FEMA ELECTRÓNICA

User's Manual

ELECTRONICS FOR INDUSTRIAL AUTOMATION
PANEL METERS . SIGNAL CONVERTERS . LARGE DISPLAYS

Series B . Models Bxx-485

Process meters

INDUSTRIAL SERIES . LARGE FORMAT METERS

Large format industrial meters for RS-485 ASCII protocol. Different formats available with 60 mm and 100 mm digit height, 4 and 6 digits, in red or green color. Sturdy metal housing, with full IP65 protection, designed for panel, wall or hanging mount. Versatile and configurable with local or remote alarm control, 'watchdog' function, 'bus activity', configurable fast access menu, 'on power up' function, password and 5 configurable brightness levels. Universal AC and DC power. Accepts up to 3 output and control options (relays, analog retransmission, Modbus RTU, transistor outputs, RS-485 ASCII, ...). Configuration from frontal keypad or remote keypad.

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4382r01

1. Series B, models Bxx-485

Large format industrial meters for RS-485 ASCII protocol

Large format meters for long distance reading, for industrial applications. Different formats available with 4 and 6 digits, with 60 mm and 100 m digit height. Front keypad to access the configuration menu, and optional remote keypad.

Meters controlled via RS-485 ASCII protocol. Control of the reading value and decimal point position through ASCII protocol via RS-485 bus.

Three working modes available to work with numeric values (integers) or alphanumerical values (ASCII characters), with remote control of the alarms through the bus, or locally from the instrument *(see section 1.18.2).*

- the 'Process slave' mode works with numeric values (integers) and alarms are controlled locally ar the instrument.
- the 'Full slave' mode works with numeric values (integers) and alarms are controlled from the bus.
- the 'Text' mode works with alphanumerical ASCII characters and alarms are controlled from the bus.

Bus speed up to 38.400 bps and addresses from 1 to 31. Broadcast at address 128. 'Watchdog' function to control loss of communication with the master, with control of error message and alarm activation *(see section 1.18.4)*.

'Bus activity' function for help on communications start-up *(see section 1.18.11).*

Output and control options with 1, 2 and 3 relays, transistor outputs, controls for SSR relays, isolated analog outputs, communications in Modbus RTU, RS-485 ASCII and RS-232.

Sturdy metal housing with full IP65 protection. Internal connections by plug-in screw clamp terminals, and output through cable glands. Housing prepared for panel, wall and hanging mount.

- Configurable '**Fast access**' to selected functions with key 'UP' (▲) *(see section 1.18.10)*
- '**On power up**' for system protection on 'cold' start-up and control of alarm status *(see section 1.18.12)*
- alarms in 'Process slave' mode, with 1 or 2 setpoints, independent activation and deactivation delays, hysteresis, manual unlocking, ... *(see section 1.18.7)*

Memory of maximum and minimum reading, password protection, 5 brightness levels.

1.1 How to order

Format	Model	Power	Color	Option 1	Option 2	Option 3*	Others
B46	485	H					

- Format: B24 *(60 mm, 4 digits)*; B26 *(60 mm, 6 digits)*; B44 *(100 mm, 4 digits)*; B46 *(100 mm, 6 digits)*
- Power: -H *(85-265 Vac and 120-370 Vdc)*; -L *(11-36 Vdc isolated)*
- Color: -R *(red led)*; -G *(green led)*
- Option 1: -R1 *(1 relay)*; -AO *(analog output)*; -RTU *(Modbus RTU)*; -S4 *(RS-485)*; -S2 *(RS-232)*; -T1 *(1 transistor)*; -SSR *(1 control SSR)*; -0 *(empty)*

**Option 3 available with formats B26 and B46*

1.2 Index

1.3 How to use this manual

If this is the first time you are configuring a Series B large format meter, below are the steps to follow to install and configure the instrument. Read all the manual sections in order to have a full and clear view of the characteristics of the instrument. Do not forget to read the installation precautions at section *1.21*.

1. Identify the instrument format *(see section 1.8)*
2. Power and signal connections
   - open the instrument *(see section 1.9)*
   - connect the power *(see section 1.11)*
   - connect the signal *(see section 1.12)*
   - close the instrument *(see section 1.9)*
3. Configure the instrument *(see section 1.18)*
   - select the working mode, and the bus configuration *(see section 1.18.2)*
   - configure the protocol *(see section 1.18.6)*
4. Advanced configuration (optional)
   - configure the instrument alarms *(see section 1.18.7)*
   - configure the fast access *(see section 1.18.10)*
   - configure other functions: 'on power up' *(1.18.12)*, key 'LE' *(1.18.15)* and password *(1.18.21)*
5. If the instrument includes analog output (AO) or serial communications (RTU, S4, S2)
   - to include an option to an instrument see section *1.10*
   - to configure an installed option, access the option configuration menu *(see section 1.18.25)*
   - see section *2* for information regarding the output and control options available
6. Install the instrument
   - mount on panel, wall or hanging *(see section 1.20)*
   - adjust the brightness level according to your environmental needs *(see section 1.18.24)*

1.4 RS-485 ASCII definitions

The ASCII protocol implemented in this instrument is a proprietary serial communications protocol, based on RS-485 bus, with 'master' / 'slave' architecture. The basic needed to understand this protocol and this manual are described below:

- 'frame': data between the 'master' and the 'slave' travels inform of frames. There are 'read frames', 'write frames, 'error frames', etc. See sections *1.17.1* to *1.17.6.*
- 'registers' : frames contain orders from the master to the slave, to read or write on the internal instrument registers. Available registers depend on the working mode selected. Typically, there is a register for the reading value, a register for the alarm status, etc. See sections *1.17.7* to *1.17.9 and 1.17.11.*
  - numerical registers contain numbers (integers) and there are certain restrictions that apply *(see section 1.17.13).*
  - alphanumerical registers contain ASCII characters and can work with a wider range of characters than numerical registers *(see section 1.17.12).*
- 'CRC' : to assure that the frames are correctly sent and received, each frame contains a 'CRC' control code, which is calculated for each frame *(see section 1.17.10)*.
- 'errors' : the instrument can identify different errors associated to frames *(see section 1.16).*

1.5 Start up sequence

The instrument follows the sequence indicated below at start-up after a power loss :

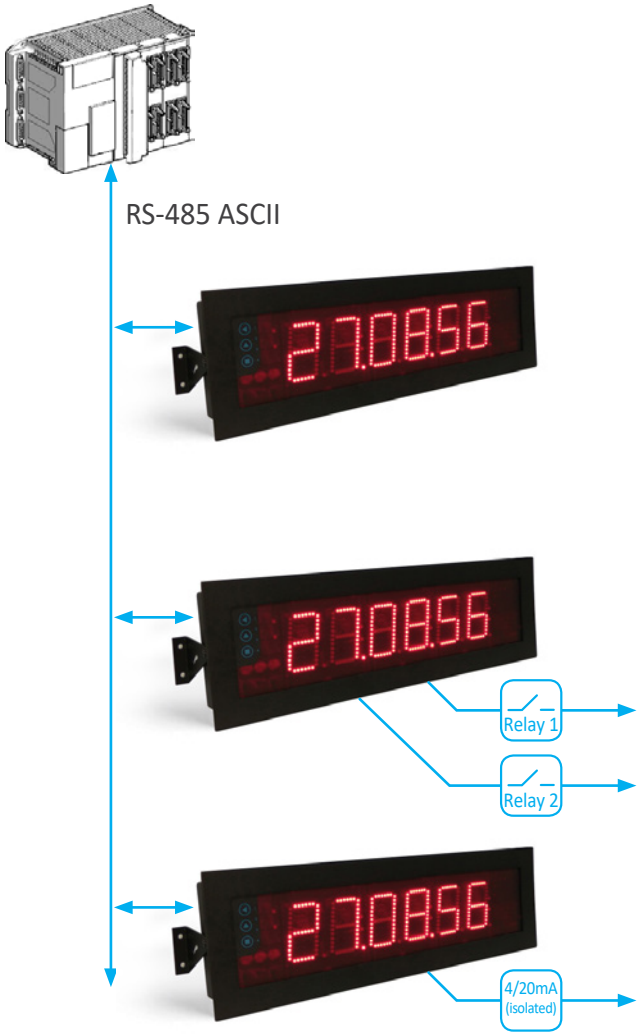
1. alarm status according to configuration *(see section 1.18.12)*
2. start up delay according to configuration *(see section 1.18.12)*
3. all registers and coils initialized to value '0'
   3.1 display set to '0'
4. detection of the active working mode 'Full slave' or 'Process slave' or 'Text' *(see section 1.18.2)*
   4.1 in 'Full slave' and 'Text' modes the alarm status is set as explained in '1.' and alarm registers are set to '0'
   4.2 in 'Process slave' mode, alarm configuration (setpoint, etc) is compared with display value ('0') and each alarm activates or deactivates according to the result of the comparison
5. waits for data reception through the communications bus

1.6 Typical application

The typical application for this models of large format industrial meters if to display numerical values associated to the production or industrial processes. Display value is controlled through the RS-485 ASCII protocol. Messages are sent by the bus master, usually a PLC or a SCADA system.

The instrument can also integrate relay outputs, which can be remotely controlled from the 'master' ('Full slave' and 'Text' working modes *(see section 1.18.2))* or locally controlled by the instrument ('Process slave' working mode *(see section 1.18.2)*).

Additional analog outputs can be also installed . See section *2* for a list of optional output and control modules available.

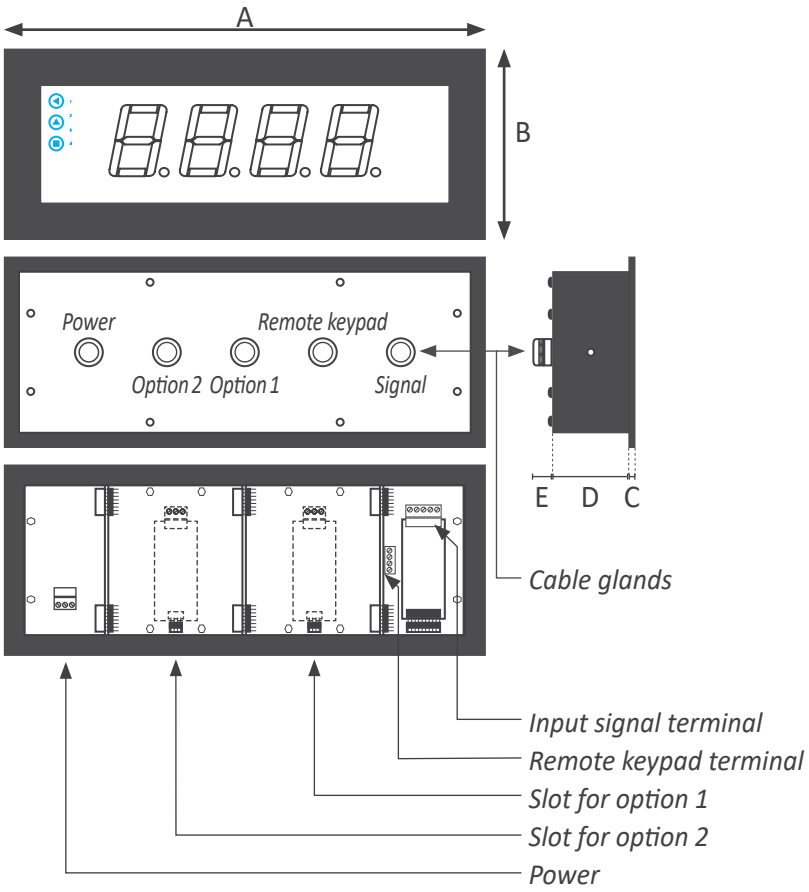


1.7 Factory configuration

Working mode	'Process slave' ('Proc')
Bus	
Speed	19200 bps
Format	8n1
Configuration	
Local address	1
'Watchdog'	10 seconds
'On error'	flash ('FLSh')
'Scroll'	off
Alarms in 'Full slave' and 'Text' modes	
Alarm 1	remote ('rMtE')
Alarm 2	remote ('rMtE')
Alarm 3	remote ('rMtE')
Alarms in 'Process slave' mode	
Alarms 1,2 and 3	
Active	disabled ('oFF')
Type	maximum
Setpoint	1000
Hysteresis	0 counts
Activation delay	0.0 seconds
Deactivation delay	0.0 seconds
Setpoint 2	off
Inverted relay	off
Locked alarms	off
Tools	
Fast access (Key UP)	off
Bus activity	off
Memory of max.	off
Memory of min.	off
Alarm 1	off
Alarm 2	off
Alarm 3	off
Address	off
'On Power Up'	
Delay	0 seconds
Alarm 1	off
Alarm 2	off
Alarm 3	off
Setpoint on bus	off
Save E2PROM	off
Key 'LE'	no function ('none')
Password	off
Brightness	3

1.8 Sizes and formats

1.8.1 Format B24

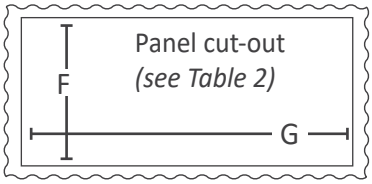


Size A	340 mm
Size B	135 mm
Size C	3 mm
Size D	55 mm
Size E	25 mm

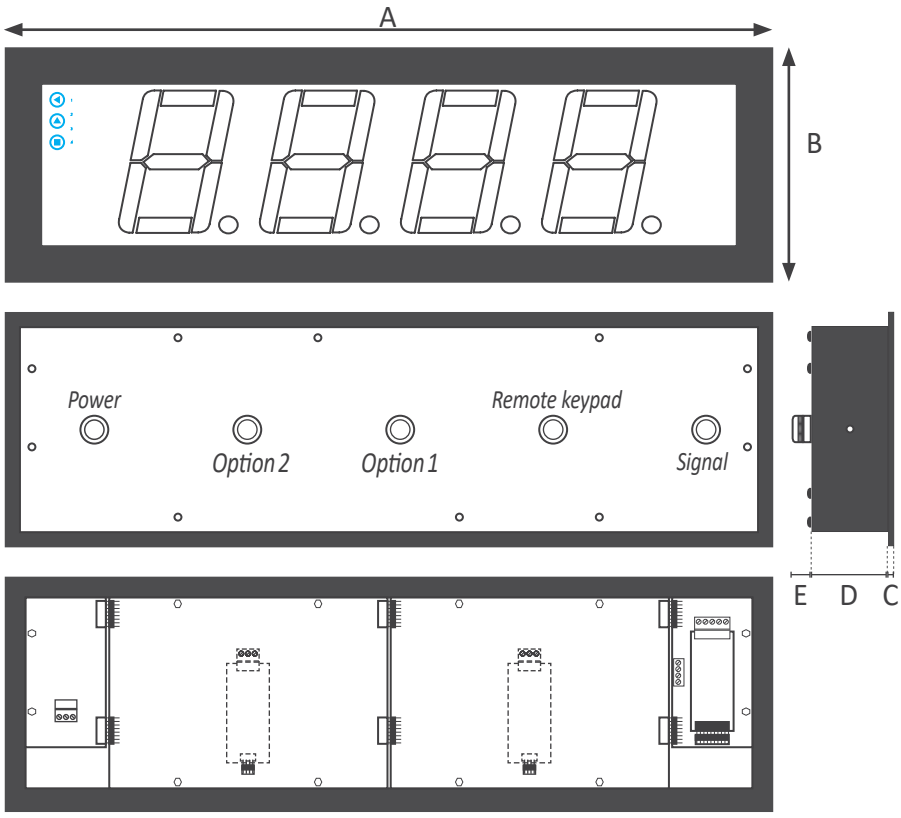
Table 1 - Sizes B24

Cut-out G	322 mm (±1)
Cut-out F	117 mm (±1)

Table 2 - Panel cut-out B24



1.8.2 Format B44

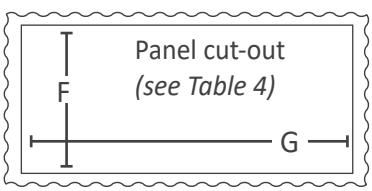


Size A	542 mm
Size B	166 mm
Size C	3 mm
Size D	55 mm
Size E	25 mm

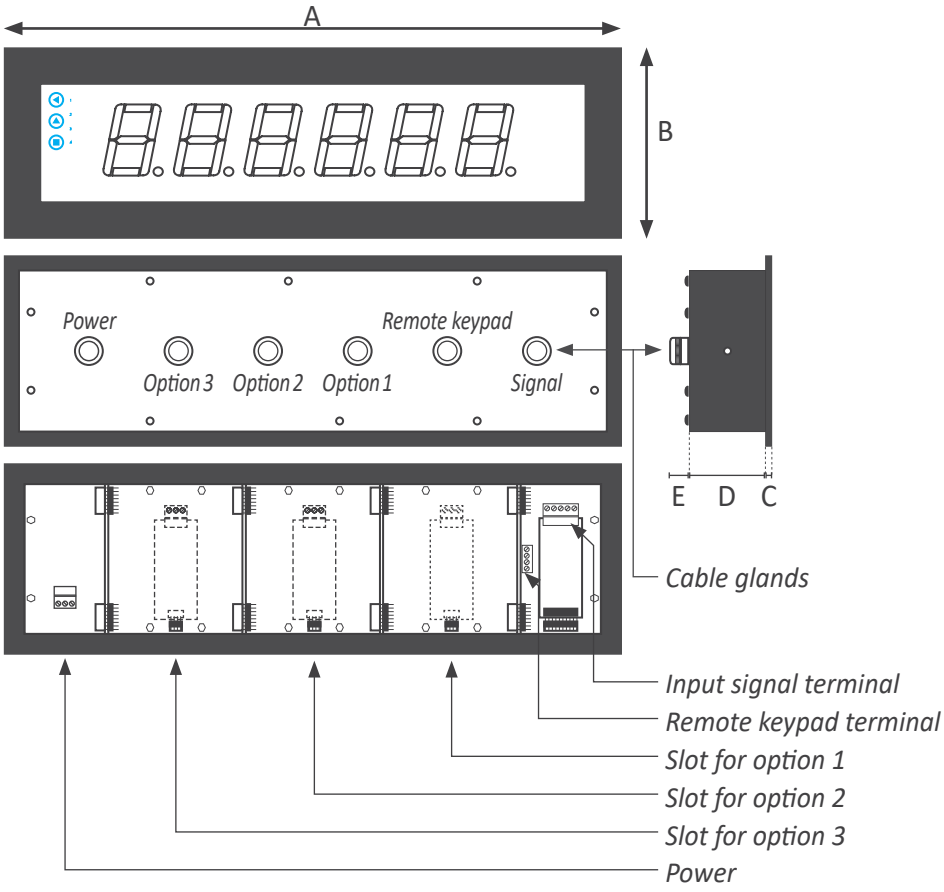
Table 3 - Sizes B44

Cut-out G	524 mm (±1)
Cut-out F	148 mm (±1)

Table 4 - Panel cut-out B44



1.8.3 Format B26

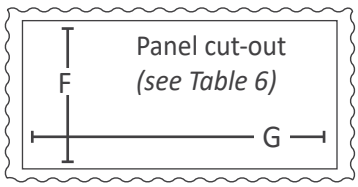


Size A	436 mm
Size B	135 mm
Size C	3 mm
Size D	55 mm
Size E	25 mm

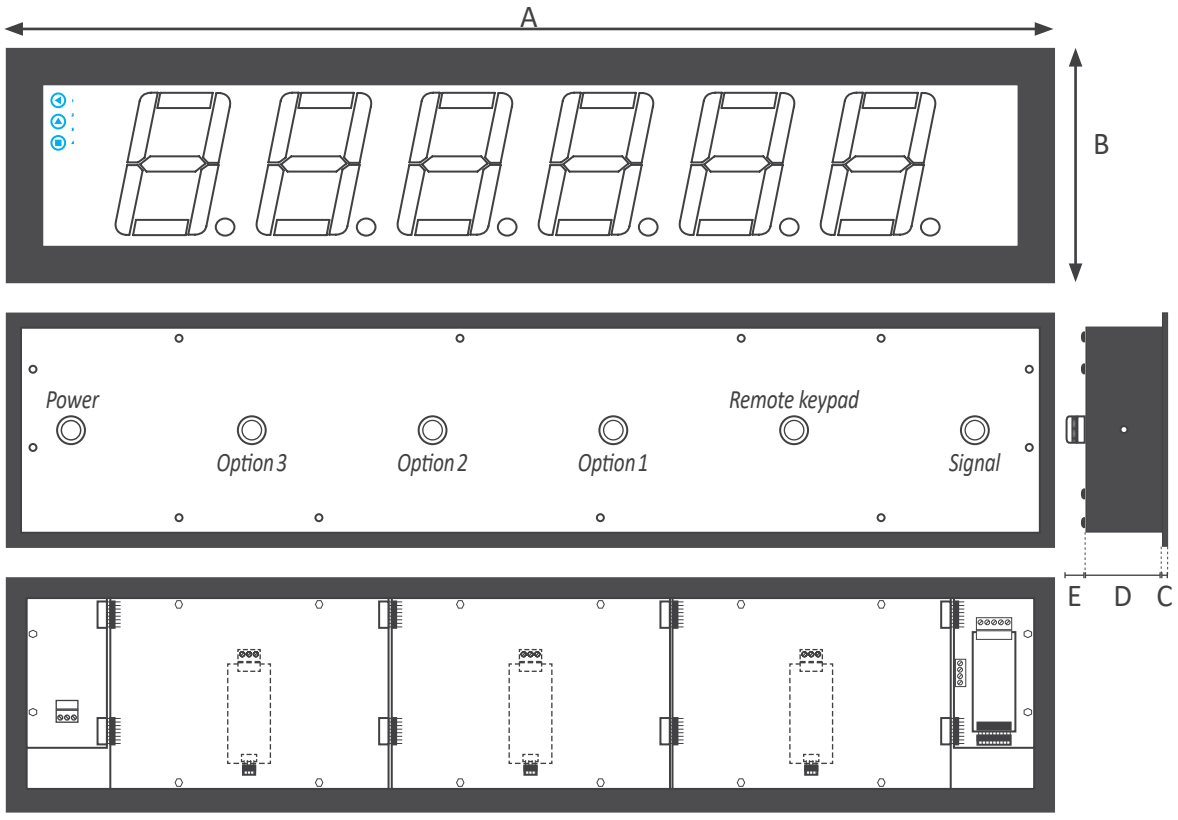
Table 5 - Sizes B26

Cut-out G	418 mm (±1)
Cut-out F	117 mm (±1)

Table 6 - Panel cut-out B26



1.8.4 Format B46

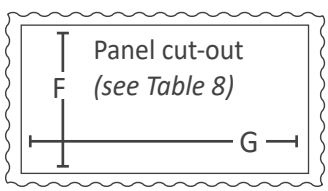


Size A	740 mm
Size B	166 mm
Size C	3 mm
Size D	55 mm
Size E	25 mm

Table 7 - Sizes B46

Cut-out G	722 mm (±1)
Cut-out F	148 mm (±1)

Table 8 - Panel cut-out B46



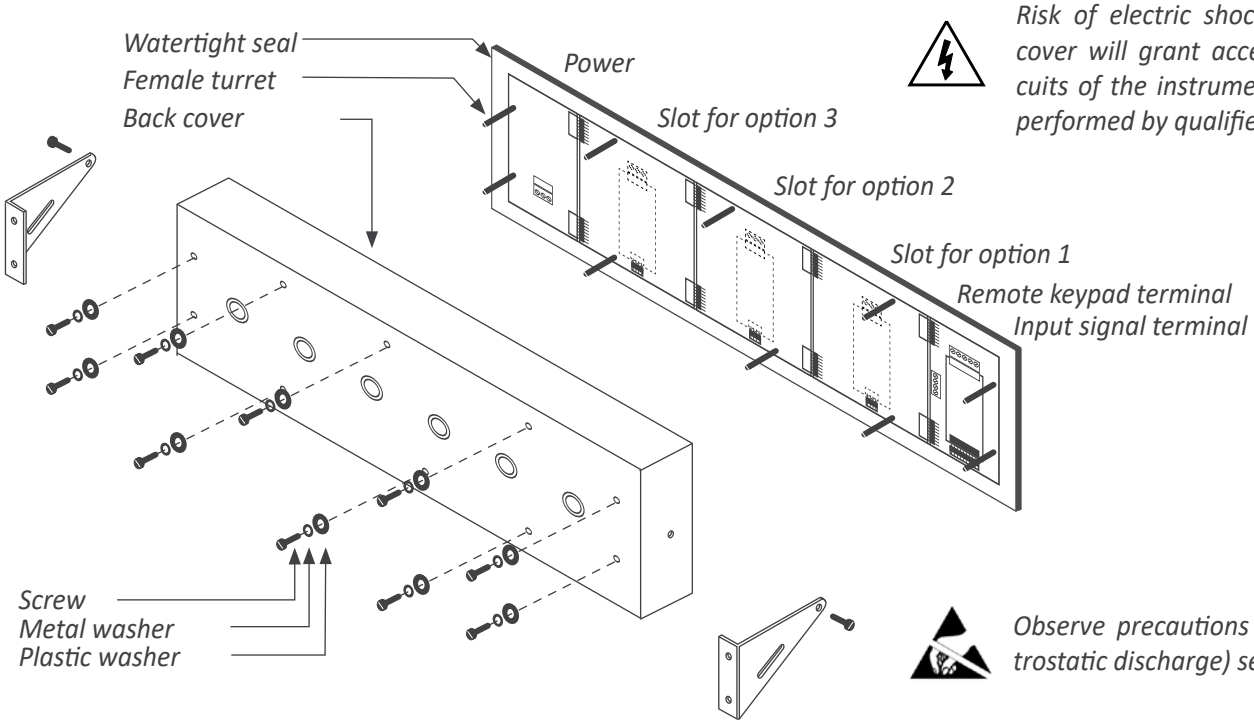
1.9 To access the instrument

To open the housing, remove the screws from the back cover. With each screw there is a metal washer and a plastic washer. Once the screws are out, remove the back cover.

The figure below shows the instrument internal structure for a B26 format. It shows the location of the 3 slots for optional output and control modules, the power terminal and the input signal terminal.

To close the instrument, place the back cover, the screws, the metal washer and the plastic washer. The plastic washer is in contact with the back cover. Confirm that the screws are correctly turning inside the internal female screws.

To ensure a correct IP65 protection tighten the back cover screws with a strength between 30 and 40 Ncm, with the help of a dynamometer screwdriver.



Risk of electric shock. Removing the back cover will grant access to the internal circuits of the instrument. Operation must be performed by qualified personnel only.

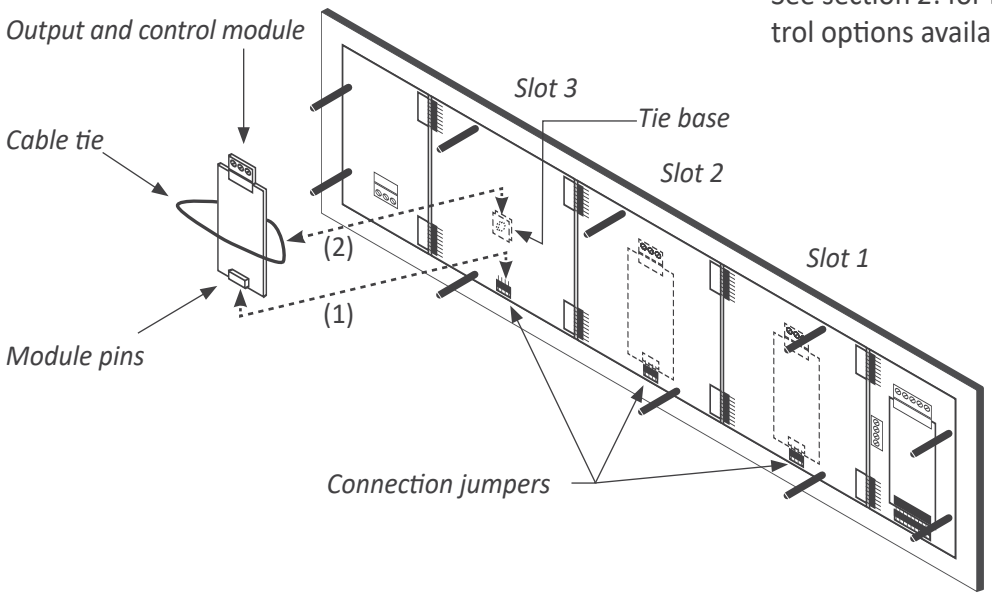
Observe precautions for handling ESD (electrostatic discharge) sensitive devices

1.10 Modular system

Large format meters from Series B are designed with an internal modular architecture. The output and control modules are independent and can be installed by accessing the internal circuits of the instrument, and connecting the module to the connection jumpers of the selected slot.

Each module is provided with a cable tie to fix the module to the tie base. The input signal modules defines the instrument function and are exchangeable, switching a temperature meter to an impulse counter only by replacing the input signal module.

See section *2.* for information regarding the output and control options available



To install an output and control module

(1) insert the 'module pins' into the 'connection jumpers' in one of the free slots

(2) place the 'cable tie' into the 'tie base' and embrace the 'module' firmly, until it is fixed

1.11 Power connections and protective earth

1. Unscrew the screws from the back cover and remove the back cover *(see section 1.9).*
2. Pass the power cable through the power cable gland *(see section 1.8).*
3. Prepare the power cables so that the earth wire is 20 cm longer than the other cables *(see Figure 1).*

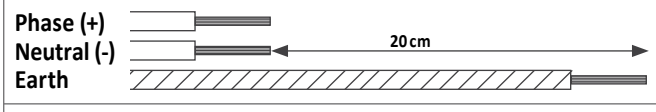


Figure 1 - Longer earth wire

4. Connect the earth wire to the internal fixed screw 'PE' *(see Figure 2)* located at the inside of the back cover. The instrument internally connects the back cover metallic structure with the front metallic structure through an internal green-yellow cable. *(dotted cable at Figure 3).*
5. Connect phase and neutral (in AC power) or positive and negative (in DC power) to the internal power terminal.
6. The connections label attached to the outside of the instrument has some free space left to write the color or local code for each cable.
7. To comply with security regulation 61010-1, add to the power line a protection fuse acting as a disconnection element, easily accessible to the operator and identified as a protection device.

Power 'H'	500 mA time-lag fuse
Power 'L'	1000 mA time-lag fuse

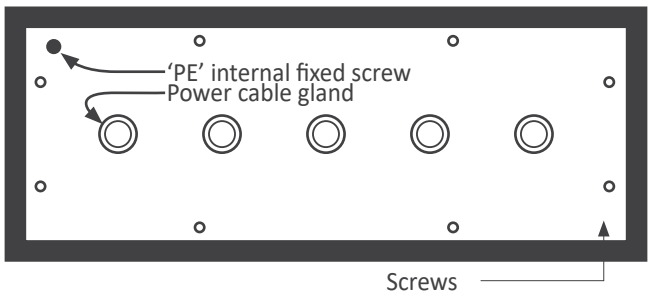


Figure 2 - Location of the internal 'PE' fixed screw and power cable gland

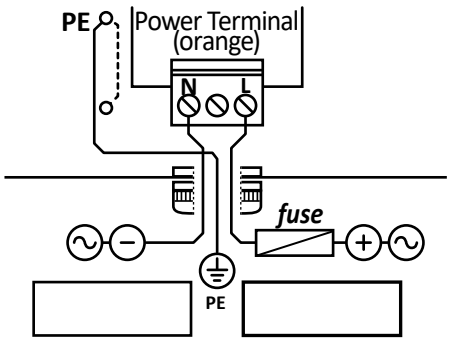
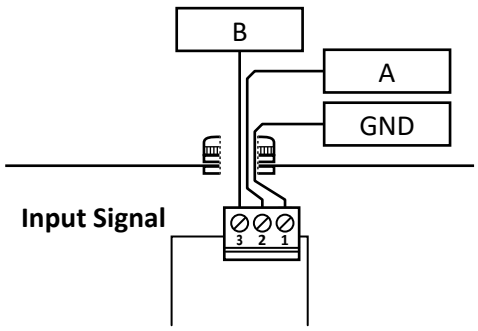


Figure 3 - Power connections

1.12 Input signal connections

1. Unscrew the screws from the back cover and remove the back cover *(see section 1.9).*
2. Locate the input signal terminal *(see section 1.8).*
3. Pass the signal cable through the signal cable gland *(see section 1.8).*
4. Connect the input signal cables *(see Figure 4).*
5. The connections label attached to the outside of the instrument has some free space left to write the color or local code for each cable.

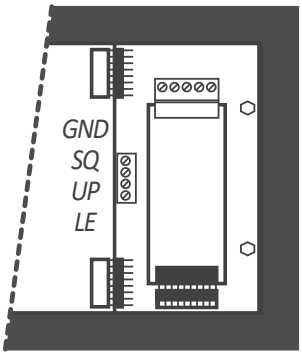


A	RS-485 A wire
B	RS-485 B wire
GND	Shield

Figure 4 - Signal connections

1.13 Connections for remote keypad

The 4 pin terminal located beside the input signal module allows to replicate a remote version of the front keypad. Connect 4 cables for front keys 'SQ' (■), 'UP' (▲) and 'LE' (◀) and for the common. Pass these cables through the 'remote keypad' cable gland *(see section 1.8).*



1.14 Technical specifications

Digits
number of digits: 4 or 6 *(see Table 9)*
digit: 7 segments
view angle: 120º
color: red or green
digit height: *(see Table 9)*

Reading
max., min.: *(see Table 9)*
decimal point: X.X.X.X.X.X.

Protocol: RS-485 ASCII
function: slave within a RS-485 bus
speed: from 38.400 bps to 600 bps
data formats: 8n1, 8e1, 8o1, 8n2
addresses: 1 to 31
bus terminator: not included
wire section: max. 0.5 mm^2

Watchdog: configurable from 1 to 120 sec.
Errors: communication loss with the master

Power
power 'H': 85 to 265 Vac and 120 to 370 Vdc isolated (isolation 2500 Vac)
power 'L': 11 to 36 Vdc isolated (isolation 1500 Vdc)
consumption: *(see Table 9)*
fuses: *(see section 1.11)*
wire section: max. 2.5 mm^2

Configuration: front keypad with 3 keys
remote keypad *(see section 3.1)*

Output and control options: relay output, analog retransmission, Modbus RTU, ... *(see section 2)*

Mechanical
IP protection: full IP65 housing
mounting: panel, wall , hanging *(see section 1.20)*
connections: cable gland outputs
internal plug-in screw terminals
housing material: textured iron, black painted
methacrylate front filter
weight: *(see Table 9)*
front sizes: *(see section 1.8)*
panel cut-out: *(see section 1.8)*
depth: *(see section 1.8)*

Temperature
operation: from 0 to +50 ºC
storage: from -20 to +70 ºC
warm-up time: 15 minutes

	Format B24	Format B44	Format B26	Format B46
Number of digits	*4*	*4*	*6*	*6*
Digit height	*60 mm*	*100 mm*	*60 mm*	*100 mm*
Reading distance	*25 meters*	*50 meters*	*25 meters*	*50 meters*
Slots for output and control options	*2*	*2*	*3*	*3*
Maximum reading	*9999*		*999999*	
Minimum reading	*-1999*		*-199999*	
Consumption (without options installed)	*3 W*	*5.25 W*	*3.5 W*	*5.5 W*
Consumption (with options installed)	*5 W*	*6.75 W*	*5,5 W*	*7 W*
Weight	*2200 gr.*	*2500 gr.*	*3500 gr.*	*4500 gr.*

Table 9 - Technical specifications associated to format

1.15 Functions included

Functions included		*Section*
Local or remote alarms	*yes, configurable*	*1.18.7*
Address	*configurable*	*1.18.3*
Watchdog	*yes, configurable*	*1.18.4*
Watchdog error	*yes, configurable*	*1.18.4*
Local alarms	*simple or double setpoint* *activation delays* *deactivation delays* *hysteresis* *inverted relays* *locked alarms*	*1.18.7*
Fast access menu	*yes, configurable*	*1.18.10*
'Bus activity'	*yes*	*1.18.11*
'On Power Up'	*yes*	*1.18.12*
'Setpoint on bus'	*yes*	*1.18.13*
Scroll	*sí, en modo 'Text'*	*1.18.5*
Key 'LE'	*yes*	*1.18.15*
Password	*configuration locked*	*1.18.21*
Brightness	*configurable, 5 levels*	*1.18.24*

Table 10 - Functions included

1.16 Messages and errors

Error messages related to the local instrument are shown on display, in flash mode *(see Table 11)*. Examples given are for instrument with 6 digit formats.

Error messages related to the protocol are sent as response frames through the communications bus *(see Table 12)*. Error messages are generated only in case of 'WRA' or 'RD' frames. Frames 'WR' do not generate error messages.

Messages and errors on display	
'Err.1'	incorrect password.
'Err.2'	at '**oPt.X**' menu entry. Installed module is not recognized.
'Err.W'	'Watchdog' error
'999999'	+ flashing mode. Reading is in overrange.
'-199999'	+ flashing mode. Reading is in underrange.

Table 11 - Messages and error codes for local instrument

Messages and errors on the ASCII protol	
1	'Unknown register'. Requested register does not exist.
4	'CRC error'. Received frame has a CRC error..
6	'Empty Data'. A 'WRA' frame has been received without 'DATA' section. Error is not sent in case of 'WR' frames.
7	'Reserved register'. Requested action is directed to a reserved register. Action is ignored.
8	'Read only register'. A write action is directed to a read-only register.
9	'Frame error'. The frame ID is not known.
10	'First char error'. When writing on numerical registers, first character must be a number or polarity ('+' or '-'). In case of other characters, this error is generated.
11	'Format error'. When writing on numerical registers, the value contains characters that can not be converted to a number. Accepted characters are '0' to '9', '+' and '-' at the beginning of the register, and one decimal point '.'
12	'Out of range'. When writing on numerical registers, the number is out of range. For example, 6 digits are being received and the instrument has 4 digits.
13	'String error'. When writing on text registers, the 'DATA' field is too long (75 bytes, 75 bytes characters).

Table 12 - Messages and error codes for the ASCII protocol

1.17 ASCII protocol

1.17.1 Frame types

The ASCII protocol implemented defines the following frame types :

• Frame 'write' ('**WR**'). Identifier 34. Frame to write data into a register. The destination register number is placed in the 'REG' byte (section 'Header'). The data to write into the register is indicated in the 'D0' to 'Dn' bytes (section 'Data').

• Frame 'write with acknowledgment' ('**WRA**'). Identifier 35. Frame to write data into a register, with acknowledgment of success. The destination register number is placed in the 'REG' byte (section 'Header'). The data to write into the register is placed in the 'D0' to 'Dn' bytes (section 'Data'). The instrument replies with an 'ok' frame ('**OK**') if the writing action succeeded, or with an 'error' frame ('**ERR**') if the writing action did not succeed.

• Frame 'ok' ('**OK**'). Identifier 39. Informs that the action of writing data into a register, was successful. This is a response frame to a 'write with acknowledgment' frame ('**WRA**').

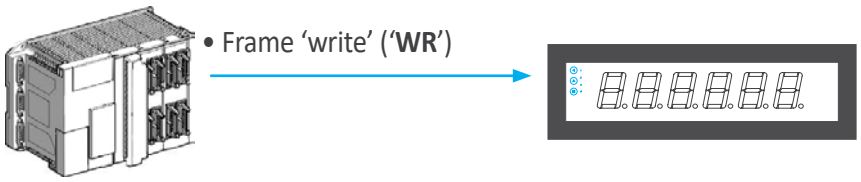
• Frame 'error' ('**ERR**'). Identifier 38. Informs that the data read ('**RD**') or data write ('**WRA**') did not succeed. The error code is codified into the 'REG' byte (section 'Header'). For a list of error codes see section *1.16.*

• Frame 'read' ('**RD**'). Identifier 36. Frame to request the data value of a register. The register number is placed in the 'REG' byte (section 'Header').

• Frame 'answer' ('**ANS**'). Identifier 37. Response frame to a 'read' frame. The register number is placed in the 'REG' byte (section 'Header'). Requested data is contained in bytes 'D0' to 'Dn' (section 'Data').

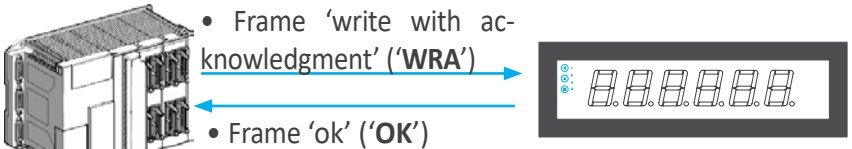
• Frame 'ping' ('**PING**'). Identifier 32. Frame 'ping' is a request of existence to the remote instrument. The remote instrument will answer with a 'pong' frame

• Frame 'pong' ('**PONG**'). Identifier 33. Frame 'pong' is a response frame to a 'ping' frame. It confirms the existence of the remote instrument.



• Frame 'write' ('**WR**')

Example, write a value on display.

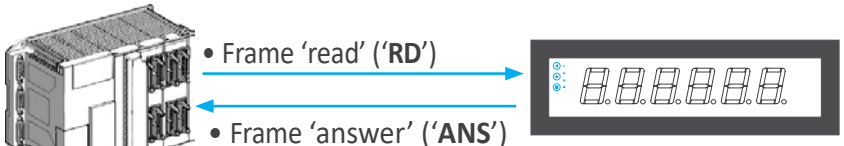


• Frame 'write with acknowledgment' ('**WRA**')

• Frame 'ok' ('**OK**')

• or frame 'error' ('**ERR**')

Example, write a value on display and request a confirmation. Confirmation is an 'ok' frame or an error frame.

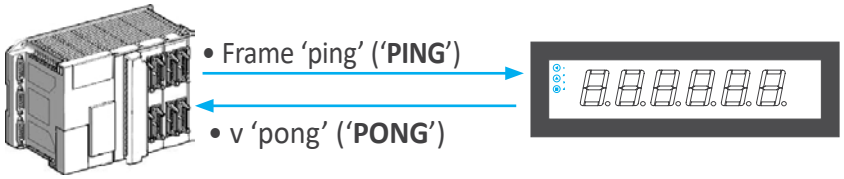


• Frame 'read' ('**RD**')

• Frame 'answer' ('**ANS**')

• or frame 'error' ('**ERR**')

Example, read the value of the display. Response from the instrument with the value or with an error frame



• Frame 'ping' ('**PING**')

• v 'pong' ('**PONG**')

Example, confirmation request that the remote instrument is alive. RESponse with a 'pong' frame

1.17.2 Frame structure

Header								Data				Trail	
STX	ID	RSV	FROM	TO	REG	RSV	LONG	D0	D1	...	Dn	CRC	ETX
2	x	32	x	x	x	32	n+1	[data]				x	3
0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*...*	*n+7*	*n+8*	*n+9*

The ASCII protocol frames implemented have a structure made of 'Header', 'Data' and end of frame 'Trail'.

Section 'Header'

Contains the start of frame byte ('STX'), the frame identifier ('ID'), the sender ('FROM') and destination ('TO') addresses, the register number ('REG') and the length ('LONG') of the 'Data' section.

Section 'Data'

Contains the data of the register ('REG').

Section 'Trail'

Contains the 'CRC' code and the end of frame byte ('ETX').

'Real value' and 'Frame value'

In order to use frame characters that are representable and easily recognizable on screen in case of need, the protocol codifies the values before introducing them into the frame. The following nomenclature is defined :

- 'real value' is the value of the field without codification
- 'frame value' is the value codified

Field	*Description*	*Size*	*Position*	*Real value*	*Frame value*
STX	*Start of frame*	*1 byte*	*0*	*does not apply*	*2*
ID	*Type of frame*	*1 byte*	*1*	*(see section 1.17.1)*	*real_value*
RSV	*Reserved*	*1 byte*	*2*	*0*	*32*
FROM	*Sender address*	*1 byte*	*3*	*0 ('Master')/1 to 31 ('Slave')*	*32 + real_value*
TO	*Destination address*	*1 byte*	*4*	*0 ('Master')/1 to 31 ('Slave')* *128 ('broadcast')*	*32 + real_value*
REG	*Register number*	*1 byte*	*5*	*see sections 1.17.7, 1.17.8 and 1.17.9*	*32 + real_value*
RSV	*Reserved*	*1 byte*	*6*	*0*	*32*
LONG	*Length of 'Data' section*	*1 byte*	*7*	*n (between 0 and 32)*	*32 + real_value*
D0 ... Dn	*Data*	*n bytes*	*8 to n+7*	*number 0 to 9* *decimal point* *polarity (+/-)*	*number ASCII code (48 to 57)* *point ASCII code (46)* *'+' ASCII code (43)* *'-' ASCII code (45)*
CRC	*CRC calculated value*	*1 byte*	*n+8*	*does not apply*	*(see section 1.17.10)*
ETX	*End of frame*	*1 byte*	*n+9*	*does not apply*	*3*

Table 13 - Description of the ASCII frame bytes

1.17.3 Example for 'WRA' (35) and 'OK' (39) frames

Example - The 'Master' (address '0') sends a write frame, with request of acknowledgment (frame 'WRA') with value '765.43' to register number '0' (display value) of the 'Slave' with address '28'. The 'Slave' answers to the 'Master' with an 'ok' frame ('OK'). In case of error, it answers with an 'error' frame ('ERR').

Header								Data								Trail	
STX	ID	RSV	FROM	TO	REG	RSV	LONG	D0	D1	D2	D3	D4	D5	D6	D7	CRC	ETX
2	35	32	32	60	32	32	40	43	48	55	54	53	46	52	51	51	3
Start	WRA	---	0	28	0	---	8	+0765.43								CRC	Stop

Header								Trail	
STX	ID	RSV	FROM	TO	REG	RSV	LONG	CRC	ETX
2	39	32	60	32	32	32	32	57	3
Start	OK	---	28	0	0	---	0	CRC	Stop

1.17.4 Example for 'ERR' (38) frame

Example - The 'Slave' with address '28' answers to the 'Master' (address '0') with an error frame ('ERR') indicating that the register is unknown ('UNKNOWN_REGISTER', error code '1'). The error code is indicated in the 'REG' byte. For a list of error codes see section 1.16.

Header								Trail	
STX	ID	RSV	FROM	TO	REG	RSV	LONG	CRC	ETX
2	38	32	60	32	33	32	32	57	3
Start	ERR	---	28	0	1	---	0	CRC	Stop

1.17.5 Example for 'PING' (32) and 'PONG' (33) frames

Example - The 'Master' (address '0') requests confirmation of existence to the 'Slave' at address '22' (frame 'PING') and the 'Slave' answers to the 'Master' with a 'PONG' frame.

Header								Trail	
STX	ID	RSV	FROM	TO	REG	RSV	LONG	CRC	ETX
2	32	32	32	54	32	32	32	52	3
Start	Ping	---	0	22	0	---	0	CRC	Stop

Header								Trail	
STX	ID	RSV	FROM	TO	REG	RSV	LONG	CRC	ETX
2	33	32	54	32	32	32	32	53	3
Start	Pong	---	22	0	0	---	0	CRC	Stop

1.17.6 Example for 'RD' (36) and 'ANS' (37) frames

Example - The 'Master' (address '0') requests the value of register number '0' (display value) to the 'Slave' with address '28' (frame 'RD') and the 'Slave' answers to the 'Master' with a frame ('ANS') that contains the value requested (765.43).

Header								Trail	
STX	ID	RSV	FROM	TO	REG	RSV	LONG	CRC	ETX
2	36	32	32	60	32	32	32	58	3
Start	RD	---	0	28	0	---	0	CRC	Stop

Header								Data								Trail	
STX	ID	RSV	FROM	TO	REG	RSV	LONG	D0	D1	D2	D3	D4	D5	D6	D7	CRC	ETX
2	37	32	60	32	32	32	40	43	48	55	54	53	46	52	51	53	3
Start	ANS	---	28	0	0	---	8	+0765.43								CRC	Stop

1.17.7 Registers in 'Process slave' mode

List of registers accessible *(see Table 14)* for an instrument configured in 'Process slave' mode.

• register 0 contains the value to show on display. It is a numerical value, with or without polarity at the first character ('+' or '-') and with a single decimal point, or without decimal point.

Example 1 : send characters '+' '3' '7' '4' '.' '6' '1' to read on display '374.61'

Example 2 : send characters '-' '0' '0' '4' '6' to read on display '-46'

• registers 3, 4 and 5 contain the setpoint values for alarms 1, 2 and 3. By default, write access to these registers is disabled (setpoint value is modified through the front keypad). To enable read and write access to these registers through the bus, see section *1.18.13*.

• write frames to the setpoint registers when they are disabled will return error 8 'Read only register'.

• to save into the E2PROM the values written through the bus into these registers, (values will be maintained incase of power loss) enable parameter 'E2Pr' *(see section 1.18.14)*.

• after power loss, the instrument will start-up with all registers initialized to a value of '0' *(see section 1.5)*.

• the alarm status is accessible at register 6. The format of this register is explained at section *1.17.11*.

Register number	Name	Type (R=Read, W=Write)	Description
0	Display	R / W	Register with the display value, including the decimal point and polarity.
1	Reserved	---	---
2	Reserved	---	---
3	Setpoint 1	R / W*	Value of the alarm setpoint. *Write to these registers is disabled by default (see section 1.18.13).
4	Setpoint 2	R / W*	
5	Setpoint 3	R / W*	
6	Alarm status	R	Status of alarms 1, 2 and 3 (see section 1.17.11).

Table 14 - Registers in 'Process slave' mode

1.17.8 Registers in 'Full slave' mode

of registers accessible *(see Table 15)* for an instrument configured in 'Full slave' mode.

• register 0 contains the value to show on display. It is a numerical value, with or without polarity at the first character ('+' or '-') and with a single decimal point, or without decimal point.

Example 1 : send characters '+' '3' '7' '4' '.' '6' '1' to read on display '374.61'

Example 2 : send characters '-' '0' '0' '4' '6' to read on display '-46'

• the alarm status is accessible at register 6. The format of this register is explained at section *1.17.11*.

• after power loss, the instrument will start-up with all registers initialized to a value of '0' *(see section 1.5)*.

Register number	Name	Type (R=Read, W=Write)	Description
0	Display	R / W	Register with the display value, including the decimal point and polarity.
1	Reserved	---	---
2	Reserved	---	
3	Reserved	---	
4	Reserved	---	
5	Reserved	---	
6	Alarm status	R / W	Status of alarms 1, 2 and 3 (see section 1.17.11).

Table 15 - Registers en 'Full slave' mode

1.17.9 Registers in 'Text' mode

List of registers accessible *(see Table 16)* for an instrument configured in 'Text' mode.

- register 0 contains the value to show on display. It is an alphanumerical value. The register can contain up to 71 characters.
- acceptable characters are indicated at *Table 18*.
- character '+' is represented as an empty space. characters received not included in this table, are shown as 3 horizontal stripes on display (≡).
- if the register contains more than 6 characters, the 'scroll' mode is activated *(see section 1.18.5).*
- the alarm status is accessible at register 6. The format of this register is explained at section *1.17.11*.
- after power loss, the instrument will start-up with all registers initialized to a value of '0' *(see section 1.5).*

Register number	Name	Type (R=Read, W=Write)	Description
0	Display	R / W	Register with the alphanumerical characters to represent on display. See section 1.17.12 for a list of representable characters.
1	Reserved	---	---
2	Reserved	---	
3	Reserved	---	
4	Reserved	---	
5	Reserved	---	
6	Alarm status	R / W	Status of alarms 1, 2 and 3 (see section 1.17.11).

Table 16 - Registers in 'Text' mode

1.17.10 CRC calculation

The frame_value for the CRC byte is calculated based on the frame_values *(see section 1.17.2)* of the bytes from the 'Header' and 'Data' sections. Calculation consists on a 'XOR' function from byte '0' ('STX') to the last data byte (byte Dn).

- If the CRC calculated value is lower than '32', it is normalized with the function 'complement to 1'.

CRC0=STX ^ ID ^ RSV ^ FROM ^ TO ^ REG ^ RSV ^ LONG ^ D0 ^...^ Dn

- If (CRC0<32) -> CRC=!CRC0 (complement_to_1 function)
- Id (CRC0>31) -> CRC=CRC0

```
//example of CRC calculation in C language
int8 Calculate_CRC(int8 CRC_Position)
{
 int8 i,CRC=0;
 for(i=0;c<CRC_Position;c++)
 {
    crc=crc ^ frame[i];
 }
 if(crc<32) CRC=~CRC;
 return(CRC);
}
```

1.17.11 The 'Alarm status' register

The 'Alarm Status' register (register 6) is available as a read_ only register for the 'Process slave' mode and as a read/ write register for the 'Full slave' and 'Text' modes. This register contains the status of alarms 1, 2 and 3. Status is active or inactive.

The 'Alarm Status' register is 1 character (1 byte) register, with possible values from '0' to '7'. The alarm status for each value are indicated at *Table 17.*

Note that the 'Alarm Status' register contains a value that is the ASCII code of a number from '0' to '7'. The reason is to maintain the protocol structure of transmitting ASCII codes. Also note that the value represented by this character is the binary code representing the status of the alarms:

Example: ASCII code 53 represents number '5', which in binary is '0101', and corresponds with alarm status 3, 2 and 1 in 'on', 'off' and 'on'.

Register value	ASCII character	Alarm 3 status	Alarm 2 status	Alarm 1 status
'0'	48	off	off	off
'1'	49	off	off	on
'2'	50	off	on	off
'3'	51	off	on	on
'4'	52	on	off	off
'5'	53	on	off	on
'6'	54	on	on	off
'7'	55	on	on	on

Table 17 - Register 'Alarm Status'.

1.17.12 Representable characters

Representable characters are indicated in the following table.

- In numerical modes ('Full slave' and 'Process slave' modes) only numbers from '0' to '9', decimal point ('.' or ',') and polarity ('+' or '-') are representable. Missing polarity is assimilated to positive polarity. Character '+' is not represented on display.
- In 'Text' mode all characters in the table are representable. Character '+' is represented as a blank space. Characters not included in this table are represented with 3 horizontal stripes(≡).
- Character '.' and character ',' represent both the decimal point.

Representable characters

Character	Display	ASCII code	Character	Display	ASCII code	Character	Display	ASCII code	Character	Display	ASCII code
0	0	48	A a	A	65 / 97	K k	K	75 / 107	T t	t	84 / 116
1	1	49	B b	b	66 / 98	L l	L	76 / 108	U u	u	85 / 117
2	2	50	C c	c	67 / 99	M m	M	77 / 109	V v	U	86 / 118
3	3	51	D d	d	68 / 100	N n	n	78 / 110	W w	H	87 / 119
4	4	52	E e	E	69 / 101	Ñ ñ	ñ	165 / 164	X x	H	88 / 120
5	5	53	F f	F	70 / 102	O o	o	79 / 111	Y y	y	89 / 121
6	6	54	G g	G	71 / 103	P p	P	80 / 112	Z z	2	90 / 122
7	7	55	H h	h	72 / 104	Q q	q	81 / 113	'.' ','	.	44 / 46
8	8	56	I i	I	73 / 105	R r	r	82 / 114	-	-	45
9	9	57	J j	J	74 / 106	S s	5	83 / 115	+	*(not representable)	43

*Table 18 - Representable characters. *Charácter '+' is accepted as polarity, but has not translation to the display.*

1.17.13 Restrictions on numerical registers

Registers that must contain a numerical value, are checked to assure that the value received from the frame is a numerical value. If controls are successful, the value is saved into the register. Otherwise, an error is generated. Registers which must contain numerical values are the following :

- 'Display' register
- 'Setpoint 1', 'Setpoint 2' and 'Setpoint 3' registers

When writing data into these registers, the instrument converts the ASCII characters received on the 'DATA' section of the frame, to a numerical value. The following controls are applied, in the order indicated below :

- Section 'DATA' can not be empty of characters. It generates an error 6 'Empty Data'.
- First character must be '+', '-', '.', ',' or a number from '0' to '9'. It generates error 10 'First char error'.
- Section 'DATA' must contain maximum one decimal point. It generates error 11 'Format error'.
- Section 'DATA' can contain only characters from '0' to '9' or decimal point (',' o '.'). First character has already been controled and is not controlled again. If other character is found, it generates error 11 'Format error'.
- If section 'DATA' does not contain decimal point, its maximum length is 7 characters. If section 'DATA' contains decimal point, its maximum length is 8 characters. Larger data generates error 12 'Out of range'.
- Conversion from ASCII characters to a number. Decimal point is separated from the number, which is treated as an integer.

Examples : possible conversions are as follows:

'1234' is read on display as 1234
'-1234' is read on display as -1234
'-12.34' is read on display as -12.34

'+.995' is read on display as 0.995
'+0.995' is read on display as 0.995
'0.995' is read on display as 0.995
'.995' is read on display as 0.995

'+000027' is read on display as 27
'+27' is read on display as 27
'27' is read on display as 27

- The numerical integer is sent to display. If the number is higher than the maximum number that can be represented by the display, it generates an error 12 'Out of range'.

Example : '-4567.89' is not representable on display, because minimum display is -199999. Instrument will generate an 'Out of range' error. 'Display' register is not updated. It generates an answer frame 12 'Out of range' if the writing was requested with a 'WRA' frame.

Note : character '.' and ',' are equivalent and both are associated to the decimal point.

1.18 Configuration

1.18.1 How to operate the menus

The instrument has two menus accessible to the user :

'*Configuration menu*' (key 'SQ') (■)

'*Fast access*' menu (key 'UP') (▲)

Configuration menu

The '*configuration menu*' modifies the configuration parameters to adapt the instrument to the application needs. To access the '*configuration menu*' press for 1 second the 'SQ' (■) key. This access can be blocked by activating the '**Password**' ('**PASS**') function. While operating the '*configuration menu*', the alarm status is 'hold' to the status it had before accessing the menu, and the output and control modules remain in '*error*' state. When leaving the '*configuration menu*', the instrument applies a system reset, followed by a brief disconnection of the alarms and the output and control modules. Functionality is then recovered.

For a detailed explanation on the '*configuration menu*' see the following sections, and for a full view of the '*configuration menu*' see section *1.19*.

'*Fast access*' menu

The '*fast access*' menu is an operator configurable menu, providing fast and direct access to the most usual functions of the instrument with a single key pad stroke. Press key 'UP' (▲) to access this menu.

See section *1.18.10* for a list of selectable functions for the '*fast access*' menu in this instrument. The '**Password**' ('**PASS**') function does not block access to this menu. Accessing and modifying parameters in the '*fast access*' menu does not interfere with the normal functionality of the instrument, and it does not generate any system reset when validating the changes.

Operating with the front keypad inside the menus

Key 'SQ' (■) - press the 'SQ' (■) key for 1 second to access the '*configuration menu*'. Inside the menu, the 'SQ' (■) key acts as an '*ENTER*'. It enters into the menu option selected, and when entering a numerical value, it validates the number.

Key 'UP' (▲) - press the 'UP' (▲) key to access the '*fast access*' menu. Inside the menu,the 'UP' (▲) key sequentially moves through the available parameters and menu entries. When entering a numerical value, it modifies the digit selected by increasing its value to 0, 1, 2, 3, 4, 5, 6, 7, 8, 9.

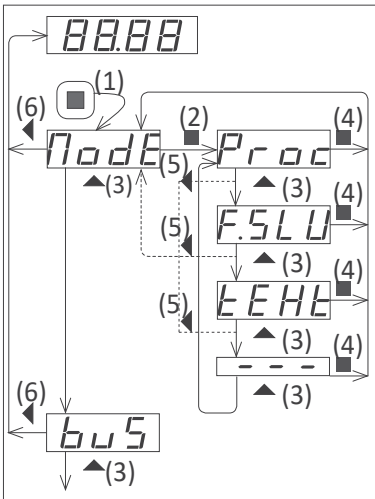
Key 'LE' (◀) - press the 'LE' (◀) key to activate the configured special functions associated to this key. Inside the menu, the 'LE' (▲) acts as an 'ESCAPE'. It leaves the selected menu level and eventually, by leaving all menu levels, it leaves from the configuration menu. Then changes are applied and the instrument is back to normal function. When entering a numerical value, it selects the active digit, and the value is then modified by key 'UP' (▲).

'Rollback'

After 30 seconds without interaction from the operator, the instrument will rollback and leave the '*configuration menu*' or the '*fast access*' menu. All changes will be discarded.

Instruments with 4 and 6 digits

The configuration menus included in this document show values for a 6 digit instrument. In case of 4 digit instruments, note that maximum reading values should be 9999 instead of 999999 to 9999 and minimum reading values should be -1999 instead of -199999.



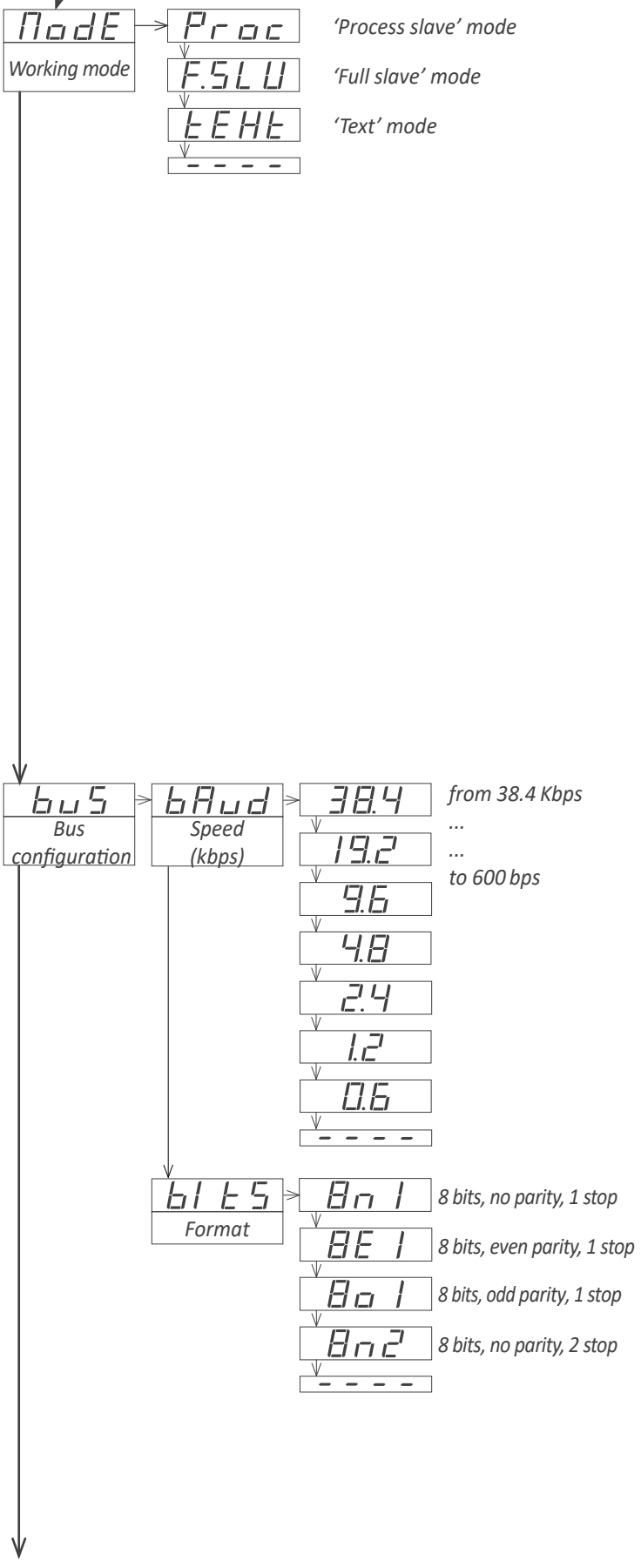
Example of operation inside the '*configuration menu*'.

1. The (■) key enters into the 'configuration menu'.
2. The (■) key enters into the '**InP**' menu.
3. The (▲) key moves through the menu options.
4. The (■) key selects the desired range and returns to the '**InP**' menu.
5. The (◀) key leaves the actual menu level and moves to the previous menu level.
6. The (◀) key leaves the 'configuration menu'. Changes are applied and saved at this moment.

Figure 5 - Example of operation inside the 'configuration menu'

1.18.2 Initial set-up

Press 'SQ' (■) for 1 second to access the '*configuration menu*'. For a description on how to operate inside the menus see section *1.18.1*. For a full vision of the '*configuration menu*' structure see section *1.19*.



To configure the initial set up of the instrument, select the working mode and configure the bus parameters.

The instrument has 3 working modes named 'Process slave', 'Full slave' and 'Text'. In all modes, the reading value is received from the communications bus. The differences between modes are related to how the alarms are controlled and how the information received is translated.

At the '**Working mode**' ('**ModE**') parameter, select one of the working modes.

- select '**Process slave**' to receive a numerical value to show on display. Alarms are controlled locally from the instrument, by manually configuring the setpoint and other alarm parameters. Analog outputs and other output and control modules are controlled locally from the instrument.
- select '**Full slave**' to receive a numerical value to show on display. Alarms are controlled through the communications bus, by writing to the internal instrument registers. Analog outputs and other output and control modules are controlled locally from the instrument.
- select '**Text**' to receive an alphanumerival value made of a string of ASCII codes, to show on display. Characters are not translated as numbers but as individual characters. All characters shown in section *1.17.12* are representable on display. Alarms are controlled through the communications bus, by writing to the internal instrument registers. No analog outputs are permitted in this mode.

Configuration menus for each mode are slightly different. The following sections will mention when a parameter applies only to some modes.

At the '**Bus configuration**' ('**buS**') menu configure the bus speed and the bus data format.

- at the '**Speed**' ('**bAud**') parameter select the bus speed, in kbps.
- at the '**Format**' ('**bItS**') parameter select the bus format between '8n1', 8e1', '8o1' and '8n2'.

1.18.3 Addresses and broadcast

The instrument can be assigned any address between 1 and 31. Additionally, address 128 is a 'broadcast' address.

The instrument will process the frames addressed to his local address.

Additionally, frames directed to address 128 will be accepted by all instruments.

Frames directed to address 128 'broadcast' will not generate any answer frame.

- a 'ping' frame ('**PING**') to address 128 does not generate answer frames
- a 'write with aknowldgement' ('**WRA**') frame to address 128 does not generate answer frames
- a 'read' ('**READ**') frame to address 128 does not generate answer frames
- a frame directed to address 128 that contains an error (for example, a CRC error) does not generate answer frames

1.18.4 'Watchdog' function

The 'watchdog' function activates an error state in case of loss of communication with the 'master'. To configure the 'watchdog' indicate the maximum time accepted to wait between two frames received. If the configured time is exceeded, the instrument activated the 'watchdog error'. When a correct frame is received, the 'watchdog' timer is reset.

Frames that can reset the 'watchdog' timer are those addressed to the 'slave' instrument. These frames must conform to the Modbus RTU protocol and have a correct CRC.

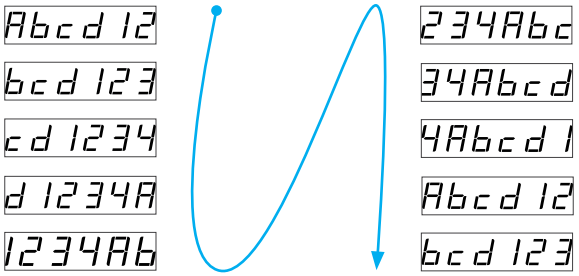
If the function or register or coil indicated in the frame is not correct, the 'slave' instrument will still reset the 'watchdog' timer. It will also reply with the corresponding error message.

The internal alarms of the instrument can be associated to the 'watchdog'. In case of 'watchdog' activation, the associated alarm will also activate *(see section 1.18.7)*.

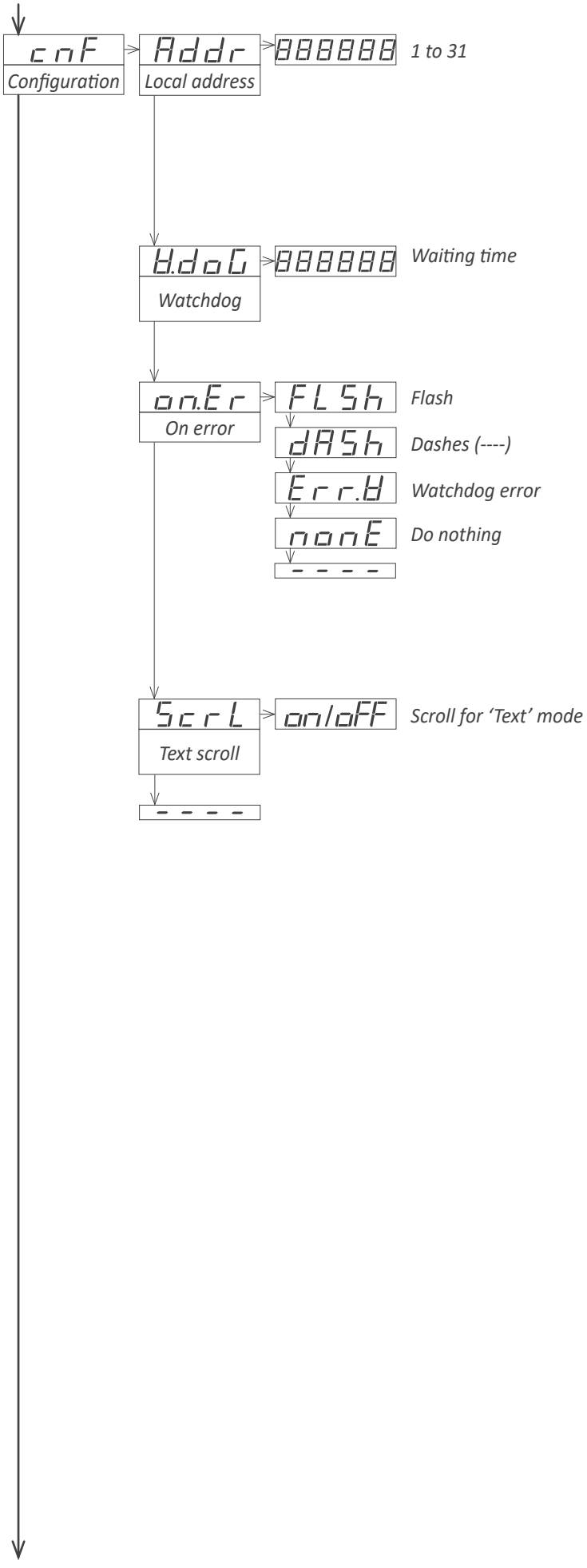
Display can also be configured to show an error message in case of 'watchdog' error. It can be configured for flashing, dash ('------') or to show message 'Err.W'.

1.18.5 'Scroll' function

The 'Text' mode has a 'scroll' function to represent messages with a number of characters larger than number of spaces on display. A message with characters 'Abcd1234' will be represented as:



1.18.6 Protocol configuration menu



At the '**Configuration**' ('**cnF**') menu, configure the parameters associated to the instrument function, such as the local address, the 'watchdog' time and error behavior and the scroll in 'Text' mode.

- at the '**Local address**' ('**Addr**') parameter configure the local address of the instrument. Values from 1 to 31.
- at the '**Watchdog**' ('**W.doG**') parameter configure the maximum waiting time between frames, in seconds. Select '0' to disable the 'watchdog'. Maximum value 120 seconds. In case of watchdog error activation, the function '**on.Er**' will be triggered *(see section 1.18.4)*.
- at the '**On error**' ('**on.Er**') parameter configure the action in case of watchdog error:
  - select '**Flash**' ('**FLSh**') to activate the flash on display
  - select '**Dashes**' ('**dASh**') to activate dashes ('**----**') on display
  - select '**Watchdog error**' ('**Err.W**') to activate the message '**Err.W**' on display.
  - select '**do nothing**' ('**nonE**') to perform no action.
- the '**Scroll**' ('**ScrL**') parameter applies only to 'Text' mode. Select '**on**' to activate the scroll *(see section 1.18.5)*.

1.18.7 Alarms

The instrument manages 3 independent internal alarms, each one controlling the activation of an optional relay, transistor or control SSR output.

Optional modules *(see section 2)* are installed at the free slots inside the instrument *(see section 1.8)*. B24 and B44 formats have 2 free slots for output and control modules, while B26 and B46 formats have 3 free slots for output and control modules.

The instrument has 3 front leds that reflect the state of the 3 internal alarms. These leds are only for local help during installation, as they are not appropriate for long distance reading.

Each alarm controls the activation of the relay, transistor or control SSR installed on its associated slot, and the front led.

• **Alarms in 'Full slave' and 'Text' modes**

In 'Full slave' and 'Text' modes, the alarms are controlled through the bus.

An alarm can be associated to the watchdog. This alarm will activate when the watchdog error activates *(see section 1.18.4)*. This function allows to activate a relay to inform about loss of communication.

• **Alarms in 'Process slave' mode**

In 'Process slave' mode, the alarms are controlled locally at the instrument, and the operator must manually configure them.

Each alarm has several parameters for configuration, starting with the usual setpoint, hysteresis and maximum (alarm active when reading is higher than setpoint) or minimum (alarm active when reading is lower than minimum) alarm types *(see Figure 6).*

Each alarm can configure independent activation and deactivation delays. These delays affect the alarm as a whole, and the delay will affect the front led and the associated relay.

Configuring a second setpoint creates 'windowed alarms'. The windowed alarm controls with a single relay output if the reading is inside or outside the values defined *(see Figure 7)*.

Activate the 'inverted relay' function to invert the activation logic of the associated relay.

Activate the 'locked alarms' function will force the operator to interact with the instrument when an alarm has been activated. Once activated, the alarm will remain locked at active state, even if the reading returns to a value below setpoint, until the operator manually unlocks the alarms pressing the front key 'LE' (or the remote key 'LE', see section *3.1*).

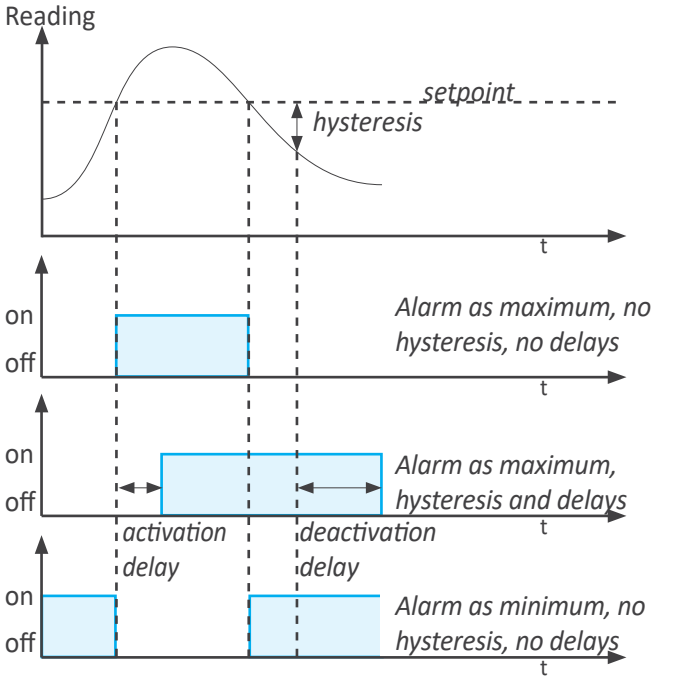


Figure 6 - Examples of alarm with 1 setpoint

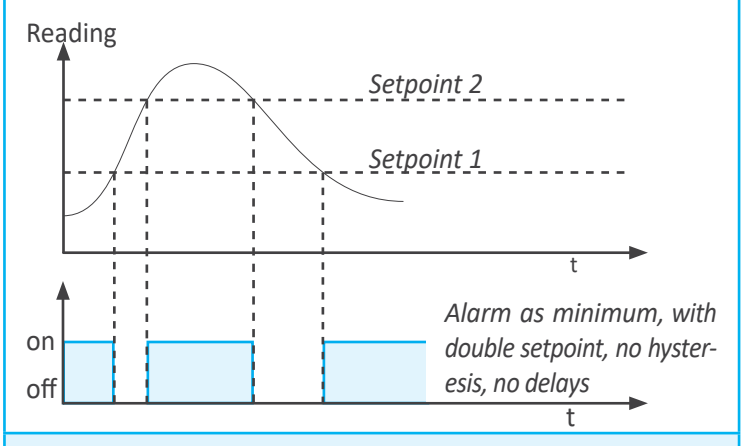
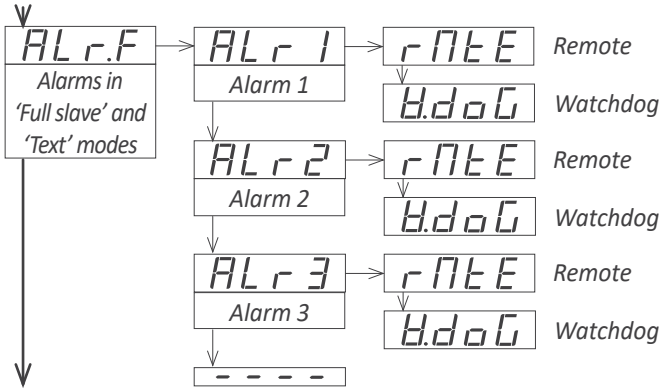


Figure 7 - Example of alarm with 2 setpoints

1.18.8 Alarms configuration menu for 'Full slave' and 'Text'

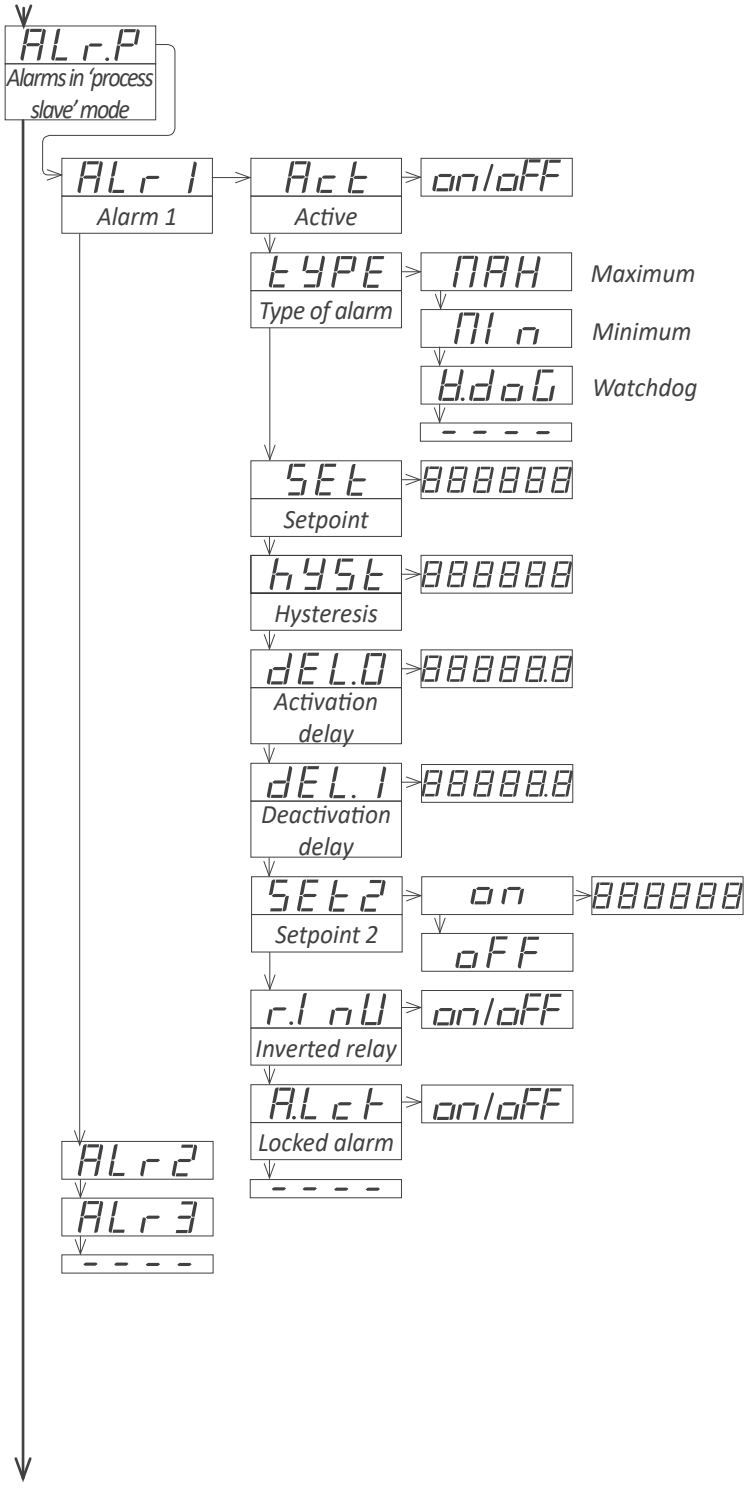


Menu available only in 'Full slave' and 'Text' modes. Alarms are remotely controlled from the bus.

By default all alarms are set to 'remote' ('**rMtE'**) when the 'full slave' mode is selected. Select the '**Watchdog**' ('**W.doG**') value to any alarm to activate in case of watchdog error.

For more information see section *1.18.7.*

1.18.9 Alarms configuration menu for 'Process slave'



Menu available only in 'Process slave' mode. In 'process slave' mode, alarms are locally controlled from the instrument. Locally configure the alarm parameters for each alarm. For more information see section *1.18.7*. At the alarm menu ('**ALr1**', '**ALr2**' or '**ALr3**') configure the following parameters:

- at the '**Active**' ('**Act**') parameter select '**on**'
- at the '**Type of alarm**' ('**TypE**') parameter select '**MAX**' for maximum alarm (activates when reading is higher than setpoint), or '**MIn**' for minimum alarm (activates when reading is lower than setpoint), or select watchdog alarm ('**W.doG**') to activate the alarm in case of watchdog error *(see section 1.18.4).*
- at the '**Setpoint**' ('**SEt**') parameter configure the alarm activation point. Parameter value is accessible through 'fast access' *(see section 1.18.10).*
- at the '**Hysteresis**' ('**hySt**') parameter select the hysteresis value. Hysteresis applies to the alarm deactivation. Alarm deactivates once the reading is beyond the setpoint plus the hysteresis value. Hysteresis prevents relay switching in case of signal fluctuations close to the setpoint value.
- at the '**Activation delay**' ('**dEL.0**') parameter configure the delay to apply before the alarm is activated. Delay starts to count once the setpoint is reached. Value from 0.0 to 99.9 seconds.
- at the '**Deactivation delay**' ('**dEL.1**') parameter configure the delay to apply before the alarm is deactivated. Delay starts to count once the setpoint is reached plus the hysteresis value. Value from 0.0 to 99.9 seconds.
- to work with 'windowed alarms' *(see Figure 7)* activate '**Setpoint 2**' ('**SEt2**') to '**on**' and then configure the desired second setpoint value. Second setpoint must always be higher in value than the first setpoint.
- at the '**Inverted relay**' ('**r.Inv**') parameter select '**on**' to invert the activation logic of the relay. Relay is inactive when alarm is active, and relay is active when alarm is inactive.
- at the '**Locked alarm**' ('**A.Lck**') parameter select '**on**' to block the automatic alarm deactivation. Alarm deactivation must be performed manually, by pressing the 'LE' front button *(see section 1.18.15)*.

1.18.10 Fast access

The '*fast access*' is an operator configurable menu. The operator can access this menu with a single press of the front key 'UP' (▲). The configured menu entries will be accessible. Eligible parameters to be accessed by this menu are:

- access to the bus activity through the 'UP' (▲) key allows to see if there is activity at the bus *(see 1.18.11)*.
- access to the maximum and minimum alarms through the 'UP' (▲) key allows to read and reset the values. To reset the memory values: visualize the value on display, press the 'UP' (▲) key, when the '**rSt**' message appears, press 'SQ' (■) . The instrument will return to the memory visualization. Press the 'LE' (◀) key to exit his menu.
- access to the alarm setpoints through the 'UP' (▲) key allows to read and modify the values. Only in 'Process slave' mode.
- access to the address through the 'UP' (▲) key allows to read the local address of the instrument.

The '*fast access*' menu is not affected by the password function. This means that the configuration menu can be password blocked, while some configured functions or parameters can still be accessible to the operator through the '*fast access*' menu.

- **Super fast access**

If only a single function is selected for the '*fast access*' menu, pressing the the 'UP' (▲) key will shortly display the function name and then automatically jump to the function value.

1.18.11 'Bus activity' function

'Bus activity' function is a detector of electrical activity on the bus. The function is to help when connecting the instrument to the bus for the first time. It provides information on wether there is electrical activity on the bus or not.

The 'Bus activity' function is visible in the form of a counter increasing its value on the display. It indicates that the UART is detecting information bytes on the bus. This detection means that there are data on the bus, and that it conforms to the configured speed and data format.

The 'Bus activity' is accessible through the key 'UP' (▲) when configuring the fast access menu *(see section 1.18.10)*.

1.18.12 'On power up' function

The '**On Power Up**' ('**on.Pu**') functions allows to define a series of actions to activate when the instrument restarts after a power loss. Functions available are a delay so the instrument waits a defined time before starting to measure and control, and the state of the alarms. The functions will apply only after a restart due to power-loss, they will not apply after a restart due to changes in configuration.

Delaying the measure and control functions gives additional time to elements of the system who are slower, so they can start completely before the instrument begins to acquire signal and control the outputs.

While on delay mode, the instrument shows all decimal points lightened and flashing, all alarms are deactivated, and there is no signal acquisition or communications control. When the delay time is over, the instrument starts its normal functioning.

1.18.13 'Setpoint on bus' parameter

In 'Process slave' mode, the alarms are controlled locally and the alarm configuration is performed by the operator through the front keypad. Enable the '**Setpoint on bus**' ('**StP.b**') to '**on**' to enable the writing of setpoint alarms though the bus. By default the value if '**oFF**'.

Note : when the 'setpoint on bus' parameter is enabled, writing a value to the register will update the alarm setpoint, but modifying a setpoint through the front keypad will not update the register value.

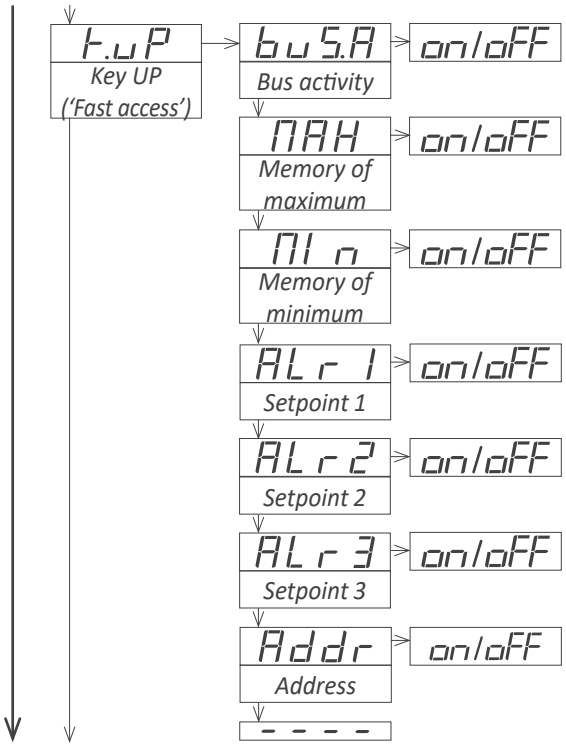
1.18.14 Save setpoint in E2PROM

Select '**on**' to save to the internal E2PROM setpoint values updated through the bus *(see section 1.18.13)*. By default this parameter is set to 'oFF' as the expected life for an E2PROM memory is around 100.000 saving cycles.

1.18.15 Key 'LE'

The 'LE' (◀) key at the front of the instrument can be configured to activate several functions. Only one function can be assigned to the 'LE' (◀) key. Eligible functions are the alarm unlock function *(see section 1.18.7)*.

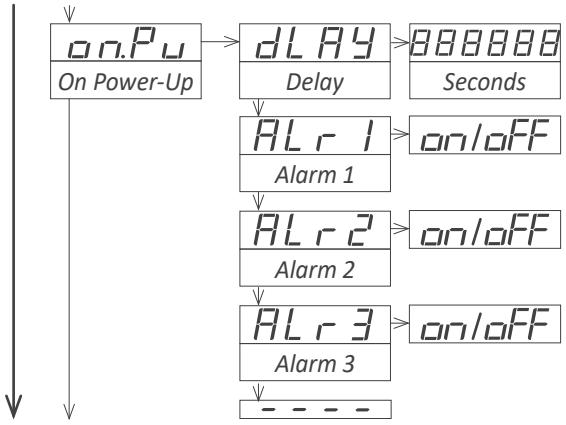
1.18.16 'Fast access' configuration menu



At the '**Key UP ('fast access')**' ('**K.uP**') menu configure which functions and parameters will be accessible through the 'fast access' menu. Select '**on**' to activate each function. For more information see section *1.18.10.*

- the '**Bus activity**' ('**buS.A**') function allows to visualize if there is activity at the communications bus *(see 1.18.11)*.
- the '**Memory of maximum**' ('**MAX**') or '**Memory of minimum**' ('**MIn**') functions allow to visualize the maximum or minimum reading value stored in memory.
- the '**Setpoint 1**' ('**ALr1**') function allows to visualize and modify the alarm 1 setpoint through the 'fast access' menu. Only in 'Process slave' mode.
- the '**Setpoint 2**' ('**ALr2**') function allows to visualize and modify the alarm 2 setpoint through the 'fast access' menu. Only in 'Process slave' mode.
- the '**Setpoint 3**' ('**ALr3**') function allows to visualize and modify the alarm 3 setpoint through the 'fast access' menu. Only in 'Process slave' mode.
- the '**Address**' ('**Addr**') function allows to visualize the address of the instrument.

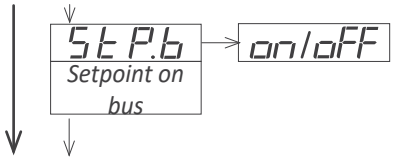
1.18.17 'On power up' configuration menu



The '**On Power Up**' ('**on.Pu**') menu assigns functions to be applied when the instrument starts after a power loss. For more information see section *1.18.12.*

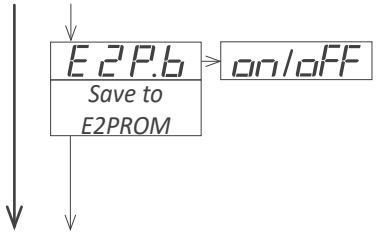
- at the '**Delay**' ('**dLAy**') parameter configure the time the instrument will wait before starting normal functionality. Time between 0 and 200 seconds.
- at the '**Alarm 1**', '**Alarm 2**' and '**Alarm 3**' parameters configure the state for the alarms at power up.

1.18.18 Setpoint on bus' configuration menu



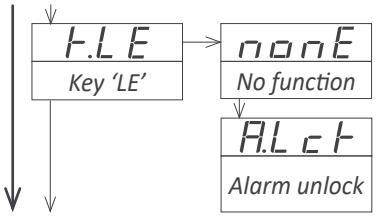
Available in 'Process slave' mode only. Enables access to the alarm setpoint registers through the bus. For more information see section *1.18.13.*

1.18.19 Save setpoint on E2PROM configuration menu



Enables to write to internal E2PROM setpoint values modified from the bus *(see section 1.18.14)*.

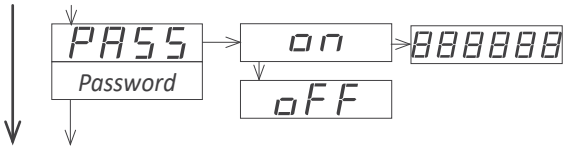
1.18.20 'Key LE' configuration menu



The 'LE' (◂) key at the front of the instrument can be configured to activate several functions. Only one function can be assigned to the 'LE' (◂) key. Eligible functions are the alarm unlock function *(see section 1.18.7).*

- the '**No function**' ('**nonE**') parameter assigns no function.
- the '**Alarm unlock**' ('**A.Lck**') parameter assigns the manual alarm unlocking, when the '**Locked alarms**' ('**A.Lck**') is active.

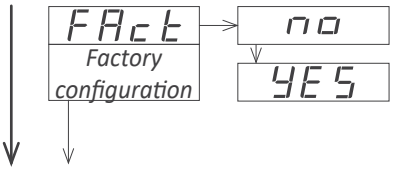
1.18.21 Password configuration



The password function blocks access to the configuration menu. The '*fast access*' menu is not affected by the password function. This means that the configuration menu can be password blocked, while some configured functions or parameters can still be accessible to the operator through the '*fast access*' menu.

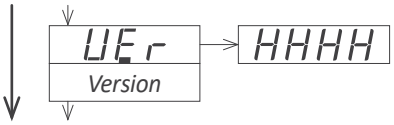
To active the '**Password**' function select '**on**' and introduce the 6 digits code. The code will be requested when trying to access the 'configuration menu' (front key 'SQ' (■)).

1.18.22 Default factory configuration



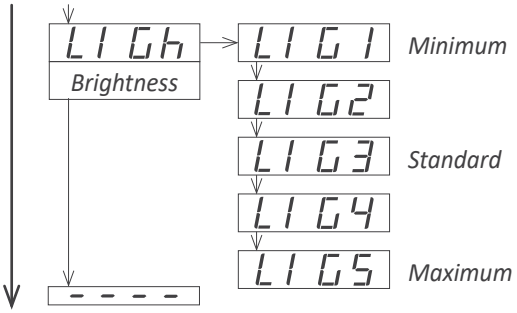
At the '**FActory configuration**' ('**FAct**') menu select '**yes**' to activate the default factory configuration. See section *1.7* for a list of default parameters.

1.18.23 Firmware version



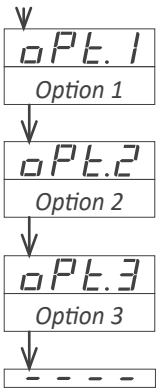
The '**Version**' ('**VEr**') menu informs about the firmware version installed on the instrument.

1.18.24 Brightness configuration



At the '**Brightness**' ('**LIGh**') menu select the intensity level for the display . Use this function to adapt the brightness to match other instruments in the vicinity or to the darkness or clarity of your environment.

1.18.25 Access to the options configuration menu



Access to the optional module installed at slot 1

Access to the optional module installed at slot 2

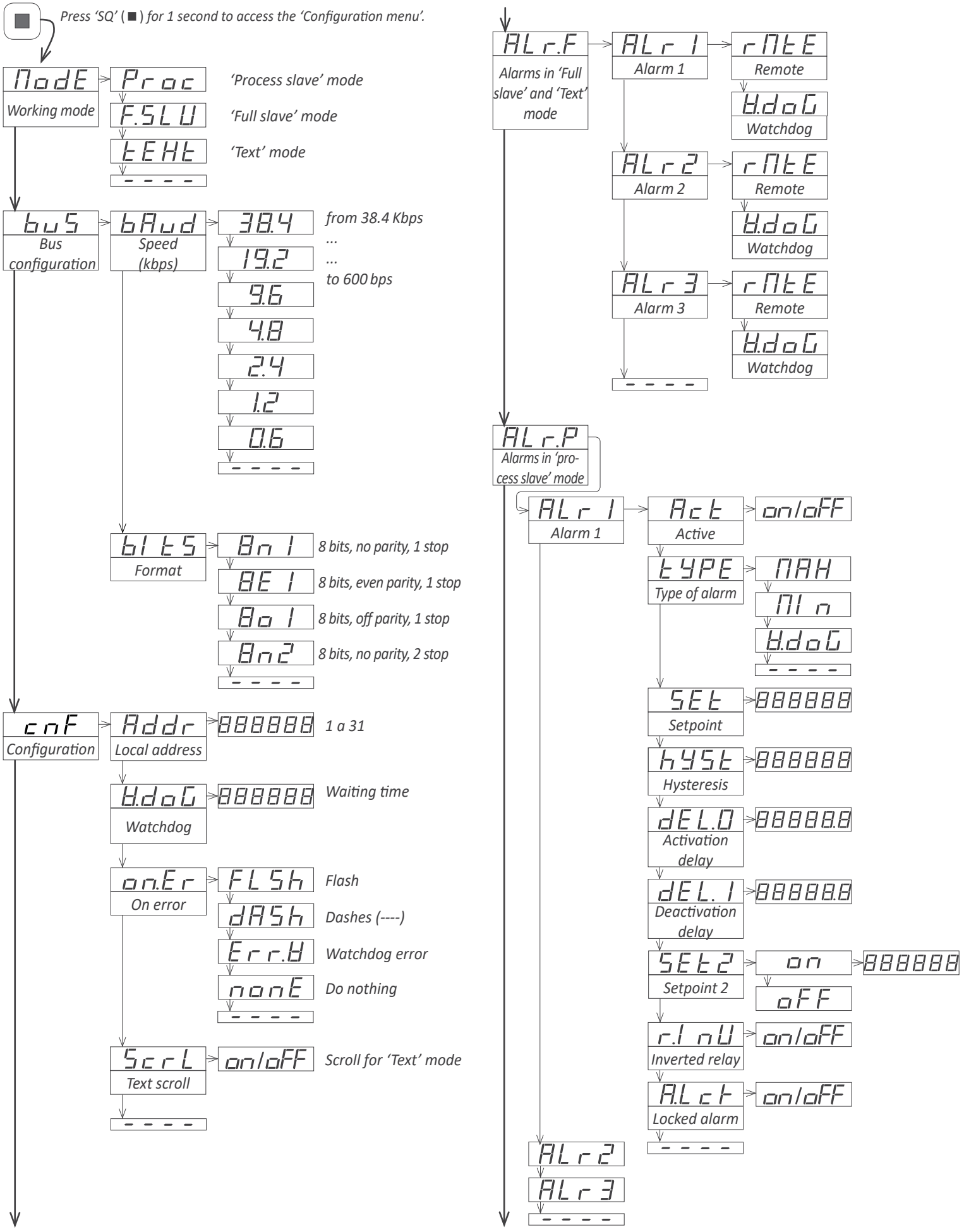
Access to the optional module installed at slot 3

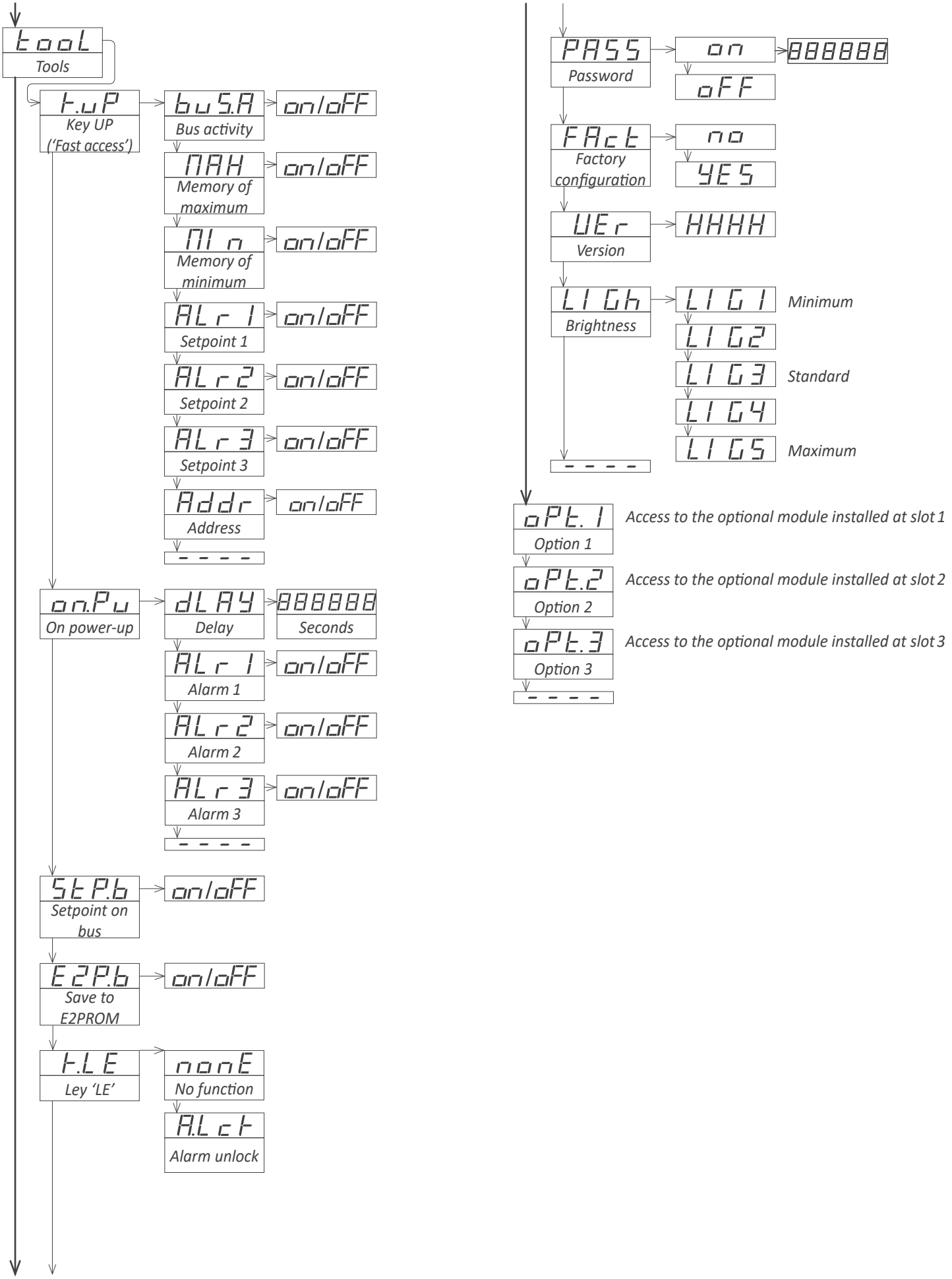
The output and control options are optional modules that can be installed at the instrument. Formats B24 and B44 have 2 free slots for output and control options, while formats B26 and B46 have 3 free slots *(see section 1.8)*.

Several of these optional modules have their own configuration menu embedded. The '**OPt.1**', '**OPt.2**' and '**OPt.3**' menu entries give access to the configuration menu of the option installed.

See section *2* for a list of available output and control modules.

1.19 Full configuration menu




tooL
Tools
t.uP
Key UP ('Fast access')
buS.A
Bus activity
on/oFF
MAH
Memory of maximum
MI n
Memory of minimum
ALr 1
Setpoint 1
ALr2
Setpoint 2
ALr3
Setpoint 3
Addr
Address
- - - -
on.Pu
On power-up
dLAY
Delay
888888
Seconds
Alarm 1
Alarm 2
Alarm 3
StP.b
Setpoint on bus
E2P.b
Save to E2PROM
t.LE
Ley 'LE'
nonE
No function
A.LcK
Alarm unlock
PASS
Password
on
oFF
FAct
Factory configuration
no
YES
UEr
Version
HHHH
LIGh
Brightness
LIG1
Minimum
LIG2
LIG3
Standard
LIG4
LIG5
Maximum
oPt.1
Option 1
Access to the optional module installed at slot 1
oPt.2
Option 2
Access to the optional module installed at slot 2
oPt.3
Option 3
Access to the optional module installed at slot 3

1.20 Mounting

The instrument fixations are designed to allow panel mount, wall mount, or hanging mount. For each type of mounting, see the position of the fixations at the images below.

- Panel mount. Apply the cut-out to the panel as seen on section *1.8.* Remove the side fixations. Introduce the instrument into the panel cut-out. Mount the side fixations as shown *(see Figure 8).* Slightly loosen the fixation screw of one side and press the instrument against the panel. Tighten the fixation screw so it presses the panel and maintains the fixation. Repeat with the opposite side fixation.

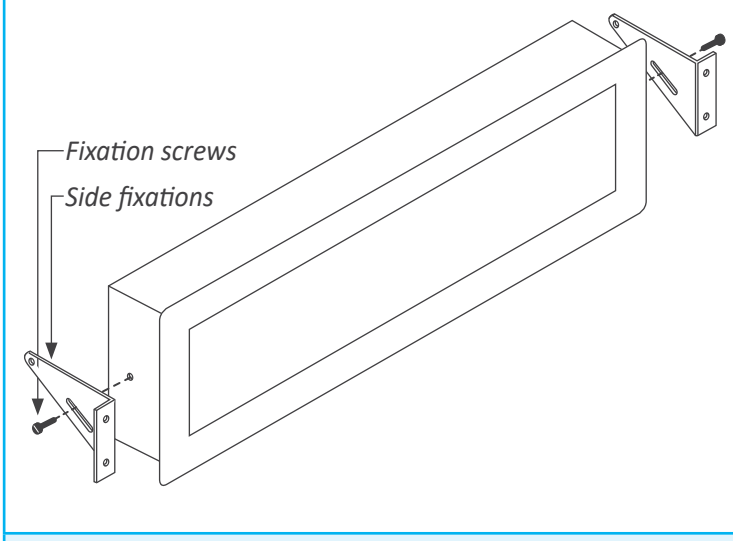


Figure 8 - Panel mount

- Wall mount. Mount the side fixations against the wall, as shown *(see Figure 10)*. Each fixation has 2 holes with 4,5 mm diameter and a separation between hole centers of 30 mm. Once the side fixations are secured against the wall, place the instrument and press the fixation screws slightly. Tilt the instrument to the desired viewing angle and firmly screw the fixation screws.

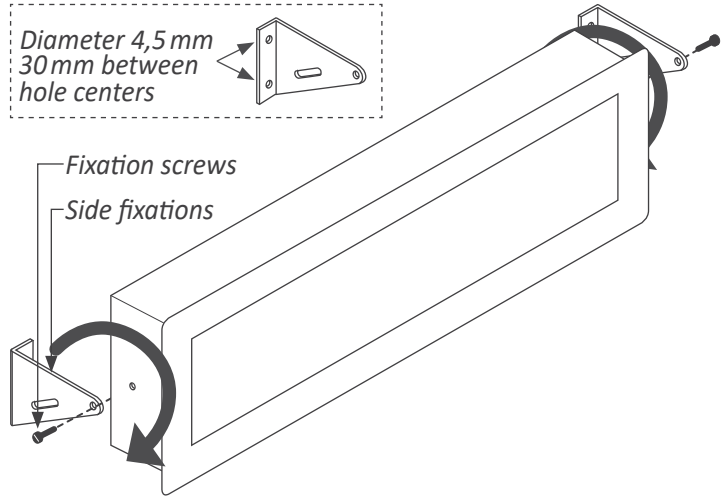


Figure 10 - Wall mount

- Hanging mount. Mount the side fixations as shown *(see Figure 9)*. Each fixation has 2 holes with 4,5 mm diameter and a separation between hole centers of 30 mm. Instrument can be hanged using cable, threaded rod, ...

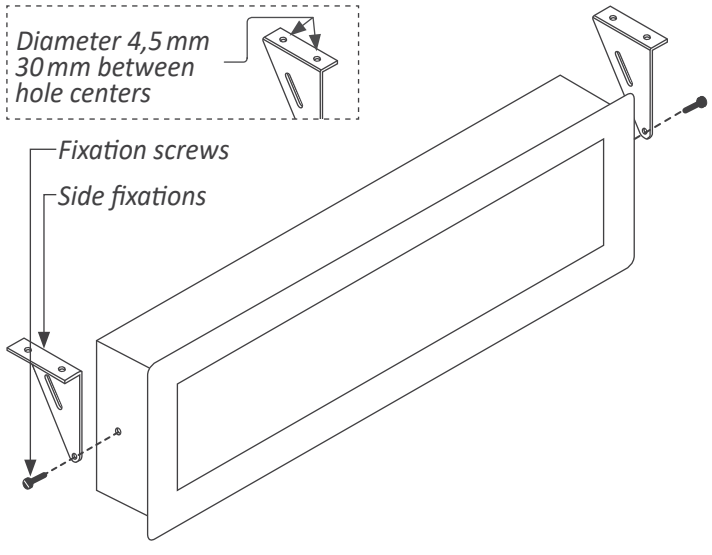


Figure 9 - Hanging mount

1.21 Installation precautions

Risk of electrical shock. Instrument terminals can be connected to dangerous voltage.

Instrument conforms to CE rules and regulations.

This instrument has been designed and verified conforming to the 61010-1 CE security regulation, for industrial applications. Installation of this instrument must be performed by qualified personnel only. This manual contains the appropriate information for the installation. Using the instrument in ways not specified by the manufacturer may lead to a reduction of the specified protection level. Disconnect the instrument from power before starting any maintenance and / or installation action.
The instrument does not have a general switch and will start operation as soon as power is connected. The instrument does not have protection fuse, the fuse must be added during installation.
An appropriate ventilation of the instrument must be assured. Do not expose the instrument to excess of humidity. Maintain clean by using a humid rag and do NOT use abrasive products such as alcohols, solvents, etc.
General recommendations for electrical installations apply, and for proper functionality we recommend : if possible, install the instrument far from electrical noise or magnetic field generators such as power relays, electrical motors, speed variators, ... If possible, do not install along the same conduits power cables (power, motor controllers, electrovalves, ...) together with signal and/or control cables.
Before proceeding to the power connection, verify that the voltage level available matches the power levels indicated in the label on the instrument.
In case of fire, disconnect the instrument from the power line, fire alarm according to local rules, disconnect the air conditioning, attack fire with carbonic snow, never with water.

1.22 Warranty

This instrument is warranted against all manufacturing defects for a period of 24 MONTHS from the shipment date. This warranty does not apply in case of misuse, accident or manipulation by non-authorized personnel. In case of malfunction get in contact with your local provider to arrange for repair. Within the warranty period and after examination by the manufacturer, the unit will be repaired or substituted when found to be defective. The scope of this warranty is limited to the repair cost of the instrument, not being the manufacturer eligible for responsibility on additional damages or costs.

1.23 CE declaration of conformity

Manufacturer FEMA ELECTRÓNICA, S.A.
Altimira 14 - Pol. Ind. Santiga
E08210 - Barberà del Vallès
BARCELONA - SPAIN
www.fema.es - info@fema.es

Products B24-485, B44-485, B26-485, B46-485

The manufacturer declares that the instruments indicated comply with the directives and rules indicated below.

Electromagnetic compatibility directive 2014/30/EU
Low voltage directive 2014/65/EU
Directive ROHS 2011/65/EU
Directive WEEE 2012/19/EU

Security rules EN-61010-1:2010

Instrument Fixed, Permanently connected
Pollution degree 1 and 2 (without condensation)
Isolation Basic + Protective union

Electromagnetic compatibility rules EN-61326-1:2013

EM environment		Industrial
Immunity levels		
EN-61000-4-2	By contact ±4 KV	Criteria B
	By air ±8 KV	Criteria B
EN-61000-4-3		Criteria A
EN-61000-4-4	On AC power lines: ±2 KV	Criteria B
	On DC power lines: ±2 KV	Criteria B
	On signal lines : ±1 KV	Criteria B
EN-61000-4-5	Between AC power lines ±1 KV	Criteria B
	Between AC power lines and earth ±2 KV	Criteria B
	Between DC power lines ±1 KV	Criteria B
	Between DC power lines and earth ±2 KV	Criteria B
	Between signal lines and earth ±1 KV	Criteria B
EN-61000-4-6		Criteria A
EN-61000-4-8	30 A/m at 50/60 Hz	Criteria A
EN-61000-4-11	0 % 1 cycle	Criteria A
	40 % 10 cycles	Criteria A
	70 % 25 cycles	Criteria B
	0 % 250 cycles	Criteria B
Emission levels		
CISPR 11	Instrument Class A, Group 1	Criteria A

Barberà del Vallès October 2020
Xavier Juncà - Product Manager

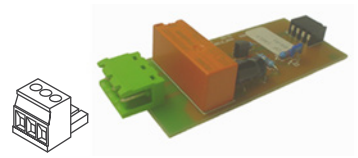
Declarations available:
CE - www.fema.es/docs/5647_CE-Declaration_B_en.pdf
UK CA - www.fema.es/docs/5653_UKCA-Declaration_B_en.pdf

According to directive 2012/19/EU, electronic equipment must be recycled in a selective and controlled way at the end of its useful life.

2. Output and control modules

2.1 Module R1

The R1 module provides 1 relay output to install in large format industrial meters from Series B. Formats B26 and B46 accept up to 3 relays, and formats B24 and B44 accept up to 2 relays.
Configuration is performed from the front keypad of the instrument, by setting the alarm parameters. Check the alarm menu parameters at the instrument user's manual for full information.
Modules R1 can be provided factory installed into a Series B instrument, or standalone for delayed installation. No soldering or special configuration is required. See section *1.10* on how to install output and control modules.



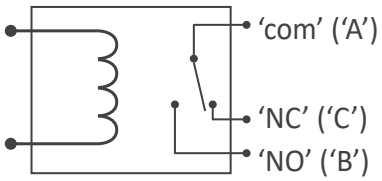
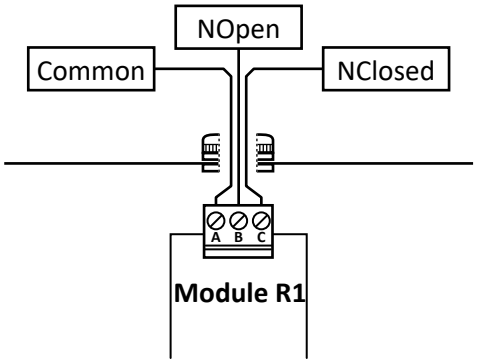


Figure 11 - Module 'R1' and internal schematic

Type of relay	3 contacts (Com, NO, NC)
Max. current	3 A (resistive load)
Voltage	250 Vac continuous
Isolation	3500 Veff
Terminal	plug-in screw clamp, pitch 5.08 mm
Installation allowed at	slot 1, slot 2, slot 3



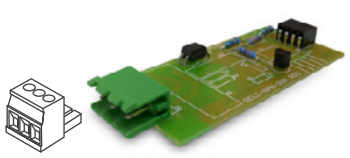
A	Common
B	NO (Normally Open)
C	NC (Normally Closed)

Figure 12 - Connections for 'R1' relay output module

For more information:
http://fema.es/docs/4326_SERIES-B_OPTIONS_manual_en.pdf

2.2 Module T1

The T1 module provides 1 transistor output to install in large format industrial meters from Series B. Formats B26 and B46 accept up to 3 transistor outputs, and formats B24 and B44 accept up to 2 transistor outputs.
Configuration is performed from the front keypad of the instrument, by setting the alarm parameters. Check the alarm menu parameters at the instrument user's manual for full information.
Modules T1 can be provided factory installed into a Series B instrument, or standalone for delayed installation. No soldering or special configuration is required. See section *1.10* on how to install output and control modules.



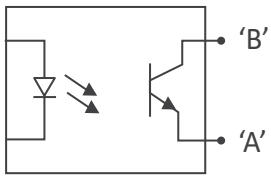
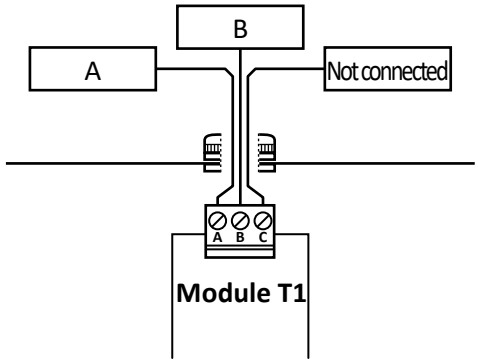


Figure 13 - Module 'T1' and internal schematic

Type of output	transistor
Max. voltage	35 Vdc
Max. current	50 mA
Isolation	3500 Veff, optoisolated
Terminal	plug-in screw clamp, pitch 5.08 mm
Installation allowed at	slot 1, slot 2, slot 3



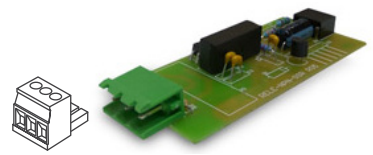
A	Emitter
B	Collector
C	Not connected

Figure 14 - Connections for 'T1' transistor output module

For more information:
http://fema.es/docs/4326_SERIES-B_OPTIONS_manual_en.pdf

2.3 Module SSR

The SSR module provides 1 output for SSR relay control, to install in large format industrial meters from Series B. Formats B26 and B46 accept up to 3 SSR control outputs, and formats B24 and B44 accept up to 2 SSR control outputs.
Configuration is performed from the front keypad of the instrument, by setting the alarm parameters. Check the alarm menu parameters at the instrument user's manual for full information.
Modules SSR can be provided factory installed into a Series B instrument, or standalone for delayed installation. No soldering or special configuration is required. See section *1.10* on how to install output and control modules.



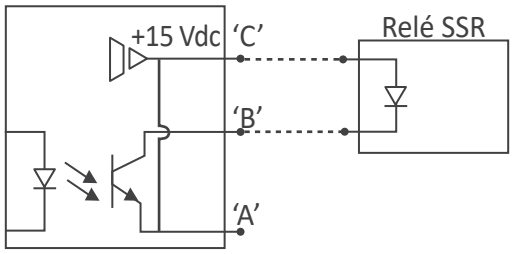
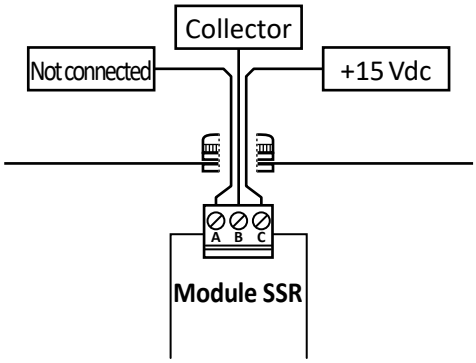


Figure 15 - Module 'SSR' and internal schematic

Type of output	for SSR relay control
Output voltage	+15 Vdc
Max. current	45 mA
Isolation	1000 Vdc
Terminal	plug-in screw clamp, pitch 5.08 mm
Installation allowed at	slot 1, slot 2, slot 3



A	Not connected
B	Collector (-)
C	+15 Vdc (+)

Figure 16 - Connections for 'SSR' control module

For more information:
http://fema.es/docs/4326_SERIES-B_OPTIONS_manual_en.pdf

2.4 Module AO

The AO module provides 1 analog output, configurable for 4/20 mA or 0/10 Vdc signal, to install in large format industrial meters from Series B. Formats B26 and B46 accept up to 3 analog outputs, and formats B24 and B44 accept up to 2 analog outputs.
Output signal is fully scalable, both with positive and negative slopes, and is proportional to the reading. The mA output can be configured for active loops (the instrument provides the power to the mA loop) or passive loops (the loop power is external to the instrument).
Configuration is performed from the front keypad of the instrument, by accessing the menu entries 'Opt.1', 'Opt.2' or 'Opt.3', according to the slot where the module is installed.
AO modules can be provided factory installed into a Series B instrument, or standalone for delayed installation. No soldering or special configuration is required. See section *1.10* on how to install output and control modules.

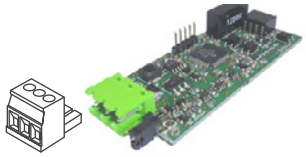
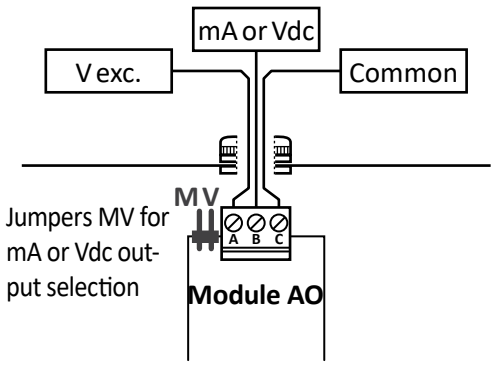


Figure 17 - Module 'AO'

Signal output	4/20mA, 0/10Vdc (active and passive)
Accuracy	0.1% FS
Isolation	1000 Vdc
Terminal	plug-in screw clamp, pitch 5.08 mm
Installation allowed at	slot 1, slot 2, slot 3



A	Excitation voltage
B	Signal in mA or Vdc
C	Common
Jumper M	Jumper closed for mA output
Jumper V	Jumper closed for Vdc output

Figure 18 - Connections for 'AO' analog output module

For more information:
http://fema.es/docs/4326_SERIES-B_OPTIONS_manual_en.pdf

2.5 Module RTU

The RTU module provides an isolated Modbus RTU communications port, to install in large format industrial meters from Series B.

The RTU module implements function '4' ('*Read Input Registers*') of the Modbus RTU protocol, to access the instrument registers (reading value, alarm status, memory of maximum and minimum, ...).

Configuration is performed from the front keypad of the instrument, by accessing the menu entries 'Opt.1', 'Opt.2' or 'Opt.3', according to the slot where the module is installed.

Modules RTU can be provided factory installed into a Series B instrument, or standalone for delayed installation. No soldering or special configuration is required. See section *1.10* on how to install output and control modules.

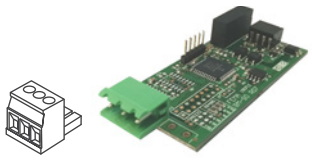
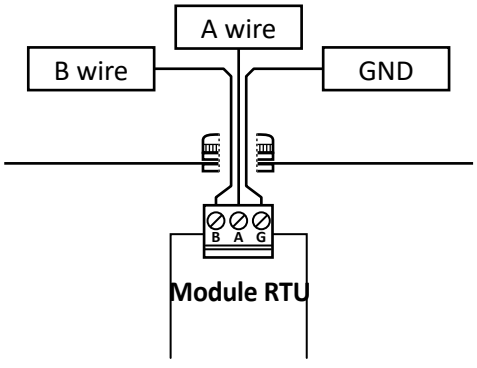


Figure 19 - Communications module 'RTU'

Protocol	Modbus RTU
Bus	RS-485, up to 57.6 Kbps
Isolation	1000 Vdc
Terminal	plug-in screw clamp, pitch 5.08 mm
Installation allowed at	slot 1, slot 2, slot 3



A	Bus signal A
B	Bus signal B
G	GND

Figure 20 - Connections for Modbus 'RTU' communications module

For more information:
http://fema.es/docs/4326_SERIES-B_OPTIONS_manual_en.pdf

2.6 Module S4

The S4 module provides an isolated RS-485 ASCII communications port, to install in large format industrial meters from Series B.

The S4 module implements a MASTER / SLAVE protocol, with up to 31 addressable slaves. In SLAVE mode allows access to reading values, alarm status, memory of maximum and minimum, ...

Configuration is performed from the front keypad of the instrument, by accessing the menu entries 'Opt.1', 'Opt.2' or 'Opt.3', according to the slot where the module is installed.

Modules S4 can be provided factory installed into a Series B instrument, or standalone for delayed installation. No soldering or special configuration is required. See section *1.10* on how to install output and control modules.

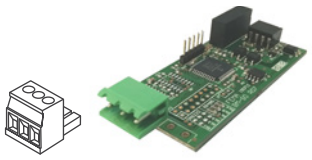
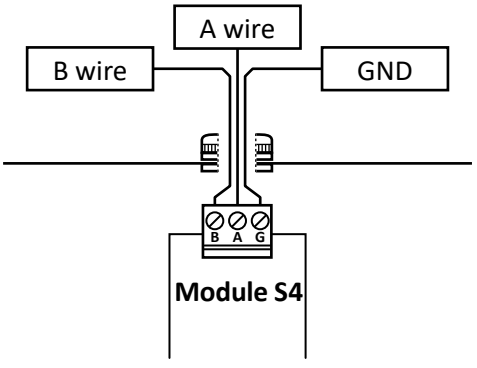


Figure 21 - Communications module 'S4'

Protocol	ASCII
Bus	RS-485, up to 57.6 Kbps
Isolation	1000 Vdc
Terminal	plug-in screw clamp, pitch 5.08 mm
Installation allowed at	slot 1, slot 2, slot 3



A	Bus signal A
B	Bus signal B
G	GND

Figure 22 - Connections for RS-485 'S4' communications module

For more information:
http://fema.es/docs/4326_SERIES-B_OPTIONS_manual_en.pdf

2.7 Module S2

The S2 module provides an isolated RS-232 ASCII communications port, to install in large format industrial meters from Series B.

The S2 module implements a MASTER / SLAVE protocol, with up to 31 addressable slaves, with 'daisy-chain' connection. In SLAVE mode allows access to reading values, alarm status, memory of maximum and minimum, ...

Configuration is performed from the front keypad of the instrument, by accessing the menu entries 'Opt.1', 'Opt.2' or 'Opt.3', according to the slot where the module is installed.

Modules S2 can be provided factory installed into a Series B instrument, or standalone for delayed installation. No soldering or special configuration is required. See section *1.10* on how to install output and control modules.

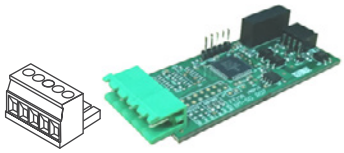
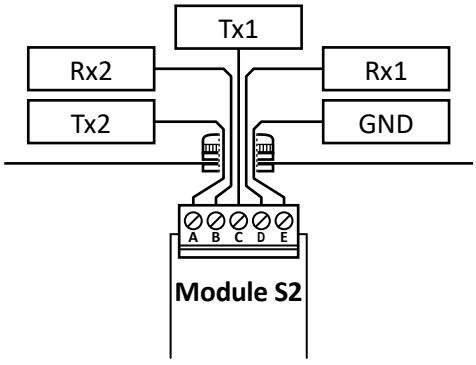


Figure 23 - Communications module Module 'S2'

Protocol	ASCII
Bus	RS-232, up to 57.6 Kbps
Isolation	1000 Vdc
Terminal	plug-in screw clamp, pitch 5.08 mm
Installation allowed at	slot 1, slot 2, slot 3



A	'Daisy chain' Tx data transmission
B	'Daisy chain' Rx data reception
C	Tx data transmission
D	Rx data reception
E	GND

Figure 24 - Connections for RS-232 'S2' communications module

For more information:
http://fema.es/docs/4326_SERIES-B_OPTIONS_manual_en.pdf

3. Other options and accessories

3.1 RKB - Remote keypad

Remote keypad for large format industrial meters from Series B. Replicates a remote version of the front keypad, close to the operator.

*(*Cable not provided).*

3.2 Red LED

Red LED

3.3 Green LED

Green LED

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