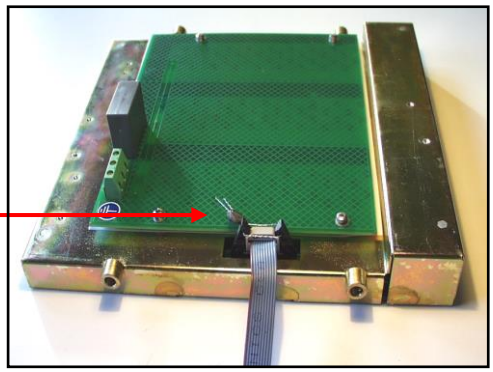


Photo 12: : *Computing Head TW1-M and TW1nA-M Display rear view*

It's possible to use the right or the left holes.

Lead that prevents from removing the display connection cable.

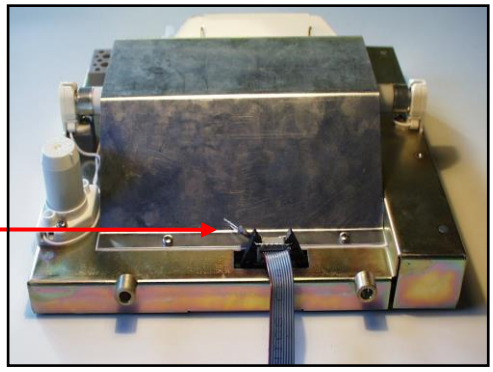


Photo 13: *Computing Head TW1-M and TW1nA-M Display rear view . Neon tube back-lighting version*

Note

The spiral that keeps from removing the containers (CPU and Display) from the dispenser must be fastened to a part that cannot be moved from the dispenser.