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1. LDB-RTU Series

Large format industrial meters for Modbus RTU 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 Modbus RTU protocol. Control of the reading value, decimal point and alarm status, by writing to internal registers. Standard Modbus RTU 16 bit registers for readings from 32767 to -32767, and configurable to 32 bits registers for readings from 999999 to -199999 *(see section 1.21.5).*

Alarms can be configured for remote or local control by selecting the 'Full slave' or 'Process slave' modes *(see section 1.21.2)*. In 'Full slave' mode alarms can be controlled by writing to registers or to coils *(see section 1.21.6).*

Bus speed up to 38.400 bps and addresses from 1 to 247. 'Watchdog' function to control loss of communication with the master, with control of error message and alarm activation *(see section 1.21.4)*.

'Bus activity' function for help on communications start-up *(see section 1.21.12).*

Output and control options with 1, 2 and 3 relays, transistor outputs, controls for SSR relays, isolated analog outputs, communications in Modbus RTU, RS485 ASCII and RS232.

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 1.21.11)*
- '**On power up**' for system protection on 'cold' start-up and control of alarm status *(see section 1.21.13)*
- alarms in 'Process slave' mode, with 1 or 2 setpoints, independent activation and deactivation delays, hysteresis, manual unlocking, ... *(see section 1.21.8)*

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
LDB-24	RTU	H					

Format		Power		Color		Option 1		Option 2		Option 3*	
LDB-24	*(60 mm, 4 digits)*	-H	*(85-265 Vac and 120-370 Vdc)*	-R	*(red led)*	-R1	*(1 relay)*	-AO	*(analog output)*	**Option 3 available with formats LDB-26 and LDB-46*	
LDB-26	*(60 mm, 6 digits)*	-L	*(11-36 Vdc isolated)*	-G	*(green led)*	-RTU	*(Modbus RTU)*	-S4	*(RS-485)*		
LDB-44	*(100 mm, 4 digits)*							-S2	*(RS-232)*		
LDB-46	*(100 mm, 6 digits)*							-T1	*(1 transistor)*		
								-SSR	*(1 control SSR)*		
								-0	*(empty)*		

1.2 Index

1.3 How to use this manual

If this is the first time you are configuring a LDB series 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 *1.24*.

1. Identify the instrument format *(see section 1.7)*
2. Power and signal connections
   - open the instrument *(see section 1.8)*
   - connect the power *(see section 1.10)*
   - connect the signal *(see section 1.11)*
   - close the instrument *(see section 1.8)*
3. Configure the instrument *(see section 1.21)*
   - select the working mode, and the bus configuration *(see section 1.21.2)*
   - configure the protocol *(see section 1.21.7)*
4. Advanced configuration (optional)
   - configure the instrument alarms *(see section 1.21.8)*
   - configure the fast access *(see section 1.21.11)*
   - configure other functions: 'on power up' *(1.21.13)*, key 'LE' *(1.21.20)* and password *(1.21.21)*
5. If the instrument includes analog output (AO) or serial communications (RTU, S4, S2)
   - to include an option to an instrument see section *1.9*
   - to configure an installed option, access the option configuration menu *(see section 1.21.25)*
   - see section *2* for information regarding the output and control options available
6. Install the instrument
   - mount on panel, wall or hanging *(see section 1.23)*
   - adjust the brightness level according to your environmental needs *(see section 1.21.24)*

1.4 Modbus RTU definitions

The Modbus RTU protocol is a serial communications protocol, based on RS-485 bus, with 'master'/'slave' architecture. Modbus RTU elements needed to understand this manual are described below:

- 'registers': are memory sections inside the 'slave' instrument, where the 'master' reads or writes data. Registers store numerical data. Modbus works with registers of 16 bits, which allows for numerical values from 32767 to -32767. For displays with 6 digits (display values from 999999 to -199999) registers of 32 bits are needed *(see section 1.21.5)*.
- 'coils': are memory sections inside the 'slave' instrument, where the 'master' reads or writes data. Coils store binary data ('1' or '0'). Coils are typically used for alarm control and other elements with 2 states : 'on' and 'off'.
- 'functions': are actions that indicate to write or read values into 'registers' or 'coils' *(see Table 1)*.
- 'errors' : Modbus is a protocol with a 'master' / 'slave' architecture and the 'master' will always expect a reply from the 'slave'. If a requested 'function', 'register' or 'coil' is not available, the 'slave' will answer with an error. See section *1.15* for a list of errors available.

Function	*Name*	*Description*
6	*Write single register*	*writes on a single register*
16	*Write multiple registers*	*writes on multiple registers*
3	*Read registers*	*reads on multiple registers*
5	*Write single coil*	*writes on a single coil*
15	*Write multiple coils*	*writes on multiple coils*
1	*Read coils*	*reads on multiple coils*

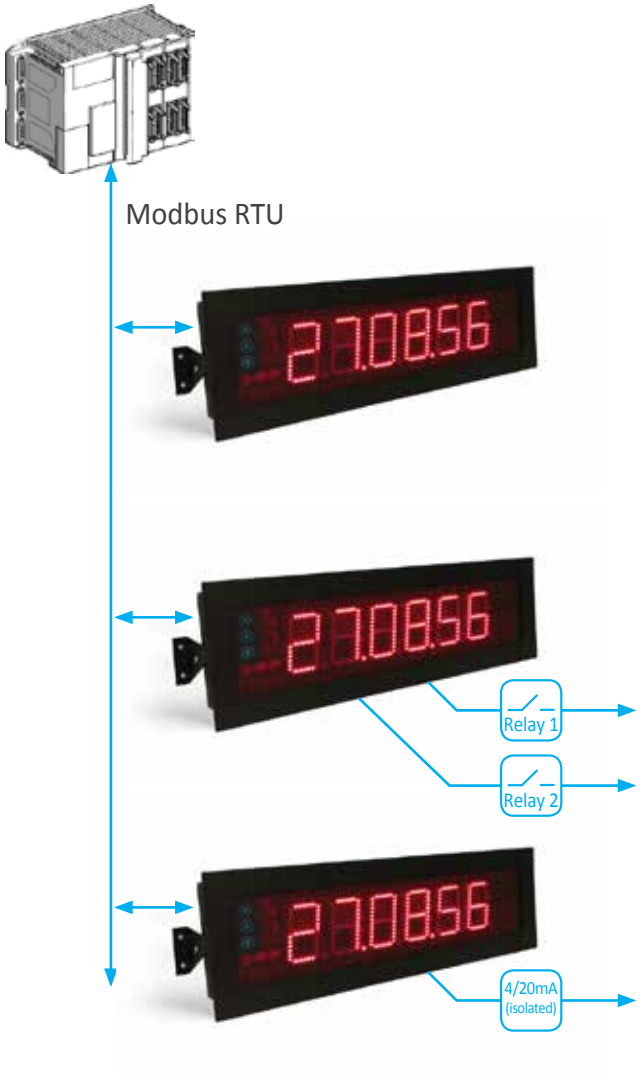
Table 1 - Modbus RTU supported functions

1.5 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 Modbus RTU protocol. Modbus RTU 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' working mode *(see section 1.21.2))* or locally controlled by the instrument ('Process slave' working mode *(see section 1.21.2)*).

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

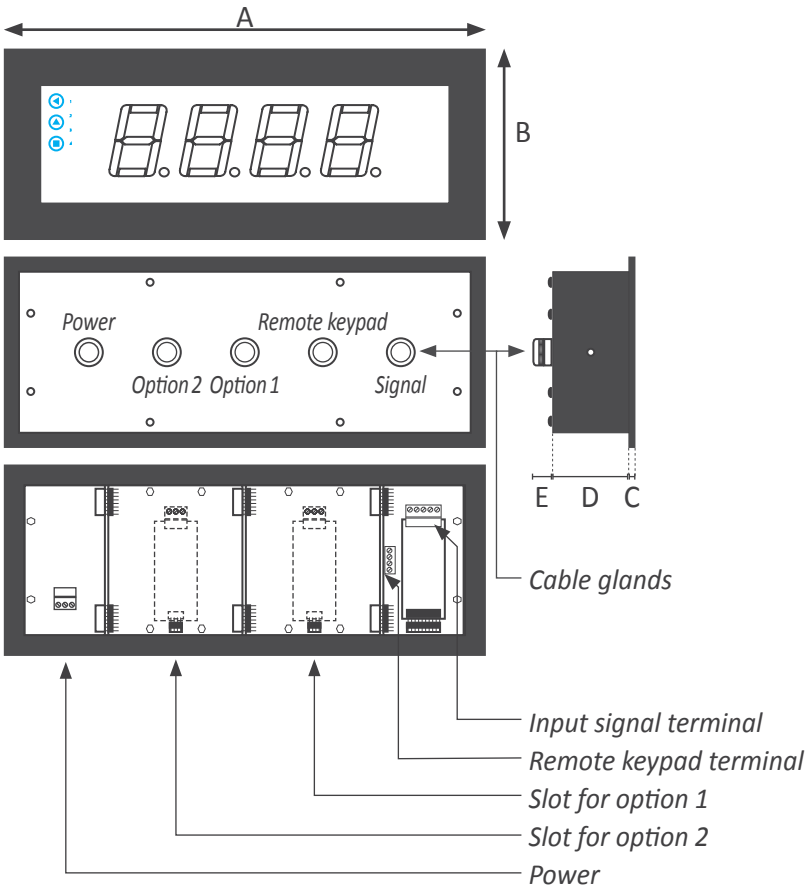


1.6 Factory configuration

Working mode	'Full slave' ('F.SLV')
Bus	
Speed	19200 bps
Format	8n1
Configuration	
Local address	1
'Watchdog'	10 seconds
'On error'	flash ('FLSh')
Data length	16 bits
Alarm control	by coil
Alarms in 'Full slave' mode	
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 maximum	off
Memory of minimum	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
Decimal point	remote ('rMtE')
Key 'LE'	no function ('none')
Password	off
Brightness	3

1.7 Sizes and formats

1.7.1 Format LDB-24

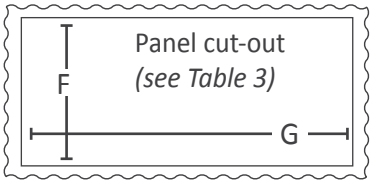


Size A	340 mm
Size B	135 mm
Size C	3 mm
Size D	55 mm
Size E	25 mm

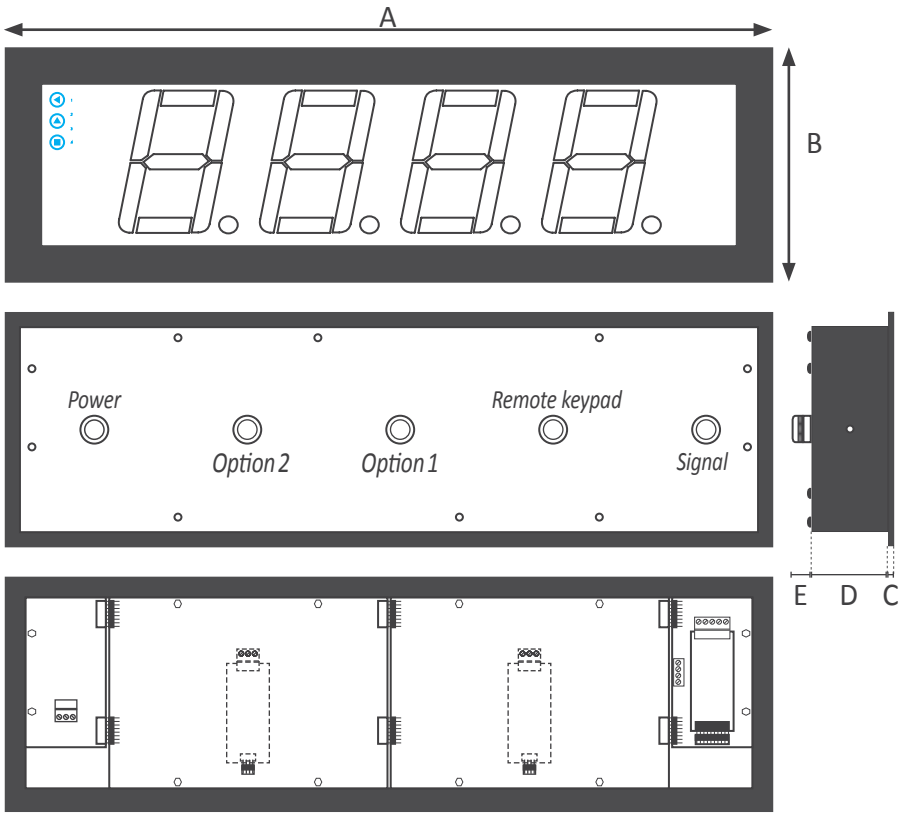
Table 2 - Sizes LDB-24

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

Table 3 - Panel cut-out LDB-24



1.7.2 Format LDB-44

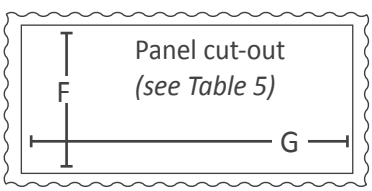


Size A	542 mm
Size B	166 mm
Size C	3 mm
Size D	55 mm
Size E	25 mm

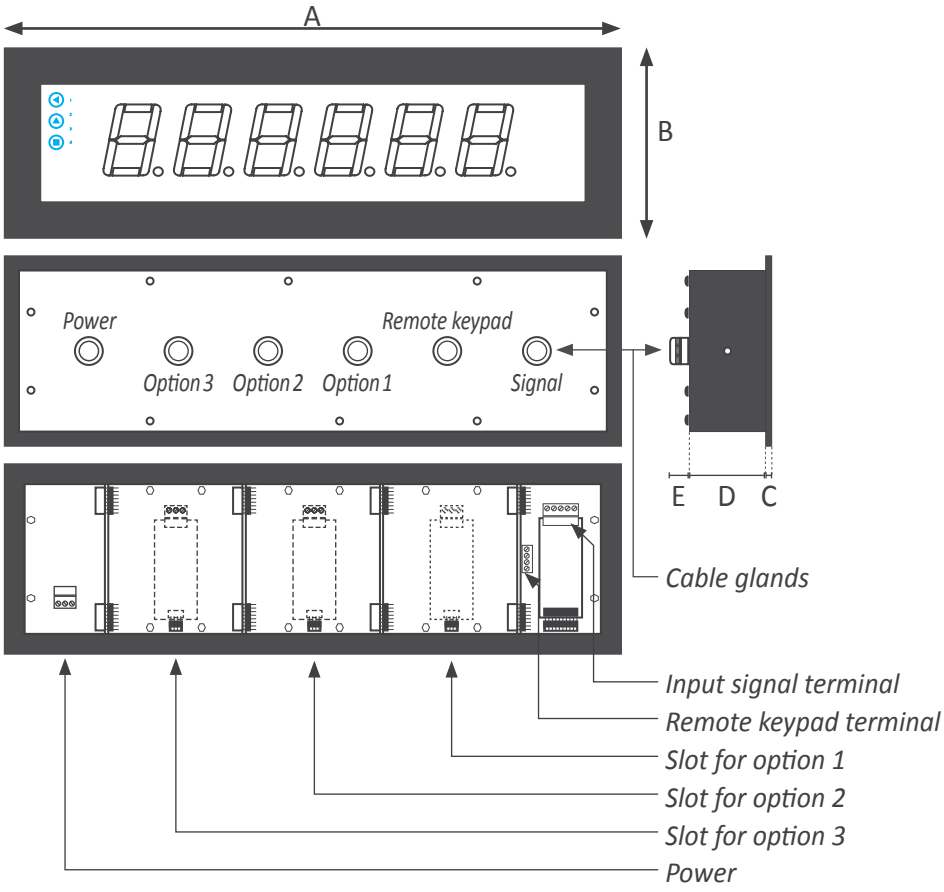
Table 4 - Sizes LDB-44

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

Table 5 - Panel cut-out LDB-44



1.7.3 Format LDB-26

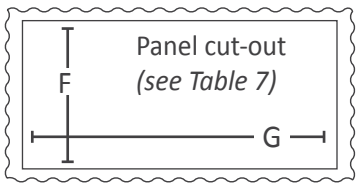


Size A	436 mm
Size B	135 mm
Size C	3 mm
Size D	55 mm
Size E	25 mm

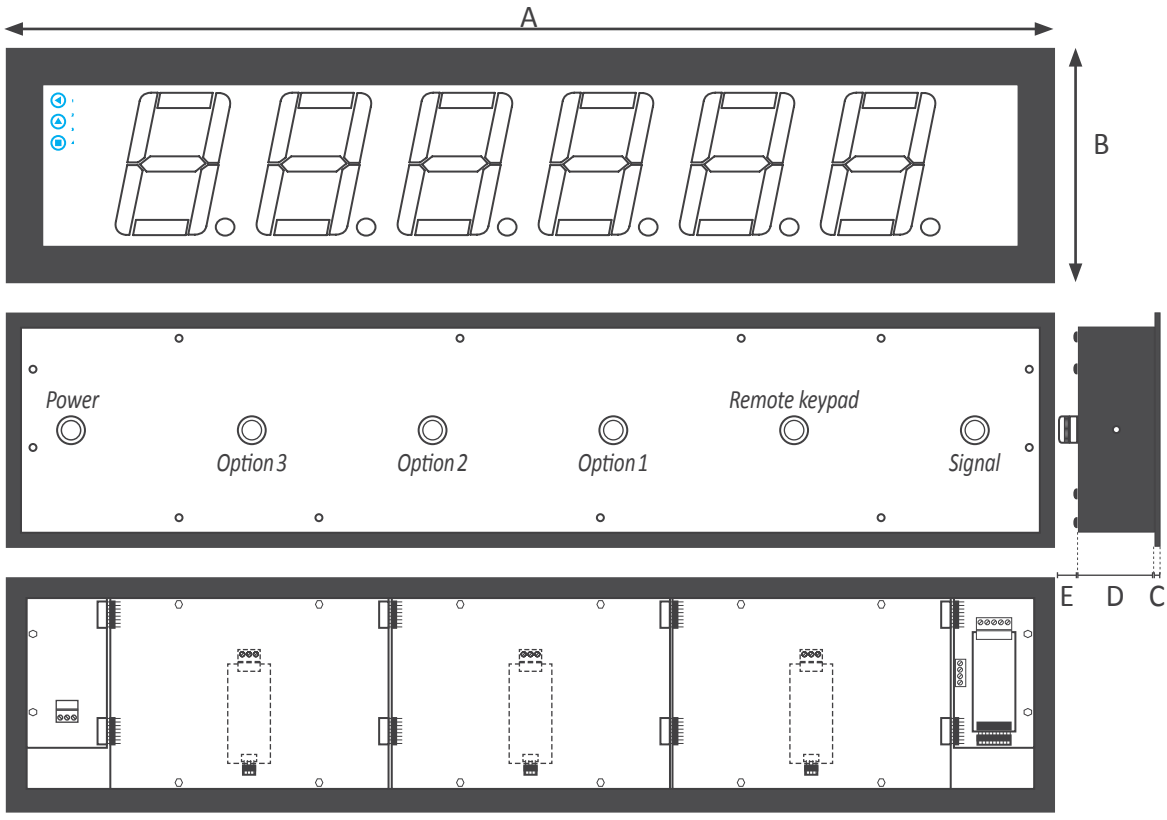
Table 6 - Sizes LDB-26

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

Table 7 - Panel cut-out LDB-26



1.7.4 Format LDB-46

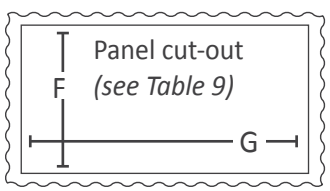


Size A	740 mm
Size B	166 mm
Size C	3 mm
Size D	55 mm
Size E	25 mm

Table 8 - Sizes LDB-46

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

Table 9 - Panel cut-out LDB-46



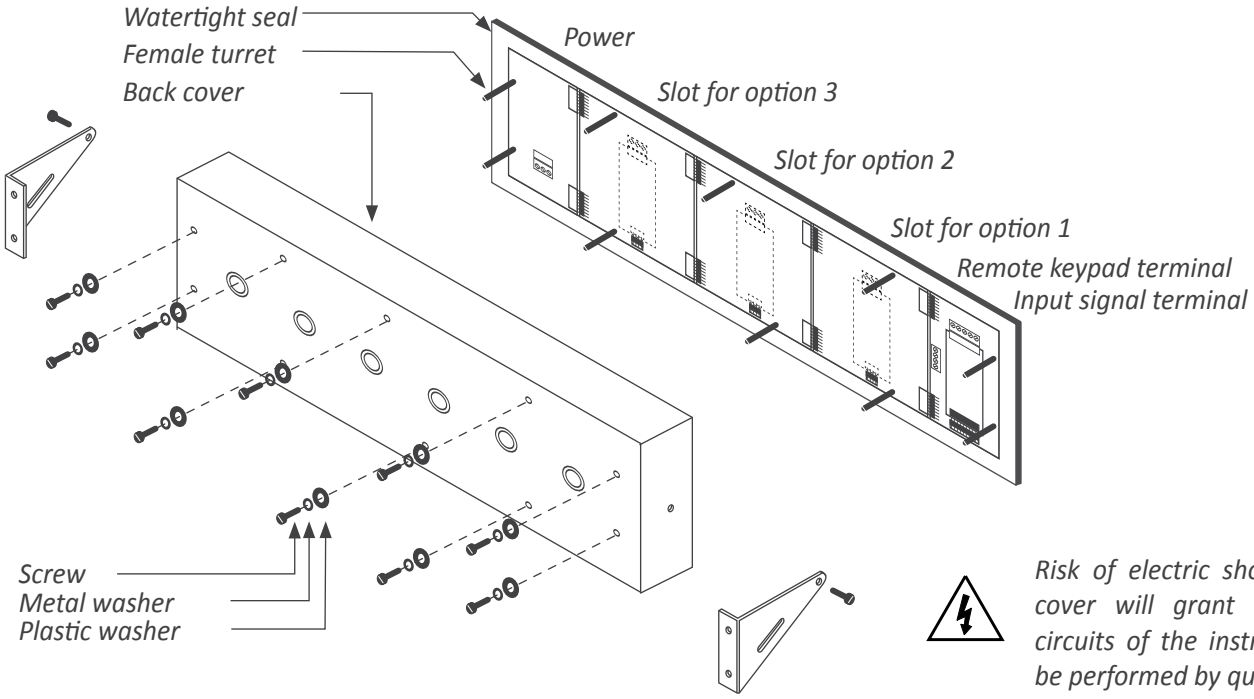
1.8 To access the instrument

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 LDB-26 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.



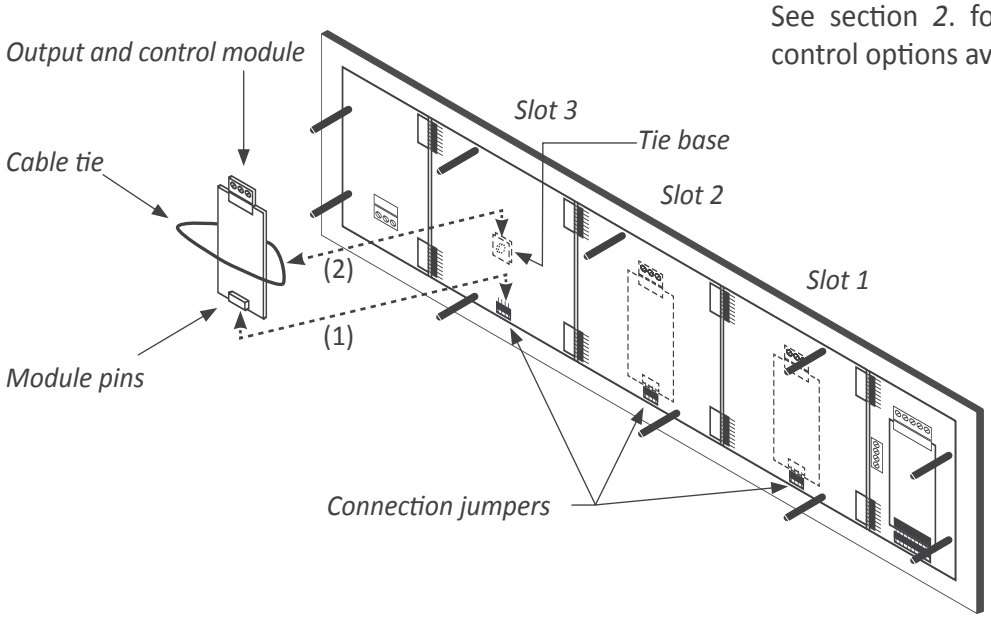
Risk of electric shock. Removing the back cover will grant access to the internal circuits of the instrument. Operation must be performed by qualified personnel only.

1.9 Modular system

Large format meters from LDB series 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

1.10 Power connections and protective earth

1. Unscrew the screws from the back cover and remove the back cover *(see section 1.8).*
2. Pass the power cable through the power cable gland *(see section 1.7).*
3. Prepare the power cables so that the earth wire is 20 cm longer than the other cables *(see Figure 1).*

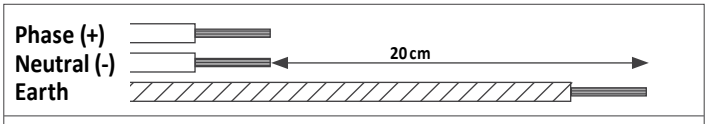


Figure 1 - Longer earth wire

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

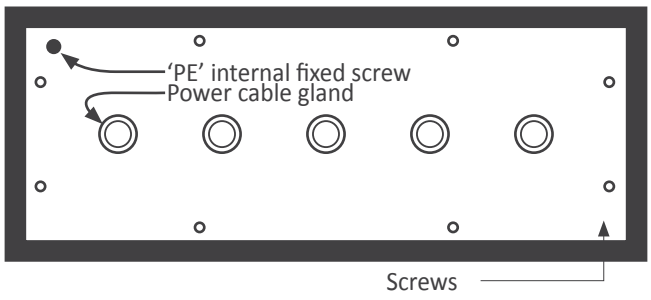


Figure 2 - Location of the internal 'PE' fixed screw and power cable gland

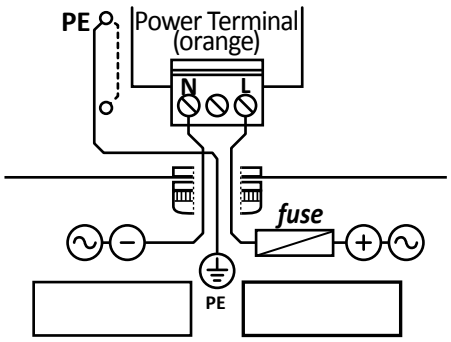
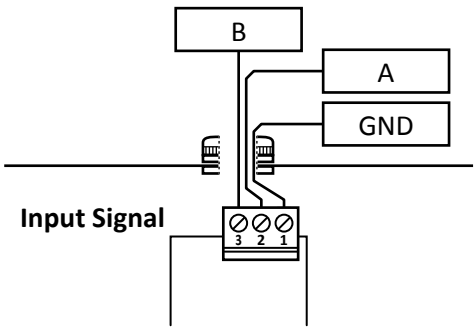


Figure 3 - Power connections

1.11 Input signal connections

1. Unscrew the screws from the back cover and remove the back cover *(see section 1.8).*
2. Locate the input signal terminal *(see section 1.7).*
3. Pass the signal cable through the signal cable gland *(see section 1.7).*
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.

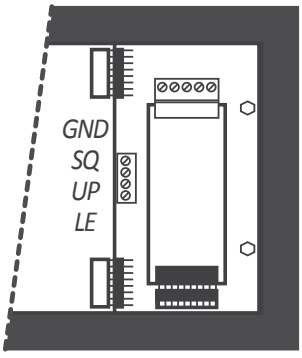


A	RS-485 A wire
B	RS-485 B wire
GND	Shield

Figure 4 - Signal connections

1.12 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 1.7).*



1.13 Technical specifications

Digits

number of digits	4 or 6 *(see Table 10)*
digit	7 segments
view angle	120º
color	red or green
digit height	*(see Table 10)*

Reading

max., min.	*(see Table 10)*
decimal point	X.X.X.X.X.X.

Protocol

	Modbus RTU
function	slave within a Modbus RTU bus
speed	from 38.400 bps to 600 bps
data formats	8n1, 8e1, 8o1, 8n2
addresses	1 to 247
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 10)*
fuses	*(see section 1.10)*
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 1.23)*
connections	cable gland outputs internal plug-in screw terminals
housing material	textured iron, black painted methacrylate front filter
weight	*(see Table 10)*
front sizes	*(see section 1.7)*
panel cut-out	*(see section 1.7)*
depth	*(see section 1.7)*

Temperature

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

	Format LDB-24	Format LDB-44	Format LDB-26	Format LDB-46
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 10 - Technical specifications associated to format

1.14 Functions included

Functions included		*Section*
Local or remote alarms	*yes, configurable*	*1.21.8*
Address	*configurable*	*1.21.3*
Watchdog	*yes, configurable*	*1.21.4*
Watchdog error	*yes, configurable*	*1.21.4*
Registers	*16 or 32 bits*	*1.21.5*
Remote alarms	*by 'coil' or 'register'*	*1.21.6*
Local alarms	*simple or double setpoint* *activation delays* *deactivation delays* *hysteresis* *inverted relays* *locked alarms*	*1.21.8*
Fast access menu	*yes, configurable*	*1.21.11*
'Bus activity'	*yes*	*1.21.12*
'On Power Up'	*yes*	*1.21.13*
'Setpoint on bus'	*yes*	*1.21.14*
'Decimal point'	*yes*	*1.21.15*
Key 'LE'	*yes*	*1.21.20*
Password	*configuration locked*	*1.21.21*
Brightness	*configurable, 5 levels*	*1.21.24*

Table 11 - Functions included

1.15 Messages and errors

Error messages related to the local instrument are shown on display, in flash mode *(see Table 12)*. 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 13)*.

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 12 - Messages and error codes for local instrument

Messages and errors on the Modbus RTU protocol	
1	'Illegal function'. Function requested is not available.
2	'Illegal data'. Register or coil requested is not available.

Table 13 - Messages and error codes for the Modbus RTU protocol

1.16 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 1.21.13)*
2. start up delay according to configuration *(see section 1.21.13)*
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' *(see section 1.21.2)*
   4.1 in 'Full slave' mode 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

1.17 Registers and functions : 16 bits ‘Process slave’

List of available registers *(see Table 14)* and available functions *(see Table 15)* for instruments configured in ‘Process slave’ mode and 16 bits data length.

- accessing a function not listed in the table, returns error 1 ‘Illegal Function’.
- accessing a register not listed in the table, returns error 2 ‘Illegal Data Address’.
- working with 16 bit registers allows for codification of numbers between 32767 and -32767. To work with numbers up to 999999 / -199999, configure registers for 32 bits data *(see section 1.21.5).*
- registers Setpoint 1, Setpoint 2 and Setpoint 3 are disabled by default (setpoint value is modified through the front keypad). To enable access to read and write these registers through the bus, while staying in ‘Process slave’ mode, see section *1.21.14.*

- writing to the setpoint registers when they are disabled returns error 2 ‘Illegal Data Address’.

- modifying a setpoint value manually from the front keypad, does not update the value stored at the setpoint register. Reading the setpoint register does not access the setpoint value configured in the instrument, but the last written value on the register.

- after power loss, the instrument starts up with all registers initialized to ‘0’ *(see section 1.16).*
- the ‘Resolution’ register contains a numerical value indicating the number of decimal places on display. Valid values from 0 to 5. Writing value 2 lights the decimal point at position XXXX.XX. Non valid values are discarded and no error message is generated.
- all registers are read and write registers.
- access to reserved registers does not generate error messages.

Example - to update the display of the instrument to a value of 432.1, write onto ‘Display’ register the number ‘4321’ and write onto ‘Resolution’ register the number ‘1’.

Register ‘Display’ : ‘4321’

Register ‘Resolution’ : ‘1’

Register number	*Name*
0	*Display*
1	*Resolution*
2	*Setpoint 1**
3	*Setpoint 2**
4	*Setpoint 3**
5	*Reserved*

Table 14 - Registers in 16 bits and ‘Process slave’ mode

Function number	*Name*
6	*Write single register*
16	*Write multiple registers*
3	*Read registers*

Table 15 - Functions in 16 bits and ‘Process slave’ mode

1.18 Registers and functions : 16 bits 'Full Slave'

List of available registers *(see Table 16),* available 'coils' *(see Table 17)* and available functions *(see Table 18)* for instruments configured in 'Full slave' mode and 16 bits data length.

- accessing a function not listed in the table, returns error 1 'Illegal Function'.
- accessing a register not listed in the table, returns error 2 'Illegal Data Address'.
- working with 16 bit registers allows for codification of numbers between 32767 and -32767. To work with numbers up to 999999 / -199999, configure registers for 32 bits data *(see section 1.21.5).*
- after power loss, the instrument starts up with all registers initialized to '0' *(see section 1.16).*
- the 'Resolution' register contains a numerical value indicating the number of decimal places on display. Valid values from 0 to 5. Writing value 2 lights the decimal point at position XXXX.XX. Non valid values are discarded and no error message is generated.
- alarms can be controlled using 'Alarm' registers or 'coils'. By default, alarms are controlled by coils*(see Table 17).* To enable the 'Alarm' register see section *1.21.6*. The 'Alarm' register is made of bits. Bit '0' controls the state of Alarm 1, bit '1' control the state of Alarm 2 and bit '2' controls the state of Alarm 3
- all registers are read and write registers.
- access to reserved registers does not generate error messages.

Example - to update the display of the instrument to a value of 432.1, write onto 'Display' register the number '4321' and write onto 'Resolution' register the number '1'.

Register 'Display' : '4321'

Register 'Resolution' : '1'

Register number	*Name*
0	*Display*
1	*Resolution*
2	*Alarms*
3 *4* *5*	*Reserved*

Table 16 - Registers in 16 bits and 'Full Slave' mode

'Coil' number	*Name*
0	*Alarm 1*
1	*Alarm 2*
2	*Alarm 3*
3 *4* *5* *6* *7*	*Reserved*

Table 17 - 'Coils' in 16 bits and 'Full Slave' mode

Function number	*Name*
6	*Write single register*
16	*Write multiple registers*
3	*Read registers*
5	*Write single 'coil'*
15	*Write multiple 'coils'*
1	*Read 'coils'*

Table 18 - Functions in 16 bits and 'Full Slave' mode

1.19 Registers and functions : 32 bits 'Process slave'

List of available registers *(see Table 19)* and available functions *(see Table 20)* for instruments configured in 'Process slave' mode and 32 bits data length.

- accessing a function not listed in the table, returns error 1 'Illegal Function'.
- accessing a register not listed in the table, returns error 2 'Illegal Data Address'.
- working with 16 bit registers allows for codification of numbers between 32767 and -32767. If higher or lower values are codified into a register, it will force the instrument to overrange or underrange the reading.
- registers Setpoint 1, Setpoint 2 and Setpoint 3 are disabled by default (setpoint value is modified through the front keypad). To enable access to read and write these registers through the bus, while staying in 'Process slave' mode, see section *1.21.14.*

- writing to the setpoint registers when they are disabled returns error 2 'Illegal Data Address'.

- sending values higher than 999999 (or lower than -199999) to the setpoint registers will save the value 999999 (or -199999)

- modifying a setpoint value manually from the front keypad, does not update the value stored at the setpoint register. Reading the setpoint register does not access the setpoint value configured in the instrument, but the last written value on the register.

- after power loss, the instrument starts up with all registers initialized to '0' *(see section 1.16).*
- registers of 32 bits are written with function 'Write Multiple Registers'. Both registers ('high' and 'low') must be written with the same write function. If write function is received only for one of the registers ('high' or 'low') the instrument will discard the write function. No error code will be generated.
- the 'Resolution' register contains a numerical value indicating the number of decimal places on display. Valid values from 0 to 5. Writing value 2 lights the decimal point at position XXXX.XX. Non valid values are discarded and no error message is generated.
- all registers are read and write registers.
- access to reserved registers does not generate error messages.

Register number	*Name*
0	*Display Low*
1	*Display High*
2	*Resolution Low*
3	*Resolution High*
4	*Setpoint 1 Low*
5	*Setpoint 1 High*
6	*Setpoint 2 Low*
7	*Setpoint 2 High*
8	*Setpoint 3 Low*
9	*Setpoint 3 High*
10	*Reserved*
11	*Reserved*

Table 19 - Registers in 32 bits and 'Process slave' mode

Function number	*Name*
16	*Write multiple registers*
3	*Read registers*

Table 20 - Functions in 32 bits and 'Process slave' mode

Example - to update the display of the instrument to a value of 6543.21, it is needed to work with 32 bits registers. Convert the value to hex format and write to the 'Display high' register the first 16 bits and to the 'Display low' register the last 16 bits.

654321 decimal translated to hexadecimal is 0x0009FBF1
register 'display high' = 0x0009 = '9'
register 'display low' = 0xFBF1 = '64497'

When programming, this is directly achieved with functions DIV (integer division) and MOD (rest of integer division).

register 'display high' = 654321 DIV 65536 = 9
register 'display low' = 654321 MOD 65536 = 64497

register 'resolution high' = 0
register 'resolution low' = 2

1.20 Registers and functions : 32 bits 'Full Slave'

List of available registers *(see Table 21)*, available 'coils' *(see Table 22)* and available functions *(see Table 23)* for instruments configured in 'Full slave' mode and 32 bits data length.

- accessing a function not listed in the table, returns error 1 'Illegal Function'.
- accessing a register not listed in the table, returns error 2 'Illegal Data Address'.
- working with 16 bit registers allows for codification of numbers between 32767 and -32767. If higher or lower values are codified into a register, it will force the instrument to overrange or underrange the reading.
- after power loss, the instrument starts up with all registers initialized to '0' *(see section 1.16).*
- registers of 32 bits are written with function 'Write Multiple Registers'. Both registers ('high' and 'low') must be written with the same write function. If write function is received only for one of the registers ('high' or 'low') the instrument will discard the write function. No error code will be generated.
- the 'Resolution' register contains a numerical value indicating the number of decimal places on display. Valid values from 0 to 5. Writing value 2 lights the decimal point at position XXXX.XX. Non valid values are discarded and no error message is generated.
- alarms can be controlled using 'Alarm' registers or 'coils'. By default, alarms are controlled by coils*(see Table 17).* To enable the 'Alarm' register see section *1.21.6*. The 'Alarm' register is made of bits. Bit '0' controls the state of Alarm 1, bit '1' control the state of Alarm 2 and bit '2' controls the state of Alarm 3
- all registers are read and write registers.
- access to reserved registers does not generate error messages.

Register number	Name
0	Display Low
1	Display High
2	Resolution Low
3	Resolution High
4	Alarms Low
5	Alarm as High
6 a 11	Reserved

Table 21 - Registers in 32 bits and 'Full slave' mode

'Coil' number	Name
0	Alarm 1
1	Alarm 2
2	Alarm 3
3 4 5 6 7	Reserved

Table 22 - 'Coils' in 32 bits and 'Full Slave' mode

Function number	Name
16	Write multiple registers
3	Read registers
5	Write single 'coil'
15	Write multiple 'coils'
1	Read 'coils'

Table 23 - Functions in 32 bits and 'Full Slave' mode

Example - to update the display of the instrument to a value of 6543.21, it is needed to work with 32 bits registers. Convert the value to hex format and write to the 'Display high' register the first 16 bits and to the 'Display low' register the last 16 bits.

654321 decimal translated to hexadecimal is 0x0009FBF1
register 'display high' = 0x0009 = '9'
register 'display low' = 0xFBF1 = '64497'

When programming, this is directly achieved with functions DIV (integer division) and MOD (rest of integer division).

register 'display high' = 654321 DIV 65536 = 9
register 'display low' = 654321 MOD 65536 = 64497

register 'resolution high' = 0
register 'resolution low' = 2

1.21 Configuration

1.21.1 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 *1.22*.

'*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 *1.21.11* 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.

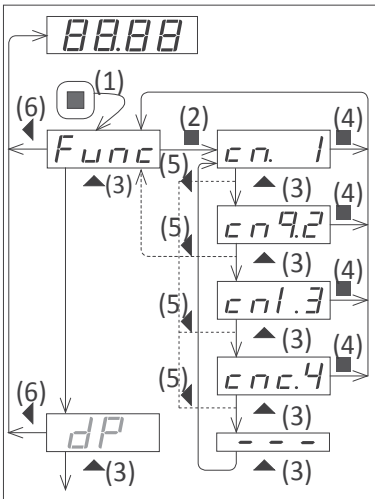
Key 'LE' (◀) - press the 'LE' (◀) key to activate the configured special functions associated to this key. Inside the menu, the 'LE' (▲) acts as an 'ESCAPE'. It leaves the selected menu level and eventually, by leaving all menu levels, it leaves from the configuration menu. Then changes are applied and 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.

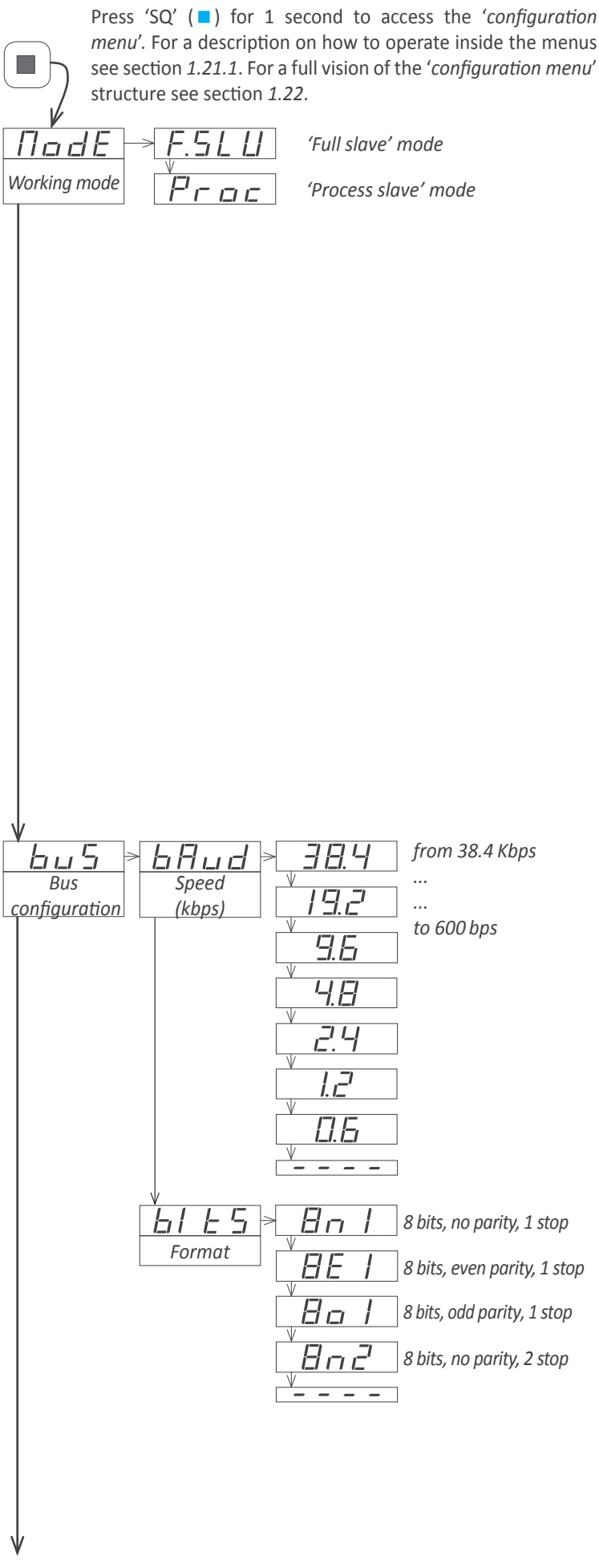


Example of operation inside the '*configuration menu*'.

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'

1.21.2 Initial set-up



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

The instrument has 2 working modes named 'Full slave' and 'Process slave'. In both modes, the reading value is received from the communications bus. The differences between modes are related to how the alarms are controlled.

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

- select '**Full slave**' to control the alarms directly from 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 '**Process slave**' to control the alarms 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.

Configuration menus for both modes are slightly different. The following sections will mention when a parameter applies only to one of the 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'.

1.21.3 Addresses

The instrument can be assigned any address between 1 and 247.

1.21.4 '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 1.21.8)*.

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'.

1.21.5 16 bits or 32 bits registers

As a standard, Modbus RTU protocol is designed to work with registers of 16 bits. This allows to work with numerical values between 32767 and -32767. In order to work with numerical values up to 999999 and -199999, larger register of 32 bits are needed *(see section 1.21.5)*. A 32 bits register is read and written as if it was composed of 2 registers of 16 bits.

To write on 32 bits registers use function 16 'Write multiple registers' and to read on 32 bits registers use function 3 'Read registers'. Working with 32 bits registers has the following limitations:

- registers of 32 bits (2 registers of 16 bits) must be written or read using the same single function. It is not allowed to write 16 bits with a function and then write the following 16 bits in the next function.
- in case of writing (or reading) only a part of a 32 bits register (only first 16 bits or last 16 bits) the instrument will discard the write (or read) function. Instrument will not transmit error code.

Available 'functions', 'registers' and 'coils' for each mode are explained at sections *1.17, 1.18, 1.19 and 1.20.*

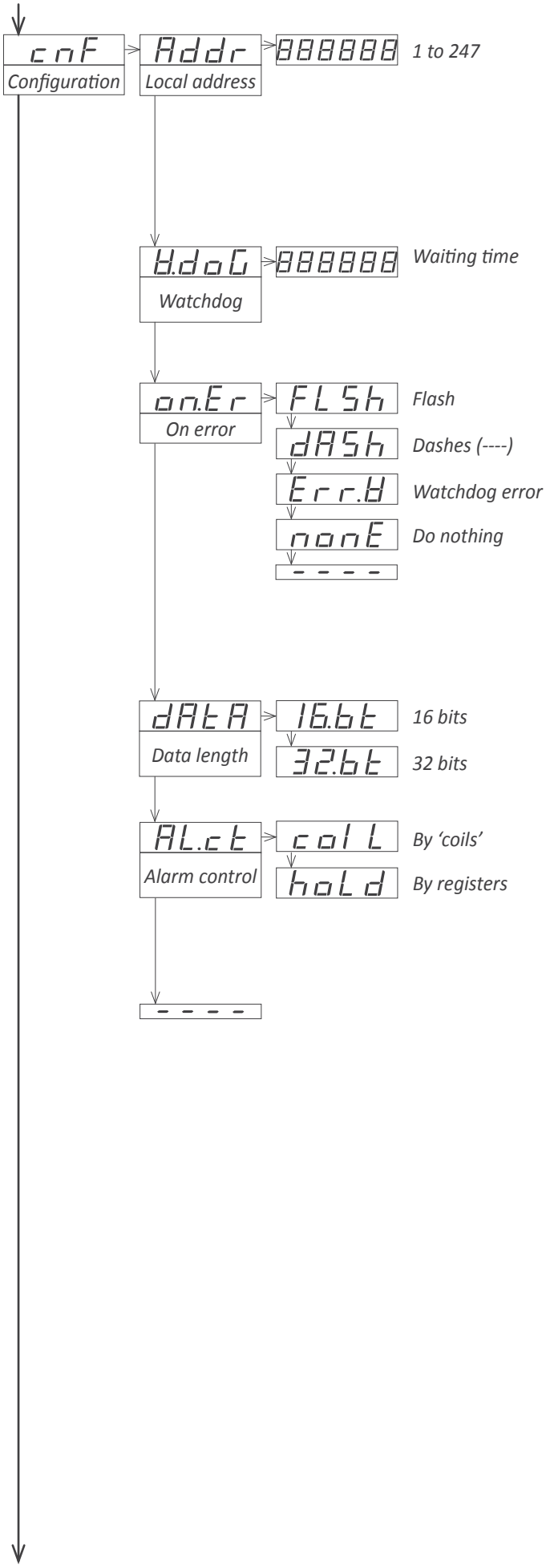
1.21.6 Alarm control : registers and 'coils'

In 'Full slave' mode, the 'master' controls the activation and deactivation of each individual alarm in the 'slave' instrument, by sending write functions to the appropriate registers or coils. By default, alarm control is performed by writing to coils. To switch to alarm control by writing to registers, configure the menu 'Alarm control' ('**AL.ct**').

Alarm control by coil or register is selectable but only one type of control can be active.

Available 'functions', 'registers' and 'coils' for each mode are explained at sections *1.17, 1.18, 1.19* and *1.20.*

1.21.7 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, the data length and the alarm control.

- at the '**Local address**' ('**Addr**') parameter configure the local address of the instrument. Values from 1 to 247.
- 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 1.21.4).*
- 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.

- at the '**Data lengh**' ('**dAtA**') parameter configure the instrument to work with 16 bit or 32 bit registers. By default, it works with 16 bit registers *(see section 1.21.5)*.
- the '**Alarm control**' ('**AL.ct**') parameter applies only in 'Full Slave' mode. Select '**coIL**' or '**hoLd**' to configure alarm control by writing to coils or to registers *(see section 1.21.6)*.

1.21.8 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 1.7)*. LDB-24 and LDB-44 formats have 2 free slots for output and control modules, while LDB-26 and LDB-46 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' mode**

In 'Full slave' mode, the alarms are controlled through the bus. By default the control is performed by writing to the 'coils'. to activate control by writing to 'registers' see section *(see section 1.21.6)*.

In 'Full slave' mode an alarm can be associated to the watchdog. This alarm will activate when the watchdog error activates *(see section 1.21.4)*. 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 ctivation 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*).

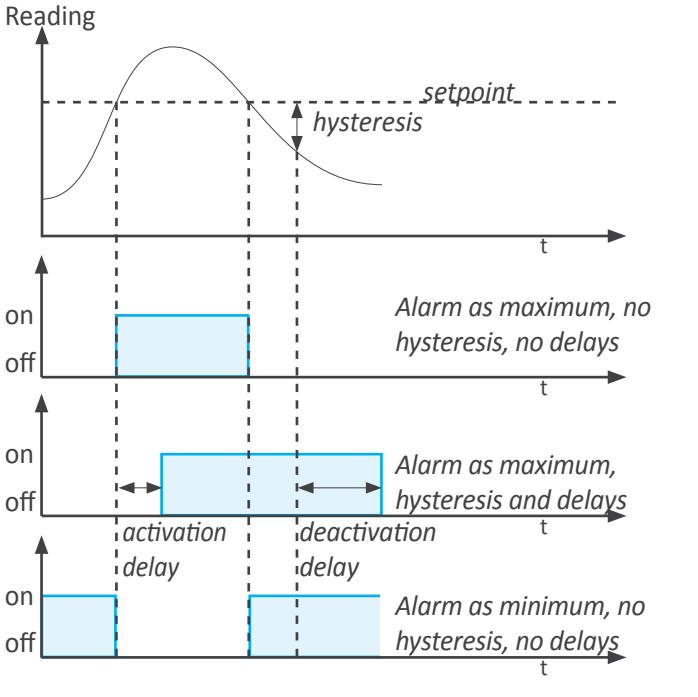


Figure 6 - Examples of alarm with 1 setpoint

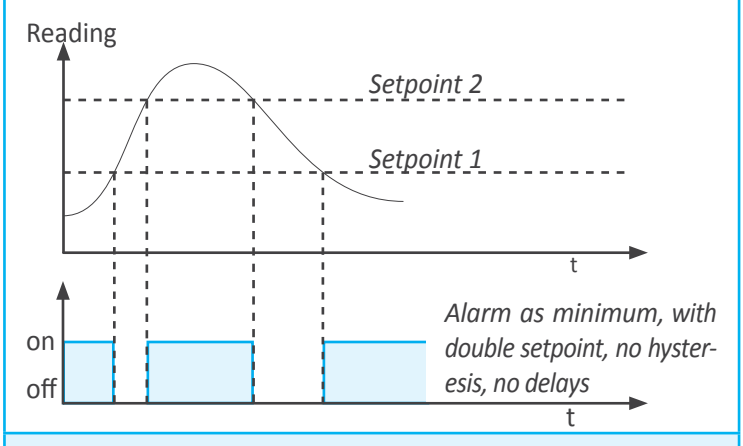
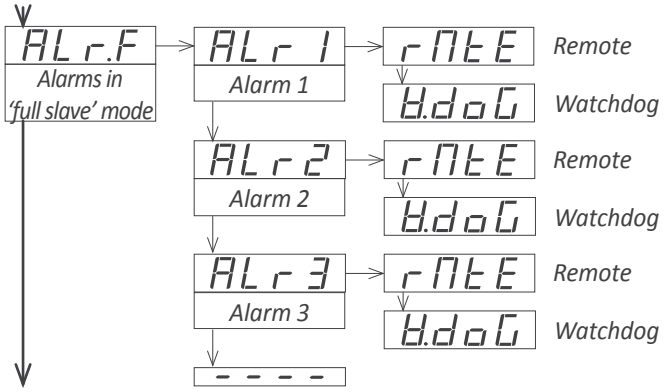


Figure 7 - Example of alarm with 2 setpoints

1.21.9 Alarms configuration menu for ‘full slave’

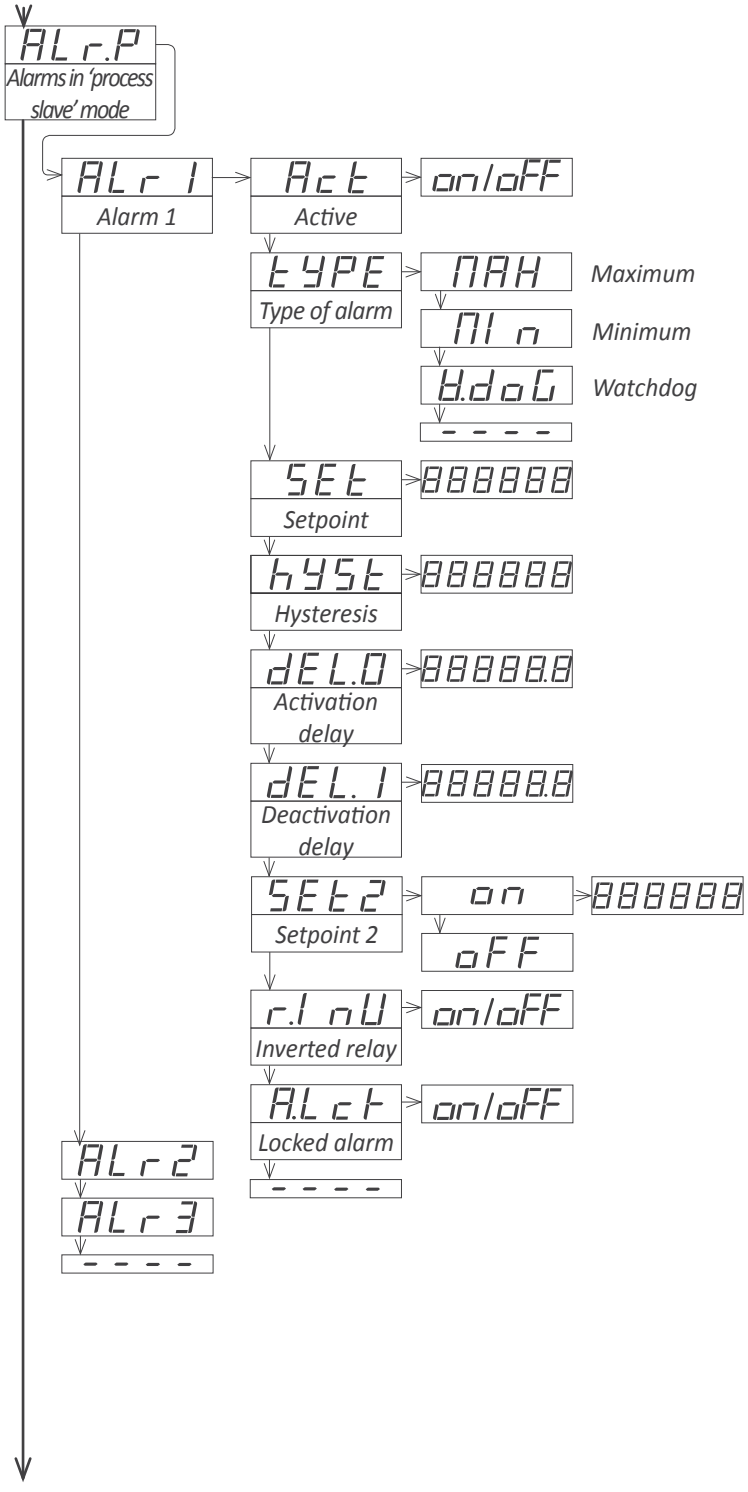


Menu available only in ‘Full slave’ mode. In ‘Full slave’ mode alarms are remotely controlled from the bus.

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 *1.21.8.*

1.21.10 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 *1.21.8*. 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 1.21.4).*
- at the ‘**Setpoint**’ (‘**SEt**’) parameter configure the alarm activation point. Parameter value is accessible through ‘fast access’ *(see section 1.21.11).*
- 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 1.21.20)*.

1.21.11 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 1.21.12)*.
- 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.

1.21.12 '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 1.21.11)*.

1.21.13 '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.

1.21.14 'Setpoint on bus' parameter

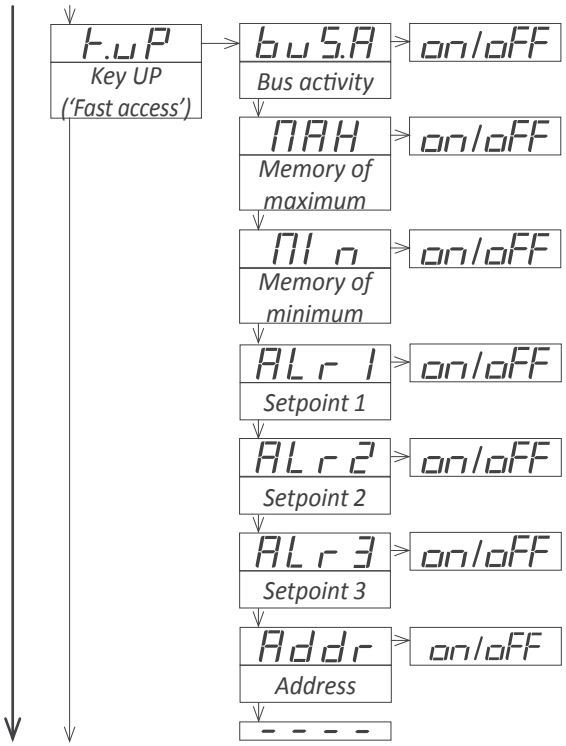
In 'Process slave' mode, the alarms are controlled locally and the alarm configuration is performed by the operator through the front keypad. Enable the '**Setpoint on bus**' ('**StP.b**') to '**on**' to enable the writing of setpoint alarms though the bus. By default the value if '**oFF**'.

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.

1.21.15 'Decimal point' parameter

Only available in 'Process slave' mode. Set to '**Manual**' to manually configure the position of the decimal point. By default, the value is set to '**Remote**' and the decimal point is controlled through the bus.

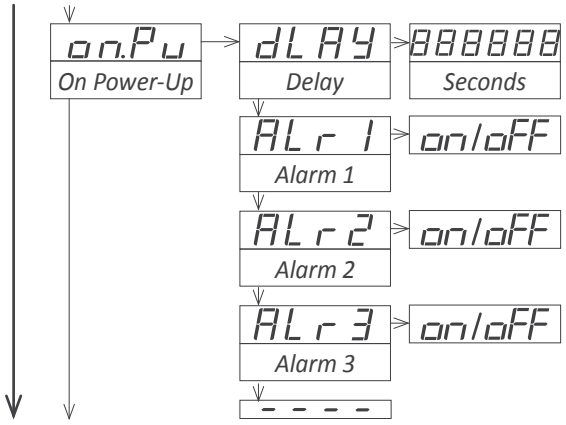
1.21.16 'Fast access' configuration menu



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 *1.21.11.*

- the '**Bus activity**' ('**buS.A**') function allows to visualize if there is activity at the communications bus *(see 1.21.12)*.
- 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.

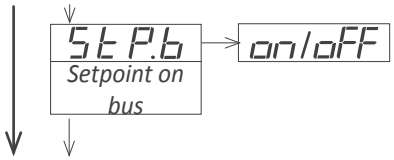
1.21.17 'On power up' configuration menu



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 *1.21.13.*

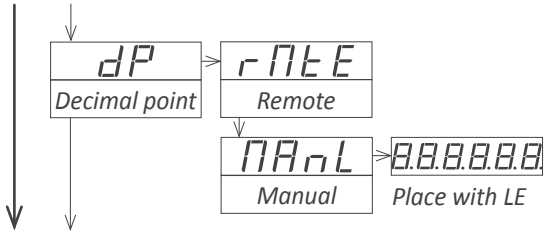
- at the '**Delay**' ('**dLAy**') parameter configure the time the instrument will wait before starting normal functionality. Time between 0 and 200 seconds.
- at the '**Alarm 1**', '**Alarm 2**' and '**Alarm 3**' parameters configure the state for the alarms at power up.

1.21.18 Setpoint on bus' configuration menu



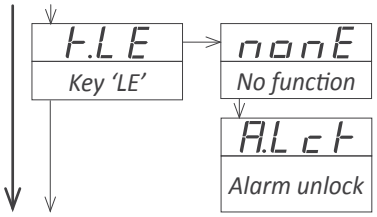
Available in 'Process slave' mode only. Enables access to the alarm setpoint registers through the bus. For more information see section *1.21.14.*

1.21.19 'Decimal point' configuration menu



Only available in 'Process slave' mode. Set to '**Manual**' to manually configure the position of the decimal point. For more information see section *1.21.15.*

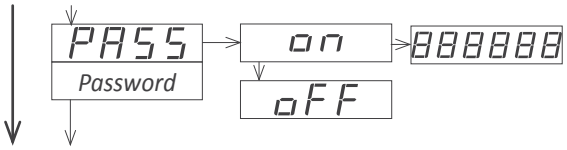
1.21.20 'Key LE' configuration menu



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 1.21.8).*

- 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.

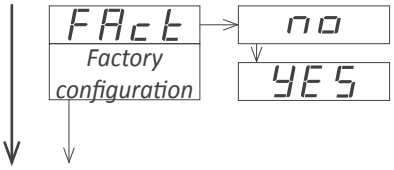
1.21.21 Password configuration



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.

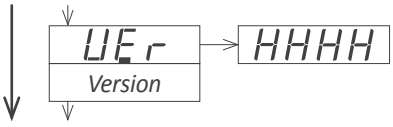
To active the '**Password**' function select '**on**' and introduce the 6 digits code. The code will be requested when trying to access the 'configuration menu' (front key 'SQ' (■)).

1.21.22 Default factory configuration



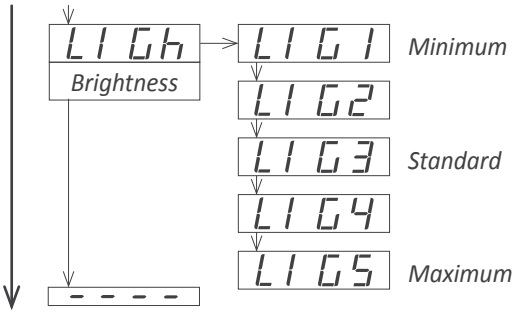
At the '**FActory configuration**' ('**FAct**') menu select '**yes**' to activate the default factory configuration. See section *1.6* for a list of default parameters.

1.21.23 Firmware version



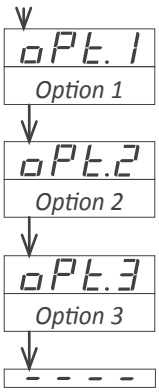
The '**Version**' ('**VEr**') menu informs about the firmware version installed on the instrument.

1.21.24 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.

1.21.25 Access to the options configuration menu



Access to the optional module installed at slot 1

Access to the optional module installed at slot 2

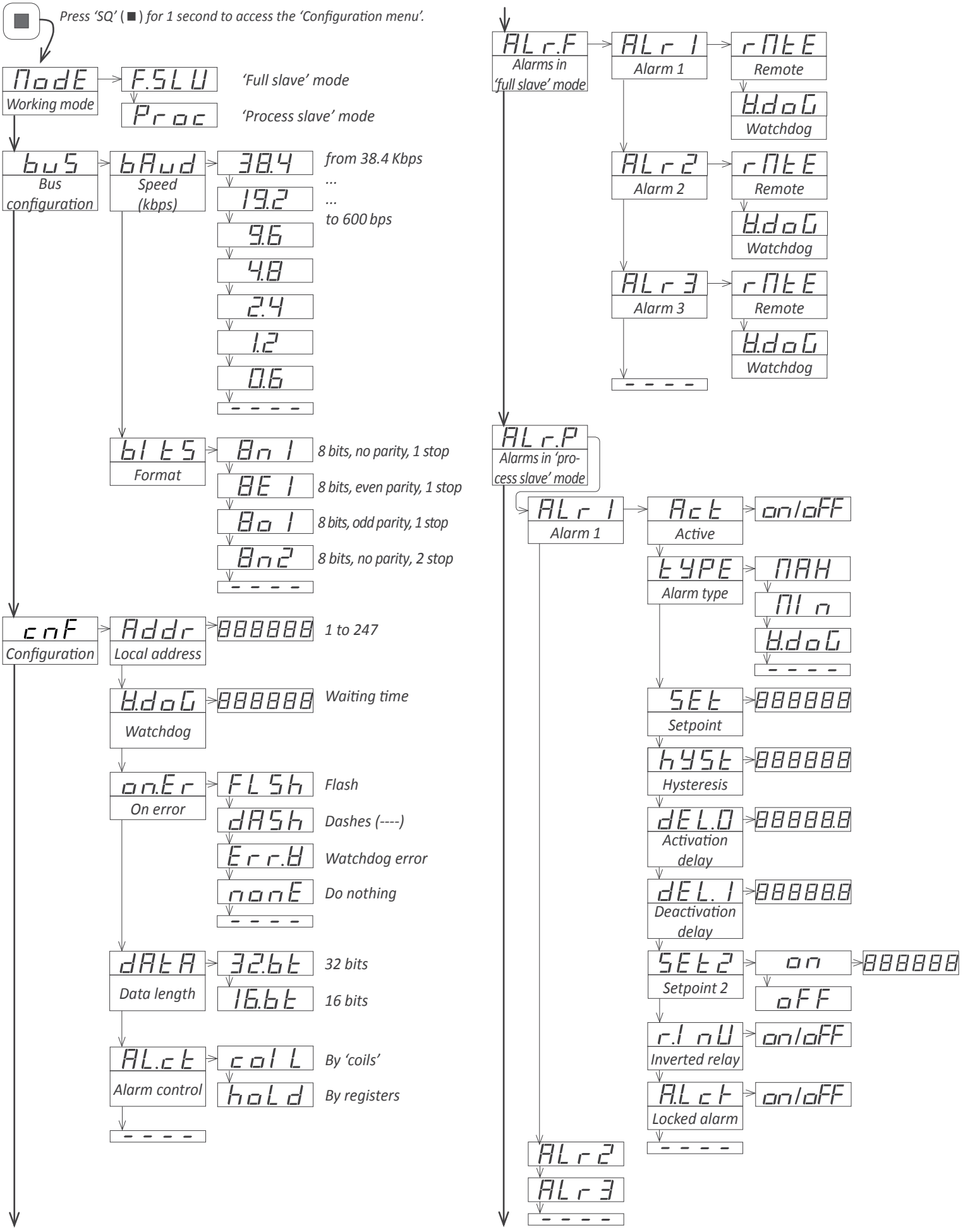
Access to the optional module installed at slot 3

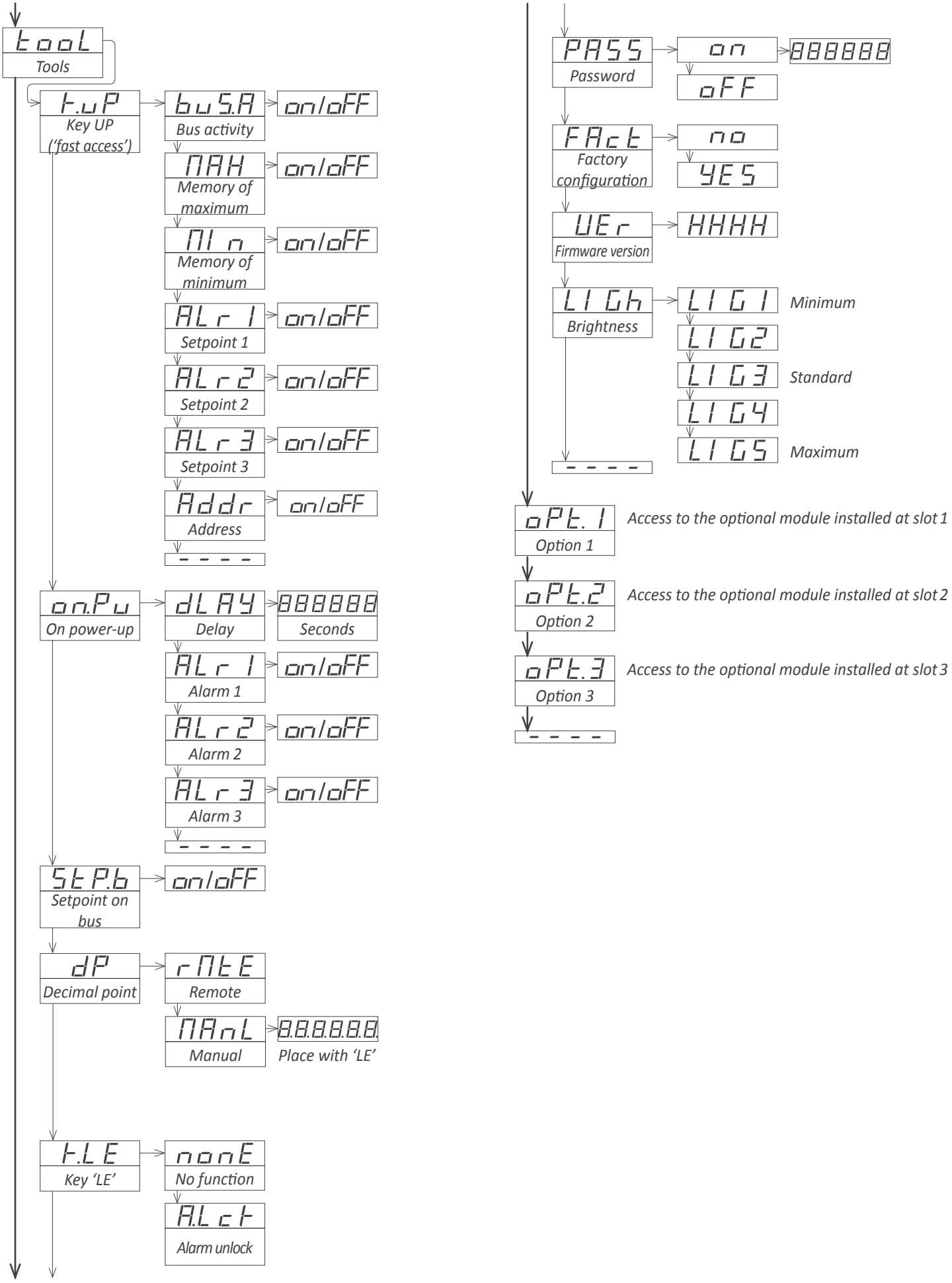
The output and control options are optional modules that can be installed at the instrument. Formats LDB-24 and LDB-44 have 2 free slots for output and control options, while formats LDB-26 and LDB-46 have 3 free slots *(see section 1.7)*.

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.

1.22 Full configuration menu




tooL
Tools
t.uP
Key UP ('fast access')
buS.A
Bus activity
on/oFF
MAH
Memory of maximum
MIn
Memory of minimum
ALr 1
Setpoint 1
ALr2
Setpoint 2
ALr 3
Setpoint 3
Addr
Address
- - - -
on.Pu
On power-up
dLAY
Delay
888888
Seconds
ALr 1
Alarm 1
ALr2
Alarm 2
ALr 3
Alarm 3
- - - -
StP.b
Setpoint on bus
dP
Decimal point
rMtE
Remote
MAnL
Manual
8.8.8.8.8.8.8.
Place with 'LE'
t.LE
Key 'LE'
nonE
No function
ALct
Alarm unlock
PASS
Password
on
oFF
888888
FAct
Factory configuration
no
YES
UEr
Firmware 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
- - - -

1.23 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 *1.7.* 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. For IP65 protection at the panel junction, see the IPB accessories at section *3.*

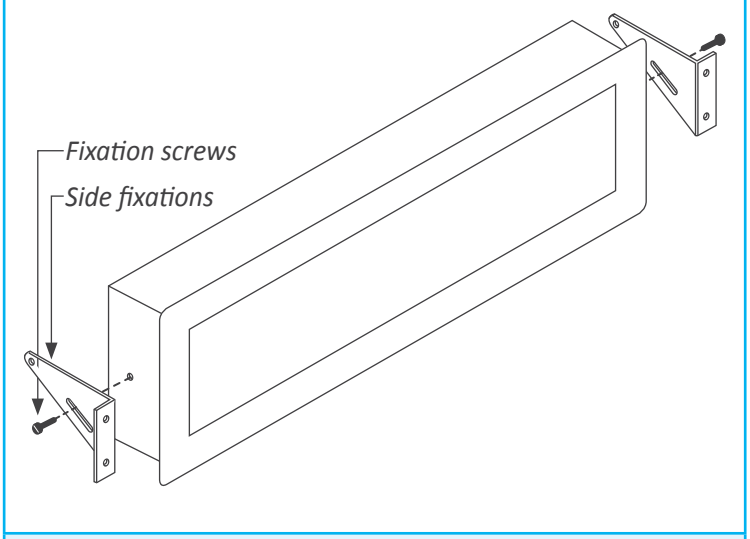


Figure 8 - Panel mount

- 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.

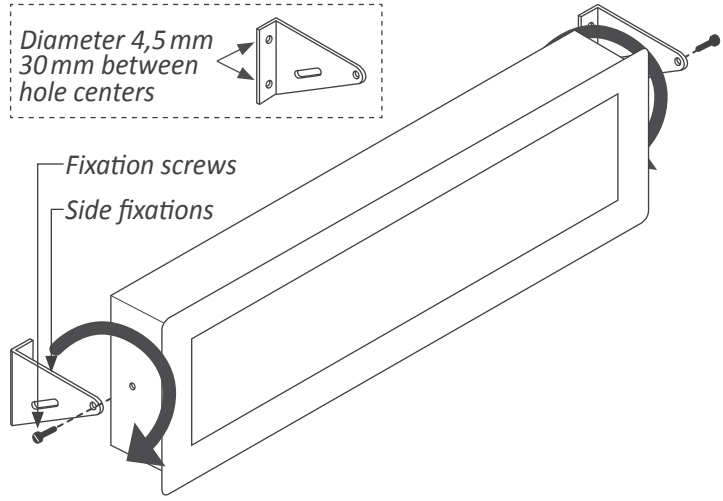


Figure 10 - Wall mount

- 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, ...

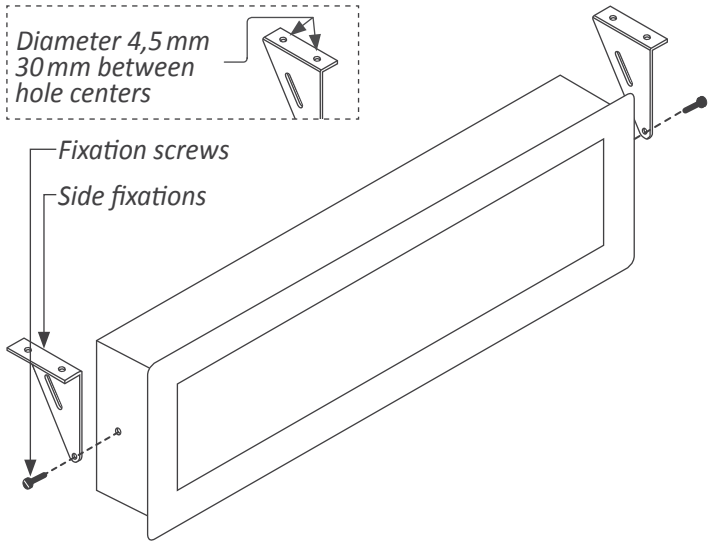


Figure 9 - Hanging mount

1.24 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.

1.25 Warranty

Please see the last page for Omega's warranty Disclaimer

1.26 CE declaration of conformity

Supplier	Omega Engineering
Products	LDB-RTU

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

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

Electromagnetic compatibility rules EN-61326-1

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

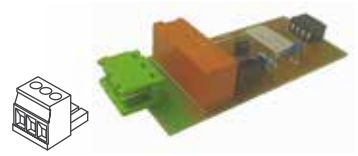
Barberà del Vallès July 2017
Xavier Juncà - Product Manager

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 LDB series. Formats LDB-26 and LDB-46 accept up to 3 relays, and formats LDB-24 and LDB-44 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 the instrument, or standalone for delayed installation. No soldering or special configuration is required. See section *1.9* on how to install output and control modules.



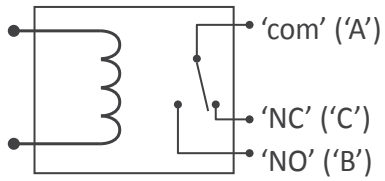
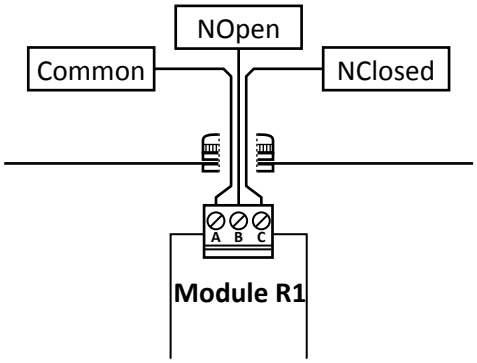


Figure 11 - Module 'R1' and internal schematic

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

2.2 Module T1

The T1 module provides 1 transistor output to install in large format industrial meters from LDB series. Formats LDB-26 and LDB-46 accept up to 3 transistor outputs, and formats LDB-24 and LDB-44 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 the instrument, or standalone for delayed installation. No soldering or special configuration is required. See section *1.9* on how to install output and control modules.

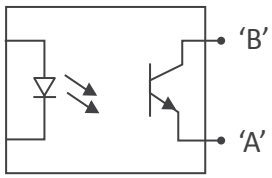
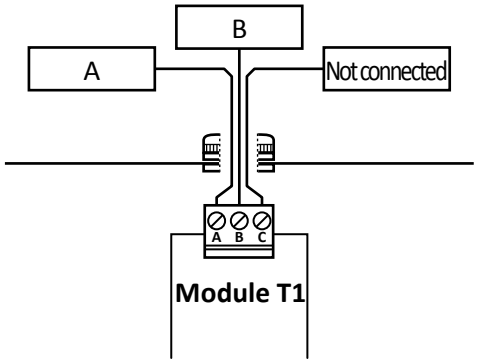


Figure 13 - Module 'T1' and internal schematic

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

2.3 Module SSR

The SSR module provides 1 output for SSR relay control, to install in large format industrial meters from LDB series. Formats LDB-26 and LDB-46 accept up to 3 SSR control outputs, and formats LDB-24 and LDB-44 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 the instrument, or standalone for delayed installation. No soldering or special configuration is required. See section *1.9* on how to install output and control modules.

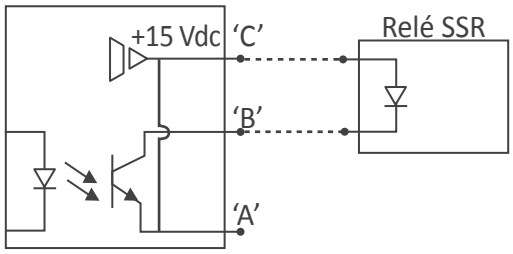
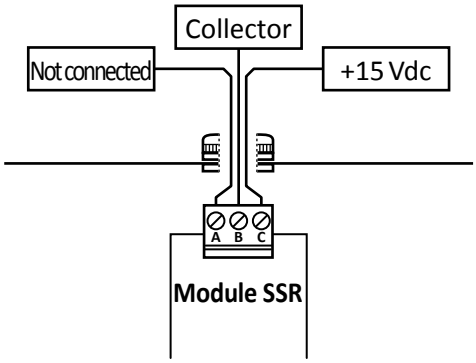


Figure 15 - Module 'SSR' and internal schematic

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

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 LDB series. Formats LDB-26 and LDB-46 accept up to 3 analog outputs, and formats LDB-24 and LDB-44 accept up to 2 analog outputs.

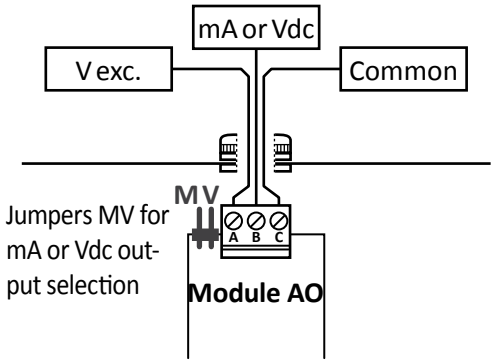
Output signal is fully scalable, both with positive and negative slopes, and is proportional to the reading. The mA output can be configured for active loops (the instrument provides the power to the mA loop) or passive loops (the loop power is external to the instrument).

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 the instrument, or standalone for delayed installation. No soldering or special configuration is required. See section *1.9* 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

2.5 Module RTU

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

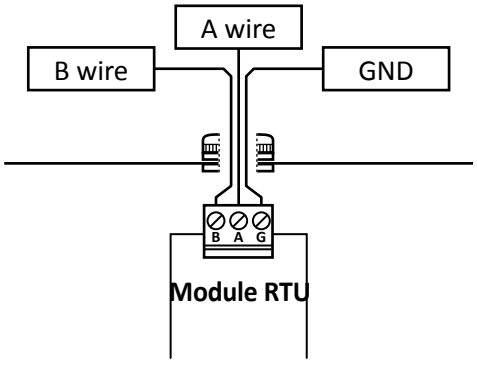
The RTU module implements function '4' ('*Read Input Registers*') of the Modbus RTU protocol, to access the instrument registers (reading value, alarm status, memory of maximum and minimum, ...).

Configuration is performed from the front keypad of the nstrument, 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 the LDB series instrument, or standalone for delayed installation. No soldering or special configuration is required. See section *1.9* 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

2.6 Module S4

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

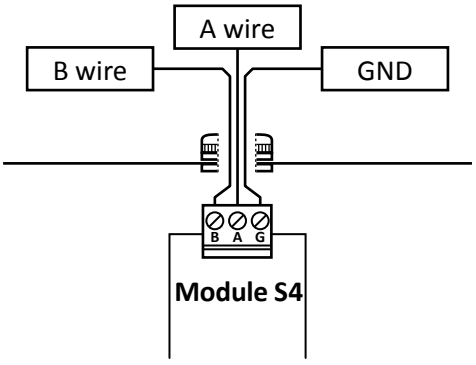
The S4 module implements a MASTER / SLAVE protocol, with up to 31 addressable slaves. In SLAVE mode allows access to reading values, alarm status, memory of maximum and minimum, ...

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 the LDB series instrument, or standalone for delayed installation. No soldering or special configuration is required. See section *1.9* 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

2.7 Module S2

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

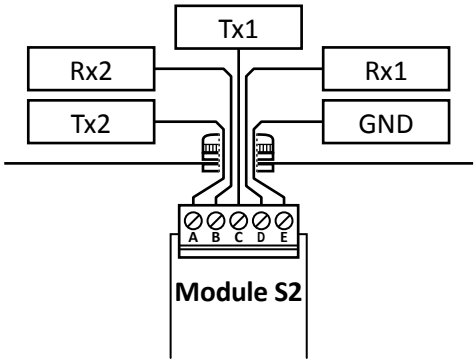
The S2 module implements a MASTER / SLAVE protocol, with up to 31 addressable slaves, with 'daisy-chain' connection. In SLAVE mode allows access to reading values, alarm status, memory of maximum and minimum, ...

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 the LDB series instrument, or standalone for delayed installation. No soldering or special configuration is required. See section *1.9* 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

Options and Accessories

Index

1.1 Read this first

All modules mentioned in this document are compatible with large format meters from LDB series has 4 formats, and each format differ in the number of digits, the digit height and the number of output and control options they can accept.

This document assumes the following :

Format	*Digits*	*Digit height*	*Options*
LDB-24	*4*	*60 mm*	*2*
LDB-44	*4*	*100 mm*	*2*
LDB-26	*6*	*60 mm*	*3*
LDB-46	*6*	*100 mm*	*3*

- inside the programming menus, when a 6 digits value is shown, it is assumed that only 4 digits apply to formats LDB-24 and LDB-44
- when this document explains that a maximum of 3 output and control modules are installable, it is assumed that the maximum is 2 modules for formats LDB-24 and LDB-44

The output and control modules mentioned in this document, are covered by the warranty of the instrument where they are installed. Check the user's manual of the instrument for more information related to warranty.

The user's manual of the instrument where the module is installed, has important information related to installation that applies also to the output and control modules mentioned in this document. Check the user's manual of the instrument for more information related to installation precautions.

The output and control modules mentioned in this document are covered by the 'CE declaration of conformity' of the instrument where they are installed. Check the user's manual of the instrument for more information related to the CE declaration of conformity.

1.2 Modular architecture

Large displays from the LDB series are designed following a modular architecture that allows the operator to install any of the output and control modules mentioned in this document. Each module is supplied with 1 cable tie, 1 square self adhesive tie base and 1 female connector.

1.3 Installation and start-up

To install an optional output and control module into a large display:

1. remove the rear cover of the instrument *(see section 1.4)*
2. install the module at one of the free slots *(see section 1.5)*
3. place the squared tie base at the free slot selected. Location to place the tie base is clearly indicated on the PCB *(see section 1.5)*.
4. pass the cable tie through the tie base *(see section 1.5)*
5. place the output and control module at the slot connection jumpers *(see section 1.5)*
6. use the cable tie to firmly fix the module *(see section 1.5)*
7. if needed, configure the appropriate jumpers at the output and control module
8. pass the connection wires through the housing cable gland
9. connect the signal wires to the terminals of the output and control module
10. place and close the rear cover of the instrument *(see section 1.4)*
11. configure the parameters at the 'Configuration menu'.
    - modules R1, T1 and SSR are configured from the alarms menu of the instrument
    - other modules are configured from from menu entries 'Opt.1', 'Opt.2' or 'Opt.3', depending on the slot where the module has been installed.

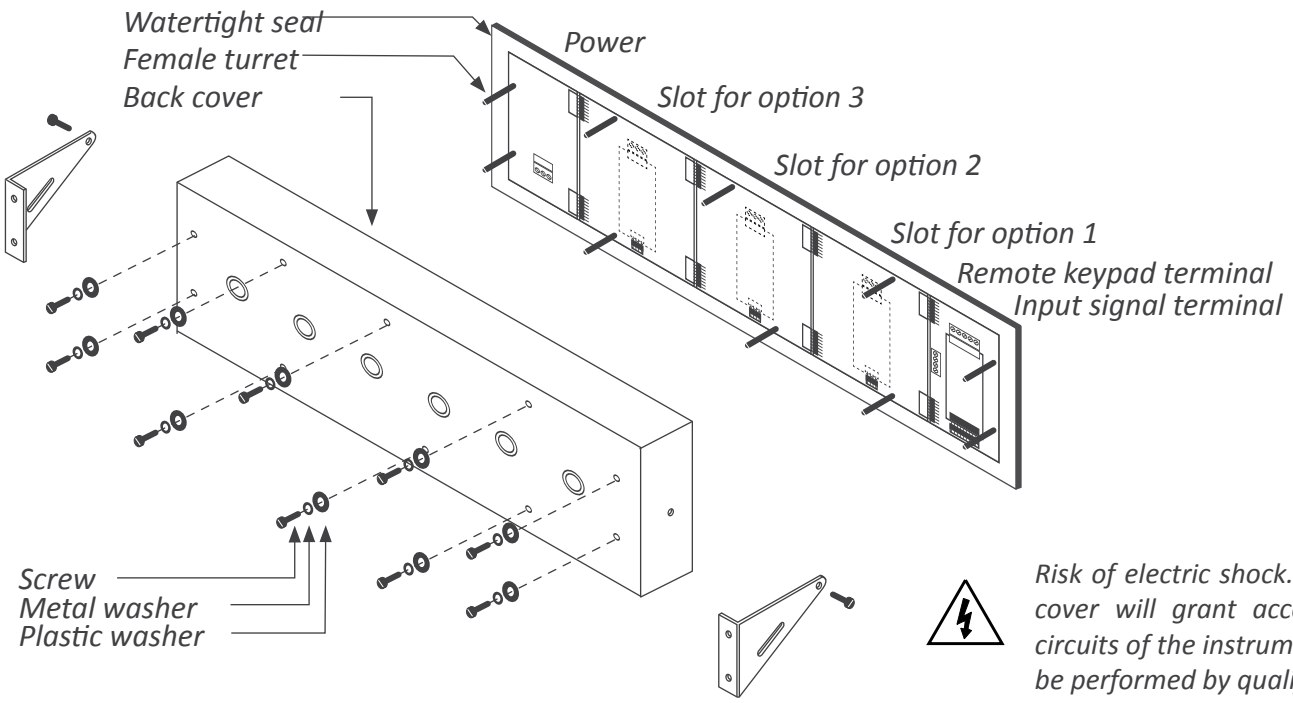
1.4 To access the instrument

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 LDB-26 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.

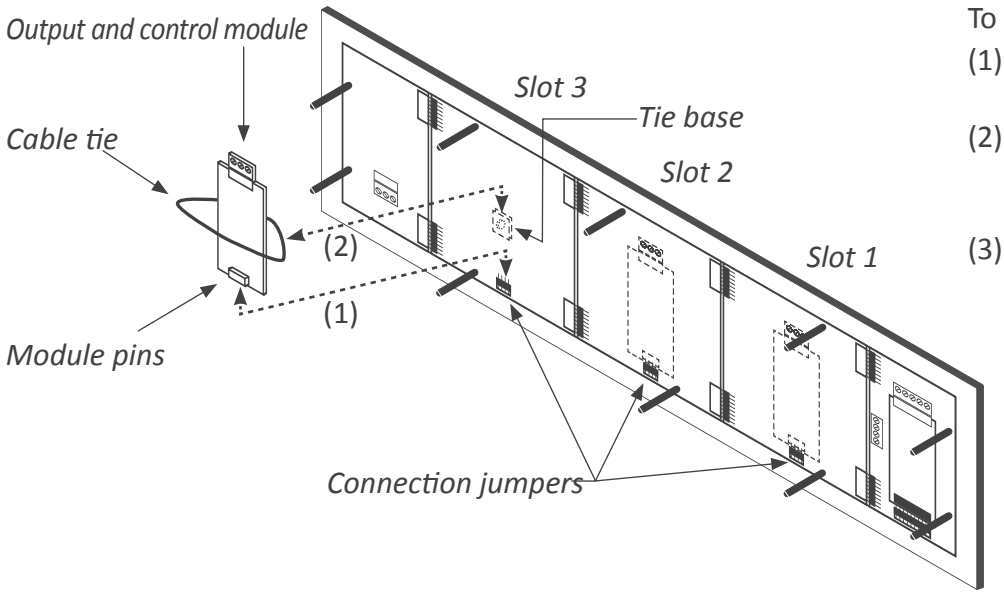
To ensure a correct IP65 protection tighten the back cover screws with a strength between 30 and 40 Ncm, with the help of a dynamometer screwdriver.



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.

1.5 Modular system

Large format meters 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. A cable gland to install at the back cover is also provided, in order to enable an output for the connection wires.



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

(3) an additional white cable tie is provided to fix as indicated below. Only needed in case of vibrations or heavy transportation.

1. Options R1, T1 and SSR

The R1, T1 and SSR modules provide 1 digital 'on/off' output. The output is configured from the instrument alarms menu ('ALr.1', 'ALr.2' o 'ALr.3').
The menu allows to configure the setpoint, hysteresis, independent activation and deactivation delays, and a second setpoint to create windowed alarms.
The R1, T1 and SSR output modules are isolated between them and between all other circuits of the instrument.

1.1 Module R1

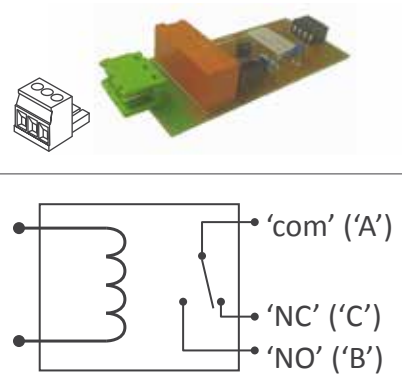
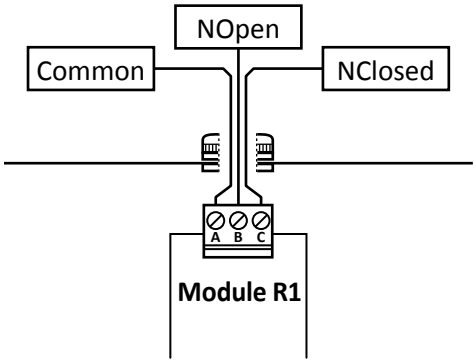


Figure 1 - Detail for the 'R1' module and internal schematic

Option	**R1**
Type of output	relay
Type of relay	3 contacts (Com, NO, NC)
Max. current	3 A (resistive load)
Voltage	250 Vac continuous
(max. 150 Vac if switching power network with Overvoltage category III)	
Isolation	3500 Veff
Type of 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 2 - Connections for the 'R1' relay output module

1.2 Module T1

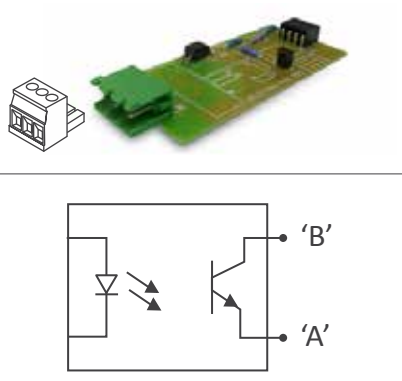
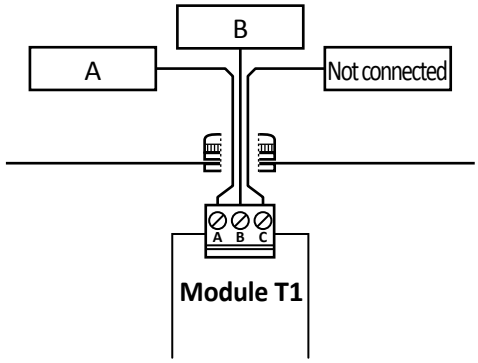


Figure 3 - Detail for the 'T1' module and internal schematic

Option	**T1**
Type of output	transistor
Max voltage	35 Vdc
Max. current	50 mA
Isolation	3500 Veff, optoisolated
Type of 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 4 - Connections for the 'T1' transistor output module

1.3 Module SSR

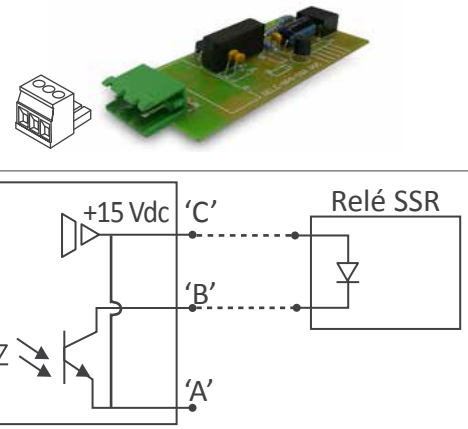
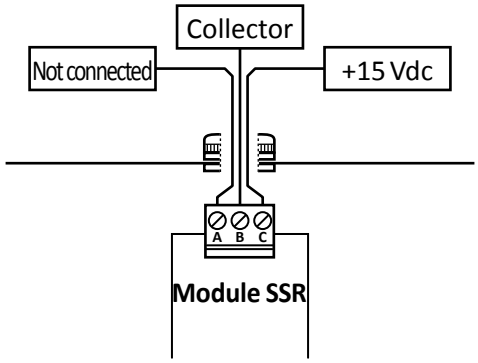


Figure 5 - Detail for the 'SSR' module and internal schematic

Option	**SSR**
Type of output	to control SSR relay
Output voltage	+15 Vdc
Max. current	45 mA
Isolation	1000 Vdc
Type of 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 6 - Connections for the SSR control output module

2. Option AO

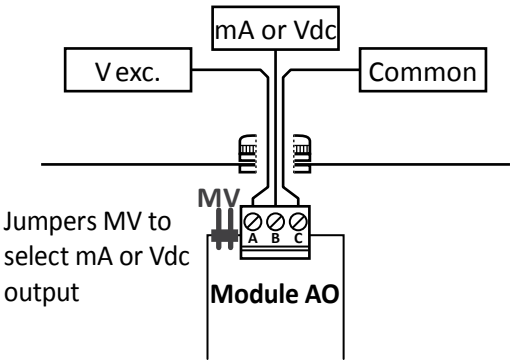
The AO modules provide 1 analog output, configurable for 4/20 mA or 0/10 Vdc signal. The analog output is configured from the options menu entry ('Opt.1', 'Opt.2' or 'Opt.3') of the instrument.

Option	**AO**
Type of output	analog output
Signal output	4/20 mA active 4/20 mA passive 0/10 Vdc
Max. signal Min. signal	22 mA, 10.5 Vdc 0 mA, -50 mVdc
Scaling	proportional to the reading positive or negative slopes
Vexc (terminal A)	+13.8 Vdc ± 0.4 Vdc (max. 25 mA) protection against shortcircuit
Load impedances	≤350 Ohm (for 4/20 mA active) ≤800 Ohm (for 4/20 mA passive) *(for 24 Vdc external Vexc) (maximum voltage 27 Vdc between 'B' and 'C')* ≥10 KOhm (en 0/10 Vdc)
Accuracy (at 25 ºC)	<0.1 % FS
Thermal stability	60 ppm/ºC in mA 50 ppm/ºC in Vdc
Step response (0% to 99% of the signal)	<75 mSeconds + step response of the reading
Isolation	1000 Vdc
Warm up	15 minutes
Type of terminal	plug-in screw clamp pitch 5.08 mm
Factory configuration	'Mode mA' 'Scaling 0/9999 = 4/20 mA' 'On error 'to_h'
Installation allowed at	slot 1, slot 2, slot 3

The output signal is proportional to the reading, and it is scalable both in positive or negative slopes. 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.

The AO analog output modules are isolated between them and between all other circuits of the instrument.

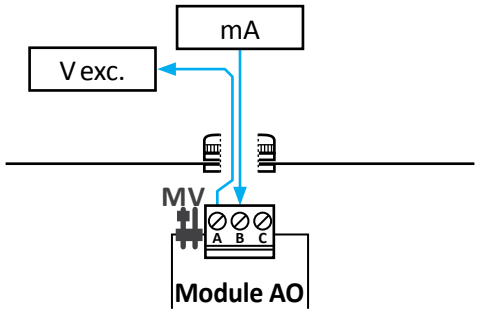
Figure 7 - Detail for the 'AO' module



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

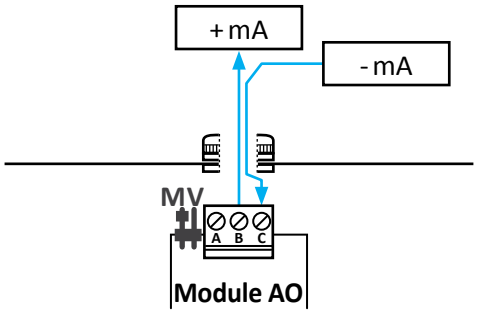
Figure 8 - Connections for 'AO' analog output module

2.1 Connection examples



Jumper M	Jumper closed
Jumper V	Jumper open

Figure 9 - Connections for active 4/20 mA. The current loop is internally powered from the 'AO' module



Jumper M	Jumper closed
Jumper V	Jumper open

Figure 10 - Connections for passive 4/20 mA. The current loop is externally powered.

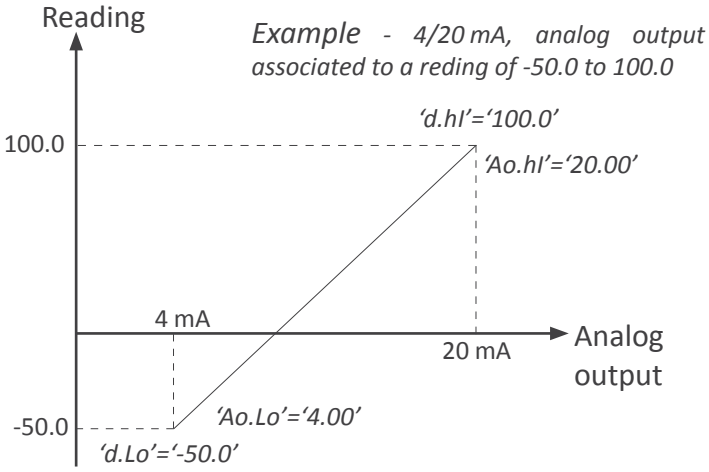
2.2 Configuration menu

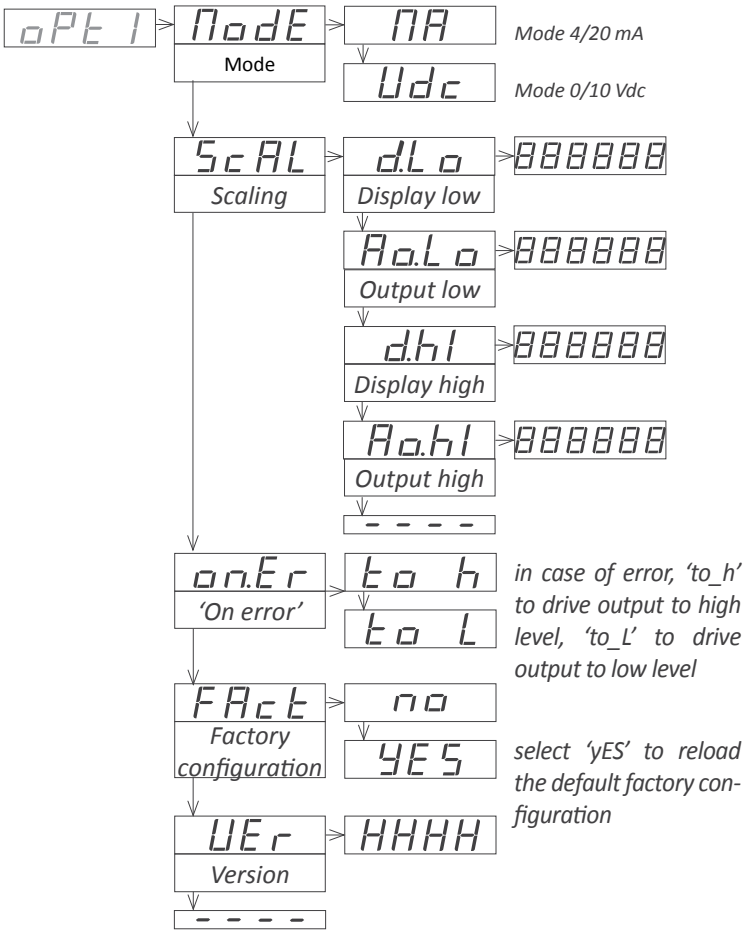
At the '**Mode**' ('**ModE**') menu configure the type of output '**4/20 mA**' ('**mA**') or '**0/10 Vdc**' ('**Vdc**'). Position for jumpers 'V' and 'M' must be according to the range selected.

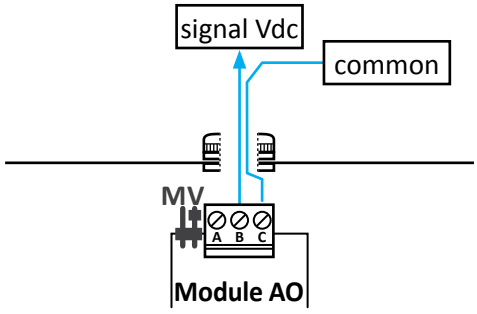
At the '**Scaling**' ('**ScAL**') menu enter the values that define the two points of the slope:

- the lower point, defined by the '**Low Display**' ('**d.Lo**') and '**Low Output**' ('**Ao.Lo**')
- the upper point, defined by the '**High Display**' ('**d.hI**') and '**High Output**' ('**Ao.hI**')

Analog output values are shown with 'XX.XX' format. acceptable values are '0.00' to '10.00' Vdc for voltage, and '0.00' to '20.00' mA for current.







Jumper M	Jumper open
Jumper V	Jumper closed

Figure 11 - Connections for 0/10 Vdc.

2.3 Error codes

'Er.34' output signal configured to value lower than 0 Vdc or 0 mA

'Er.35' output signal configured to a value higher than 10 Vdc or 20 mA

'Er.36' configured slope points are not acceptable, such as :

'd.Hi'='d.Lo'

'Ao.Hi'='Ao.Lo'

('Ao.Hi'-'Ao.Lo')>('d.Hi'-'d.Lo')

3. Option RTU

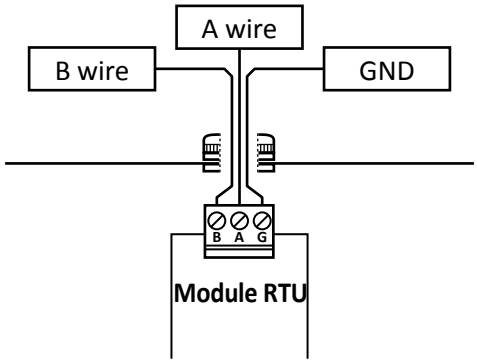
The RTU modules provide 1 port for communications in Modbus RTU protocol. Use function '4' ('*Read Input Registers*') of the Modbus RTU protocol, to access the instrument registers (reading value, alarm status, memory of maximum and minimum, setpoint values, ...).

Option	**RTU**
Type of output	Modbus RTU communication
Function implemented	4 (Read_Input_Registers)
Addresses	01 to 247
Exception codes	see section 3.3
Registers*	see section 3.1
**available registers can vary for different instruments*	
Bus	RS-485
Speed	57.6 Kbps to 600 bps
Data format	8e1 (standard), 8o1, 8n2
Bus terminator	not included
Isolation	1000 Vdc
Temperature	operation from 0 to 50 ºC storage from -20 to +70 ºC
Factory configuration	'Address 1' 'Speed 19.2 Kbps' 'Format 8e1' 'Decimal point Auto'
Installation allowed at	slot 1, slot 2, slot 3

The communication parameters are configured from the options menu entry ('Opt.1', 'Opt.2' or 'Opt.3') of the instrument.

The RTU modules are isolated between them and between all other circuits of the instrument.

Figure 12 - Detail for the 'RTU' module



A	Bus signal A
B	Bus signal B
G	GND

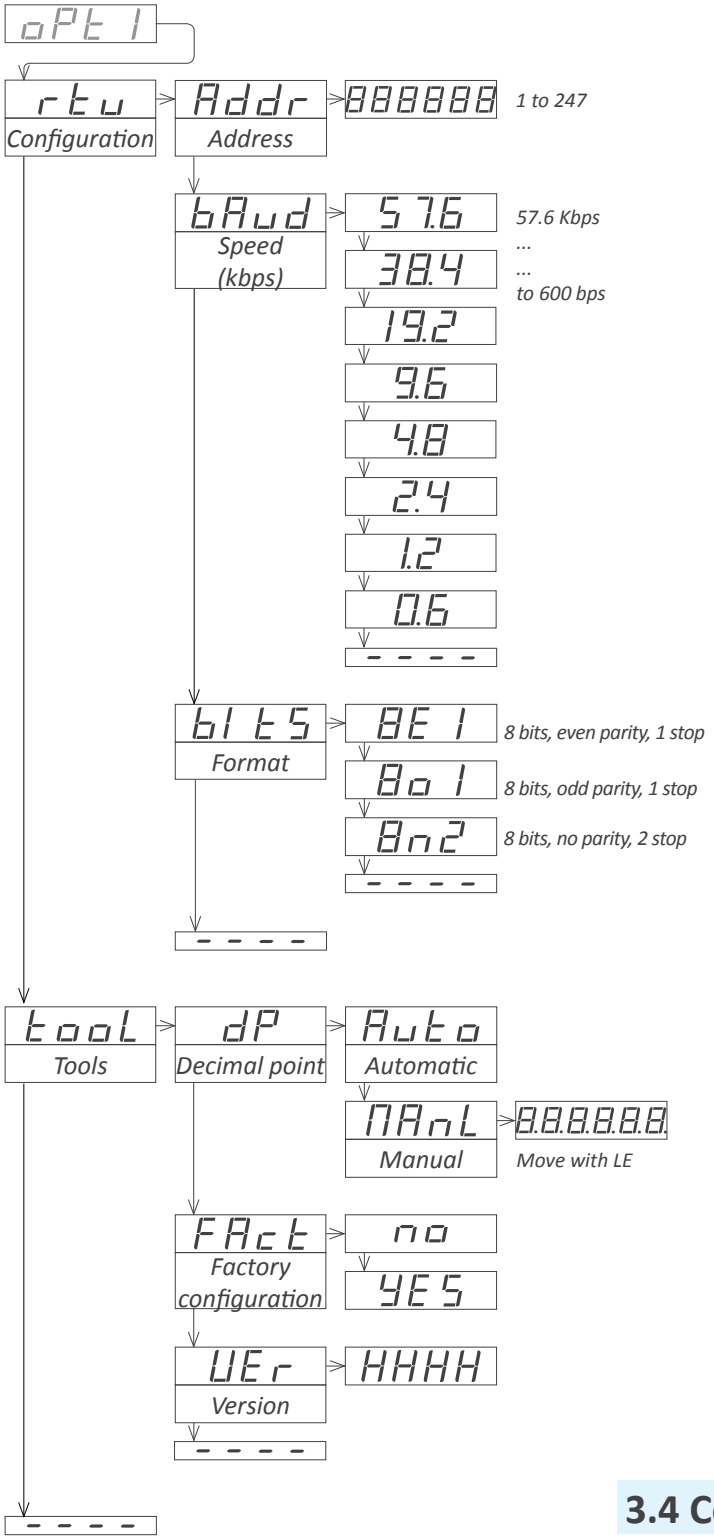
Figure 13 - Connections for Modbus 'RTU' module

3.1 Registers accessible through Modbus RTU

Register	*Name*	*Description*	*Size*	*Refresh*	*6 Digit Models (LDB-26 y LDB-46)*	*4 Digit Models (LDB-24 y LDB-44)*
0	*DISPLAY1_L*	*Display value*	*16 bits*	*same as display*	*999999 to -199999*	*9999 to -1999*
1	*DISPLAY1_H*		*16 bits*			
2	*DECIMALES1*	*Decimals on display*	*16 bits*		*0 to 6*	*0 to 4*
3	*MAXMEM_L*	*Memory of maximum*	*16 bits*	*every 30 seconds*	*999999 to -199999*	*9999 to -1999*
4	*MAXMEM_H*		*16 bits*			
5	*MINMEM_L*	*Memory of minimum*	*16 bits*		*999999 to -199999*	*9999 to -1999*
6	*MINMEM_H*		*16 bits*			
7	*SETPOINT1_L*	*Setpoint 1 value*	*16 bits*	*every 2 seconds*	*999999 to -199999*	*9999 to -1999*
8	*SETPOINT1_H*		*16 bits*			
9	*SETPOINT2_L*	*Setpoint 2 value*	*16 bits*		*999999 to -199999*	*9999 to -1999*
10	*SETPOINT2_H*		*16 bits*			
11	*SETPOINT3_L*	*Setpoint 3 value*	*16 bits*		*999999 to -199999*	*9999 to -1999**
12	*SETPOINT3_H*		*16 bits*			
13	*STATUS*	*Alarm status* *Instrument status*	*16 bits*	*same as display*	*bit 0...7 alarm status* *bit 8...16 instrument status*	
14 a 16	*Reserved*	*Reserved*	*16 x 3 bits*		*Not accessible*	*Not accessible*

Table 1 - Registers accessible through MODBUS-RTU. Registers codified as binary numbers. Negative values codified in two's complement. Available registers can vary for different instruments. Register 11 is not accessible for instruments with formats LDB-24 and LDB-44 (slot 3 is not available).

3.2 Configuration menu



At the '**Configuration**' ('**rtu**') menu, configure the '**Address**' ('**Addr**') parameter with the address value between '1' and '247', at the '**Speed**' ('**bAud**') parameter select the bus speed (in Kbps) and at the '**Format**' ('**bItS**') parameters select the data format.

Inside the '**Tools**' ('**TooL**') menu, special tools and functions are grouped.

- the '**Decimal point**' ('**dP**') menu is provided for compatibility with ancient hardware that does not support decimal point retransmission. By default, select '**Automatic**'('**Auto**').Ifyourinstrumentdoesnostransmitthe decimal point position, select '**Manual**' ('**MAnL**') and fix the position of the decimal point manually.
- at the '**Factory reset**' ('**FAct**') menu, select '**yes**' to load the default factory configuration for the instrument.

the '**Version**' ('**VEr**') menu informs of the current firmware version installed in the module.

3.3 Exception codes

The Modbus RTU protocol defines the following scenarios when a 'Master' is sending a frame to a 'Slave':

• the 'Slave' device receives the frame correctly and replies with the requested data

• the 'Slave' devices detects a CRC error, parity error, or other. and discards the frame without generating a reply frame. The 'Master' will detect a 'TIMEOUT' condition due to the absence of reply.

• the 'Slave' device receives the frame correctly, but replies with an 'EXCEPTION_CODE' as it can not process the function or register requested.

The 'EXCEPTION_CODES' configured in the RTU module are :

Exception code	*Name*	*Description*
0	ILLEGAL_FUNCTION	*Requested function is not supported*
1	ILLEGAL_DATA_ADDRESS	*Requested register is not supported*

Table 2 - Exception codes

3.4 Compatible versions

Formats LDB-26, LDB-46	*Firmware version*	*Formats LDB-24, LDB-44*	*Firmware version*
---	---	*LDB24-P, LDB44-P*	*41.57*
LDB26-P, LDB46-P	*50.00*	---	---
---	---	*LDB24-T, LDB44-T*	*44.05*
---	---	*LDB24-R, LDB44-R*	*45.05*
LDB26-C1, LDB46-C1	*27.08*	*LDB24-C1, LDB44-C1*	*47.07*
LDB26-CR, LDB46-CR	*28.02*	*LDB24-C1, LDB44-C1*	*48.05*

Table 3 - Firmware versions compatible with the indicated registers

3.5 Description and example of registers

Registers R0 and R1 (DISPLAY1_L y DISPLAY1_H)

Contains the display value of the instrument, codified in two registers of 16 bits each. Possible values are from 999999 to -199999. Decimal point position is codified at register R2.

Example R0=FBF1 (hex) and R1=0009 (hex)

Register value = 0009 FBF1 (hex)

Reading value = 654321

Register R2 (DECIMALS1)

Contains the number of decimals of the display, codified in a single register of 16 bits. Possible values are from 0 to 6.

Example R2=0002 (hex)

Number of decimals = 2 = 6543.21

Register R3 and R4 (MAXMEM_L and MAXMEM_H)

Contains the memory of maximum reading of the instrument, codified in two registers of 16 bits each. Possible values are from 999999 to -199999. Decimal point position is codified on register R2.

Example - same example as in R0 and R1 but accessing to R3 and R4.

Registers R5 and R6 (MINMEM_L and MINMEM_H)

Contains the memory of minimum reading of the instrument, codified in two registers of 16 bits each. Possible values are from 999999 to -199999. Decimal point position is codified on register R2.

Example - same example as in R0 and R1 but accessing to R5 and R6.

Registers R7 and R8 (SETPOINT1_L and SETPOINT1_H)

Contains the setpoint value of alarm 1, codified in two registers of 16 bits each. Possible values are from 999999 to -199999. Decimal point position is codified on register R2.

Example - same example as in R0 and R1 but accessing to R7 and R8.

Registers R9 and R10 (SETPOINT2_L and SETPOINT2_H)

Contains the setpoint value of alarm 2, codified in two registers of 16 bits each. Possible values are from 999999 to -199999. Decimal point position is codified on register R2.

Example - same example as in R0 and R1 but accessing to R9 and R10.

Registers R11 and R12 (SETPOINT3_L and SETPOINT3_H)

Contains the setpoint value of alarm 3, codified in two registers of 16 bits each. Possible values are from 999999 to -199999. Decimal point position is codified on register R2.

Example - same example as in R0 and R1 but accessing to R11 and R12.

Register R13 (STATUS)

Information bit-by-bit, for the alarm status (on / off) and instrument status. See below for a description.

Bit 0 Alarm 1 status (0 = inactive, 1 = active)
Bit 1 Alarm 2 status (0 = inactive, 1 = active)
Bit 2 Alarm 3 status (0 = inactive, 1 = active)
Bit 3 to 7 Reserved
Bit 8 Display overrange
Bit 9 Display underrange
Bit 10 Lost communication with the main processor
Bit 11 to 15 Reserved

Registers R14, R15 and R16

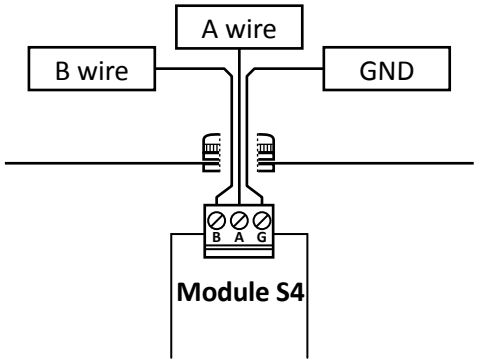
Reserved

4. Option S4

The S4 modules provide 1 port for communications RS485 ASCII protocol. Protocol with 'master' - 'slave' architecture, addressable up to 31 modules. Frames codified in representable ASCII characters (codes 32 to 255), which are visible using 'hyperterminal' or similar programs. Instrument registers are accessible through the RS-485 ASCII port (reading value, alarm status, memory of maximum and minimum, setpoint values, ...). The communication parameters are configured from the options menu entry ('Opt.1', 'Opt.2' or 'Opt.3') of the instrument. The S4 modules are isolated between them and between all other circuits of the instrument.

Option	**S4**	
Type of output	RS-485 ASCII communication	
Bus	RS-485	
Speed	57.6 Kbps to 600 bps	
Data format	8n1 (standard), 8o1, 8n2, 8e1	
Bus terminator	not included	
Protocol	ASCII	
Architecture	'master - slave'	
Addresses	01 to 31	
'Broadcast' address	128	
Registers*	see section *4.1*	
**available registers can vary for different instruments*		
Isolation	1000 Vdc	
Temperature	operation from 0 to 50 ºC	
	storage from -20 to +70 ºC	
Factory configuration	'Mode	Slave'
	'Address	1'
	'Speed	19.2 Kbps'
	'Format	8n1'
	'Decimal point	Auto'
Configuration 'Master'	'Destination address	31'
	'Frequency	0.5 sec.'
Tools	'Decimal point	Auto'
	'Legacy	Off'
	'Answer delay	0 mSec.'
Installation allowed at	'Opt.1', 'Opt.2', 'Opt.3'	

Figure 14 - Detail for the 'S4' module



A	Bus signal A
B	Bus signal B
G	GND

Figure 15 - Connections for 'S4' module

4.1 Accessible registers

Display values (DISPLAY1, MAXMEM, MINMEM, AL1, AL2, AL3) are codified with a minimum of 6 digits (left zeros are added if necessary), polarity and decimal point.

Register	*Name*	*Description*
0	*DISPLAY1*	*Display1 value*
1	*MAXMEM*	*Memory of maximum*
2	*MINMEM*	*Memory of minimum*
3	*AL1*	*Setpoint 1 value*
4	*AL2*	*Setpoint 2 value*
5	*AL3*	*Setpoint 3 value*
6	*STATUS*	*Alarm status*

Table 4 - Accessible registers for ASCII protocol.

Register 0 - DISPLAY1
Contains the display value of the instrument, in ASCII code, including polarity (positive / negative) and decimal point.
Example 1 - R0='+' '0' '6' '5' '4' '3' '.' '2' Display value = 6543.2
Example 2 - R0='-' '0' '0' '0' '4' '.' '5' '2' Display value = -4.52

Register 1 - MAXMEM
Contains the value for memory of maximum, in ASCII code, including polarity (positive / negative) and decimal point.

Register 2 - MINMEM
Contains the value for memory of minimum, in ASCII code, including polarity (positive / negative) and decimal point.

Register 3 - AL1
Contains the value for alarm 1 setpoint, in ASCII code, including polarity (positive / negative) and decimal point.

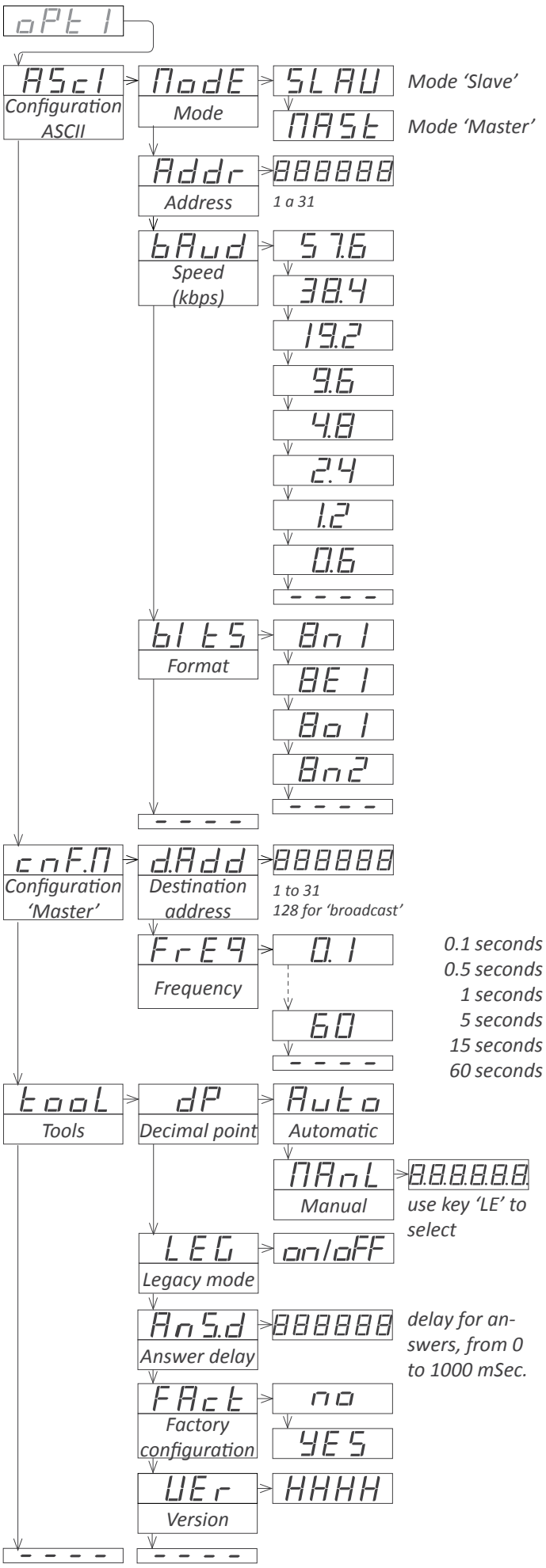
Register 4 - AL2
Contains the value for alarm 2 setpoint, in ASCII code, including polarity (positive / negative) and decimal point.

Register 5 - AL3
Contains the value for alarm 3 setpoint, in ASCII code, including polarity (positive / negative) and decimal point.

Register 6 - STATUS
Contains the alarm status (on/off).

Bit 0	Alarm 1 status (0 = inactive, 1 = active)
Bit 1	Alarm 2 status (0 = inactive, 1 = active)
Bit 2	Alarm 3 status (0 = inactive, 1 = active)
Bit 3 to 15	Reserved

4.2 Configuration menu



At the '**Configuration ASCII**' ('**AScI**') menu, configure the '**Mode**' ('**ModE**') parameter to select the 'slave' or the 'master' mode, at the '**Address**' ('**Addr**') parameter configure the local port address between '1' and '31', at the '**Speed**' ('**bAud**') parameter select the bus speed (in Kbps) and at the '**Format**' ('**bItS**') parameter select the data format.

When working as 'master', the instrument continuously transmits the display value data frame. The local module address is '0'. Configure at menu '**Configuration Master**' ('**cnF.M**') the '**Destination address**' ('**d.Add**') parameter from '1' to '31' or use value '128' for a broadcast message. At parameter '**Frequency**' ('**FrEq**') select the how often the frame with the reading value will be transmitted.

Special tools are grouped inside the '**Tools**' ('**TooL**') menu.

- the '**Decimal point**' ('**dP**') menu is provided for compatibility with ancient hardware that does not support decimal point retransmission. By default, select '**Automatic**' ('**Auto**'). If your instrument does nos transmit the decimal point position, select '**Manual**' ('**MAnL**') and fix the position of the decimal point manually.
- the '**Legacy mode**' ('**LEG'**) parameter is provided to maintain compatibility with instruments with older communication protocols. Select '**on**' to activate this mode.
- the '**Answer delay**' ('**AnS.d'**) parameter applies only to 'Slave' mode. The local module delays the answer frame. Configure for applications where the 'Master' needs additional time to switch between 'transmit' and 'receive' modes. Enter a numeric value between '0' and '1000' mSeconds.
- at the '**Factory reset**' ('**FAct**') menu, select '**yes**' to load the default factory configuration for the instrument.

the '**Version**' ('**VEr**') menu informs of the current firmware version installed in the module.

4.3 Compatible versions

Formats LDB-26, LDB-46	***Version firmware***	***Formats LDB-24, LDB-44***	***Version firmware***
Instruments with access to registers 0, 1, 2, 6			
		LDB24-P, LDB44-P	*41.57*
LDB26-P, LDB46-P	*50.00*	---	---
		LDB24-T, LDB44-T	*44.05*
		LDB24-R, LDB44-R	*45.05*
LDB26-C1, LDB46-C1	*27.08*	*LDB24-C1, LDB44-C1*	*47.07*
LDB26-CR, LDB46-CR	*28.02*	*LDB24-CR, LDB44-CR*	*48.05*

Table 5 - Firmware versions compatible with the indicated registers

4.4 Frame types

The ASCII protocol defines the following frames:

- Frame 'read' ('**RD**'). Id code 36. Request data frame. The requested register is indicated into the 'REG' byte ('Header' section).
- Frame 'answer' ('**ANS**'). Id code 37. Response frame to a request data frame. The requested register is indicated into the 'REG' byte' ('Header' section). Data of the requested register is indicated into data bytes 'D0' to 'Dn' ('Data' section).
- Frame 'error' ('**ERR**'). Id code 38. Response frame to a request data frame. Indicates that an error has occurred. Error code is codified into the 'REG' byte ('Header' section).
- Frame 'ping' ('**PING**'). Id code 32. Used to confirm the existence of the remote instrument.
- Frame 'pong' ('**PONG**'). Id code 33. Response to a 'ping' frame. It confirms the existence of the remote instrument.

4.5 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*

Protocol frames have a structure made of 'Header', 'Data' and 'Trail'.

Section 'Header'

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

Section 'Data'

Contains data for the requested register ('REG').

Section 'Trail'

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

'Real value' and 'Frame value'

To use representable ASCII values, the real values are codified before being sent into the frame. The following definitions apply :

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

Field	*Description*	*Size*	*Position*	*Real value*	*Frame value*
STX	*Start of frame*	*1 byte*	*0*	*does not apply*	*2*
ID	*Frame type*	*1 byte*	*1*	*(see section 4.4)*	*real_value*
RSV	*Reserved*	*1 byte*	*2*	*0*	*32*
FROM	*Origin 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 identification*	*1 byte*	*5*	*(see section 4.1)*	*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 (+/-)*	*ASCII code of the number (48 to 57)* *ASCII code of decimal point (46)* *ASCII code of '+' (43)* *ASCII code of '-' (45)*
CRC	*CRC calculation*	*1 byte*	*n+8*	*does not apply*	*(see section 4.7)*
ETX	*End of frame*	*1 byte*	*n+9*	*does not apply*	*3*

Table 6 - Description of the bytes for the ASCII frame

4.6 Error codes

Frames 'ERR' contain within the 'REG' field, the error code. Available error codes are :

error 1	unknown register
error 2	display overrange
error 3	display underrange
error 4	CRC error
error 5	internal error

4.8 Frame examples

4.8.1 Frames ‘RD’ (36) and ‘ANS’ (37)

Example - ‘Master’ (address ‘0’) requests the value of register ‘0’ (display value) to the ‘Slave’ at address ‘28’ (‘RD’ frame) and the ‘Slave’ replies to the ‘Master’ with a reply frame (‘ANS’ frame) containing the requested data (765.43).

**Instruments with 4 digits also send reading values formatted with 6 digits : value -321.5 is transmitted as -00321.5*

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	15	3
Start	ANS	---	28	0	0	---	8	+0765.43								CRC	Stop

4.8.2 Frames ‘ERR’ (38)

Example - ‘Slave’ at address ‘11’ replies to the ‘Master’ (address ‘0’) with an error frame (‘ERR’ frame) indicating that the requested register number is unknown (‘UNKNOWN_REGISTER’, error code ‘1’). The error code is codified into the ‘REG’ byte. For a list of error code see section 4.6.

Header								Trail	
STX	ID	RSV	FROM	TO	REG	RSV	LONG	CRC	ETX
2	38	32	43	32	33	32	32	46	3
Start	ERR	---	11	0	1	---	0	CRC	Stop

4.7.1 Frames ‘PING’ (32) and ‘PONG’ (33)

Example - ‘Master’ (address ‘0’) requests confirmation of existence to the ‘Slave’ at addrress ‘22’ (‘PING’ frame) and the ‘Slave’ replies 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

4.7 CRC calculation

The ‘frame value’ for the CRC byte is calculated applying a XOR function to the ‘frame value’ *(see section 4.5)* of all bytes in sections ‘Header’ and ‘Data’, from byte ‘0’ (‘STX’) to the last data byte (‘Dn’).

- if the calculated CRC value is lower than ‘32’, it is normalized by applying the ‘one’s complement’ function .

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

- if (CRC0<32) -> CRC=!CRC0 (one’s complement function)
- if (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);
}
```

5. Option S2

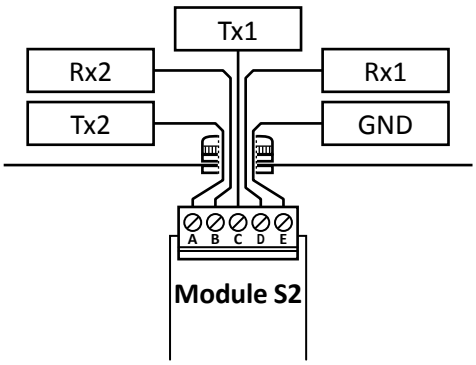
The S2 modules provide 1 port for communications RS232 ASCII protocol. The S2 modules use the same protocol as the S4 modules *(see section 4)*, the only difference is the physical layer of the bus, that is RS232 for the S2.

S2 modules allow for point-to-point communication over RS232 and also allow for multinode communication over RS232 using a 'Daisy-Chain' type of connection.

Terminals RX1 and TX1 are for the main communication with the RS232 bus. Terminals RX2 and TX2 are for the multinode connection, so all frames received at RX1 with destination address different from the local address, will be retransmitted through TX2. On the same way, frames received at RX2 with destination address different from the local address, will be retransmitted through TX1.

Option	**S2**
Type of output	RS-232 ASCII communication
Bus	RS-232
Speed	57.6 Kbps a 600 bps
Data format	8n1 (standard), 8o1, 8n2, 8e1
Protocol	ASCII
Architecture	'master - slave'
Address	01 to 31
'Broadcast' address	128
Registers*	see section for S4 module
**available registers can vary for different instruments*	
Isolation	1000 Vdc
Temperature	operation from 0 to 50 ºC storage from -20 to +70 ºC
Installation allowed at	'Opt.1', 'Opt.2', 'Opt.3'

Figure 16 - Detail for the 'S2' module



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

Figure 17 - Connections for 'S2' module

1. Remote keypad LDB-RKB

Industrial keypad with 3 push buttons to connect to large format meters from LDB series. It allows to replicate the front keypad of the instrument to a remote location.

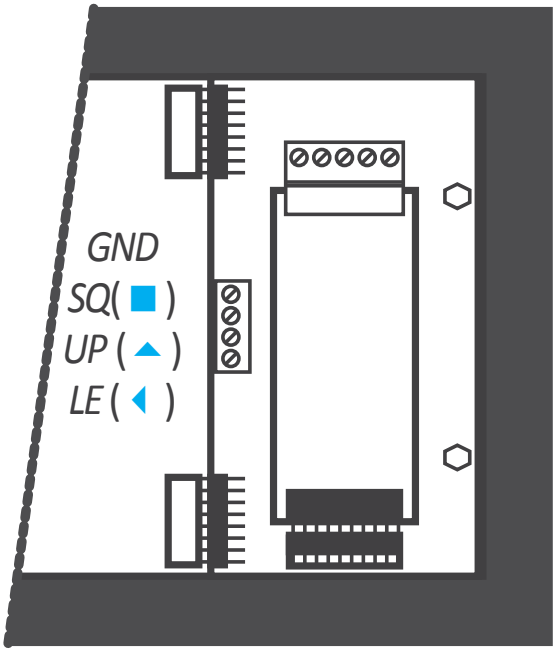
A RKB remote keypad allows the operator to access the advanced control functions from the large format meters, such as fast access to alarm setpoints, preset value modification, access to maximum and minimum reading values, signal tare for load applications, front reset, manual alarm unlock, ...

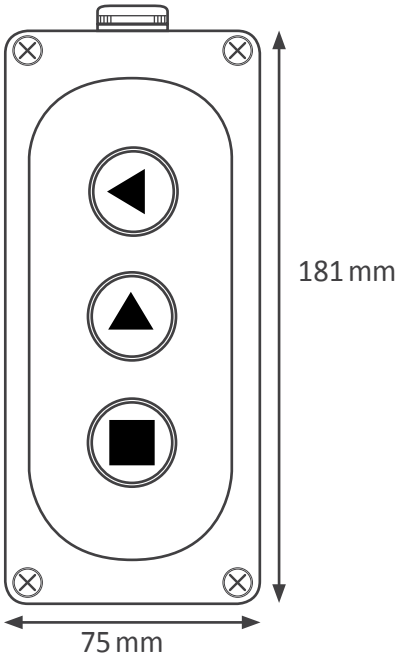
All these features are accessible while maintaining the main feature of these instruments, which is the installation in heights for long distance reading.

The RKB remote keypad is provided with an industrial IP65 protected housing, with cable gland output, aligned with the technical specifications of the LDB series. The RKB remote keypad can be easily installed against wall. The push buttons are 25 mm size for easy use even with protection gloves.

The RKB remote keypad is provided with labeled push buttons and does not included cable.

Normal button state	open
Recommended wire	0.25 mm2
Protection	IP65
Output	by cable gland
Mounting	accepts wall mount
Color	grey
Material	plastic
Weight	200 gr





Connect the wire to the 4 pole terminal located close to the input signal module. Connect 4 wires for keys 'SQ' (■), 'UP' (▲), 'LE' (◀) and common. Pass the wires through the cable gland identified as 'remote keypad' *(see Figure 2)* and connect the other end to the internal RKB push buttons.

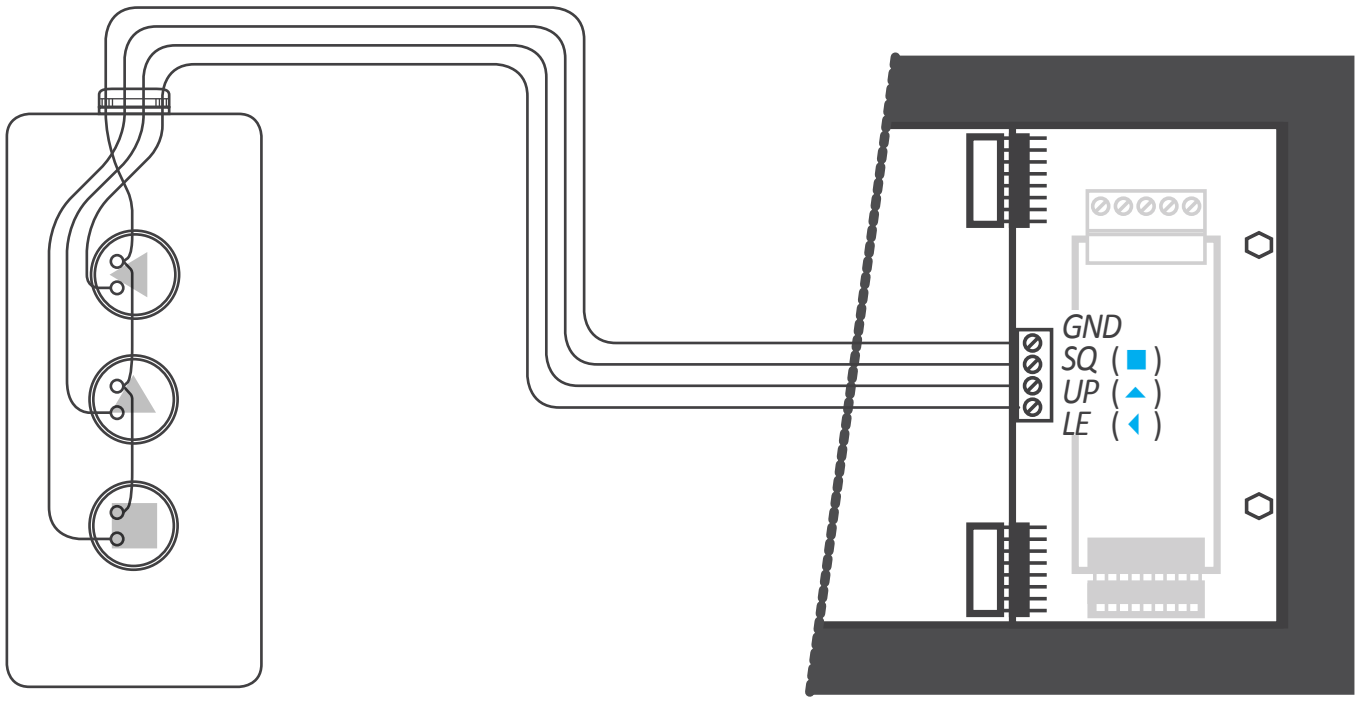


Figure 1 - Connections from RKB to the internal 4 pole terminal

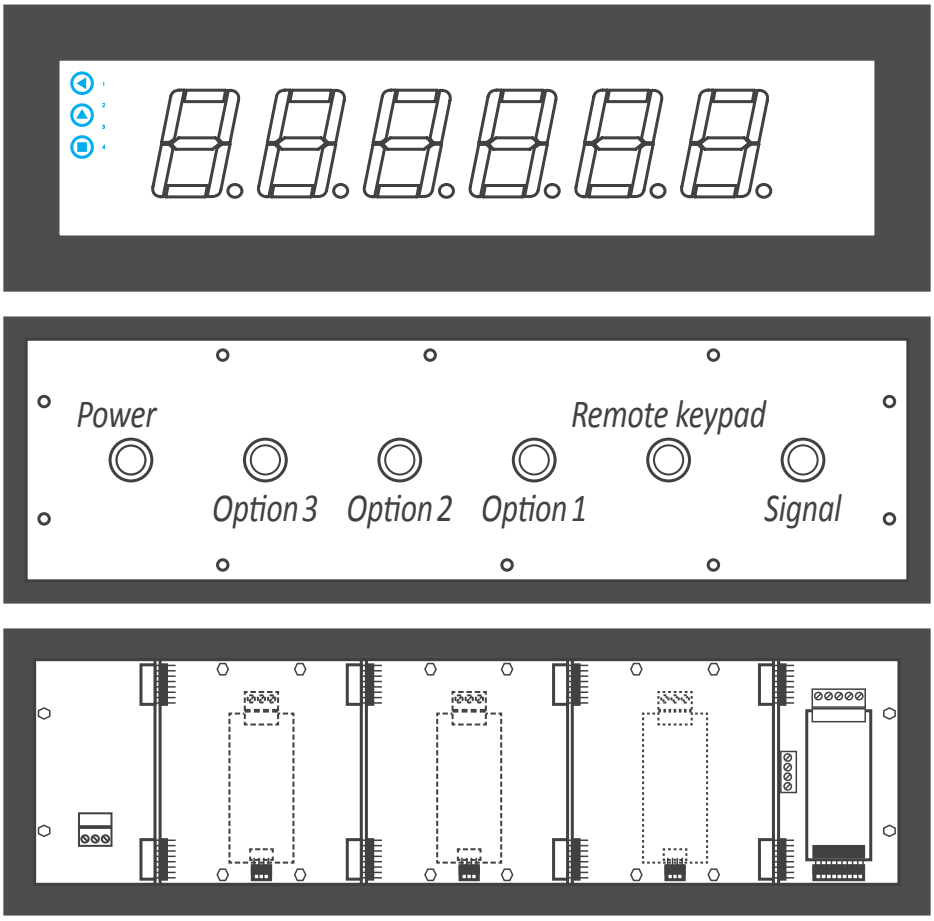


Figure 2 - LDB-26 instrument front view (top), rear view (middle) and internal view (bottom).

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OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **61 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **five (5) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

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The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

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2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

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1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

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