Installation, Operation and Maintenance Manual
MAN712 Rev. 9
June 2021

Biffi ELBS-20

Electronic Line Break System 20

Revision Details

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Section 1: Reference Document

[1]: MDE226 - “ELBS-20 Biffi Assistant User Manual”.

Section 2: General Safety Instructions

2.1 Manufacturer

Manufacturer with respect to Machinery Directive 2006/42/EC is Biffi Italia, as specified on the machinery label.

2.2 Intended Use

The ELBS-20 electronic device covered in this Installation, Operation and Maintenance Manual is designed to monitor the pipeline integrity. The ELBS-20 continuously measures the pressure in the line, it can store the pipeline data (pressure trend) and in case of failure it can send a command to the actuator to stroke the line valve to the fail-safe position. Biffi Italia will not be liable for any possible damage or physical injury resulting from use in other than the designated applications or by lack of care during installation, operation, adjustment and maintenance of the machine. Such risks lie entirely with the user. Depending on the specific working conditions, additional precautions may be requested. Considering that Biffi Italia has no direct control over particular applications, operation or maintenance conditions, it is the operator's responsibility to comply with all applicable safety rules. Please inform Biffi Italia urgently if you face unsafe situations not described in this IOM. It is the sole responsibility of the operator to ensure that the local health and safety regulations are adhered to.

⚠ WARNING

It is assumed that the installation, setting, commissioning, maintenance and repair works are carried out by qualified personnel and checked by responsible specialists.

⚠ WARNING

Any repair work other than the operations outlines in this IOM will be strictly reserved to qualified Biffi Italia personnel or to personnel directly authorised by the company itself.

ELBS-20 devices are designed in accordance with the applicable International Rules and Specifications, but the following Regulations must be observed in any case:

- The general and safety regulations.
- The plant specific regulations and requirements.
- The proper use of personal and protective devices (glasses, clothing, gloves, etc.).
- The proper use of tools, lifting and transport equipment.

⚠ WARNING

The electronic parts of the ELBS-20 and all the options can be damaged by a discharge of static electricity. Before you start, touch a grounded metal surface to discharge any static electricity.

2.3 Terms and Conditions

Biffi Italia guarantees each single product to be free from defects and to conform to current goods specifications. The warranty period is one year from the date of installation by the first user, or eighteen months from the date of shipment to the first user, whichever occurs first. No warranty is given for products which have been subject to improper storage, improper installation, misuse, or corrosion, or which have been modified or repaired by unauthorised personnel. Repair work due to improper use will be charged at standard rates.

2.4 Manufacturer's Liability

Biffi Italia declines all liability in the event of:

- Use of the device in contravention of local safety at work legislation.
- Incorrect installation, disregard or incorrect application of the instructions provided on the device nameplate and in this manual.
- Modifications without Biffi's authorisation.
- Work done on the unit by unqualified or unsuitable persons.

2.5 Applicable Standards and Regulations

EN ISO 12100-1:	Safety of machinery - Basic concepts, general principles for design. Part 1-Basic terminology, methodology.
EN ISO 12100-1:	Safety of machinery - Basic concepts, general principles for design. Part 2-Technical principles and specification.
EN 60204/1:	Electrical equipment of industrial machines. Part 1- General requirements.
2006/42/EC:	Machinery directive.
2004/108/EC:	EMC Directive
94/9/EC:	ATEX Directive
2006/95/EC:	Low Voltage Directive
IEC 60068-2-6, IEC 60068-2-57:	Vibration Test

Section 3: Storage

NOTICE

Not performing the following procedures will invalidate the product guarantee.

All the ELBS-20s leave the factory in perfect condition. When mounted together with the actuator they are guaranteed by the actuator test certificate; in other cases, they are guaranteed by an individual certificate. In order to maintain these characteristics until the ELBS-20 is installed on site, proper attention must be observed for preservation during the storage period.

The standard plastic plugs used to protect the cable entries during the transport are not waterproof; they just prevent the entry of undesired objects during transport: during the storage it is recommended to replace them with waterproof version.

In any case storage is recommended in close ambient without excessive humidity.

If the battery cells are included, the storage temperature must meet the battery cell specifications (storage).

Section 4: Device Description

General Description

The Line Break Detection System type ELBS-20 is an electronic equipment, developed by Biffi, for monitoring the pipeline integrity. The ELBS-20 measures, with a settable time interval, the pressure in the line, it can store the pipeline data (pressure trend) and in case of failure it can send a command to the actuator to stroke the line valve to the fail-safe position (Safety Action).

The ELBS-20 was especially engineered for “ON FIELD” service; it means capability of working in the severest ambient conditions, as wide operating temperature range, vibrations, explosive atmosphere, etc.

Configuration-Managing Interfaces

The ELBS-20 is provided with a powerful local operator interface, made of one 128x64 graphical OLED display and 3 push-buttons that allow entering the configuration data and visualizing the values of variables or the status of the device.

Moreover an RS232, an RS485 and a Bluetooth serial communication ports are provided for the connection with the “Biffi Assistant” software tool (see [1] for details), to carry out parameter configuration, or variables visualization or to download the recorded event data for further analysis of pipeline behavior.

Power Supply

The ELBS-20 accepts two different sources of power supplies:

- External Power Supply from 19.2 V DC to 57.6 V DC (24 V DC -20% to 48 V DC to +20%).
- Battery Pack power supply: 7.2 V DC (lithium batteries).

The two power supplies can be applied one or both per time.

When both the power supplies are present, the Battery Pack works as back-up of the External Power Supply.

The ELBS-20 monitors the status of the External Power Supply and the status of the Battery Pack Power Supply.

Battery Packs

The Battery Pack Card of the ELBS-20 provides two independent battery packs (Default and Auxiliary) with dedicated protection circuit (diodes and fuses).

Each battery pack is composed by four Li-SOCl2 size D cells (parallel of two cells in series).

Analog Inputs (Pressure and Position Sensors)

The ELBS-20 is provided with two (Pressure and Position) configurable (0 - 20 mA or 4 - 20 mA) analog inputs (AI). The ELBS-20 supplies a 14.5 V DC voltage to the sensors.

Digital Inputs (Opto-isolated)

The ELBS-20 is provided with three configurable opto-isolated Digital Inputs (DI).

Analog Output

The ELBS-20 is provided with a configurable 4 - 20 mA analog output (AO).

The AO can be used for the retransmission of the Pressure or Position measured by the AIs.

The AO can accept an external 24 V DC power supply or internally generates the 24 V DC, necessary for the 4 - 20 mA signal.

Digital Outputs (Relay contacts).

The ELBS-20 is provided with 7 Digital Outputs (DO):

- 6x SPST latching relays contacts
- 1x SPDT single side stable relay contacts

Modbus RTU

The ELBS-20 is provided with a MODBUS RTU (RS485) bus interface.

SOV Control Outputs

The ELBS-20 is provided with the following outputs dedicated to the Solenoid Valve Control:

- 2x 24 V DC - 100 mA isolated outputs (SVC)
- 2x SPDT single side stable relays contacts (RL)

The SOV Control Outputs are used for managing one or more external SOVs in order to send a command to the actuator to stroke the line valve to the fail-safe position (Safety Action).

The SOV Control Outputs can be used also to drive a contactor of an electrical actuator (no SOVs required) to stroke the line valve to the fail-safe position.

The ELBS-20 provides also the possibility to use DO1 and DO2 as SOVs Control Outputs.

Integrity Check of the Safety Action Electrical Circuit

The ELBS-20 allows monitoring the status of the Safety Action Electrical Circuits (dedicated SOV Control Output + Coil + Wiring Connection).

Auto-diagnostic

The ELBS-20 monitors the status of the power supply sources, of the internal voltages and of the Analog Inputs circuits.

4.1 Identification of the Main Parts

In this section only the main parts of the ELBS-20 are shown. Refer to Section 13 for a full list of the ELBS-20 parts.

Figure 1

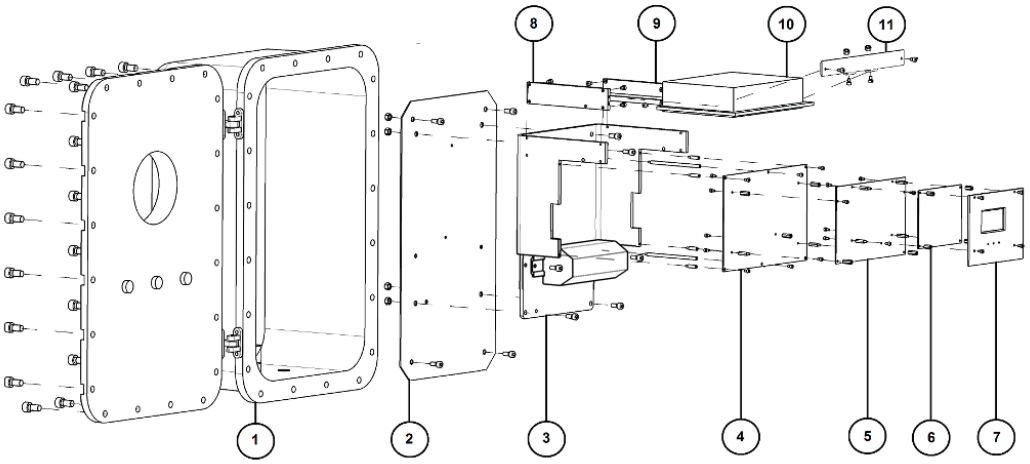


Table 1.

Pos.	Description	Qty
1	CABINET MOD. EJB51 (*)	1
2	EJB51 INTERNAL PLATE (*)	1
3	ELBS-20 CARDS BRACKET	1
4	PROCESS CARD	1
5	INTERFACES CARD	1
6	DISPLAY/BLUETOOTH CARD	1
7	DISPLAY/BLUETOOTH CARD MASK	1
8	BATTERY PACK LEFT BRACKET	1
9	BATTERY PACK RIGHT BRACKET	1
10	BATTERY PACK CARD (opt.)	1
10.1	BATTERY CELLS (opt.)	4 or 8
11	BATTERY PACK FRONTAL EXTRACTOR	1

NOTE:
(*) The EJB51 cabinet is normally provided when the following ordering options are selected: Cabinet Material = A and Cabinet Electrical Certification = B (see Section 16 for details).

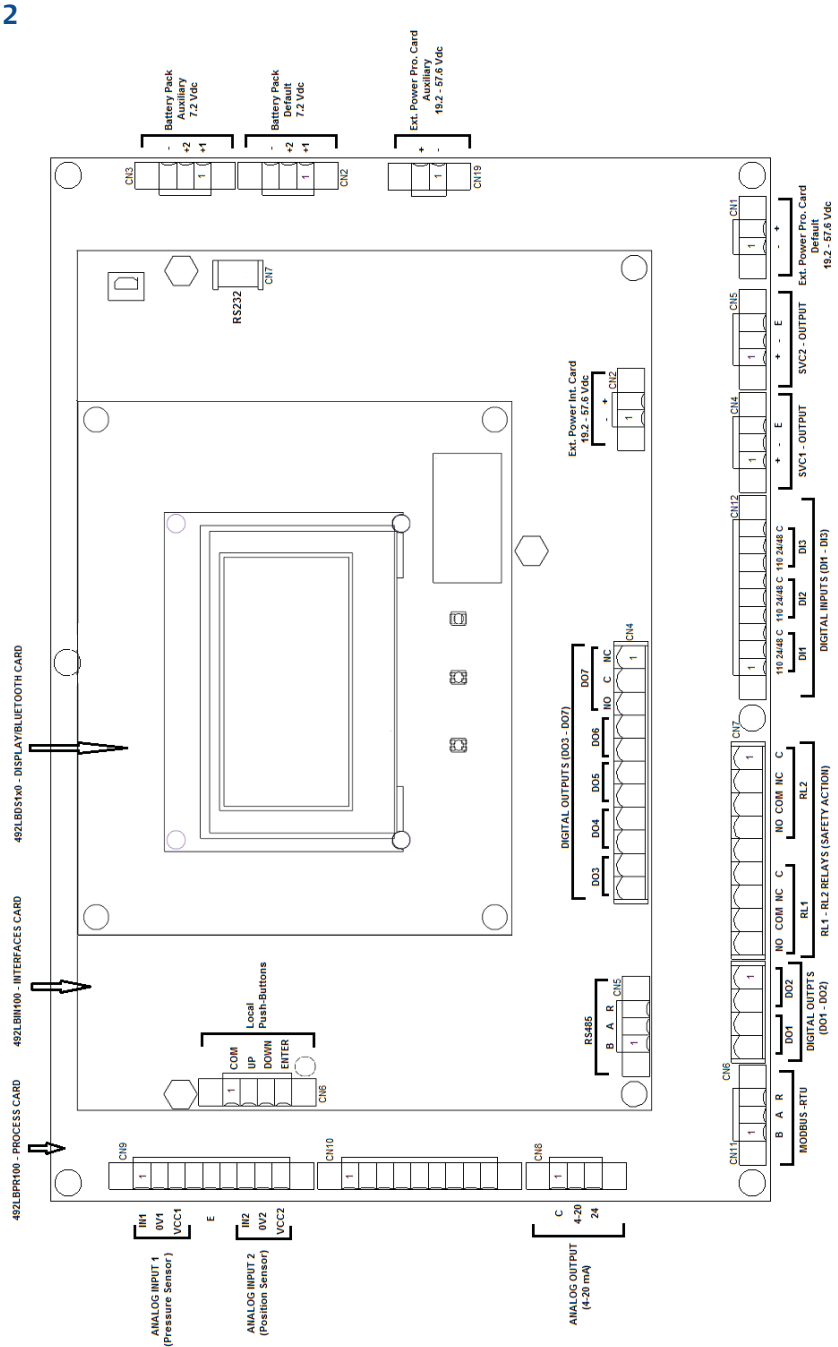
4.2 Electronic Cards

4.2.1 Electronic Cards - Pinout

The figure below shows the 292ELBS100 block that is composed by the following electronic cards:

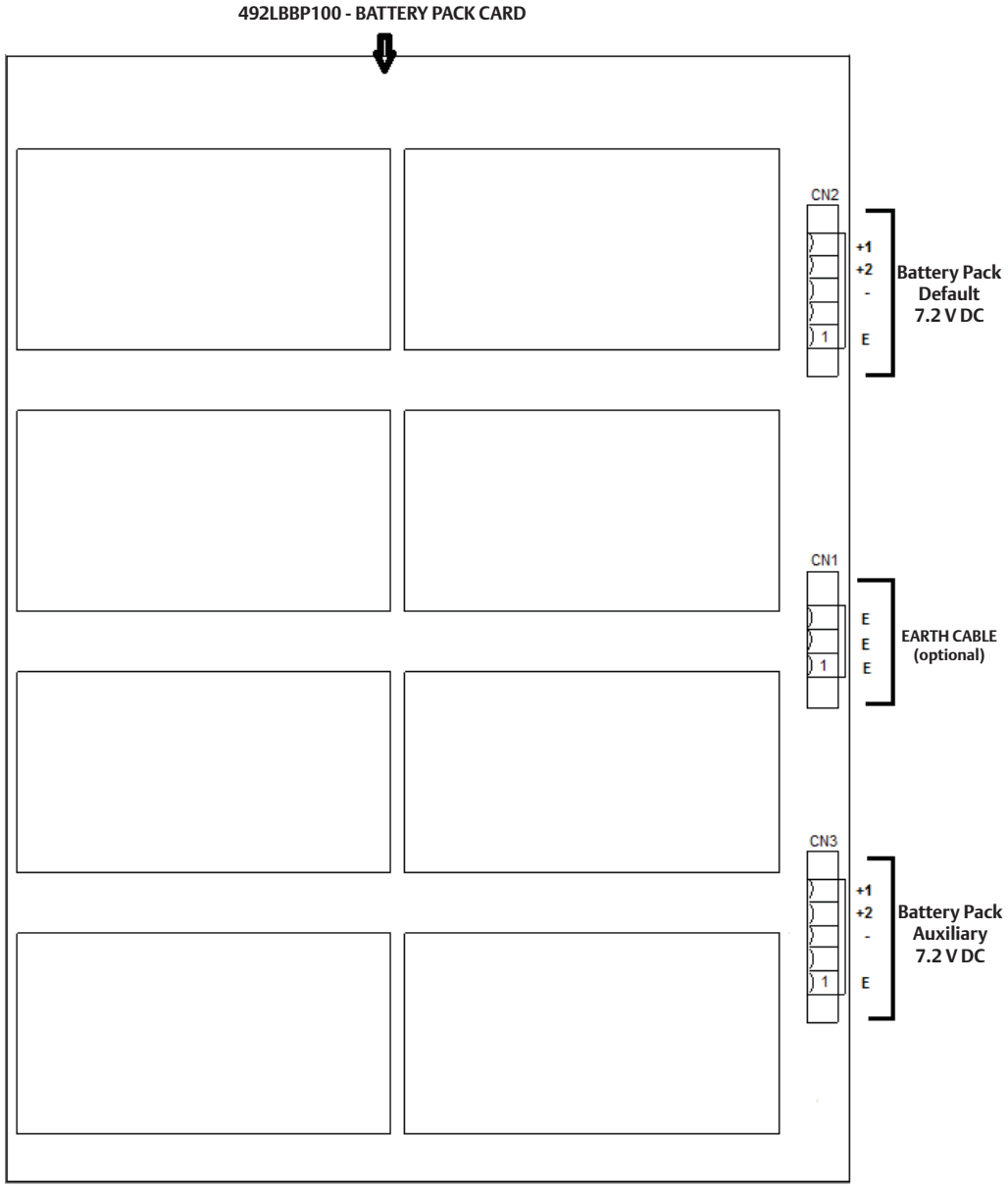
- 492LBDS100: DISPLAY/BLUETOOTH CARD
- 492LBIN100: INTERFACES CARD
- 492LBPR100: PROCESS CARD

Figure 2



The figure below shows the 492LBBP100 – BATTERY PACK CARD.

Figure 3



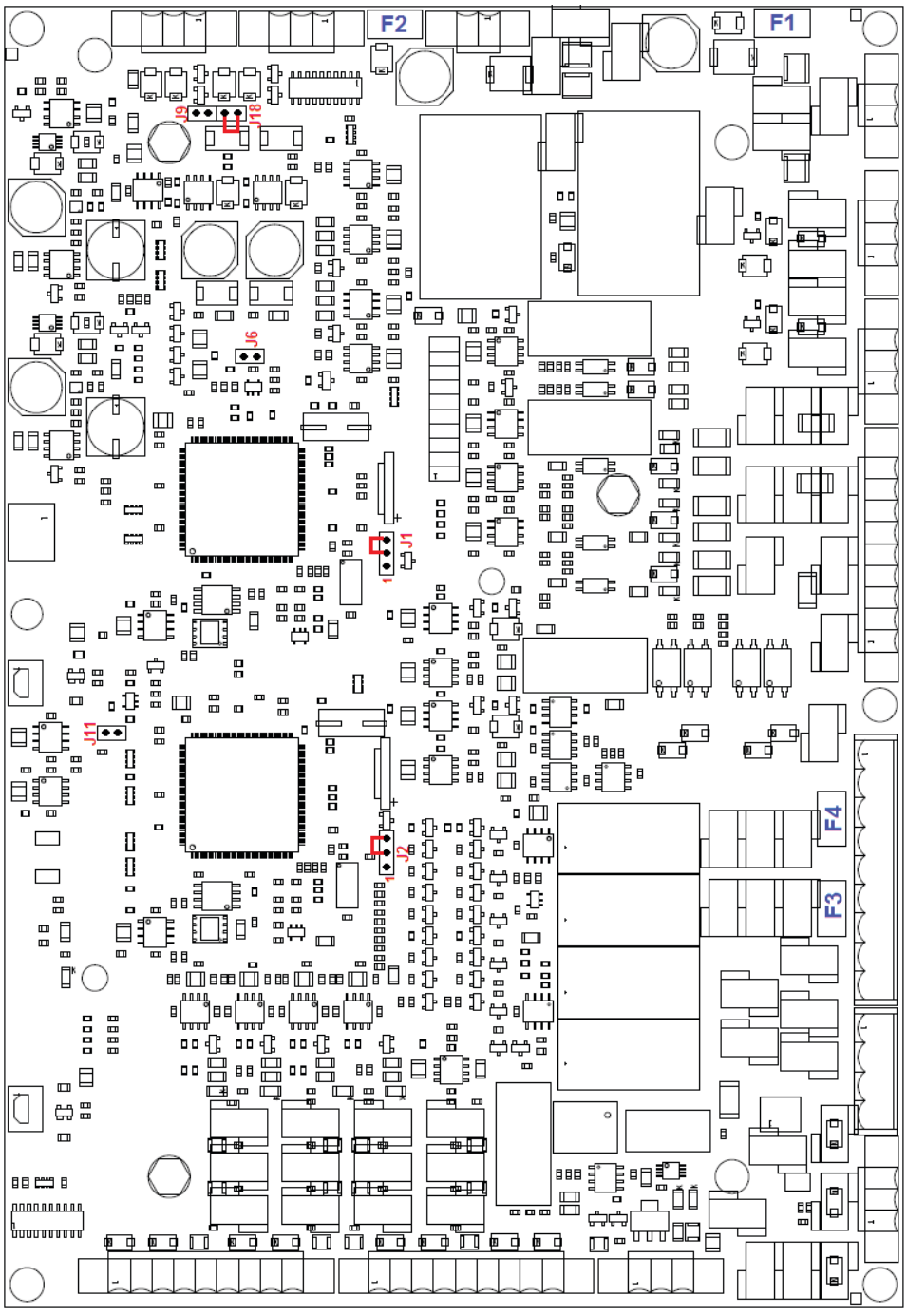
4.2.2 Electronic Card – Details (Jumpers, Fuses, Push-Buttons, Batteries)

The figure below shows the Jumper Settings and the Fuses position of the Process Card.

The Jumpers of the Process Card (Figure below) must be set as follows:

- J18: close
- J9, J11: open
- J1, J2: 2-3 close

Figure 4 Process Card



The figure below shows the Jumper Settings, the Fuse position and the Emergency Push-buttons of the Interfaces Card.

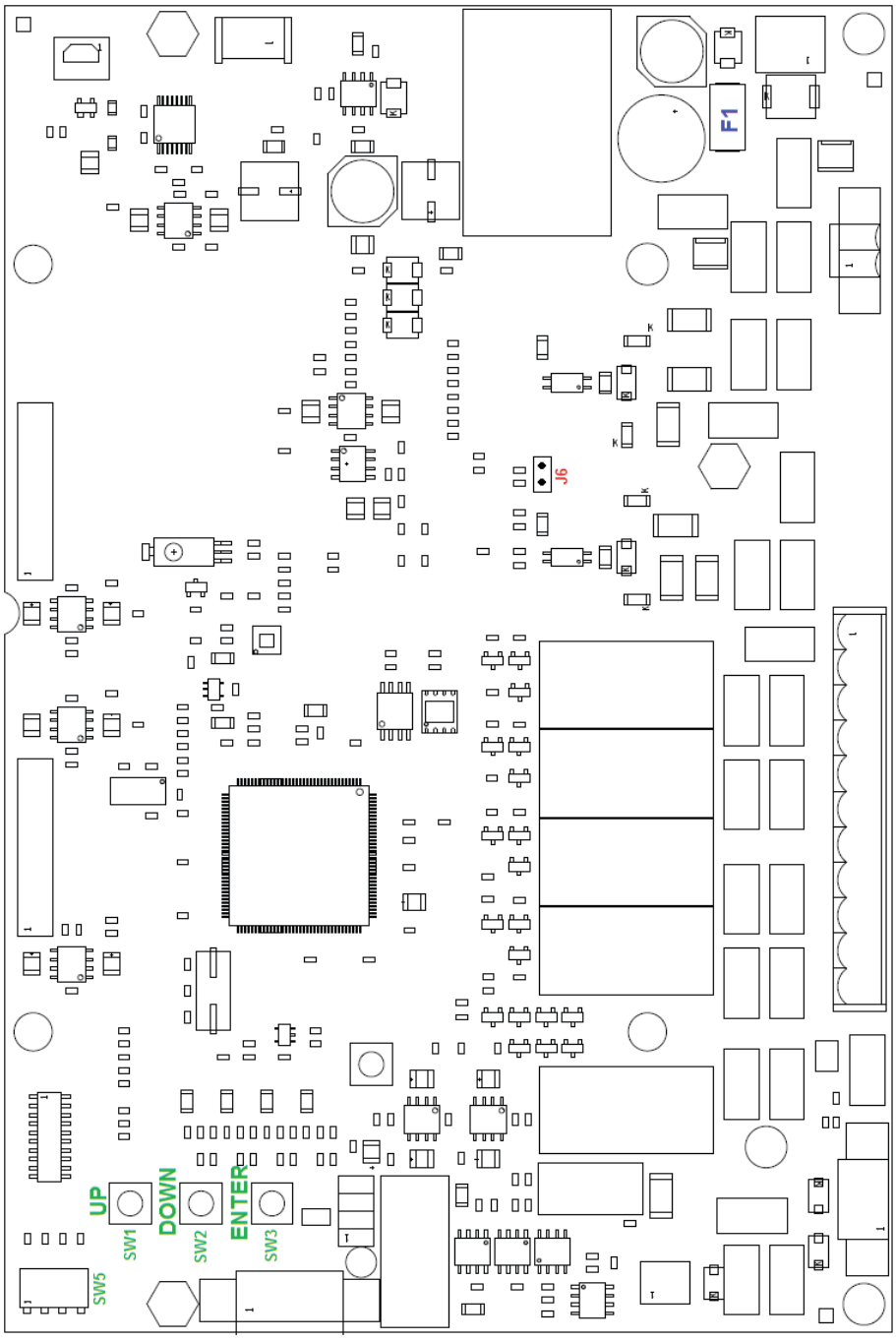
The Jumpers of the Interfaces Card (Figure below) must be set as follows:

- J6: open

The Emergency push-buttons are:

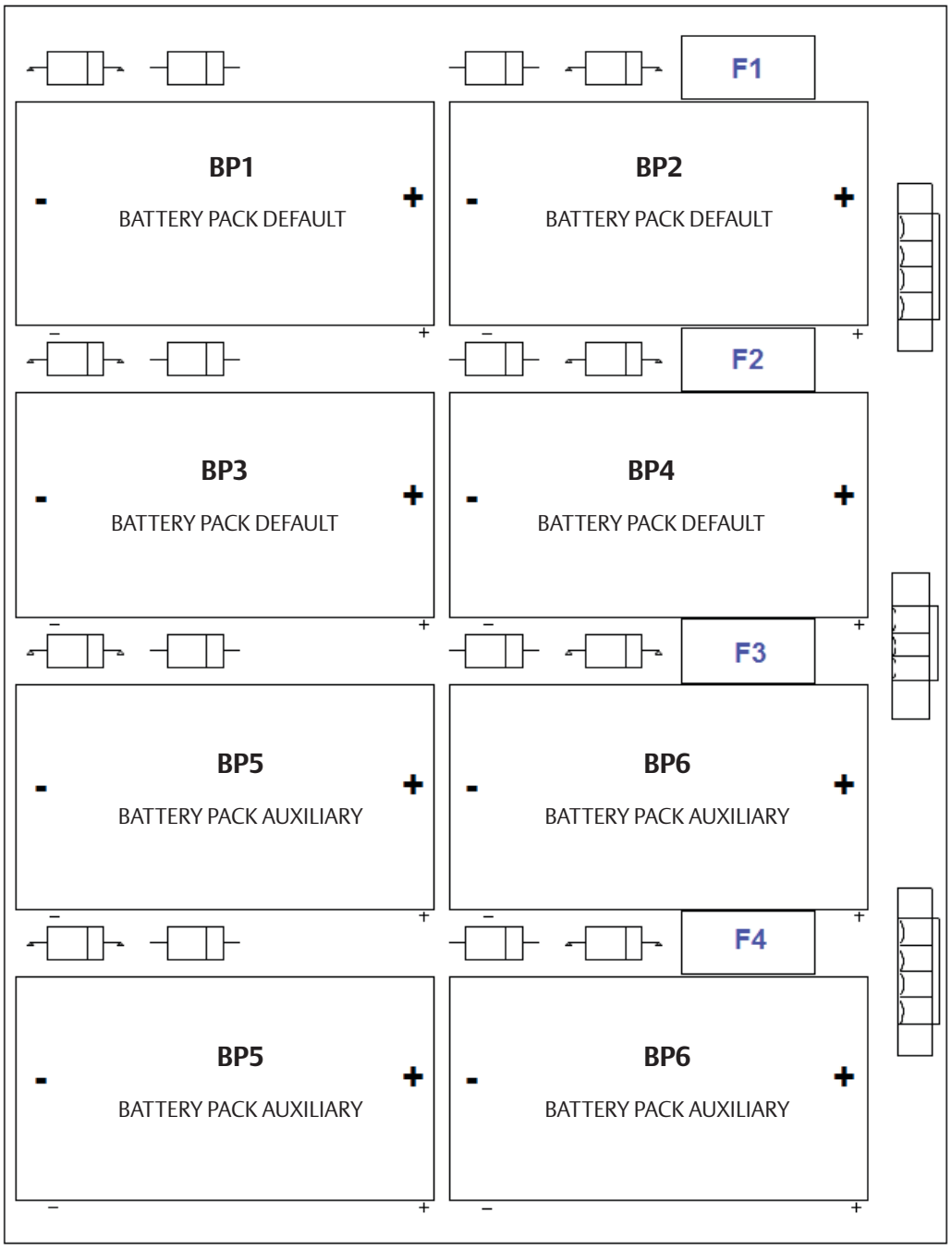
- SW1 – UP
- SW2 – DOWN
- SW3 – ENTER

Figure 5 Interfaces Card



The figure below shows the Fuses position and the Battery Packs polarity of the Battery Pack Card.

Figure 6 Battery Pack Card



4.3 Technical Specifications

Table 2.

External Power Supply	
Supply Voltage Range	19.2 V DC - 57.6 V DC (24 V DC -20% - 48 V DC +20%)
Std Current Consumption without sampling and display ON (Sleep Mode or during Safety Action) (1)	70 mA - 24 V DC, 40 mA - 48 V DC
Std Current Consumption during sampling (2)	135 mA - 24 V DC, 65 mA - 48 V DC
Additional RL1 Current Consumption	20 mA - 24 V DC, 10 mA - 48 V DC
Additional RL2 Current Consumption	20 mA - 24 V DC, 10 mA - 48 V DC
Additional SVC2 Current Consumption (100 mA Output)	200 mA - 24 V DC, 100 mA - 48 V DC
Additional AO Current Consumption (3)	60 mA - 24 V DC, 30 mA - 48 V DC
Additional MODBUS Current Consumption	20 mA - 24 V DC, 10 mA - 48 V DC
Additional RS485 Current Consumption	20 mA - 24 V DC, 10 mA - 48 V DC
Additional Bluetooth Current Consumption	20 mA - 24 V DC, 10 mA - 48 V DC
Maximum Current Consumption (4)	570 mA - 24 V DC, 290 mA - 48 V DC
Galvanic Insulation from Logic	Yes

Battery Pack Power Supply	
Battery Pack Nominal Supply Voltage	7.2 V DC
Single Cell Nominal Voltage	3.6 V DC
Single Cell Nominal Capacity	13.0 Ah or higher
Single Cell raccomended continuos current	1800 mA or higher
Single Cell raccomended operating temperature	from -55 °C to +85 °C or wider
Battery cell type	Li-SOCl2
Interval of Battery Pack replacement (5)	max. 1 year (without Auxiliary Battery Pack) max. 2 years (with Auxiliary Battery Pack)

Analog Input (Pressure and Position Sensors)	
Pressure Range	10 – 1000 bar
Sensor Signal Output	4 - 20 mA or 0 - 20 mA (2 or 3 wires)
Supply Voltage (to each sensor)	14.3 – 14.8 V DC (6)
Supply Current (to each sensor)	up to 25 mA
Internal Resistor (AI1 – Pressure Sensor)	119 ohm
Internal Resistor (AI2 – position Sensor)	102 ohm
Sensor Set-up Time	max. 10 ms
Galvanic Insulation from Logic	Yes

Digital Inputs	
Allowed Voltage (”C” and “24/48” contacts)	19.2 - 57.6 V AC/V DC (24 -20% - 48 +20%)
Current Consumption (”C” and “24/48” contacts)	min. 2.0 mA - max.11 mA
Allowed Voltage (“C” and “110” contacts)	99 – 132 V AC/V DC (110 -10% - 120 +10%)
Current Consumption (“C” and “110” contacts)	min. 2.3 mA – max. 3.3 mA
Galvanic Insulation from Logic	Yes

Digital Outputs (SPST and DPST Relay Contacts)	
Maximum allowed Voltage	up to 120 V AC ± 10% and up to 110 V DC ± 10%
Maximum switching power (resistive load)	up to 1 A – 120 V AC up to 1 A – 30 V DC up to 1 A – 48 V DC up to 0.15 – 110 V DC
Galvanic Insulation from Logic	Yes

Analog Output	
Feedback Signal	Pressure or Position
Output Current Range	4 - 20 mA
Maximum Load (cable+resistor)	300 ohm
Internal Power Supply Voltage	24 V DC
External Power Supply Voltage	21.6 - 26.4 V DC – max 25 mA
Galvanic Insulation from Logic	Yes

SOV Control Outputs (RL1 and RL2)	
Maximum allowed Voltage	up to 120 V AC ± 10% and up to 110 V DC ± 10%
Maximum switching power	up to 1 A – 120 V AC up to 1 A – 30 V DC up to 1 A – 48 V DC up to 0.15 – 110 V DC
Galvanic Insulation from Logic	Yes

SOV Control Outputs (SVC1 and SVC2)	
Output Voltage	22.5 – 24.2 V DC
Maximum Output Current	100 mA
Galvanic Insulation from Logic	Yes

MODBUS RTU	
Transmission Technology	RS485
Baud rate (configurable)	600, 1200, 2400, 4800, 9600, 19200, 38400 bps
Parity Bit (configurable)	Even, Odd, None
Stop Bit (according to Parity Bit)	1, 2
Galvanic Insulation from Logic	Yes

RS485 (Configuration Port)	
Baud rate	19200 bps
Parity Bit	Even
Stop Bit	1
Hardware flow control	Off
Galvanic Insulation from Logic	Yes
Distance (cable length) (7)	Max. 1000 meters

RS232 (Configuration Port)	
Baud rate	115200 bps
Parity Bit	Even
Stop Bit	1
Hardware flow control	Off
Distance (cable length)	Max. 10 meters

Bluetooth (Configuration Port)	
Baud rate	115200
Parity Bit	None
Stop Bit	1
Hardware flow control	On
Distance	Max. 10 meters

Various Characteristics	
Operating Ambient Temperature	from -40 °C up to +75 °C
Expected Lifetime	10 years

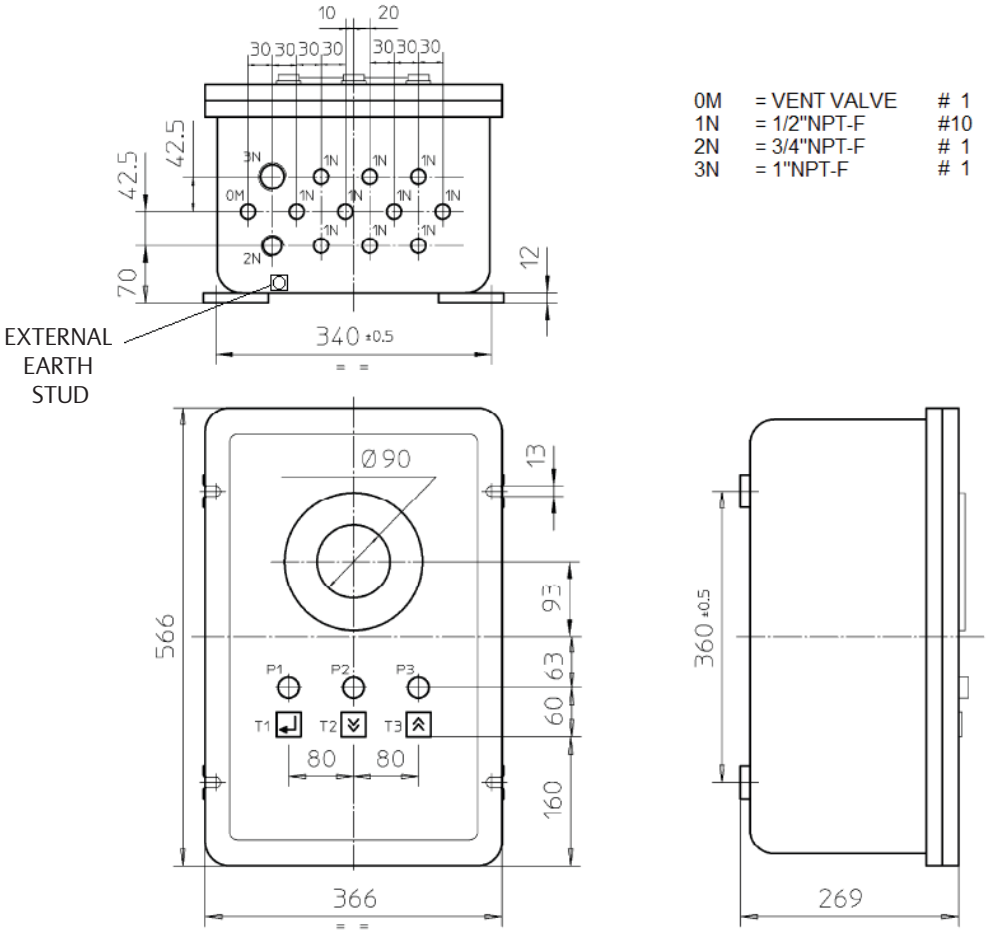
NOTES:

1. The display is ON.
2. During the Pressure and Position Sampling (both sensors are supplied with the max power consumption) with the display ON and considering the additional power for driving a DO (relay).
3. 20 mA of output by using the internal power supply.
4. During the Safety Action with SVC1, SVC2, RL1 and RL2 configured as SOV Control Outputs, the display ON and MODBUS, Bluetooth and RS485 enabled.
5. Battery Pack is the unique power supply, the Sample Rate is greater than 10 seconds and one safety action and a “normal” configuration time (10 minutes) are considered.
6. Considering both the Supply Voltage and the internal resistor, the Pressure and the Position sensors must accept the following Minimum Supply Voltage: 10 V DC (2-wires sensors) and 12 V DC (3-wires sensors).
7. It depends on cable quality and on the wires dimension.

4.4 Overall Dimensions (EJB51 Cabinet)

The overall dimensions and the standard layout of the EJB51(*) cabinet are shown in the figure below.

Figure 7



NOTE:
(*) The EJB51 cabinet is normally provided when the following ordering options are selected: Cabinet Material = A and Cabinet Electrical Certification = B (see Section 16 for details).

4.5 Options

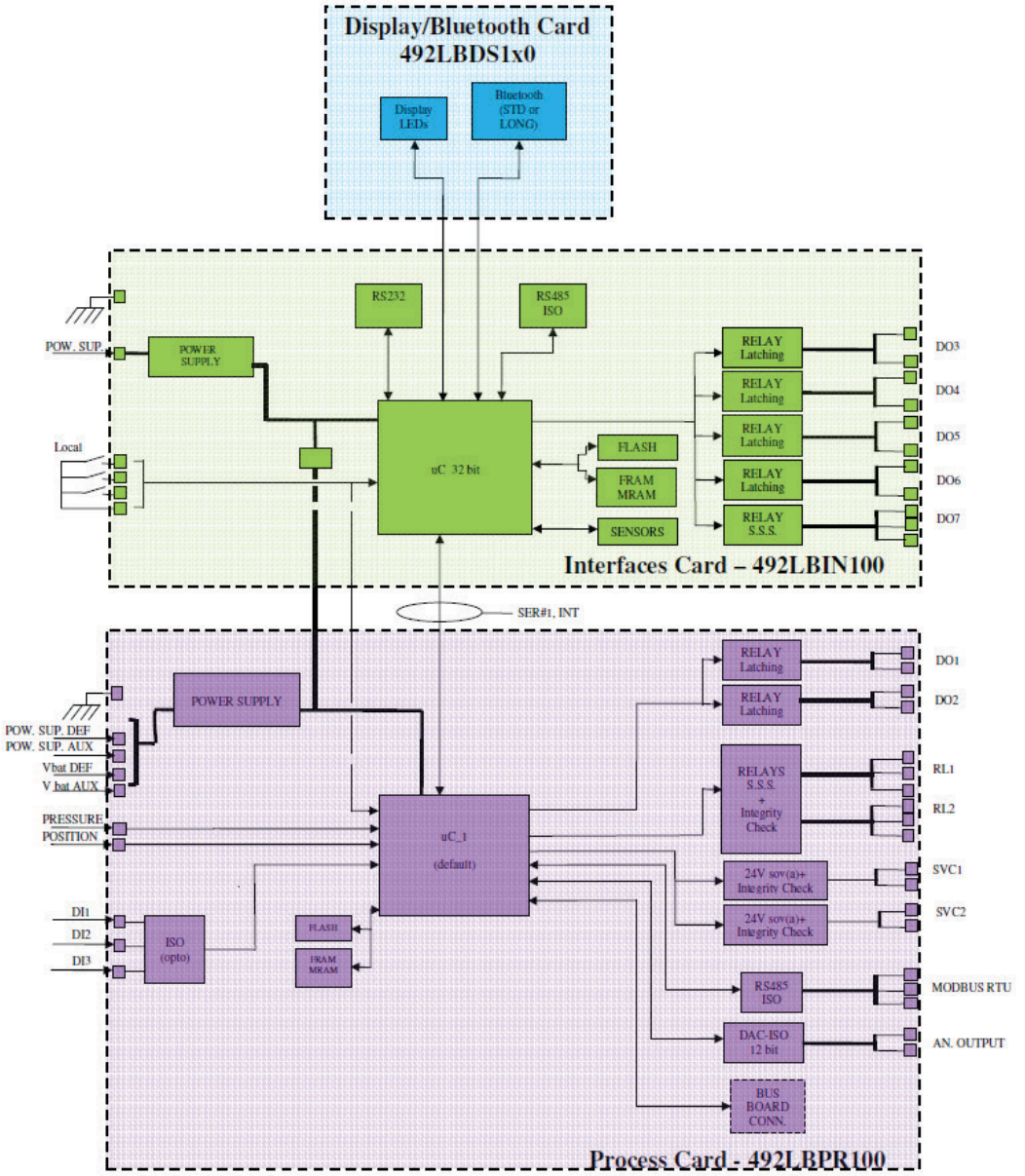
See Section 16 for the available options of the ELBS-20.

Section 5: Working Principle and Detailed Description

5.1 Working Principle

The following figure shows the block diagram of the ELBS-20.

Figure 8



The ELBS-20 samples cyclically the line pressure value, measured by the pressure transducer.

Optionally the ELBS-20 samples the position value, measured by the Pressure Sensor.

The sampled values are memorized in a temporary rolling memory, type FIFO (First in, First out).

The rolling FIFO memory allows storing 230 samples of Pressure and Position (if the optional Position Sensor is present) and the sampling rate is programmable from 0.2 to 60 seconds (see Section 6 for details).

The pressure magnitude and pressure drop rate are continuously compared to the reference values, set by the user in the configuration memory.

An event is defined as the condition that occurs when the measured pressure magnitude or pressure drop rate exceeds the customer set-point for a configurable time.

In case of event, the pressure magnitude values (and the optional position values), present in the FIFO memory are transferred to the “data memory” (4 MB flash memory).

The event data memory can store up to 1000 events, and the events have the following size:

- 115 (*) samples preceding the event and 115 samples after the event (EVENT 1, 3 and 5) (**)
- 230 (*) samples preceding the event (EVENT 2, 4, 6) (***)

The ELBS-20 transfers into the “event data memory” the following types of EVENT (****):

EVENT 1 pressure value decreases of a pre-set amount (configurable parameter)

EVENT 2 pressure reaches the low value limit (configurable parameter)

EVENT 3 pressure value increases of a pre-set amount (configurable parameter)

EVENT 4 pressure reaches the high value limit (configurable parameter)

EVENT 5 (only in ACQ mode) pressure drop exceeds the pre-set speed drop data acquisition (configurable parameter)

EVENT 6 pressure drop exceeds the pre-set speed drop valve control (configurable parameter)

(*) if already sampled
(**) if another event, with higher priority, occurs during the last 115 samples, the present event is discharged and the new event is stored. The events 2, 4 and 6 have the priority.
(***) the FIFO is cleared after the storing in flash.
(****) EVENT 5 and EVENT 6 can be disabled through the “Drop Enabled” parameter (see Section 6 for details).

The following configurable operating modes are available (see Section 5.1.1 and Section 5.2.2.3 for details):

- data acquisition
- valve control
- valve control + data acquisition
- sleep
- slow sampling

In **data acquisition** (ACQ.) operating mode the pressure and position (optional) samples relevant to an event (1, 2, 3, 4, and 5) are stored in the data memory but an event does not affect the valve position.

In **valve control** (VC) operating mode the pressure and position (optional) samples relevant to an event (1, 2, 3, 4 and 6) are not stored in the data memory but in case of EVENTS 2, 4 and 6 the ELBS-20 sends a command to the actuator to stroke the valve to the fail-safe position (Safety Action).

In **valve control + data acquisition** (VC+ACQ) operating mode the pressure and position (optional) samples relevant to an event (1, 2, 3, 4, and 6) are stored in the data memory and in case of EVENTS 2, 4 and 6 the ELBS-20 sends a command to the actuator to stroke the valve to the fail-safe position (Safety Action).

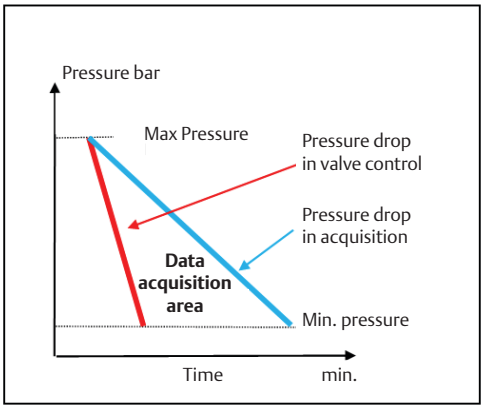
The **sleep** (SLEEP) operating mode is used to inhibit both data acquisition and valve control operating modes to put out of service the ELBS-20.

In **slow sampling** (SLOW) operating mode the Analog Inputs are measured; the events are not stored and the safety action is not performed.

In case of **alarm**, the ELBS-20 automatically enters in the "slow sampling" operating mode. In the above state the valve control and acquisition functions are off, but the ELBS-20 restores to the normal operating mode when the cause disappears.

The following figure shows the “data acquisition area” in function of the time.

Figure 9

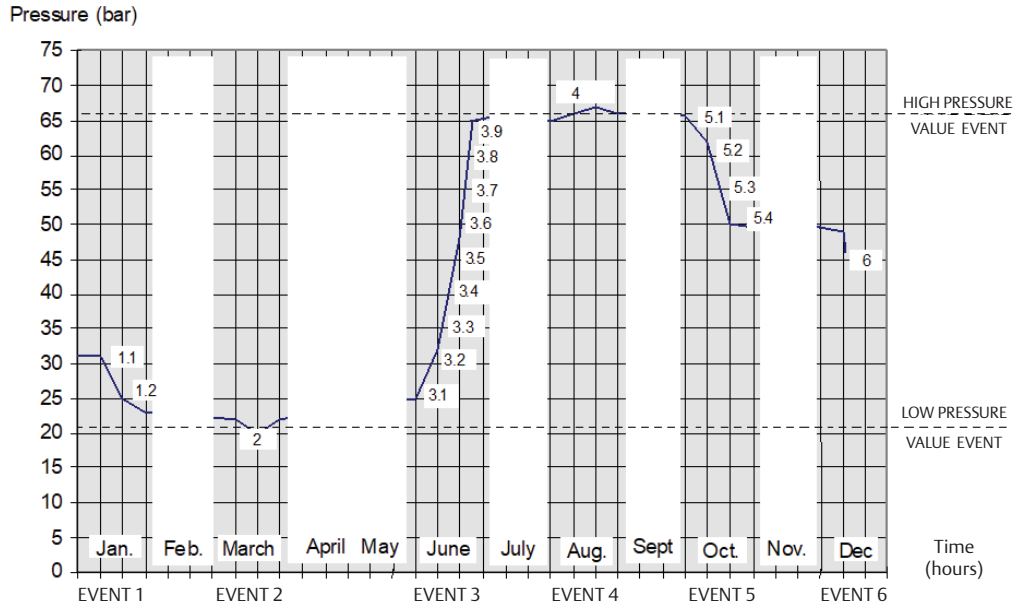


The figure below shows the above described types of EVENT that could be memorized during the pipeline data acquisition.

The Event 1, happened in January, represents a pressure that pass through the values of 30 bar and 25 bar (the “Pressure Decrease” parameter is supposed to be 5.0 bars), causing the memorization of the events in the “event data memory” (Event 1.1 and Event 1.2). In February, April, May, July September and November the pipeline pressure does not generates any Event. The Event 3 represents a pump station start-up, while the Event 5 is a pump station shut down that creates a pressure drop rate higher than the ELBS-20 adjustment, so that the Event 5.1, 5.2, 5.3 and 5.4 are memorized into the "event data memory". The Event 6 represents a Line Break that creates a pressure drop rate higher than the pipeline curve behavior present in the ELBS-20 memory. In this case, if the ELBS-20 is in VC or VC+ACQ operating mode, the actuator is controlled in order to stroke the pipeline valve in the fail position.

Figure 10

Pressure behavior relevant to one year



All the Events are memorized in the "event data memory". The following formula allows calculating the duration of the recorded time corresponding to each event and the time between two recorded pressure data in each event:

recorded time duration (min.) = sampling rate * number of samples (230 max)

time between 2 data (second) = sampling rate

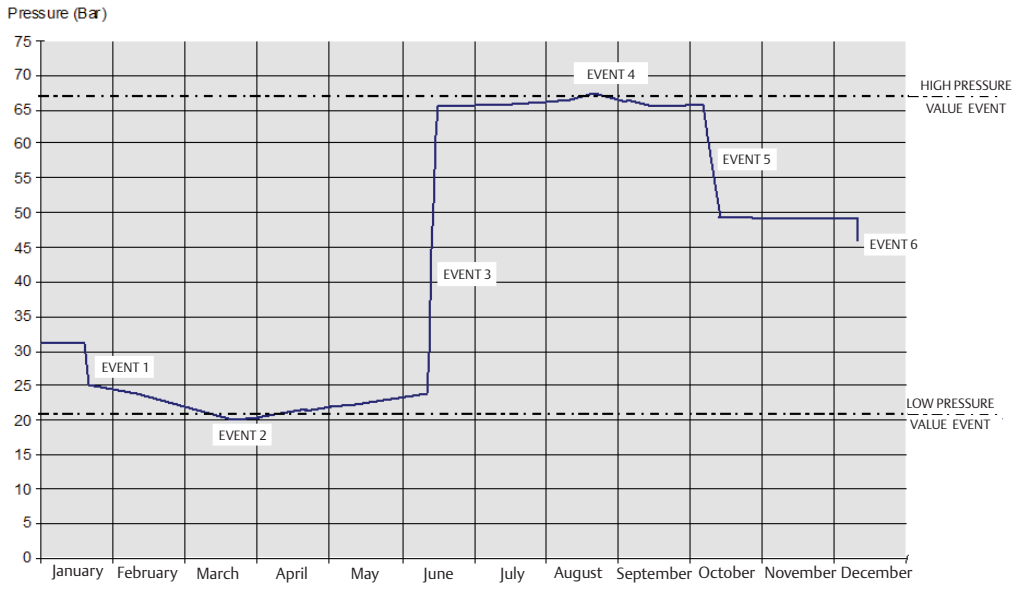
When the "event data memory" reaches 90% of its capability and the parameter "Memory 90%" is set to "On", a warning informs about the need to discharge the memory content in a portable PC in order to allow the ELBS-20 restarting its pipeline survey.

The content of the "event data memory" can be used to build-up the pipeline pressure curve relevant to the period of survey, as shown in the figure below.

The pressure curve allows calculating the typical values of pressure and pressure drop rate of the pipeline and to enter the correct set-points in the ELBS-20.

Figure 11

Pressure behavior relevant to one year



5.1.1 Table of Operating Modes

Table 3.

Operating mode	Description
Valve Control (VC) (configurable)	No data acquisition, only Safety Action in case of EVENTS 2, 4, 6(*). The ELBS-20 switches to slow sampling mode: - if there is an alarm active (see Section 6.4) excepting the SLEEP alarm. - after the execution of the Safety Action (see Section 5.1.2.7). The ELBS-20 restores to normal operating mode when the cause disappears, excepting when the Safety Action is performed. For exiting from the Slow Sampling mode after the execution of the Safety Action it is necessary to "manually" change the operating mode by using the available interfaces (Local, Serial and Modbus).
Acquisition (ACQ) (configurable)	No Safety Action, only data acquisition on EVENTS 1, 2, 3, 4, 5. The ELBS-20 switches to slow sampling mode: - if the event data memory is full and “not circular mode” is set. - if there is an alarm (see 6.4) excepting the SLEEP alarm. - in case of low pressure (EVENT 2). - in case of high pressure (EVENT 4). The ELBS-20 restores to normal operating mode when the cause disappears.
Valve Control + Acquisition (VC+ACQ) (configurable)	Safety Action on EVENTS 2, 4, 6, and data acquisition on EVENTS 1, 2, 3, 4, 6(*). The ELBS-20 switches to slow sampling mode if: - if there is an alarm (see Section 6.4) excepting the SLEEP alarm. - after the execution of the Safety Action (see Section 5.1.2.7). If event data memory is full and "not circular mode" is set, the data acquisition stops, but valve control is still active. The ELBS-20 restores to normal operating mode when the cause disappears, excepting when the Safety Action is performed. For exiting from the Slow Sampling mode after the execution of the Safety Action it is necessary to "manually" change the operating mode by using the available interfaces (Local, Serial and Modbus).
Sleep (SLEEP) (configurable)	No data acquisition and Safety Action. No pressure, position and Battery Packs voltages measurement.
Slow Sampling (SLOW) (automatic and configurable)	No data acquisition and Safety Action. The local operator interface is still available. The ELBS-20 measures the Power Supply sources, the pressure and the position (if "enabled") with a time equal to "Slow Sampling Rate" (see Section 6). The ELBS-20 restores to normal operating mode when the cause disappears, excepting when the Safety Action is performed. For exiting from the Slow Sampling mode after the execution of the Safety Action it is necessary to "manually" change the operating mode by using the available interfaces (Local, Serial and Modbus).

For additional details about the Operating Modes depending on the applied Power Supply see Section 5.2.2.3.

NOTE:

(*) Only if the Drop is enabled. "Drop Enabled" = "Yes" (see Section 6).

5.1.2 Details of the Valve Control Operating Mode

5.1.2.1 Safety Action on Pressure Drop Rate

When "Drop Enabled" = "Yes" (see Section 6) and the pressure drop rate exceeds the "Valve Control Pressure Drop Rate" (EVENT 6), the ELBS-20 c)ommands the selected SOV Control Outputs and the actuator strokes the line valve to the fail-safe position.

5.1.2.2 Safety Action on High or Low Pressure

When the pressure value is lower than the “Low Pressure Limit” (EVENT 2), or is higher than the “High Pressure Limit” (EVENT 4), the ELBS-20 commands the selected SOV Control Outputs and the actuator strokes the line valve to the fail-safe position.

5.1.2.3 Safety Action for Simulation Test (Pressure Drop)

The ELBS-20 provides a Self-Test routine (see 6) that allows entering a pressure drop rate in place of the pressure transducer value, in order to verify the output command signal to the solenoid valve and the correct operation of the device.

The test function forces the valve control (VC) operating mode. The simulated pressure will start to the high pressure limit or to the Pressure Max. (if the high pressure limit is greater than the Pressure Max.) and goes to 0 bar according with the set pressure drop (“T.Pr.Drop”). The test function can be stopped by pressing the ENTER push button.

If the condition of EVENT 2 or EVENT 6 (*) are reached or if the Pressure value becomes 0.0 bar, the Safety Action is performed and the test is finished.

The event generated during the Self-Test routine is not stored.

At the end of the test (both if interrupted and if Safety Action is performed) the ELBS-20 goes to the SLOW operating mode.

(*) The Drop must be enabled. “Drop Enabled” = “Yes” (see Section 6).

5.1.2.4 Safety Action for Simulation Test (Safety Action)

The ELBS-20 provides a routine for forcing the Safety Action, in order to verify the output command signal to the SOVs or to perform a “manual” Safety Action.

This test can be performed only if the operating mode of the ELBS-20 is VC or VC+ACQ.

This command performs a Safety Action and at the end of its operation the ELBS-20 goes to the SLOW operating mode.

5.1.2.5 Safety Action for Digital Input Command

The ELBS-20 provides a dedicated function of the Digital Inputs (DI) to perform the Safety Action through a hard-wired command.

This command performs a Safety Action and at the end of its operation the ELBS-20 goes to the SLOW operating mode (see Section 6.3).

5.1.2.6 Safety Action Delay

The ELBS-20 is fitted with a configurable time delay module that allows delaying the starting of the Safety Action. The Delay is expressed in number of Samples. The time between two consecutive samples is determined by the set “S.Rate” (see Section 6).

Example: “Delay” = 2 samples, “S.Rate” = 8 seconds => the Safety action is delayed of 16 seconds (2*8).

If the condition which causes the event (low pressure EVENT 2, high pressure EVENT 4, pressure drop rate EVENT 6), disappears during the delay time, the Safety Action will not start.

The “Delay” parameter has no effect on Safety Action caused by the Digital Input Command and the Simulation Test (Safety Action).

5.1.2.7 Execution of the Safety Action

The Safety Action is performed in the following way: the ELBS-20 controls the selected SOV Control Outputs for commanding the actuator to stroke the line valve to the fail-safe position.

The ELBS-20 initiates the Safety Action if the Operating Mode is VC or VC+ACQ (see Section 5.1.1), no alarms are active and one of the following conditions is satisfied:

- EVENT 2 happens (see Section 5.1.2.2)
- EVENT 4 happens (see Section 5.1.2.2)
- EVENT 6 happens (see Section 5.1.2.1) (*)
- Digital Input command (see Section 5.1.2.5)
- “Start Test Safety Action” command (see Section 6 and Section 5.1.2.4)
- Pressure Drop Simulation Test (see Section 6 and Section 5.1.2.3) (**)

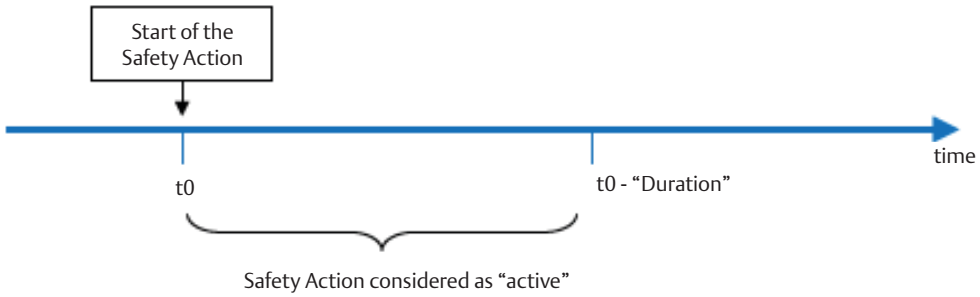
In case of EVENT 2, 4 and 6 the Safety action starts after the set value of the “Delay” parameter (see Section 5.1.2.6).

It is possible to select several SOV Control Outputs for initiating the Safety Action (see Section 5.2.8).

The ELBS-20, for performing the Safety Action, commands the dedicated SOV Control Outputs SVC1, SVC2, RL1 and RL2 for a time settable through the “Duration” parameter.

If DO1 and DO2 Digital Outputs are used as SOV Control Outputs (see Section 6.2), the “Duration” parameter has no effect on them. DO1 and DO2 commute for initiating the Safety Action and it is necessary to set the ELBS-20 in VC or VC+ACQ Operating Mode to restore their initial status (see Section 11).

In any condition, the “Duration” parameter determines the interval of time during which the ELBS-20 considers the Safety Action as “active”.



The Pressure and the Position values are not updated during the execution of the Safety Action.

The AO is disabled (0 mA transmission) during the execution of the Safety Action.

After the execution of the Safety Action the ELBS-20 goes to the Slow Sampling Operating Mode and for exiting from this status it is necessary to “manually” change the operating mode by using the available interfaces.

(*) only if the Drop is enabled; “Drop Enabled” = “Yes” (see Section 6).

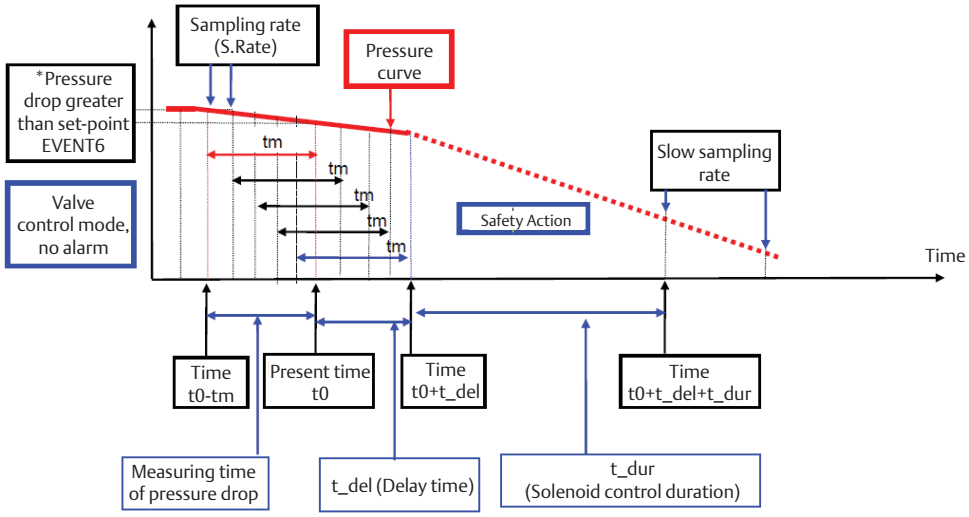
(**) the test function forces the valve control (VC) operating mode.

5.1.3 Examples of Pressure Drop Rate Control

The following figure shows the ELBS-20 behavior in presence of a continuous pressure drop rate.

Figure 12

```
tm (second)                = ((((Pres. Max/VLC PDR)*60)/200)/S.Rate +1)*S.Rate
delay (# of Samples)       = 4 Samples
t_del (second)             = 4 * S.Rate
t_dur (second)             = Duration
```

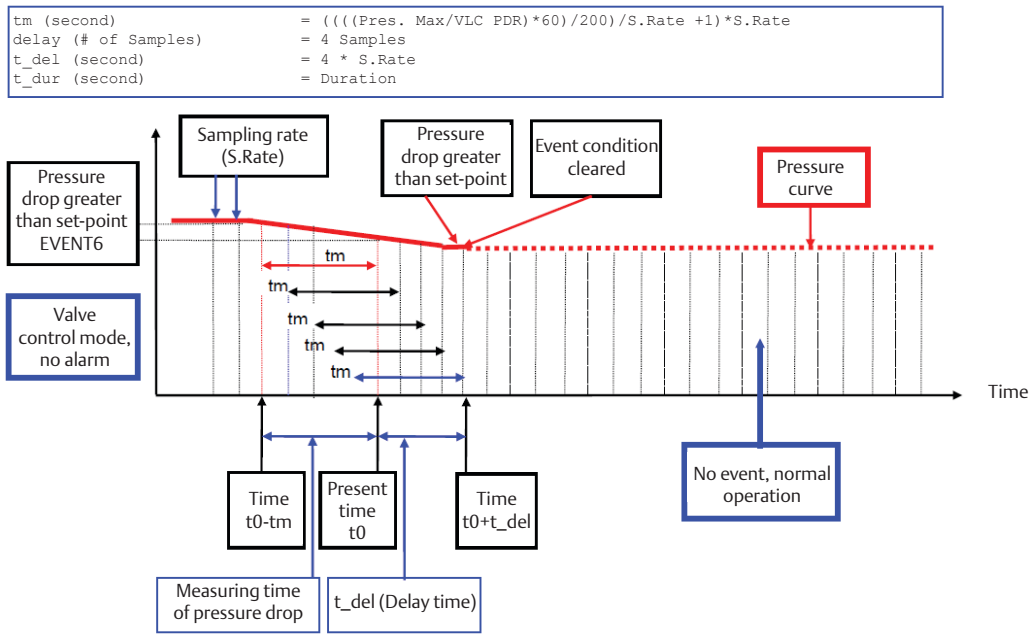


NOTICE

Before than the valve control action takes place, it needs that the EVENT 6 condition is confirmed during the “Delay time”.

The following figure shows the ELBS-20 behavior in presence of a temporary pressure drop rate.

Figure 13



5.2 Detailed Description

In this section are described the functionalities of each input, output and interface of the ELBS-20.

Refer to Section 4.2.1 and to Section 4.3 for the pinout and electrical limits of the ELBS-20.

5.2.1 Configuration-Managing Interfaces

The ELBS-20 provides the following Configuration-Managing Interfaces:

- Local Operator Interface (Keypad-Display)
- RS232 Port
- RS485 Port
- Bluetooth Port

5.2.1.1 Local Keypad and Display

The ELBS-20 is fitted with a graphic 128x64 OLED display and 3 push-buttons that allows entering the configuration parameters or to visualize the working data.

Two push-buttons “DOWN”, “UP” are used to move into the menu and for changing the value of the parameters, while the third “ENTER” is used to enter the selected information and for moving between the sub-menus and for waking-up the ELBS-20 (when the only Battery Pack Power Supply is present).

The display is automatically shut-down after one (only Battery Packs Power Supply) or five (External Power Supply applied) minutes the last button is pressed.

Press “ENTER” for waking-up the ELBS-20 and turning-on the display when the Battery Packs is the only Power Supply or press any push-button for turning on the display when the External Power Supply is present.

The ELBS-20 provides two different sets of push-buttons:

- Default push-buttons (on the cabinet)
- Emergency push-buttons on the Interfaces Card (see Section 4.2.2)

The Emergency push-buttons must be used just when the default push-buttons do not work properly. For using the Emergency push-buttons, the cabinet must be opened.

⚠ WARNING

If the device is located in hazardous area a "hot permit" must be obtained before opening the explosion proof enclosures. Moreover, the area must be cleaned from explosive mixture since batteries and power supply could generate electrical spark and cause explosion.

The configuration operations are protected by password. The operator can enter in the "Setup Mode" menu and change the parameters or select the Operating Mode, only after entering the appropriate password.

For additional details dealing with the Local Operator Interfaces see the "LOCAL OPERATOR INTERFACE" paragraph.

5.2.1.2 RS232 – RS485 – Bluetooth Ports

The RS232, RS485 and Bluetooth Ports allow configuring and managing the ELBS-20 through the "Biffi Assistant" software tool [1].

These interfaces (when enabled) are always available if the External Power Supply is applied.

When just the Battery Power Supply is present, it is necessary to wake-up the ELBS-20 by pressing the ENTER push-button and then the enabled interfaces become available.

For additional details dealing with the RS232, RS485 and Bluetooth Ports see [1].

5.2.2 Power Supply (External – Battery Pack)

The ELBS-20 accepts two different sources of power supplies:

- External power supply from 19.2 V DC to 57.6 V DC (24 V DC -20% to 48 V DC to +20%).
- Battery Pack power supply: 7.2 V DC (lithium batteries).

The two power supplies can be applied one at time or both.

When both the power supplies are present, the Battery Pack works as back up of the External Power Supply.

5.2.2.1 External Power Supply

The Interfaces Card has a dedicated isolated DC/DC converter that provides the supply for the Interfaces Card and the Display/Bluetooth Card.

The Process Card has two isolated DC/DC converters that work “in parallel”; one is called “Default” and the other one is called “Auxiliary”.

The ELBS-20 checks the status of each DC/DC converter (these data are available on the Configuration-Managing Interfaces) and limits its functionality (during the Safety Action) according with the status of the DC/DC converters (see Section 5.2.8).

5.2.2.2 Battery Pack Power Supply

The Battery Pack Power Supply must be applied on:

- CN2 of the Process Card (Default)
- CN3 of the Process Card (Auxiliary)

The two Battery Packs work “in parallel”. The ELBS-20 automatically checks the status of each Battery Packs (when they are enabled) twelve times a day and before the Safety Action and limits the using of the SOV Control Outputs according to the Battery Packs status (see Section 5.2.8).

The Battery Packs values are read through a dedicated circuit. The values shown are the voltages read on the Process Card “after” the diodes (on the Process Card and Battery Pack Card). The drop of the diodes can be considered approximately 0.65 volts.

An Automatic Battery Check is performed every two hours and before the execution of the Safety Action. It is also available a command to perform a Manual Battery Check (see Section 6 for details).

The ELBS-20 limits its functionality (during the Safety Action) according with the status of the Battery Packs (see Section 5.2.8).

5.2.2.3 Power Supply Working Mode

The ELBS-20 working mode depends on two factors:

- The Power Supply Applied
- The Operating Mode (see Section 5.1.1)

When the only Battery Pack Power Supply is applied the ELBS-20 works in a “low-consumption” mode for increasing the Battery Pack life.

During the “low-consumption” mode, if an EXTERNAL WAKE-UP (through ENTER button) does not occur, the ELBS-20 works in the following way:

- Display and Interfaces cards are not power supplied.
- The microcontroller of the Process Card disables all the interfaces and goes in "sleep mode", it periodically wakes up for measuring the Pressure and optionally the Position (Sampling Rate depends on the Operating Mode).
- When it wakes up, it performs the required actions (ex. manage DO, saving sample etc.) and then, if the safety action is not required, it returns "to sleep".
- The microcontroller of the Process Card can be externally waken up by pressing the ENTER push button. In this situation the microcontroller turns ON the Interfaces Card and the Display Card and it is possible to use the Local Operator Interface and the enabled Configuration Ports (RS232, RS485 or BLUETOOTH).
- 60 seconds after the last active communication with ELBS-20 (Push-buttons, RS485, RS232 or Bluetooth) the microcontroller of the Process Card shut-off the Display and Interfaces Cards and it returns to sleep and to periodically wake up ("low-consumption" mode).

The table below describes the ELBS-20 working modes. For the SOV Control availability see Section 5.2.8.

Table 4.

Power Supply	Operating Modes	Working mode									
		Card Status	Sample Rate	Input- Output – Interfaces Availability							
				DI	DO	AO (if enabled)	MODBUS (if enabled)	Local Operator	RS232 (if enabled)	RS485 (if enabled)	BLUE (if enabled)
Ext.	VC	All ON	S.Rate	ON	ON	ON	ON	Push any button	ON	ON	ON
	ACQ	All ON	S.Rate	ON	ON	ON	ON	Push any button	ON	ON	ON
	VC+ACQ	All ON	S.Rate	ON	ON	ON	ON	Push any button	ON	ON	ON
	SLEEP (1)	All ON	None	ON	ON (3)	OFF	ON	Push any button	ON	ON	ON
	SLOW	All ON	Slow S.Rate	ON	ON	ON	ON	Push any button	ON	ON	ON
Battery Pack	VC	Disp: OFF Inter: OFF Proc: Sleep	S.Rate	OFF	ON (2)	OFF	OFF	Push ENTER button	ON after EXTERNAL WAKE-UP	ON after EXTERNAL WAKE-UP	ON after EXTERNAL WAKE-UP
	ACQ	Disp: OFF Inter: OFF Proc: Sleep	S.Rate	OFF	ON (2)	OFF	OFF	Push ENTER button	ON after EXTERNAL WAKE-UP	ON after EXTERNAL WAKE-UP	ON after EXTERNAL WAKE-UP
	VC+ACQ	Disp: OFF Inter: OFF Proc: Sleep	S.Rate	OFF	ON (2)	OFF	OFF	Push ENTER button	ON after EXTERNAL WAKE-UP	ON after EXTERNAL WAKE-UP	ON after EXTERNAL WAKE-UP
	SLEEP (1)	Disp: OFF Inter: OFF Proc: Sleep	None	OFF	ON (2) (3)	OFF	OFF	Push ENTER button	ON after EXTERNAL WAKE-UP	ON after EXTERNAL WAKE-UP	ON after EXTERNAL WAKE-UP
	SLOW	Disp: OFF Inter: OFF Proc: Sleep	Slow S.Rate	OFF	ON (2)	OFF	OFF	Push ENTER button	ON after EXTERNAL WAKE-UP	ON after EXTERNAL WAKE-UP	ON after EXTERNAL WAKE-UP

NOTES:

(1) In the SLEEP Operating Mode the ELBS-20 does not measure Pressure and Position.

(2) DO7 (single side stable relay) is not available.

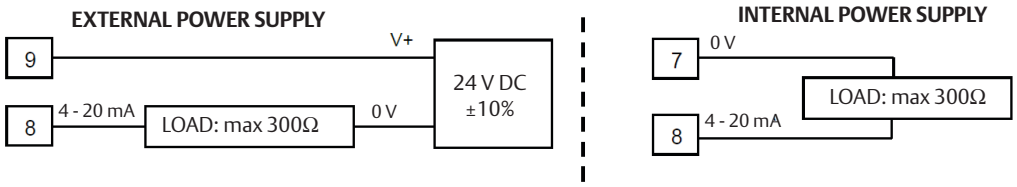
(3) Pressure, position and Battery Packs voltages are not measured so DOs dealing with the Battery Packs are not updated.

5.2.3 Analog Output (Pressure or Position Retransmission)

The ELBS-20 is provided with a configurable 4 - 20 mA analog output (AO).

The AO can be used for the retransmission of the Pressure or Position measured by the AI.

The AO can accept an external 24 V DC power supply or internally generate the 24 V DC, necessary for the 4 - 20 mA signal (see Section 9.1 for details about terminals).



The AO retransmission works with a precision of 0.5%.

The AO is available only when the External Power Supply is applied (see Section 5.2.2.3 for details).

The AO is disabled (0 mA transmission) during the execution of the Safety Action and when the ELBS-20 goes to the SLEEP operating mode.

5.2.4 Digital Input

The ELBS-20 is provided with three configurable opto-isolated Digital Inputs (DI1 – DI3).

Each DI has three terminals. The using of a couple of terminals instead of another determines the Working Voltage of the DI.

- ”C” and “24/48” terminals: 19.2 - 57.6 V AC/V DC (24 -20% - 48 +20%)
- “C” and “110” terminals: 57.6 – 121 V AC/V DC (48 +20% - 110 +10%)

The function of each DI is settable. See Section 6.3 for details.

The DIs can be configured to consider the input valid with Voltage applied (present) or not applied (absent).

When the External Power Supply is not applied and the Battery Pack is present, do not apply any voltage on the DIs because it causes an unwanted consumption of the Battery Pack.

5.2.5 Digital Output

The ELBS-20 is provided with 7 Digital Outputs (DO):

- 6x SPST latching relays contacts (D01 – DO6)
- 1x SPDT single side stable relay contacts (DO7)

The function of each DO is settable. See Section 6.2 for details.

D1 – D6 can be configured for working as BREAK (“open circuit” when active) or MAKE (“short circuit” when active).

When the External Power Supply is not applied, DO7 (single side stable relay) is not available.

5.2.6 Analog Input - Pressure Transducer

The ELBS-20 is provided with a configurable (0 - 20 mA or 4 - 20 mA) analog input (AI1) dedicated to the Pressure Transducers.

The ELBS-20 supplies a 14.5 V DC voltage to the Pressure Transducer.

The ELBS-20 can work with 2 or 3 wires Pressure Sensors.

The pressure transducer is usually supplied with the ELBS-20 and is installed on the line valve at valve-maker/customer care, according to Biffi instructions.

The pressure transmitter must be installed downstream the line valve and converts the pipeline pressure to a 0 - 20 mA or 4 - 20 mA electrical signal.

5.2.7 Analog Input - Position Sensor

The ELBS-20 is provided with a configurable (0 - 20 mA or 4 - 20 mA) analog input (AI2) dedicated to the Position Sensor.

The ELBS-20 supplies a 14.5 V DC voltage to the Position Sensor.

The ELBS-20 can work with 2 or 3 wires Position Sensor.

The Position Sensor is an optional input.

5.2.8 SOV Control Outputs

The SOV Control Outputs are used for managing one or more external SOVs in order to send a command to the actuator to stroke the line valve to the fail-safe position (Safety Action).

The SOV Control Outputs can be used also to drive a contactor of an electrical actuator (no SOVs required) to stroke the line valve to the fail-safe position.

See Section 5.1.2.7 for details about the Safety Action.

The ELBS-20 is provided with the following outputs dedicated to the safety action:

- 2x 24 V DC - 100 mA isolated outputs (SVC1 and SVC2).
- 2x SPDT single side stable relays contacts (RL1 and RL2).

The SOV Control Outputs can be used separately or simultaneously (see Section 6).

The following restrictions on the Configuration of the SOV Control Outputs, dealing with the declared Power Supply sources, must be respected otherwise a configuration alarm (CONF) is generated (see 6 for details about configuration parameters):

- External Power Supply (“V.Ext.Applied”=“Yes”): no limitations.
- Default + Auxiliary Battery Pack (“V.Bat.Applied” = “Yes” and “V.Bat.Dual” = “Yes”): no limitations.
- Default Battery Pack only (“V.Bat.Applied” = “Yes” and “V.Bat.Dual” = “No”): SVC1, RL1, SVC1+RL1 or RL1+RL2.
- At Least one SOV Control Output must be enabled.

The ELBS-20 monitors the status of the External Power Supply (on each single DC/DC converter) and the status of the Battery Packs Power Supply (see Section 5.2.2) and automatically applies the below limitations according with these statuses, on the SOV Control Outputs that are used during the Safety Action:

- External Power present (both DC/DC converter OK): no limitations (enabled SOV Outputs).
- External Power present (only one DC/DC converter OK): SVC1, RL1, SVC1+RL1 or RL1+RL2 (*).
- Default + Auxiliary Battery Packs (both OK): no limitations (enabled SOV Outputs).
- Only one Battery Pack OK: SVC1, RL1, SVC1+RL1 or RL1+RL2 (*).
- One External Power Supply OK + one Battery Pack OK: SVC1, RL1, SVC1+RL1 or RL1+RL2 (*).

(*) Case 1: if SVC1+SVC2 are enabled only SVC1 is used during the Safety Action.

(*) Case 2: if SVC1+SVC2+RL1 are enabled only SVC1+RL1 are used during the Safety Action.

(*) Case 3: if SVC1+RL1+RL2 are enabled only SVC1+RL1 are used during the Safety Action.

(*) Case 4: if SVC1+SVC2+RL1+RL2 are enabled only SVC1+RL1 are used during the Safety Action.

The selected SOV Control Outputs work in the following way during the Safety Action:

- RL1 and RL2: the coil is energized and the relay contacts commutate (NO-C = short circuit, NC-C = open circuit).
- SVC1 and SVC2: a 24 V DC (max.100 mA) is generated as output.

At the end of the Safety Action (its length is determined by the “Duration” parameter) RL1, RL2, SVC1 and SVC2 return to their original status:

- RL1 and RL2: the coil is not energized (NO-C = open circuit, NC-C = short circuit).
- SVC1 and SVC2: 0 V output.

The ELBS-20 provides also the possibility to use DO1 and DO2 as SOVs Control Outputs when they are set as “SOV Control” (see Section 6.2 for details).

5.2.8.1 Integrity Check of the SOV Control Outputs Electrical Circuits

The ELBS-20 allows monitoring the status of the SOV Control Outputs Electrical Circuits (dedicated SOV Control Output + Coil + Wiring Connection).

The Integrity Check can be performed on the following dedicated SOV Control Outputs, when they are enabled ("SVC Enabled" and "Relays Enabled"): SVC1, SVC2, RL1 and RL2.

The Integrity Check can be performed in two different ways:

- Manual
- Automatic

The Manual Integrity Check can be performed in every Operating Mode ("Start Manual I.C. SVC", "Start Manual I.C. RL").

The Automatic Integrity Check is performed only when the ELBS-20 is in VC or VC + ACQ and when it is enabled ("I.C. SVC En." = "Yes", "I.C. RL En." "Yes").

The Automatic Integrity Check is performed during the Safety Action and cyclically according to a settable period ("I.C. SVC Time", "I.C. RL Time").

If the period ("I.C. SVC Time", "I.C. RL Time") is set to "0", the Automatic Integrity check is performed only during the Safety Action.

The Automatic Integrity Check is performed for the first time on a SOV Control Output Electrical Circuit when the Operating Mode of the ELBS-20 is set to VC or VC + ACQ and both the specific SOV Control Output is enabled and its own Automatic Integrity Check is enabled.

The Integrity Check of the SVC Electrical Circuit returns a "Bad" result ("SVC1 Status", "SVC2 Status") when:

- The SVC output is "broken" (no voltage).
- The electrical connection between SVC and the SOV is damaged.
- The Coil is "Open Circuit".
- The Coil is a "Short Circuit".

The Integrity Check of the RL Electrical Circuit (NO contact) returns a "Bad" result ("RL1 Status", "RL2 Status") when:

- The power supply is not applied.
- The electrical connection between RL and the SOV is damaged.
- The protection fuse is "open".
- The Relay contact is stuck.
- The Coil is "Open Circuit".
- The Coil is a "Short Circuit".

The Integrity Check of the RL Electrical Circuit (NC contact) returns a “Bad” result (“RL1 Status”, “RL2 Status”) when:

- The power supply is not applied.
- The protection fuse is “open”.
- The Relay contact is stuck.
- The Coil is a “Short Circuit”.

If the Integrity Check fails on every enabled SOV Control Output the SAEC Alarm becomes active (see Section 6.4), the ELBS-20 goes to the SLOW Operating Mode, the Automatic Integrity Check is no more performed and it is necessary to clear this alarm and to manually set the desired Operating Mode.

See Section 6 for details about the Configuration Parameters.

5.2.9 MODBUS RTU

The ELBS-20 is provided with a MODBUS RTU bus interface.

This interface allows configuring the ELBS-20 parameters, to read the current pressure and position (if position sensor is present) value and to download the EVENT data (curves).

The MODBUS RTU interface is available only when the External Power Supply is applied (see Section 5.2.2.3 for details).

For additional details see Section 8.

Section 6: Configuration Parameters

This section lists and describes the configuration parameters of the ELBS-20. For additional details, dealing with the mapping of parameters on the Local Operator Interface, see Section 7. For additional details, dealing with the mapping of parameters by using the "Biffi Assistant" software tool (RS232, RS485 and Bluetooth), see [1]. For additional details, dealing with the mapping of parameters on the MODBUS RTU Interface, see Section 8.

The Chinese Menu is available starting from the FW version 1.00.03 of the Interfaces Card.

Table 5.

Parameters of the "View Mode" Menu and the "Setup Mode" Menu						
Parameter Name	**Description**	**Range**		**Default Value**	**R/W (1)**	**Available On (2)**
Operating Mode 操作模式	The selectable "Operating Modes" are: VC, ACQ, VC+ACQ, SLEEP and SLOW (see Section 5.1.1).	VC, ACQ, SLEEP, VC+ACQ, SLOW	阀门控制, 数据采集, 休眠, 数据采集+阀门控制, 慢采样	SLEEP 休眠	R/W	Local, Serial, Modbus.
SA Done (Safety Action Done) 阀门安全动作	The "SA Done" indicates if the Safety Action was performed. After the execution of the Safety Action, the value of this parameter becomes "Yes" and "Operating mode" becomes "SLOW". When the "Operating Mode" is set to VC or VC+ACQ, the "S.A. Done" returns to "No". It is "Act" when the Safety Action is considered as "active" (see Section 5.1.2.7).	Yes, No, Act.	有, 无, 动作中	No 无	R	Local, Serial, Modbus.
SA Source (Safety Action Source) 安全动作源	It indicates the source that generates the execution of the Safety Action. None: no Safety Action performed DI: Digital Input (see Section 6.3) CMD: Safety Action Tests EV: Event 2, 4 or 6	None, DI, CMD, EV	无, DI控制, 远程控制, 保护事件	None 无	R	Local, Serial, Modbus.
SA Date (Safety Action Date) 安全动作日期	It is the date of the last Safety Action Performed.	01-01-2012 31-12-2099		00-00-00	R	Local, Serial, Modbus.
SA Time (Safety Action Time) 安全动作时间	It is the date of the last Safety Action Performed.	01-01-2012 31-12-2099		01-01-2000	R	Local, Serial, Modbus.

Parameters of the "View Mode" Menu and the "Setup Mode" Menu					
Parameter Name	**Description**	**Range**	**Default Value**	**R/W (1)**	**Available On (2)**
HP Limit (High Pressure Limit) 高压限值	It determines the threshold for the EVENT 4 (see Section 5.1). See Section 6.1 for the Analog Input precision.	2.0-1000.0 bar	90.0 bar	R/W	Local, Serial, Modbus.
LP Limit (Low Pressure Limit) 低压限值	It determines the threshold for the EVENT 2 (see Section 5.1). See Section 6.1 for the Analog Input precision. It must be lower than "Pressure Max" and lower than "HP Limit" otherwise a CONF Alarm is generated (see Section 6.4).	0.0-1000.0 bar	30.0 bar	R/W	Local, Serial, Modbus.
Drop Enabled 压降速率启用	If set as "Yes" EVENT 5 and EVENT 6 are managed by the ELBS-20 (see Section 5). If set as "No" EVENT 5 and EVENT 6 are not considered by the ELBS-20. It means that EVENT 5 is not stored and does not cause the Safety Action and that EVENT 6 is not stored.	Yes, 是, No 否	Yes 是	R/W	-
VLC PDR (Valve Control Pressure Drop Rate) 控制模式压降速率	It is the Pressure Drop Rate in VC and VC+ACQ operating mode. It determines the threshold for the EVENT 6 (see Section 5.1). For correctly setting this parameter, see Section 6.1.	0.1-999.9 bar/min	3.0 bar/min	R/W	Local, Serial, Modbus.
D.ACQ PDR (Data Acquisition Pressure Drop Rate) 采集模式压降速率	It is the Pressure Drop Rate in ACQ mode. It determines the threshold for the EVENT 5 (see Section 5.1). For correctly setting this parameter, see Section 6.1.	0.1-999.9 bar/min	3.0 bar/min	R/W	Local, Serial, Modbus.
P. Inc. (Pressure Increase) 压力增加	It determines the threshold for the EVENT 3 (see Section 5.1). For correctly setting this parameter, see Section 6.1.	0.1- 999.9 bar	5.0 bar	R/W	Local, Serial, Modbus.
P. Dec. (Pressure Decrease) 压力下降	It determines the threshold for the EVENT 1 (see Section 5.1). For correctly setting this parameter, see Section 6.1.	0.1- 999.9 bar	5.0 bar	R/W	Local, Serial, Modbus.
S.Rate (Sampling Rate) 采样频率	It is the sampling rate (Pressure and optionally Position) that is used during the VC, VC+ACQ e ACQ Operating Modes (see Section 5.1.1). It must be set at least at 5.0 if "V.Ext. Applied" = "No", otherwise a CONF Alarm is generated (see Section 6.4).	0.2 - 60.0 seconds	10.0 seconds	R/W	Local, Serial, Modbus.
Slow S.Rate (Slow Sampling Rate) 慢采样频率	It is the sampling rate (Pressure and optionally Position) that is used during the SLOW operating mode (see Section 5.1.1).	5 - 60 seconds	30 seconds	R/W	Local, Serial, Modbus.

Parameters of the "View Mode" Menu and the "Setup Mode" Menu					
Parameter Name	**Description**	**Range**	**Default Value**	**R/W (1)**	**Available On (2)**
SVC Enabled 电磁阀控制	Set as "SVC1", SVC1 is used as SOV Control Output. Set as "Both", SVC1 and SVC2 are used as SOV Control Output. Set as "None", SVC1 and SVC2 are not used. See Section 5.2.8 for details about the SOVs Control Outputs.	RL1, Both, None 电磁阀1控制, 电磁阀1/2控制, 无	SVC1 电磁阀1控制	R/W	Local, Serial, Modbus.
Relays Enabled 继电器控制	Set as "RL1", RL1 is used as SOV Control Output. Set as "Both", RL1 and RL2 are used as SOV Control Output Set as "None", RL1 and RL2 are not used. See Section 5.2.8 for details about the SOVs Control Outputs	RL1, Both, None 继电器1控制, 继电器1/2控制, 无	None 无	R/W	Local, Serial, Modbus.
Delay 延时启动	It is the delay of the starting of the Safety Action. It is expressed in # of Samples. See Sections 5.1.2.7, 5.1.2.6 and 5.1.3.	0 - 500 # of Samples	3	R/W	Local, Serial, Modbus.
Duration 持续时间	It determines the time of command of the dedicated SOV Control Outputs (SVC and RL) to perform the Safety Action. See Sections 5.1.2.7, 5.2.8 and 5.1.3 for details.	1-360 seconds	30 seconds	R/W	Local, Serial, Modbus.
I.C. SVC En. (Integrity Check SVC Enabled) 电磁阀自动检测	If set as "Yes" the Automatic Integrity Check is performed on the set/available SVC Electrical Circuits ("SVC Enabled"). The Automatic Integrity Check is performed with a period defined by the value of "I.C. SVC Time" and during the Safety Action. If it is set as "No" the Automatic Integrity Check of the SVCs is disabled. See Section 5.2.8.1 for details about the Integrity Check.	Yes, No 是, 否	Yes 是	R/W	Local, Serial, Modbus.
I.C. SVC Time (Integrity Check SVC Time) 电磁阀检测周期	It determines the period of the Automatic Integrity Check of the SVC Electrical Circuits when "I.C. SVC En." is set as "Yes". If set as "0", the Automatic Integrity of the SVCs is performed only during the Safety Action.	0 – 24 hours	8 hours	R/W	Local, Serial, Modbus.
SVC1 Status 电磁阀1状态	It is the result of the Integrity Check of the SVC1 Electrical Circuit. It is applicable only if SVC1 is set as SOV Control Output ("SVC Enabled"), otherwise it is shown as "Ok". If SVC1 is set as SOV Control Output and no Integrity Check is performed, it is shown as "Ok". By setting "SVC Enabled = "None" or "SVC1" it is set to "Ok".	Ok, Bad 正常, 异常	-	R	Local, Serial, Modbus.
SVC2 Status 电磁阀2状态	It is the result of the Integrity Check of the SVC2 Electrical Circuit. It is applicable only if SVC2 is set as SOV Control Output ("SVC Enabled"), otherwise it is shown as "Ok". If SVC2 is set as SOV Control Output and no Integrity Check is performed, it is shown as "Ok". By setting "SVC Enabled = "None" or "SVC1" it is set to "Ok".	Ok, Bad 正常, 异常	-	R	Local, Serial, Modbus.

Parameters of the "View Mode" Menu and the "Setup Mode" Menu					
Parameter Name	**Description**	**Range**	**Default Value**	**R/W (1)**	**Available On (2)**
Start Manual I.C. SVC (Start Manual Integrity Check SVC) 手动检测电磁阀	This command performs an Integrity Check of the set/available SVC Electrical Circuit. See Section 5.2.8.1 for details about the Integrity Check.	Start	-	C	Local, Serial, Modbus.
I.C. RL En. (Integrity Check RL Enabled) 继电器自动检测	If set as "Yes" the Automatic Integrity Check is performed on the set/available RL Electrical Circuits ("Relays Enabled"). The Automatic Integrity Check is performed with a period defined by the value of "I.C. RL Time" and during the Safety Action.If it is set as "No" the Automatic Integrity Check of the RLs is disabled. "RL1 Contacts" and "RL2 Contacts" must be set correctly. See Section 5.2.8.1 for details about the Integrity Check.	Yes, No 是, 否	No 否	R/W	Local, Serial, Modbus.
I.C. RL Time (Coils Test RL Time) 继电器检测周期	It determines the period of the Automatic Integrity Check of the RL Electrical Circuits when "I.C. RL En." is set as "Yes". If set as "0", the Automatic Integrity of the RLs is performed only during the Safety Action	0 – 24 hours	8 hours	R/W	Local, Serial, Modbus.
RL1 Contacts 继电器1触点	It indicates which contact of the RL1 is used (NC = Normally Closed or NO = Normally Open). It deals with the Integrity Check execution and if it is not set correctly, the result of the Integrity Check of the RL1 Electrical Circuit has no sense. See Section 5.2.8.1 for details about the Integrity Check.	NC, NO 常闭, 常开	NO 常开	R	Local, Serial, Modbus.
RL2 Contacts 继电器2触点	It indicates which contact of the RL2 is used (NC = Normally Closed or NO = Normally Open). It deals with the Integrity Check execution and if it is not set correctly, the result of the Integrity Check of the RL2 Electrical Circuit has no sense. See Section 5.2.8.1 for details about the Integrity Check.	NC, NO 常闭, 常开	NO 常开	R	Local, Serial, Modbus.
RL1 Status 继电器1状态	It is the result of the Integrity Check of the RL1 Electrical Circuit. It is applicable only if RL1 is set as SOV Control Output ("Relays Enabled"), otherwise it is shown as "Ok". If RL1 is set as SOV Control Output and no integrity Check is performed, it is shown as "Ok". By setting "Relays Enabled = "None" it is set to "Ok".	Ok, Bad 正常, 异常	-	R	Local, Serial, Modbus.
RL2 Status 继电器2状态	It is the result of the COILS TEST of the RL2 Electrical Circuit. It is applicable only if RL2 is set as SOV Control Output ("Relays Enabled"), otherwise it is shown as "Ok". If RL2 is set as SOV Control Output and no Integrity Check is performed, it is shown as "Ok". By setting "Relays Enabled" "None" or "RL1" it is set to "Ok".	Ok, Bad 正常, 异常	-	R	Local, Serial, Modbus.
Start Manual I.C. RL (Start Manual Integrity Check RL) 手动检测继电器回路	This command performs an Integrity Check of the set/available RL Electrical Circuit. "RL1 Contacts" and "RL2 Contacts" must be set correctly. See Section 5.2.8.1 for details about the Integrity Check.	Start	-	C	Local, Serial, Modbus.

Parameters of the "View Mode" Menu and the "Setup Mode" Menu				
Parameter Name	Description	Range	Default Value	R/W (1)	Available On (2)
V.Ext.Applied (External Power Supply Applied) 外部供电	If this parameter is set as "Yes" the ELBS-20 check s the status of the External Power Supply and decides the working mode (see Section 5.2.2.3). If it is set as "No" the ELBS-20 works as the External Power Supply is not applied (see Section 5.2.2.3).	Yes, No 是, 否	No 否	R/W	Local, Serial, Modbus.
V.Ext.Status Def (External Power Supply Status Default) 默认供电回路	It indicates the status of the output voltage of the Default DC/DC converter (see Section 5.2.2). It is applicable only when "V. Ext. Applied" is set "Yes", otherwise it is shown as "Bad".	Ok, Bad 正常, 异常	-	R	Local, Serial, Modbus.
V.Ext.Status Aux (External Power Supply Status Auxiliary) 备用供电回路	It indicates the status of the output voltage of the Auxiliary DC/DC converter (see Section 5.2.2). It is applicable only when "V. Ext. Applied" is "Yes", otherwise it is shown as "Bad".	Ok, Bad 正常, 异常	-	R	Local, Serial, Modbus.
V.Bat.Applied (Battery Pack Power Supply Applied) 默认电池组检测	If this parameter is set as "Yes", the ELBS-20 checks the status of the Default Battery Pack otherwise it is considered as "Bad".	Yes, No 是, 否	Yes 是	R/W	Local, Serial, Modbus.
V.Bat.Dual (Dual Battery Pack) 备用电池组检测	If "V.bat.Applied" is set as "Yes" and if this parameter is set as "Yes", the ELBS-20 checks the status of the Auxiliary Battery Pack otherwise it is considered as "Bad".	Yes, No 是, 否	Yes 是	R/W	Local, Serial, Modbus.
Batt.Off V. (Battery Off Voltage) 电池电压未启动	It is used as threshold for establishing the Battery Pack status. See "V. Bat. Status Def" and "V. Bat. Status Aux"	0 -10.0 Volt	4.2 Volt	R/W	Local, Serial, Modbus.
Batt.On V. (Battery On Voltage) 电池工作电压	It is used as threshold for establishing the Battery Pack status. See "V. Bat. Status Def" and "V. Bat. Status Aux"	0 -10.0 Volt	5.2 Volt	R/W	Local, Serial, Modbus.
Manual Battery Check (Manual Battery Check) 手动检测电池组	It performs a reading of the value of the Battery Packs Power Supplies that are declared as applied (see "V.Bat. Applied" and "V.Bat.Dual"). See Section 5.2.2.2 for details.	Start	-	C	Local, Serial, Modbus.
V.Bat.Status Def (Battery Pack Status Default) 默认电池组状态	It indicates the status of the Default Battery Pack (see Section 5.2.2). It is "Bad" when the Battery Pack voltage comes under "Batt. Volt Off" and it returns "Ok" when it comes over the "Batt. Volt On". It is applicable only if "V. Batt. Applied" is set as"Yes", otherwise it is shown as "Bad".	Ok, Bad 正常, 异常	-	R	Local, Serial, Modbus.
V.Bat. Def (Voltage Battery Pack Default) 默认电池组电压	It indicates the value (voltage) of the Default Battery Pack, measured during the last Battery Check (see Section 5.2.2.2). It is 0.0 if V.Ext.Applied" is "No".	0 -10.00 Volt	-	R	Local, Serial, Modbus.
V.Bat.Status Aux (Battery Pack Status Auxiliary) 备用电池组状态	It indicates the status of the Auxiliary Battery Pack (see Section 5.2.2). It is "Bad" when the Battery Pack voltage comes under "Batt. Volt Off" and it returns "Ok" when it comes over the "Batt. Volt On". It is applicable only if "V.Ext.Applied" is "Yes" and "V. Batt. Dual" is "Yes", otherwise it is shown as "Bad".	Ok, Bad 正常, 异常	-	R	Local, Serial, Modbus.
V.Bat. Aux (Voltage Battery Pack Auxiliary) 备用电池组电压	It indicates the value (voltage) of the Auxiliary Battery Pack, measured during the last Battery Check (see Section 5.2.2.2). It is 0.0 if V.Ext.Applied" is "No" or "V. Batt. Dual" is "No".	0 -10.00 Volt	-	R	Local, Serial, Modbus.

Parameters of the "View Mode" Menu and the "Setup Mode" Menu					
Parameter Name	**Description**	**Range**	**Default Value**	**R/W (1)**	**Available On (2)**
Start Manual I.C. SVC (Start Manual Integrity Check SVC) 手动检测电磁阀	This command performs an Integrity Check of the set/available SVC Electrical Circuit. See Section 5.2.8.1 for details about the Integrity Check.	Start	-	C	Local, Serial, Modbus.
I.C. RL En. (Integrity Check RL Enabled) 继电器自动检测	If set as "Yes" the Automatic Integrity Check is performed on the set/available RL Electrical Circuits ("Relays Enabled"). The Automatic Integrity Check is performed with a period defined by the value of "I.C. RL Time" and during the Safety Action.If it is set as "No" the Automatic Integrity Check of the RLs is disabled. "RL1 Contacts" and "RL2 Contacts" must be set correctly. See Section 5.2.8.1 for details about the Integrity Check.	Yes, 是, No 否	No 否	R/W	Local, Serial, Modbus.
I.C. RL Time (Coils Test RL Time) 继电器检测周期	It determines the period of the Automatic Integrity Check of the RL Electrical Circuits when "I.C. RL En." is set as "Yes". If set as "0", the Automatic Integrity of the RLs is performed only during the Safety Action	0 – 24 hours	8 hours	R/W	Local, Serial, Modbus.
RL1 Contacts 继电器1触点	It indicates which contact of the RL1 is used (NC = Normally Closed or NO = Normally Open). It deals with the Integrity Check execution and if it is not set correctly, the result of the Integrity Check of the RL1 Electrical Circuit has no sense. See Section 5.2.8.1 for details about the Integrity Check.	NC, 常闭, NO 常开	NO 常开	R	Local, Serial, Modbus.
RL2 Contacts 继电器2触点	It indicates which contact of the RL2 is used (NC = Normally Closed or NO = Normally Open). It deals with the Integrity Check execution and if it is not set correctly, the result of the Integrity Check of the RL2 Electrical Circuit has no sense. See Section 5.2.8.1 for details about the Integrity Check.	NC, 常闭, NO 常开	NO 常开	R	Local, Serial, Modbus.
RL1 Status 继电器1状态	It is the result of the Integrity Check of the RL1 Electrical Circuit. It is applicable only if RL1 is set as SOV Control Output ("Relays Enabled"), otherwise it is shown as "Ok". If RL1 is set as SOV Control Output and no integrity Check is performed, it is shown as "Ok". By setting "Relays Enabled = "None" it is set to "Ok".	Ok, 正常, Bad 异常	-	R	Local, Serial, Modbus.
RL2 Status 继电器2状态	It is the result of the COILS TEST of the RL2 Electrical Circuit. It is applicable only if RL2 is set as SOV Control Output ("Relays Enabled"), otherwise it is shown as "Ok". If RL2 is set as SOV Control Output and no Integrity Check is performed, it is shown as "Ok". By setting "Relays Enabled" "None" or "RL1" it is set to "Ok".	Ok, 正常, Bad 异常	-	R	Local, Serial, Modbus.
Start Manual I.C. RL (Start Manual Integrity Check RL) 手动检测继电器回路	This command performs an Integrity Check of the set/available RL Electrical Circuit. "RL1 Contacts" and "RL2 Contacts" must be set correctly. See Section 5.2.8.1 for details about the Integrity Check.	Start	-	C	Local, Serial, Modbus.

Parameters of the "View Mode" Menu and the "Setup Mode" Menu					
Parameter Name	**Description**	**Range**	**Default Value**	**R/W (1)**	**Available On (2)**
Pres. Signal (Pressure Signal) 压力传感器值	It must be set according to the output of the Pressure Transducer (Analog Input 1).	0 - 20 mA, 4 - 20 mA	4 - 20 mA	R/W	Local, Serial, Modbus.
Pres. Min. (Pressure Minimum) 压力传感器零点	For Biffi use only	0.0 bar	0.0 bar	R	Local, Serial, Modbus.
Pres. Max. (Pressure Maximum) 压力传感器量程	It must be set to the Pressure Transducer Span (20 mA). See Section 6.1 for the precision of the Analog Input.	10.0-1000 bar	100.0 bar	R/W	Local, Serial, Modbus.
Calibrate Pressure 压力传感器校准	For Biffi use only	-	-	-	Local, Serial, Modbus.
Pos. Sens. En. (Position Sensor Enabled) 位置传感器	When it is set as "Yes", the value of the Position Sensor (Analog Input 2) is sampled. When it is set as "No" the shown position is "0.0%".	Yes, 是, No 否	No 否	R/W	Local, Serial, Modbus.
Pos. Signal (Position Signal) 位置传感器值	It must be set according to the output of the Position Sensor.	0 - 20 mA, 4 - 20 mA	4 - 20 mA	R/W	Local, Serial, Modbus.
Pos. Op. Mode (Position Operating Mode) 位置传感器作用模式	It determines in which way the AI2 (Position) input is read by the ELBS-20. Normal: 20 mA = 100% (Fully Open), 0 or 4 mA(*) = 0% (Fully Close) Reverse: 20 mA = 0% (Fully Close), 0 or 4 mA(*) = 100% (Fully Open) (*) It depends on "Pos. Signal" value	Normal, 正向, Reverse 反向	Normal 正向	R/W	Local, Serial, Modbus.
Start 20mA Calibration (Calibrate Position 20 mA) 开始校准 20mA	It is used for accepting a tolerance of the 20 mA value transmitted by the Position Sensor. For using this utility, it is necessary to move the actuator for reaching the position corresponding to the 20 mA transmission (see Section 10.6). This command does not work if Operating Mode = SLEEP	Start	-	C	Local
Start 4 mA Calibration (Calibrate Position 4 mA) 开始校准4mA	It is used for accepting a tolerance of the 4 mA value transmitted by the Position Sensor. For using this utility, it is necessary to move the actuator for reaching the position corresponding to the 4 mA transmission (see Section 10.6). It is useful only if "Pos. Signal" = 4 - 20 mA. DO NOT USE IT IF "Pos. Signal" = 0 - 20 mA. This command does not work if Operating Mode = SLEEP.	Start	-	C	Local
Start 0mA Calibration (Calibrate Position 0 mA) 开始校准 0 mA	It is used for accepting a tolerance of the 0 mA value transmitted by the Position Sensor. For using this utility, it is necessary to move the actuator for reaching the position corresponding to the 0 mA transmission (see Section 10.6). It is useful only if "Pos. Signal" = 0 - 20 mA. This command does not work if Operating Mode = SLEEP.	Start	-	C	Local
Factory Settings 出厂设置	For Biffi use only	Start	-	C	Local

Parameters of the "View Mode" Menu and the "Setup Mode" Menu					
Parameter Name	**Description**	**Range**	**Default Value**	**R/W (1)**	**Available On (2)**
DO1 Function DO1功能	It is the function associated to the DO1.	See Section 6.2	ARMED 阀门控制模式	R/W	Local, Serial, Modbus.
DO1 Op. Mode (DO1 Operating Mode) DO1动作	"Make": the DO1 is a short circuit (closed) when the associated function is active. "Break": the DO1 is an open circuit (open) when the associated function is active.	Break, 断开, Make 闭合	Make 闭合	R/W	Local, Serial, Modbus.
DO1 Status DO1状态	"Act": when the associated condition to the DO1 is active. "Not Act": when the associated condition to the DO1is not active.	Active, 激活, Not Active 未激活	-	R	Local, Serial, Modbus.
DO2 Function DO2功能	It is the function associated to the DO2.	See Section 6.2	ALARM 系统报警	R/W	Local, Serial, Modbus.
DO2 Op. Mode (DO2 Operating Mode) DO2动作	"Make": the DO2 is a short circuit (closed) when the associated function is active. "Break": the DO2 is an open circuit (open) when the associated function is active.	Break, 断开, Make 闭合	Make 闭合	R/W	Local, Serial, Modbus.
DO2 Status DO2状态	"Act": when the associated condition to the DO2 is active. "Not Act": when the associated condition to the DO2 is not active.	Active, 激活, Not Active 未激活	-	R	Local, Serial, Modbus.
DO3 Function DO3功能	It is the function associated to the DO3.	See Section 6.2	OFF 无	R/W	Local, Serial, Modbus.
DO3 Op. Mode (DO3 Operating Mode) DO3动作	"Make": the DO3 is a short circuit (closed) when the associated function is active. "Break": the DO3 is an open circuit (open) when the associated function is active.	Break, 断开, Make 闭合	Make 闭合	R/W	Local, Serial, Modbus.
DO3 Status DO3状态	"Act": when the associated condition to the DO3 is active. "Not Act": when the associated condition to the DO3 is not active.	Active, 激活, Not Active 未激活	-	R	Local, Serial, Modbus.
DO4 Function DO4功能	It is the function associated to the DO4.	See Section 6.2	OFF 无	R/W	Local, Serial, Modbus.
DO4 Op. Mode (DO4 Operating Mode) DO4动作	"Make": the DO4 is a short circuit (closed) when the associated function is active. "Break": the DO4 is an open circuit (open) when the associated function is active.	Break, 断开, Make 闭合	Make 闭合	R/W	Local, Serial, Modbus.
DO4 Status DO4状态	"Act": when the associated condition to the DO4 is active. "Not Act": when the associated condition to the DO4 is not active.	Active, 激活, Not Active 未激活	-	R	Local, Serial, Modbus.
DO5 Function DO5功能	It is the function associated to the DO5.	See Section 6.2	OFF 无	R/W	Local, Serial, Modbus.
DO5 Op. Mode (DO5 Operating Mode) DO5动作	"Make": the DO5 is a short circuit (closed) when the associated function is active. "Break": the DO5 is an open circuit (open) when the associated function is active.	Break, 断开, Make 闭合	Make 闭合	R/W	Local, Serial, Modbus.
DO5 Status DO5状态	"Act": when the associated condition to the DO5 is active. "Not Act": when the associated condition to the DO5 is not active.	Active, 激活, Not Active 未激活	-	R	Local, Serial, Modbus.

Parameters of the "View Mode" Menu and the "Setup Mode" Menu					
Parameter Name	Description	Range	Default Value	R/W (1)	Available On (2)
DO6 Function DO6功能	It is the function associated to the DO6.	See Section 6.2	OFF 无	R/W	Local, Serial, Modbus.
DO6 Op. Mode (DO6 Operating Mode) DO6动作	"Make": the DO6 is a short circuit (closed) when the associated function is active. "Break": the DO6 is an open circuit (open) when the associated function is active.	Break, Make 断开, 闭合	Make 闭合	R/W	Local, Serial, Modbus.
DO6 Status DO6状态	"Act": when the associated condition to the DO6 is active. "Not Act": when the associated condition to the DO6 is not active.	Active, Not Active 激活, 未激活	-	R	Local, Serial, Modbus.
DO7 Function DO7功能	It is the function associated to the DO7. DO7 is available only when the External Power Supply is applied.	See Section 6.2	OFF 无	R/W	Local, Serial, Modbus.
DO7 Contacts DO7触点	It indicates which contact of the Relay is used.	NC, NO 常闭, 常开	NO 常开	R/W	Local, Serial, Modbus.
DO7 Op. Mode (DO7 Operating Mode) DO7动作	"Make": the selected contact of DO7 (NC or NO) is a short circuit (closed) when the associated function is active. "Break": the selected contact of DO7 (NC or NO) is an open circuit (open) when the associated function is active.	Break, Make 断开, 闭合	Make 闭合	R/W	Local, Serial, Modbus.
DO7 Status DO7状态	"Act": when the associated condition to the DO7 is active. "Not Act": when the associated condition to the DO7 is not active.	Active, Not Active 激活, 未激活	-	R	Local, Serial, Modbus.
DI1 Function DI1功能	It is the function associated to the DI1.	See Section 6.3	OFF 无	R/W	Local, Serial, Modbus.
D1 Act. if (D1 Active if) DI1激活	"Present": the input is considered active when a correct voltage is applied on the DI1 terminals. "Absent": the input is considered active when no voltage is applied on the DI1 terminals.	Present, Absent 得电, 失电	Present 得电	R/W	Local, Serial, Modbus.
D1 Command DI1触发方式	"Push-to-Run": the function is executed till the input is considered active. "Self-Maintained": the function is completely performed when the input stays active for more than 1 second The applicability of this parameter depends on the selected "DI1 Function" (see Section 6.3).	Push-to-Run, Self-Maintained 点动, 自保持	-	R	Local, Serial, Modbus.
DI1 Status DI1状态	It shows the status of the DI1. When a correct voltage is applied on the DI1 terminals it is "High" otherwise it is "Low".	High, Low 高, 低	-	R	Local, Serial, Modbus.
DI2 Function DI2功能	It is the function associated to the DI2.	See Section 6.3	OFF 无	R/W	Local, Serial, Modbus.
DI2 Act. if (DI2 Active if) DI2激活	"Present": the input is considered active when a correct voltage is applied on the DI2 terminals. "Absent": the input is considered active when no voltage is applied on the DI2 terminals.	Present, Absent 得电, 失电	Present 得电	R/W	Local, Serial, Modbus.
DI2 Command DI2触发方式	"Push-to-Run": the function is performed till the input is considered active. "Self-Maintained": the function is completely performed when the input stays active for more than 1 second The applicability of this parameter depends on the selected "DI2 Function" (see Section 6.3).	Push-to-Run, Self-Main-tained 点动, 自保持	-	R	Local, Serial, Modbus.
DI2 Status DI2状态	It shows the status of the DI2. When a correct voltage is applied on the DI2 terminals it is "High" otherwise it is "Low".	High, Low 高, 低	-	R	Local, Serial, Modbus.

Parameters of the "View Mode" Menu and the "Setup Mode" Menu						
Parameter Name	**Description**	**Range**		**Default Value**	**R/W (1)**	**Available On (2)**
DI3 Function DI3 功能	It is the function associated to the DI3.	See Section 6.3		OFF 无	R/W	Local, Serial, Modbus.
DI3 Act. if (D3 Active if) DI3 激活	"Present": the input is considered active when a correct voltage is applied on the DI3 terminals. "Absent": the input is considered a ctive when no voltage is applied on the DI3 terminals.	Present, Absent	得电, 失电	Present 得电	R/W	Local, Serial, Modbus.
DI3 Command DI3 触发方式	"Push-to-Run": the function is performed till the input is considered active. "Self-Maintained": the function is completely performed when the input stays active for more than 1 second The applicability of this parameter depends on the selected "DI3 Function" (see Section 6.3).	Push-to-Run, Self-Maintained	点动, 自保持	-	R	Local, Serial, Modbus.
DI3 Status DI3 状态	It shows the status of the DI3. When a correct voltage is applied on the DI3 terminals it is "High" otherwise it is "Low".	High, Low	高, 低	-	R	Local, Serial, Modbus.
AO Enabled (Analog Output Enabled) 模拟输出 AO	If it is set as "Yes" the Analog Output 4 - 20 mA is enabled. The Analog Output is available only when the External Power Supply is applied.	Yes, No	是, 否	No 否	R/W	Local, Serial, Modbus.
AO Selected (Analog Output Selected) AO 电源选择	It selects the source of the AO 4 - 20 retransmission. "Pressure": the value measured on the Analog Input 1 (Pressure) is re-transmitted. "Position": the value measured on the Analog Input 2 (Position) is re-transmitted.	Pressure, Position	压力传感器, 位置传感器	Pressure 压力传感器	R/W	Local, Serial, Modbus.
AO Supply (Analog Output Supply) AO 输出信号	Before to change this parameter, to be sure that "AO Enabled" is set to NO. If it is set as "Internal" the ELBS-20 generates the 24 V DC, necessary for the Analog Output. If it is set as "External" the ELBS-20 needs an external 24 V DC for the Analog Output.	Internal, External	内部, 外部	Internal 内部	R/W	Local, Serial, Modbus.
AO Op. Mode (Analog Output Operating mode) AO 信号类型	If it set as "Normal": 4 mA corresponds to "Pres. Min." or 0% 20 mA corresponds to "Pres. Max" or 100% If it set as "Reverse": 4 mA corresponds to "Max. Pres" or 100% 20 mA corresponds to "Pres. Min." or 0%	Normal, Reverse	正向, 反向	Normal 正向	R/W	Local, Serial, Modbus.
AO Value (Analog Output Value) AO 输出值	It is the value of the Analog Output.	4 - 20 mA		-	R	Local, Serial, Modbus.
AO Calibration AO 校准	For Biffi use only.	-		-	C	Local

Parameters of the "View Mode" Menu and the "Setup Mode" Menu					
Parameter Name	Description	Range	Default Value	R/W (1)	Available On (2)
Blue. Enabled (Bluetooth Enabled) 蓝牙	If it set "Yes" the Bluetooth Port is enabled (see Section 5.2.2.3 for details).	Long, Short 是, 否	No 否	R/W	Local, Serial, Modbus.
Blue. Type (Bluetooth Type) 蓝牙类型	For Biffi use only. It is not visible through Biffi Assistant when logged in as "Operator" (see [1]).	Long, Short 长, 短	Short 短	R	Local, Serial, Modbus.
Blue. Name (Bluetooth Tag name) 蓝牙名称	The Bluetooth name is created as follows: "BIFFI-" + 12characters + "-ELBS". This name is used for the Bluetooth connection. The value of this parameter is used by the Biffi Assistant for the name of the Main Menu (see [1])	12 characters	All "0"	R/W	Local, Serial, Modbus.
RS232 Enabled RS232	If it set "Yes" the RS232 Port is enabled (see Section 5.2.2.3 for details).	Yes, No 是, 否	No 否	R/W	Local, Serial, Modbus.
RS485 Enabled RS485	If it set "Yes" the RS485 Port is enabled (see Section 5.2.2.3 for details).	Yes, No 是, 否	No 否	R/W	Local, Serial, Modbus.
RS485 Term. Act. (RS485 Termination Active) RS485 激活	If it set as "Yes" the termination on the RS485 loop is activated	Yes, No 是, 否	Yes 是	R/W	Local, Serial, Modbus.
Mod. Enabled (Modbus Enabled) Modbus	If it set "Yes" the Modbus RTU Interface is enabled (see Section 5.2.2.3 for details).	Yes, No 是, 否	No 否	R/W (3)	Local, Serial, Modbus.
Mod. Address (Modbus Address) Modbus 地址	The MODBUS RTU Interface is available only when the External Power Supply is applied.	1-247	1	R/W (3)	Local, Serial, Modbus.
Mod. Baud (Modbus Baud Rate) Modbus 波特率	It is the Modbus RTU Address.	600, 1200, 2400, 4800, 9600, 19200, 38400	19200	R/W (3)	Local, Serial, Modbus.
Mod. Parity (Modbus parity Bit) Modbus 校验	It is the Modbus RTU Baud Rate. This setting becomes "active" by disabling and enabling the Modbus Interface (Mod. Enabled).	Even, Odd, None 奇校验, 偶校验, 无	Even 奇校验	R/W (3)	Local, Serial, Modbus.
Mod. Term. Act. (Modbus Termination Active) Modbus 激活	It is the Modbus RTU Parity Bit. This setting becomes "active" by disabling and enabling the Modbus Interface (Mod. Enabled). If it set as "Yes" the termination on the Modbus loop is activated. This setting becomes "active" by disabling and enabling the Modbus Interface (Mod. Enabled).	Yes, No 是, 否	No 否	R/W (3)	Local, Serial, Modbus.

Parameters of the "View Mode" Menu and the "Setup Mode" Menu					
Parameter Name	**Description**	**Range**	**Default Value**	**R/W (1)**	**Available On (2)**
Last Batt. Maint. (Last Battery Maintenance Date) 上次电池维护日期	It indicates the date of the last battery change. See Section 12 for the correct Battery Maintenance procedure	01-01-1990 31-12-2099	-	R	Local, Serial, Modbus.
Next Batt. Maint. (Next Battery Maintenance Date) 下次电池维护日期	It indicates the date of the next required battery change. If the present date is greater than or equal to the value of "Next. Batt. Maint.", a MAINT warning is activated (see Section 6.4).	01-01-2012 31-12-2099	-	R	Local, Serial, Modbus.
Batt. Maint Period (Battery Maintenance Period) 电池维护周期	It is used for updating the "Next Batt. Maint" parameter by using the "Upd. Batt. Maint. Date" command". It is suggested to leave it at the default value (1 year).	1-5 years	1 year	R/W	Local, Serial, Modbus.
Upd. Batt. Maint. Date (Update Battery Maintenance Date) 更新电池维护日期	It updates the value of the "Last Batt. Maint." And "Next. Batt. Maint." Parameters ("Last Batt. Maint." = present date and "Next. Batt. Maint." = present date+"Batt. Mnt. Period"). A Battery Check is performed. See Section 12 for the correct Battery Maintenance procedure.	Start	-	C	Local, Serial, Modbus.
T.Pr.Drop (Test Pressure Drop) 模拟压降速率	It is the Pressure drop value used by the test function ("Start Test P. Drop").	0.2-200 bar/min	3.0 bar/min	R/W	Local, Serial, Modbus.
Start Test Pres. Drop (Start Test Pressure Drop) 开始压降测试	Start the Test Pressure Drop. A pressure drop is simulated according with the set value of "Test Pres. Drop". This command forces the device to the VC operating mode. The test execution can be interrupted by pressing the 'ENTER' push-button (the ELBS-20 goes to SLOW Op. Mode). See Section 5.1.2.3 for details. If display turns off during the test, the test continues. For stopping it, it is necessary to press ENTER (for waking up the display) and launch another test and stop it.	Start	-	C	Local, Serial
Start Test Safe Act. (Start Test Safety Action) 开始安全动作测试	Start the Test Safety Action. The test function forces the execution of the Safety Action if the ELBS-20 is in VC or VC+ACQ mode. This test cannot be interrupted and when it is finished the ELBS-20 goes to the SLOW operating mode. See Section 5.1.2.4 for details.	Start	-	C	Local, Serial, Modbus.
Device Type 设备类型	-	ELBS20	ELBS20	R	Local, Serial, Modbus.
Manufacturer 制造商	-	Biffi	Biffi	R	Local, Serial, Modbus.
Serial Number 序列号	It is not visible through Biffi Assistant when logged in as "Operator" (see [1]).	1-16 characters	All 0s	R	Local, Serial, Modbus.
FW Int. (FW Interfaces) 接口板固件版本	It is the FW version of the Interfaces Card	x.xx.xx	-	R	Local, Serial, Modbus.
FW Pro. (FW Process) 主板固件版本	It is the FW version of the Process Card.	x.xx.xx		R	Local, Serial, Modbus.
Tag Name 位号	It is the device Tag Name	1-16 characters	Biffi Line Break	R/W	Local, Serial, Modbus.

Parameters of the "View Mode" Menu and the "Setup Mode" Menu					
Parameter Name	**Description**	**Range**	**Default Value**	**R/W (1)**	**Available On (2)**
Date 日期	It is the date (dd-mm-yyyy) "updated" by the RTC of the ELBS-20.	01-01-1990 31-12-2099	actual	R/W	Local, Serial, Modbus.
Time 时间	It is the time (hh:mm:ss) "updated" by the RTC of the ELBS-20.	00-00-00 23-59-59	actual	R/W	Local, Serial, Modbus.
RTC Adjust RTC调整	It is the number of seconds to add to the RTC value every 24 hours to increase the RTC precision. This parameter is available from revisions 1.00.05 (Interfaces Card) and 1.00.04 (Process Card). It is factory set. Only for expert user.	-127 - 127	Factory set	R/W	Local, Serial, Modbus.
Change OPR PWD (Change Operator Password) 设置密码	It is the Password of the Local Operator Interface for logging in as "Operator". It is possible to set the new value when logged in as "Operator". The new password is active (the old one is no longer valid) after the log out.	8 characters	00000000	R/W	Local
Alarms Status 报警状态	Each type of alarm (see Section 6.4) is listed and it is indicated if it is active ("On") or not active ("Off").	-	-	R	Local, Serial, Modbus.
Alarms List 报警日志	Up to 50 alarms' change of status (activation and "clearing") are listed. When an alarm becomes active its acronym (see 6.4) is listed as "ON". When an alarm is cleared its acronym (see 6.4) is listed as "OFF". By using the Local Operator Interface it is possible to see Date and Time of a specific alarm' change of status by selecting it ("UP" and "DOWN" buttons) and then pushing "ENTER"). Push "ENTER" another time for returning to the Alarms List.	-	-	R	Local, Serial, Modbus.
Clear Alarms List 清除报警	This command clears the Alarms List.	Start	-	C	Local, Serial, Modbus.
Warnings Status 警告状态	Each type of warning (see Section 6.4) is listed and it is indicated if it is active ("On") or not active ("Off").	-	-	R	Local, Serial, Modbus.
Warnings List 警告日志	Up to 50 warning changes of status (activation and "clearing") are listed. When a warning becomes active its acronym (see 6.4) is listed as "ON". When a warning is cleared its acronym (see 6.4) is listed as "OFF". By using the Local Operator Interface it is possible to see Date and Time of a specific warning' change of status by selecting it ("UP" and "DOWN" buttons) and then pushing "ENTER"). Push "ENTER" another time for returning to the Warnings List.	-	-	R	Local, Serial, Modbus.
Clear Warnings List 清除警告	This command clears the Warnings List.	Start	-	C	Local, Serial, Modbus.

Parameters of the "View Mode" Menu and the "Setup Mode" Menu					
Parameter Name	**Description**	**Range**	**Default Value**	**R/W (1)**	**Available On (2)**
Events Stored 事件记录数	It indicates the number of the stored events.	0-1000	0	R	Local, Serial, Modbus.
Event ID 事件编号	It indicates the event whose data (event type and date and time) are shown in the "Event Info". The last event has the" Event ID" = 1 and the oldest event has the "Event ID" = "Events Stored". This parameter can "automatically" change its value during the Export of the graphs through "Biffi Assistant" (see [1]).	1-1000	0	R/W	Local, Serial, Modbus.
Event Info 事件内容	The Event type and the related date and time of the selected event ("Event ID") are shown. If "Event ID" > "Events Stored" than "all zeros" are shown. By using the Serial Interfaces, the "Event Info"	- -	R	Local, Serial, Modbus (4).	Local, Serial, Modbus.
Mem. Circular (Memory Circular) 循环保存	Circular (Yes) = when the event memory is full the new event takes the place of the oldest one. Not circular (No) = when the memory is full the acquisition function stops working. The '' Clear Event Memory '' command restarts the acquisition function.	Yes, 是, No 否	Yes 是	R/W	Local, Serial, Modbus.
Memory 90 % (Memory 90%Full Warning) 90%容量警告	If "Memory 90%" is set as "On" and "Mem. Circular" = "Off", a MEM90 warning (see 6.4 for details) is generated when the event data memory content reaches the 90%.	On, Off	开, 关	Off 关	R/W
Clear Event Memory 清空事件记录	The execution of this command clears the event data memory (every stored event is deleted). Its execution takes up to 40 seconds.	Clear	-	C	Local, Serial, Modbus.
Events to load	It is used for View/export the graphs of the stored events by using "Biffi Assistant" (see [1]).	-	-	R/W	Serial
Load Event List	It is used for View/export the graphs of the stored events by using "Biffi Assistant" (see [1]).	-	-	C	Serial
Language 语言	It indicates the language used by the menu. This parameter is available starting from rev. 1.00.03 of the Interfaces Card.	English, Chinese	English	R/W	Local

Parameters of the "Normal Mode" Menu (5)					
Parameter Name	**Description**	**Range**	**Default Value**	**R/W (1)**	**Available On (2)**
Pressure 压力	It is the value of the Pressure measured on the Analog Input 1 (Pressure Transducer). See Section 6.1 for the precision of Shown value.	0-1000 bar	actual	R	Local, Serial, Modbus.
Position 位置	It is the value of the Position measured on the Analog Input 2 (Position Sensor). See Section 6.1 for the precision of Shown value.	0-100 %	actual	R	Local, Serial, Modbus.
Date 日期	It is the time "updated" by the RTC of the ELBS-20.	00-00-00 23-59-59	actual	R	Local, Serial, Modbus.
Time 时间	It is the date "updated" by the RTC of the ELBS-20.	01-01-1990 31-12-2099	actual	R	Local, Serial, Modbus.
Temperature 温度	It is the temperature measured into the cabinet of the ELBS-20.	-40 to 85 °C	actual	R	Local, Serial, Modbus.
Humidity 湿度	It is the humidity measured into the cabinet of the ELBS-20.	0 -100 %	actual	R	Local, Serial, Modbus.
Alarms 报警	It indicates the number of the active alarms.	0-255	actual	R	Local, Serial, Modbus.
Warnings 警告	It indicates the number of the active warnings.	0-255	actual	R	Local, Serial, Modbus.

NOTES:

(1) In the "View Mode Menu" (or Logged in as "Guest") the parameters are only readable. In the "Setup Mode Menu" (Logged in as "Operator") it is possible to set the parameters value (if R/W) or to perform a command (C). Modbus interface does not require any password and it is allowed setting its own available parameters (R/W or C).

(2) Specify the availability of the parameter on each interface: Local (Local Operator Interface), Serial (RS232, RS485 and Bluetooth) and MODBUS (MODBUS RTU).

(3) It is only readable by using the Modbus RTU Interface.

(4) Serial (RS232, RS485 and Bluetooth) and MODBUS (MODBUS RTU) interfaces allow download ing the curve of each event.

(5) After a "wake-up" of the ELBS-20, the values of these parameters are updated after the first sampling of the pressure according to the values of "S.Rate" and "Slow S.Rate".

6.1 Precision of the Analog Inputs

The Analog Inputs have the following precision depending on the input type:

- Input 0 - 20 mA: 0.5%
- Input 4 - 20 mA: 0.5%

The value of the Pressure is shown and stored (event data memory) in the following way depending on the size of the Pressure Transducer:

- 0.0 - 99.9 bar: 2 fractional digits
- 100.0 – 999.9 bar: 1 fractional digit
- 1000 bar: 0 fractional digit

Depending on the size of the Pressure Transducer, the parameters “Valve Control Pressure” (VLC PDR), “Data Acquisition Pressure” (D.ACQ P.), “Pressure Increase” (P. Inc) and “Pressure Decrease” (P. DEC) must respect the following limits when they are set.

Table 6.

Pres. Max. (Pressure Maximum) (bar)	VLC PDR. and D.ACQ. PDR. LIMITS (bar/min)	P. Inc and P. Dec LIMITS (bar)
0.0 – 50.0	0.1 – “Maximum Pressure” / 4	0.1 – “Maximum Pressure”
50.1 – 100.0	0.2 – “Maximum Pressure” / 4	0.2 – “Maximum Pressure”
100.1 – 150.0	0.3 – “Maximum Pressure” / 4	0.3 – “Maximum Pressure”
150.1 – 200.0	0.4 – “Maximum Pressure” / 4	0.4 – “Maximum Pressure”
200.1 – 300.0	0.6 – “Maximum Pressure” / 4	0.6 – “Maximum Pressure”
300.1 – 400.0	0.8 – “Maximum Pressure” / 4	0.8 – “Maximum Pressure”
400.1 – 500.0	1.0 – “Maximum Pressure” / 4	1.0 – “Maximum Pressure”
500.1 - 1000	2.0 – “Maximum Pressure” / 4	2.0 – “Maximum Pressure”

6.2 Table of Digital Outputs Functions

Table 7.

DO FUNCTION	DESCRIPTION (*)	DO AVAILABILITY (*)
OFF 无	It forces the Relay to have a not active associated function.	All
SOV C. (SOV CONTROL) 安全动作已执行	It is active when the Safety Action starts, and it is cleared when the Operating Mode is set to VC or VC+ACQ. This function can be used both for monitoring the safety action and for using DO1 or DO2 as SOVs Control Outputs (connected to the SOVs). In any case at least one between SVC1, SVC2, RL1 and RL2 must be enabled. If DO1 or DO2 are used as SOVs Control Outputs (connected to the SOVs), it is necessary to follow the “Restore the Valve Control” procedure (see Section 11) to correctly clear them.	DO1, DO2
ARMED 阀门控制模式	It is active when the ELBS-20 is in VC or VC+ACQ operating mode (see Section 5.1.1).	All
ALARM 系统报警	It is active when at least one alarm is active (see Section 6.4).	All
ACQ. (ACQUISITION) 数据采集模式	It is active when the ELBS-20 is in ACQ or VC+ACQ operating mode (see Section 5.1.1).	All
WARN. (WARNING) 系统警告	It is active when at least one warning is active (see Section 6.4).	All
S. ACT (Safety action) 安全动作激活	It is active when the Safety Action it is considered as “active” (see Section 5.1.2.7).	DO1, DO2
V.E.KO (External Power Supply KO) 外部供电异常	It active when at least one of the following warnings is active: “External Power Supply Default” or “External Power Supply Auxiliary” (see Section 6.4).	All
V.B.KO (Battery Pack Power Supply KO) 电池供电异常	It is active when at least one of the following warnings is active: “Battery Pack Default” or “Battery Pack Auxiliary” (see Section 6.4).	All
HEATER 低温启动加热器	The ELBS-20 use this DO for driving an external HEATER connected on the DO7. -30 °C is the threshold for activating the HEATER. -28 °C is the threshold for de-activating the HEATER.	DO7
B.MNT (Battery Maintenance Required) 电池维护要求	It is active when the “Battery Maintenance Required” warning is active.	All
S.A DONE (Safety Action Done) 阀门动作结束	It becomes active at the end of the execution of the Safety Action, when the ELBS-20 considers the Safety Action as no more “active” (see Section 5.1.2.7). It is cleared when the Operating Mode is set to VC or VC+ACQ.	All
SVC KO 电磁阀异常	It is active when at least one of the following warnings is active: “SVC1” or “SVC2” (see Section 6.4).	All
RL KO 电磁阀异常	It is active when at least one of the following warnings is active: “RL1” or “RL2” (see Section 6.4).	All
EVENT 2 事件类型2	It is active when “EVENT2” occurs or, if the Operating Mode is SLOW, the Pressure value is lower than the “LP Limit” parameter. Once activated, it’s cleared when the Pressure value is equal or higher than the “LP Limit” parameter or after a power cycle.	All (**)
EVENT 4 事件类型4	It is active when “EVENT4” occurs or, if the Operating Mode is SLOW, the Pressure value is higher than the “HP Limit” parameter. Once activated, it’s cleared when the Pressure value is equal or lower than the “HP Limit” parameter or after a power cycle.	All (**)
EVENT 6 事件类型6	It is active when “EVENT6” occurs. Once activated, it’s cleared when the Operating Mode is reset to VC or VC+ACQ (the ELBS20 is ARMED) or after a power cycle	All (**)

NOTES:

(*): DO7 works only when the External Power Supply is applied (NO contact is always Open and NC contact is always Closed).

(**): The “EVENT2”, “EVENT4” and “EVENT6” functions are available starting from Process Card FW 2.00.06 and Interfaces Card FW 2.00.11.

6.3 Table of Digital Inputs Functions

Table 8.

DI FUNCTION (*) (**)	DESCRIPTION	DI AVAILABILITY
SLOW EN (Slow Enable) 启动慢采样模式	When it is active, the ELBS-20 goes to the SLOW Mode (see Section 5.1.1). It works as follows: **Actual Operating Mode** → **Next Operating Mode** SLEEP → SLOW SLOW → SLOW VC → SLOW ACQ → SLOW VC + ACQ → SLOW This function works always as “Self-Maintained” command (minimum duration 1 second).	All
S.A.C. (Safety Action Command) 执行安全动作	When it is active, the ELBS-20 performs the Safety Action, according to the set SOVs Control Outputs (SVC1, SVC2, RL1, RL2, DO1 or DO2). It works only in VC and VC+ACQ Operating Mode (see Section 5.1.1). This function works always as “Self-Maintained” command (minimum duration 1 second).	All
CLR.M. (Clear Event Memory) 清空内存	When it is active, the ELBS-20 clears the event data memory (every stored event is deleted). This function works always as “Self-Maintained” command (minimum duration 1 second).	All
VC EN (Valve Control Enable) 启动VC模式	When it is active, the ELBS-20 enables the Valve Control (see Section 5.1.1). It works as follows: **Actual Operating Mode** → **Next Operating Mode** SLEEP → SLOW SLOW → SLOW VC → SLOW ACQ → SLOW VC + ACQ → SLOW This function works always as “Self-Maintained” command (minimum duration 1 second).	All
ACQ EN (Acquisition Mode Enable) 启动ACQ模式	When it is active, the ELBS-20 goes to the SLOW Mode (see Section 5.1.1). It works as follows: **Actual Operating Mode** → **Next Operating Mode** SLEEP → SLOW SLOW → SLOW VC → SLOW ACQ → SLOW VC + ACQ → SLOW This function works always as “Self-Maintained” command (minimum duration 1 second).	All
.C.SVC (Integrity Check SVC) 检查电磁阀回路	When it is active the ELBS-20 performs a Manual Integrity Check on the SVCs that are enables as SOV Control Outputs. See Section 5.2.8.1 for details about the Integrity Check. This function works always as “Self-Maintained” command (minimum duration 1 second).	All
I.C.RL (Integrity Check RL) 检查继电器回路	When it is active the ELBS-20 performs a Manual Integrity Check on the RLs that are enables as SOV Control Outputs. See Section 5.2.8.1 for details about the Integrity Check. This function works always as “Self-Maintained” command (minimum duration 1 second).	All
OFF 无	No function associated to the DI.	All

NOTES:

(*): The last command active is performed.

(**): The Self Maintained command works on the first valid signal commutation, according with the setting of the DI (Active if “Present” or “Active”) and it is not repeated till a new valid signal commutation.

6.4 Tables of the Alarms and Warnings

Table 9.

Table of the Alarms (*)		
Alarm Type	**Acronym**	**Description**
Pressure Transducer Problem 压力传感器异常	AI1_PR	It is active when some problem, dealing with the Pressure Transducer, occurs (ex. Measured value > 20.6 mA or internal power supply problem)
Power Supply Alarm 供电异常	POW_S	It is active when no Power Supply sources are “Ok”, it means that: “V. Ext Status Def” = “Bad” “V. Ext Status Aux” = “Bad” “V. Bat Status Def” = “Bad” “V. Bat Status Aux” = “Bad”
Wrong Configuration 配置错误	CONF	It is active when at least one of the following configuration errors is made: - Limits of “VLC PDR”, “D.ACQ. PDR”, “P. Inc.” e “P. Dec.” are not respected (see Section 6.1) - “LP limit” > “Max. Pressure” - “LP limit” >= “HP Limit” - All the SOV Controls Outputs are disabled - “V.Ext.Applied” = “No” and “S.Rate” < 5 seconds - Enabled SOV control Outputs do not respect the limitation dealing with the applied power supply (see Section 5.2.2)
Sleep Operating Mode 系统休眠模式	SLEEP	It is active when "SLEEP” operating mode is selected.
Safety Action Electrical Circuits Alarm 阀门控制回路异常	SAEC	It is active when: - All the SOV Control Outputs (SVC1, SVC2, RL1, RL2) are disabled. - All the enabled SOV Control Outputs have their Status = “Bad” (example: SVC1 and SVC2 are the enabled SOV Control Output and “SVC1 Status” = “Bad” and “SVC2 Status” = “Bad”)
Reset 重启	RESET	It is not a real alarm; it is just logged in the “Alarms List” after a reset (power cycle) of the ELBS-20

Table 10.

Table of the Warnings (*)		
Warning Type	**Acronym**	**Description**
Event Data Memory 90% 90%内存容量	MEM90	It is active when the event data memory is not set as circular ("Mem. Circular" = "No") it reaches 90% of its capacity and if the parameter "Memory 90%" is set as "On".
Temperature 温度超范围	TEMP	It is active when the temperature is higher than +75 °C is lower than -30 °C
Battery Maintenance Required 电池维护到期	MAINT	It is active if the present date is greater than or equal to the "Next Batt. Ch." parameter. It is applicable only when the one or both the Battery Packs are enabled ("V.Bat.Applied" is "Yes").
Position Transducer Problem 位置传感器异常	AI2_PO	It is active when some problem, dealing with the Position Sensor, occurs (ex. Measured value > 20.6 mA or internal power supply problem). When the Position sensor is disabled, it is automatically cleared.
Interfaces Card Problem 接口卡通信异常	INTER	It is active when some problem, dealing with the communication with the Interfaces Card, occurs
External Power Supply Default 默认供电电路异常	V_EX_D	It is active when "V. Ext Applied" is "Yes" and "V. Ext Status Def" is "Bad".
External Power Supply Auxiliary 备用供电电路异常	V_EX_A	It is active when "V. Ext Applied" is "Yes" and "V. Ext Status Aux" is "Bad"
SVC1 Circuit Problem 电磁阀回路1异常	SVC1	It is active when SVC1 is set as SOV Control Output and "SVC1 Status" is "Bad". See 5.2.8.1 for details.
SVC2 Circuit Problem 电磁阀回路2异常	SVC2	It is active when SVC2 is set as SOV Control Output and "SVC2 Status" is "Bad". See 5.2.8.1 for details.
RL1 Circuit Problem 继电器回路1异常	RL1	It is active when RL1 is set as SOV Control Output and "RL1 Status" is "Bad". See 5.2.8.1 for details.
RL2 Circuit Problem 继电器回路2异常	RL2	It is active when RL2 is set as SOV Control Output and "RL2 Status" is "Bad". See 5.2.8.1 for details.
Battery Pack Default 默认电池组异常	BAT_D	It is active when "V.Bat.Applied" is "Yes" and the "V. Bat Status Def" is "Bad".
Battery Pack Auxiliary 备用电池组异常	BAT_A	It is active when "V.Bat.Applied" is "Yes", "V.Bat.Dual" is "Yes" and the "V. Bat Status Aux" is "Bad".
Flash Process Card Flash设备异常	FL_P	It is active when the Flash memory of the Process Card has problems.
MRAM Process Card MRAM设备异常	MR_P	It is active when the MRAM memory of the Process Card has problems. This warning is not saved in the Warning List.
Flash Interfaces Card Flash接口卡异常	FL_I	It is active when the Flash memory of the Interfaces Card has problems.
MRAM Interfaces Card MRAM接口卡异常	MR_I	It is active when the MRAM memory of the Interfaces Card has problems.
Reset 重启	RESET	It is not a real warning; it is just logged in the "Warnings List" after a reset (power cycle) of the ELBS-20.

NOTE:
(*): The Active Alarms and Warnings are cleared after a power cycle of the device. After the power cycle if the cause of the alarm or of the warning is still present, the alarm or warning will be again activated.

Section 7: Local Operator Interface

The Chinese Menu is available starting from the FW version 1.00.03 of the Interfaces Card.

This section describes the Local Operator Interfaces that is available by using the local Push-buttons and the display.

The ELBS-20 is fitted with a graphic 128x64 OLED display and 3 push-buttons that allows entering the configuration parameters or to visualize the working data.

Two push-buttons “DOWN”, “UP” are used to move into the menu and for changing the value of the parameters, while the third “ENTER” is used to enter the selected information and for moving between the sub-menus and for waking-up the ELBS-20 (when only the Battery Pack Power Supply is present).

See Section 7.4.2 for more details.

The Local Operator Interface is organized in four different main Menus:

- Normal Mode Menu (Section 7.2 for details)
- Login Menu (Section 7.3 for details)
- Setup Mode Menu (see Section 7.4 for details)
- View Mode Menu (see Section 7.4 for details)

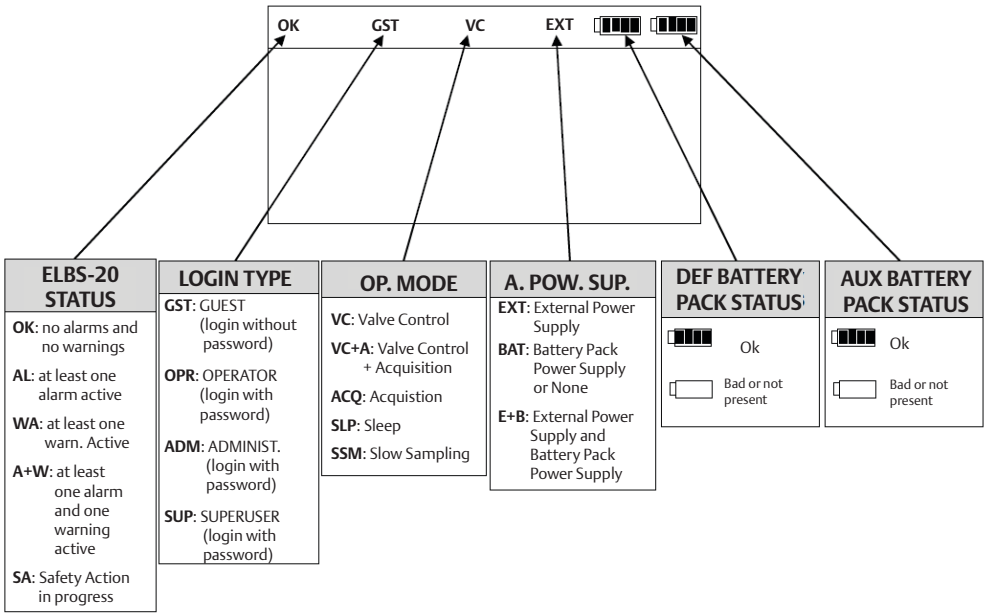
The Local Operator Interface is not available when a Biffi Assistant connection is active (see [1]).

7.1 Info Bar

The Info Bar is present in every display-screen of the Local Operator Interface. It contains the following pieces of information:

- ELBS-20 Status
- Login Type
- Operating Mode
- Applied Power Supplies
- Default Battery Pack Status
- Auxiliary Battery Pack Status

Figure 14

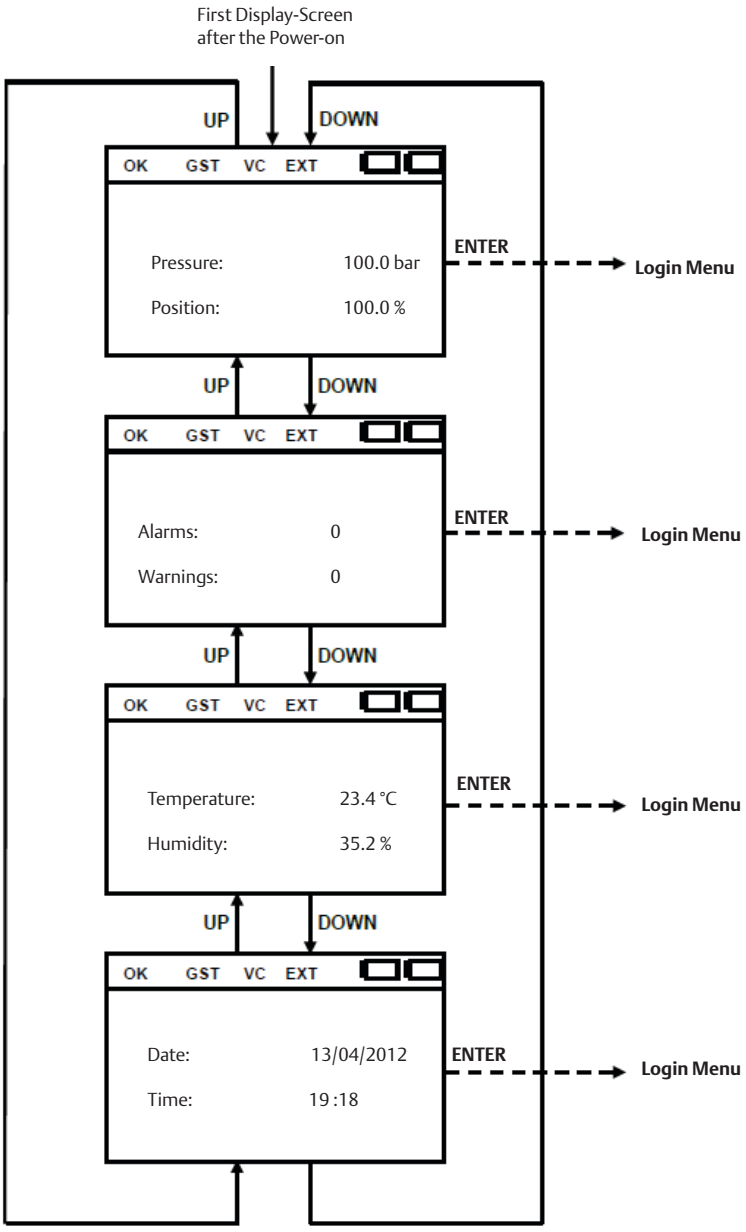


7.2 Normal Mode Menu

The Normal Mode Menu is composed of four display-screens, which are available without any password and give some general pieces of information.

The language of the Normal Mode Menu is defined by the “Language” parameter (see Section 6).

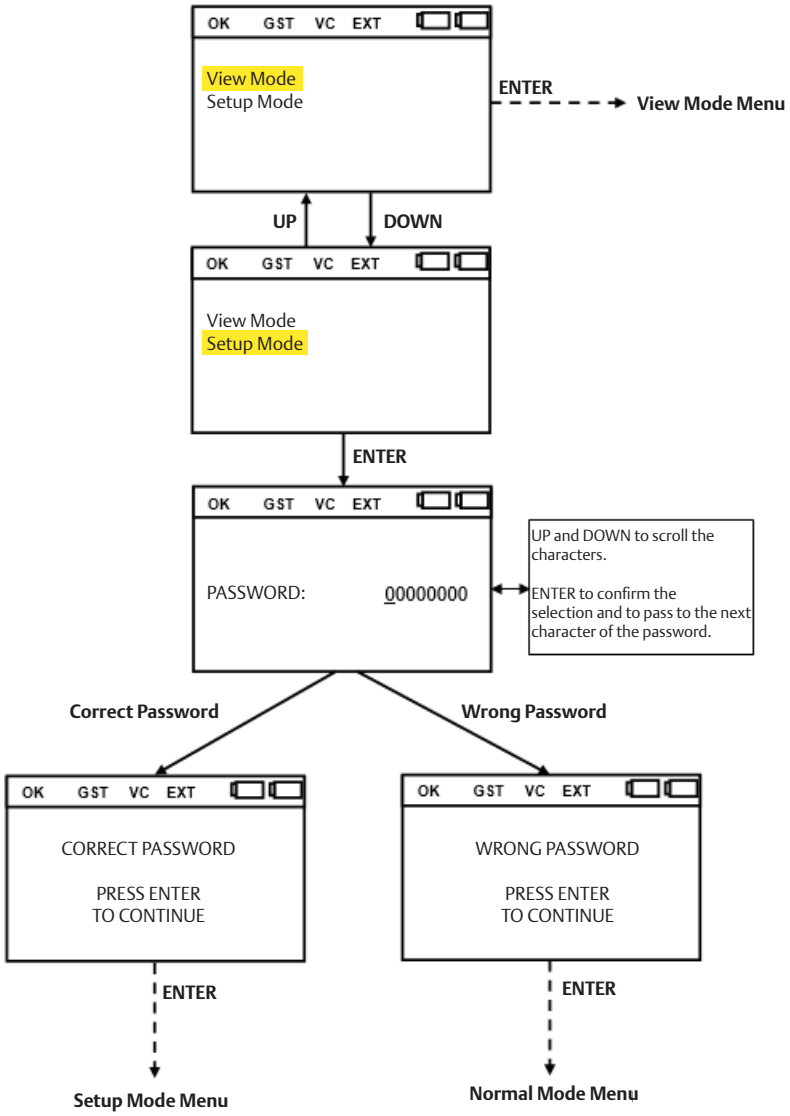
Figure 15



7.3 Login Menu

The Login Menu allows entering in the View Mode Menu (without password) as “Guest” and in the Setup Mode Menu (with password) as “Operator”, “Administrator” or “Developer”.

Figure 16



7.4 View Mode and Setup Mode Menus

The Setup Mode Menu (login with password is required) allows configuring the available parameters (see Section 6 for details).

The View Mode Menu (no password is required) allows viewing the available parameters (the same ones of the Setup Mode Menu) but it is not possible to set their value.

The current position into the Setup and View Mode menus is highlighted in yellow.

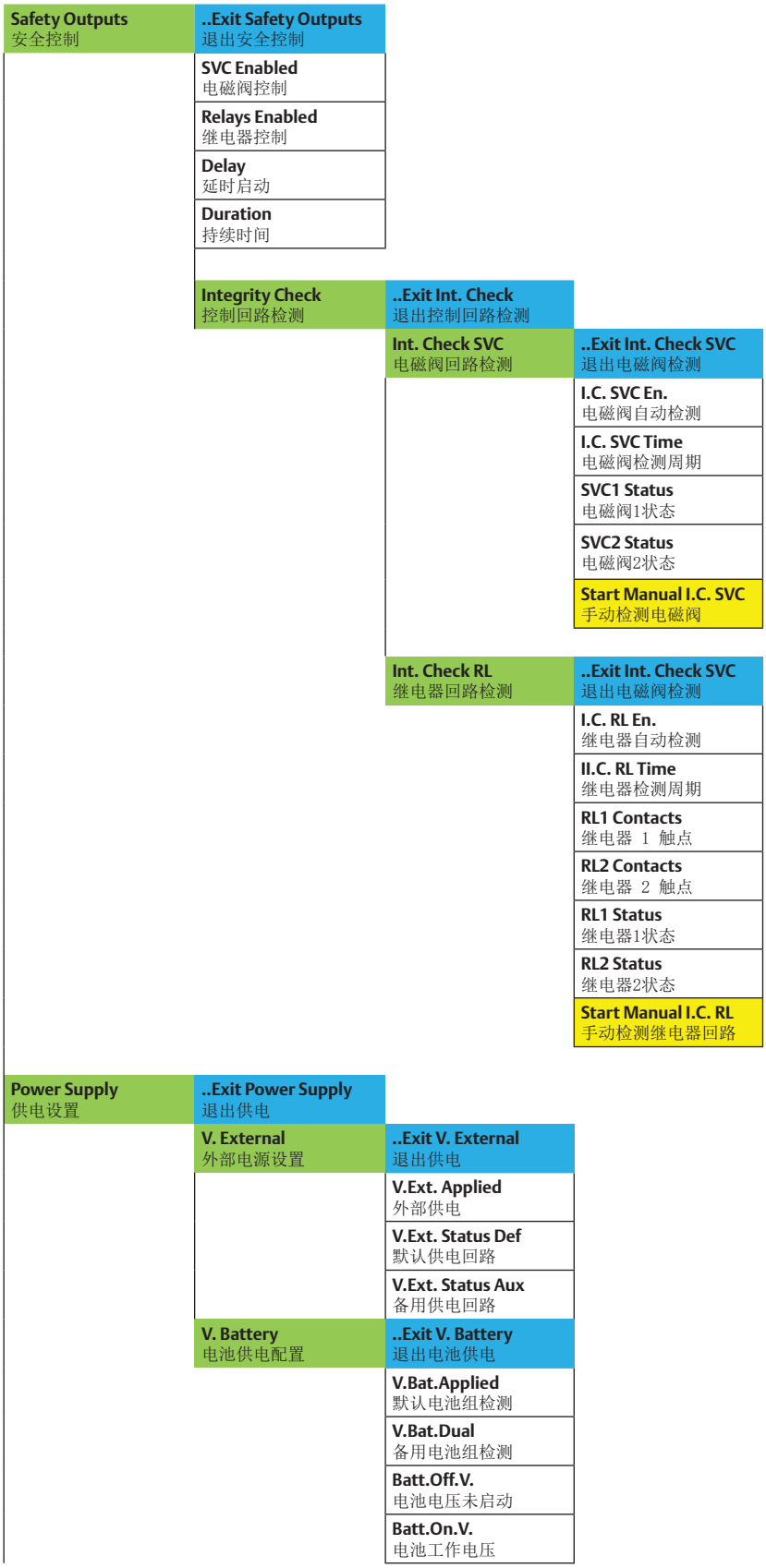
7.4.1 View Graph of the Setup/View Mode Menus

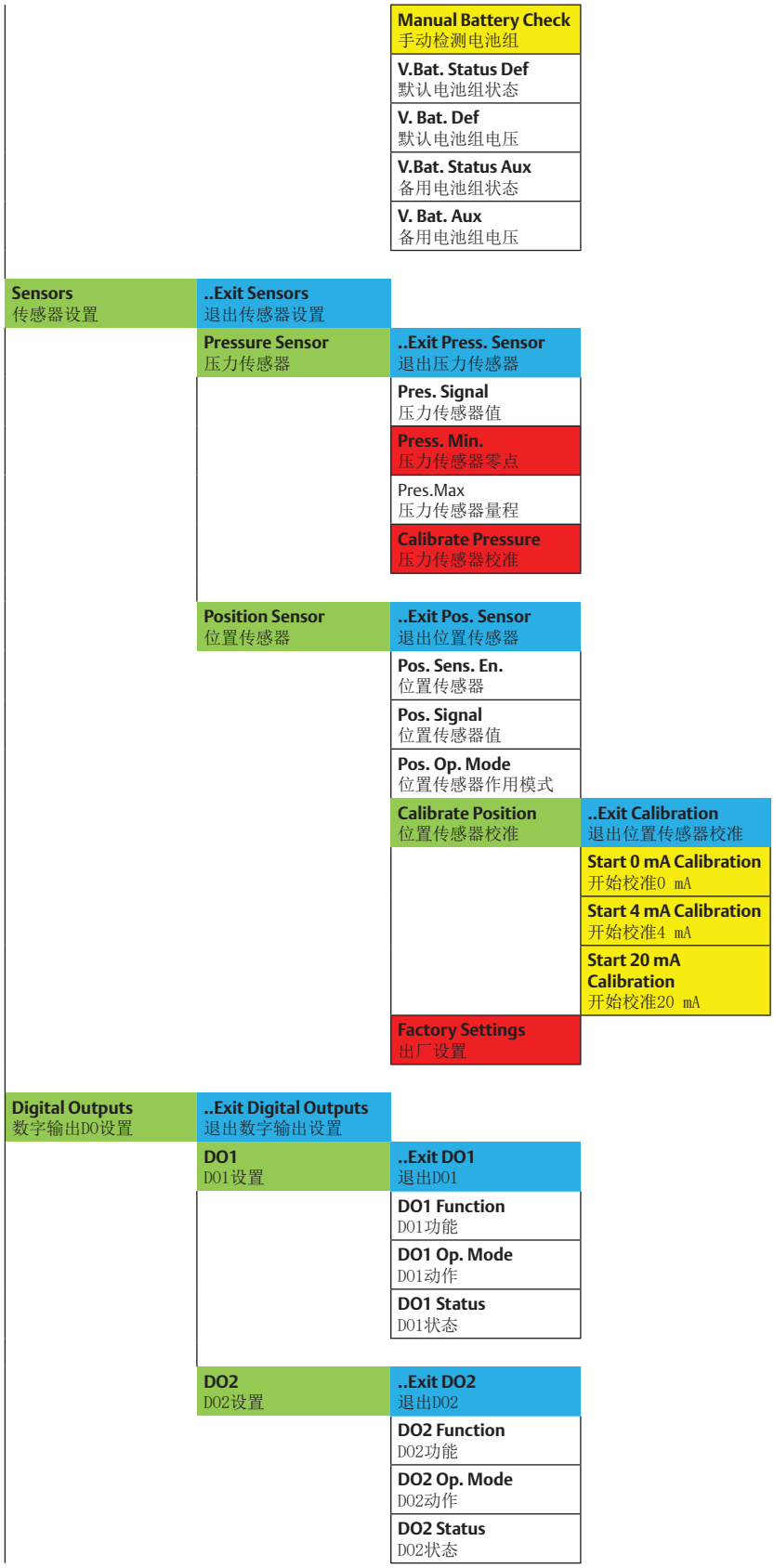
The View Graph of the Setup and View Mode Menus shows the position of each available parameter of these menus.

For making easier the reading of the View Graph, a different color is associated to the different entries of the menus.

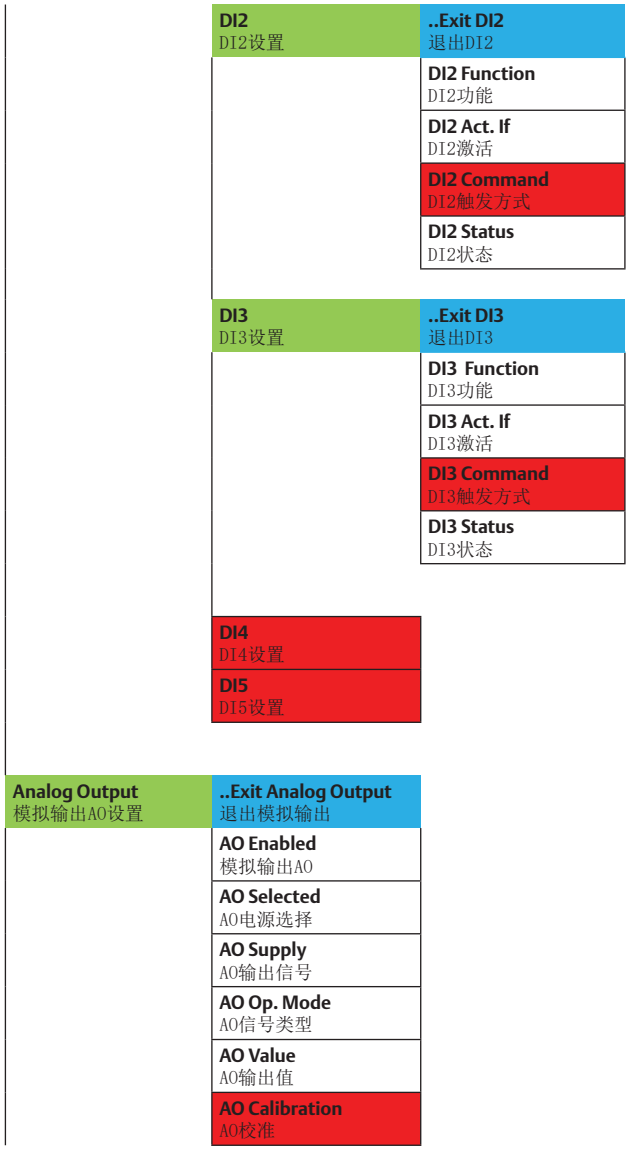
Menu and Sub-Menu
Exit of Menu and Sub-Menu
Available Parameter
Available Command/Calibration
Unavailable Parameter or Command/Calibration
(for Biffi use only)

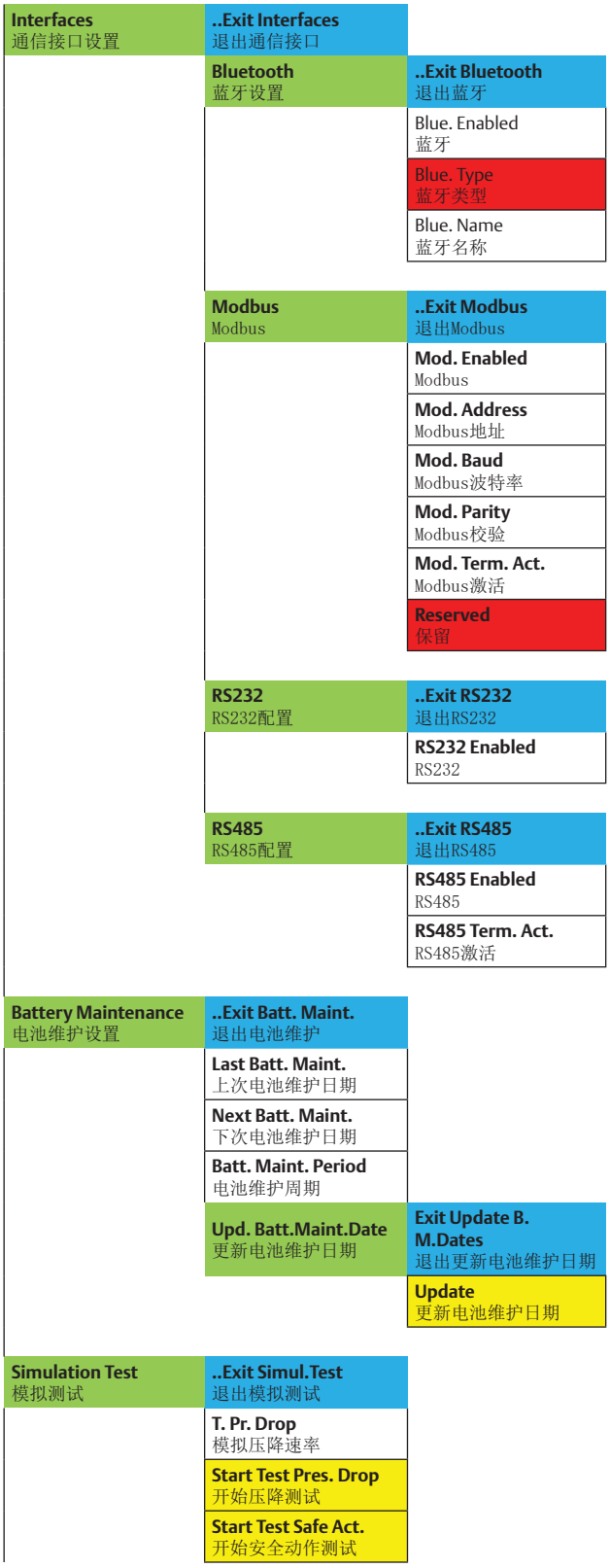
View Mode Menu 查看模式		
Setup Mode Menu 设置模式	**..Exit View-Setup** 退出查看-设置模式	
	Operating Mode 操作模式设置	**..Exit Operating Mode** 退出操作模式
		Operating Mode 操作模式
		SA Done 阀门安全动作
		SA Source 安全动作源
		SA Date 安全动作日期
		SA Time 安全动作时间
	Event Settings 保护动作设置	**..Exit Event Settings** 退出保护动作设置
		HP Limit 高压限值
		LP Limit 低压限值
		Drop Enabled 压降速率启用
		VLC PDR 控制模式压降速率
		D.ACQ PDR 采集模式压降速率
		P. Inc. 压力增加
		P. Dec. 压力下降
		S.Rate 采样频率
		Slow S.Rate 慢采样频率

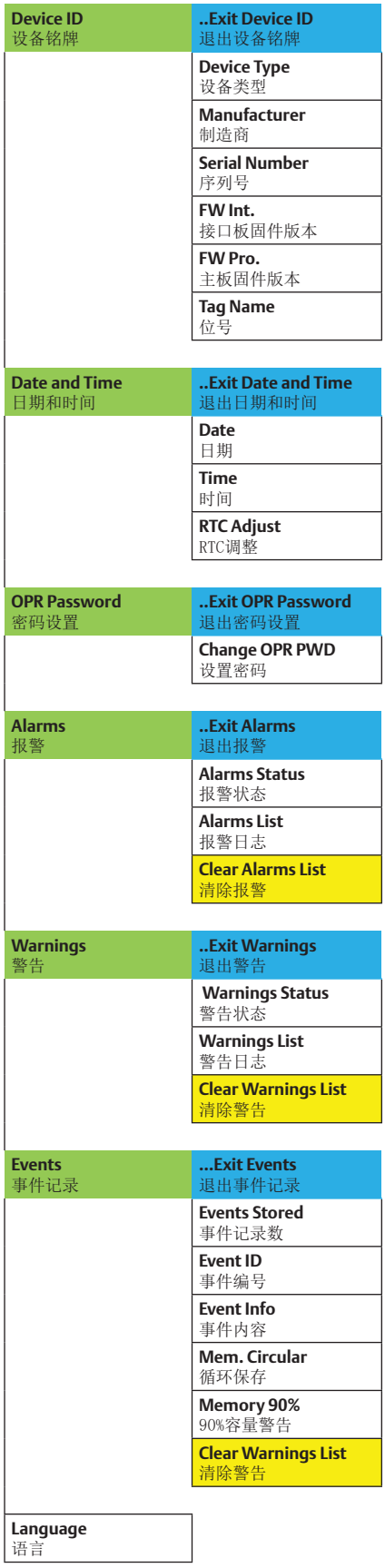

Safety Outputs
安全控制
..Exit Safety Outputs
退出安全控制
SVC Enabled
电磁阀控制
Relays Enabled
继电器控制
Delay
延时启动
Duration
持续时间
Integrity Check
控制回路检测
..Exit Int. Check
退出控制回路检测
Int. Check SVC
电磁阀回路检测
..Exit Int. Check SVC
退出电磁阀检测
I.C. SVC En.
电磁阀自动检测
I.C. SVC Time
电磁阀检测周期
SVC1 Status
电磁阀1状态
SVC2 Status
电磁阀2状态
Start Manual I.C. SVC
手动检测电磁阀
Int. Check RL
继电器回路检测
..Exit Int. Check SVC
退出电磁阀检测
I.C. RL En.
继电器自动检测
II.C. RL Time
继电器检测周期
RL1 Contacts
继电器 1 触点
RL2 Contacts
继电器 2 触点
RL1 Status
继电器1状态
RL2 Status
继电器2状态
Start Manual I.C. RL
手动检测继电器回路
Power Supply
供电设置
..Exit Power Supply
退出供电
V. External
外部电源设置
..Exit V. External
退出供电
V.Ext. Applied
外部供电
V.Ext. Status Def
默认供电回路
V.Ext. Status Aux
备用供电回路
V. Battery
电池供电配置
..Exit V. Battery
退出电池供电
V.Bat.Applied
默认电池组检测
V.Bat.Dual
备用电池组检测
Batt.Off.V.
电池电压未启动
Batt.On.V.
电池工作电压


Manual Battery Check
手动检测电池组
V.Bat. Status Def
默认电池组状态
V. Bat. Def
默认电池组电压
V.Bat. Status Aux
备用电池组状态
V. Bat. Aux
备用电池组电压
Sensors
传感器设置
..Exit Sensors
退出传感器设置
Pressure Sensor
压力传感器
..Exit Press. Sensor
退出压力传感器
Pres. Signal
压力传感器值
Press. Min.
压力传感器零点
Pres.Max
压力传感器量程
Calibrate Pressure
压力传感器校准
Position Sensor
位置传感器
..Exit Pos. Sensor
退出位置传感器
Pos. Sens. En.
位置传感器
Pos. Signal
位置传感器值
Pos. Op. Mode
位置传感器作用模式
Calibrate Position
位置传感器校准
..Exit Calibration
退出位置传感器校准
Start 0 mA Calibration
开始校准0 mA
Start 4 mA Calibration
开始校准4 mA
Start 20 mA Calibration
开始校准20 mA
Factory Settings
出厂设置
Digital Outputs
数字输出DO设置
..Exit Digital Outputs
退出数字输出设置
DO1
DO1设置
..Exit DO1
退出DO1
DO1 Function
DO1功能
DO1 Op. Mode
DO1动作
DO1 Status
DO1状态
DO2
DO2设置
..Exit DO2
退出DO2
DO2 Function
DO2功能
DO2 Op. Mode
DO2动作
DO2 Status
DO2状态

	DO3 DO3设置	**..Exit DO3** 退出DO3
		DO3 Function DO3功能
		DO3 Op. Mode DO3动作
		DO3 Status DO3状态
	DO4 DO4设置	**..Exit DO4** 退出DO4
		DO4 Function DO4功能
		DO4 Op. Mode DO4动作
		DO4 Status DO4状态
	DO5 DO5设置	**..Exit DO5** 退出DO5
		DO5 Function DO5功能
		DO5 Op. Mode DO5动作
		DO5 Status DO5状态
	DO6 DO6设置	**..Exit DO6** 退出DO6
		DO6 Function DO6功能
		DO6 Op. Mode DO6动作
		DO6 Status DO6状态
	DO7 DO7设置	**..Exit DO7** 退出DO7
		DO7 Function DO7功能
		DO7 Contact DO7触点
		DO7 Op. Mode DO7动作
		DO7 Status DO7状态
Digital Inputs 数字输入DI设置	**..Exit Digital Inputs** 退出DI	
	DI1 DI1设置	**..Exit DI1** 退出DI1
		DI1 Function DI1功能
		DI1 Act. If DI1激活
		DI1 Command DI1触发方式
		DI1 Status DI1状态


DI2
DI2设置
..Exit DI2
退出DI2
DI2 Function
DI2功能
DI2 Act. If
DI2激活
DI2 Command
DI2触发方式
DI2 Status
DI2状态
DI3
DI3设置
..Exit DI3
退出DI3
DI3 Function
DI3功能
DI3 Act. If
DI3激活
DI3 Command
DI3触发方式
DI3 Status
DI3状态
DI4
DI4设置
DI5
DI5设置
Analog Output
模拟输出AO设置
..Exit Analog Output
退出模拟输出
AO Enabled
模拟输出AO
AO Selected
AO电源选择
AO Supply
AO输出信号
AO Op. Mode
AO信号类型
AO Value
AO输出值
AO Calibration
AO校准


Interfaces
通信接口设置
..Exit Interfaces
退出通信接口
Bluetooth
蓝牙设置
..Exit Bluetooth
退出蓝牙
Blue. Enabled
蓝牙
Blue. Type
蓝牙类型
Blue. Name
蓝牙名称
Modbus
Modbus
..Exit Modbus
退出Modbus
Mod. Enabled
Modbus
Mod. Address
Modbus地址
Mod. Baud
Modbus波特率
Mod. Parity
Modbus校验
Mod. Term. Act.
Modbus激活
Reserved
保留
RS232
RS232配置
..Exit RS232
退出RS232
RS232 Enabled
RS232
RS485
RS485配置
..Exit RS485
退出RS485
RS485 Enabled
RS485
RS485 Term. Act.
RS485激活
Battery Maintenance
电池维护设置
..Exit Batt. Maint.
退出电池维护
Last Batt. Maint.
上次电池维护日期
Next Batt. Maint.
下次电池维护日期
Batt. Maint. Period
电池维护周期
Upd. Batt.Maint.Date
更新电池维护日期
Exit Update B. M.Dates
退出更新电池维护日期
Update
更新电池维护日期
Simulation Test
模拟测试
..Exit Simul.Test
退出模拟测试
T. Pr. Drop
模拟压降速率
Start Test Pres. Drop
开始压降测试
Start Test Safe Act.
开始安全动作测试


Device ID
设备铭牌
..Exit Device ID
退出设备铭牌
Device Type
设备类型
Manufacturer
制造商
Serial Number
序列号
FW Int.
接口板固件版本
FW Pro.
主板固件版本
Tag Name
位号
Date and Time
日期和时间
..Exit Date and Time
退出日期和时间
Date
日期
Time
时间
RTC Adjust
RTC调整
OPR Password
密码设置
..Exit OPR Password
退出密码设置
Change OPR PWD
设置密码
Alarms
报警
..Exit Alarms
退出报警
Alarms Status
报警状态
Alarms List
报警日志
Clear Alarms List
清除报警
Warnings
警告
..Exit Warnings
退出警告
Warnings Status
警告状态
Warnings List
警告日志
Clear Warnings List
清除警告
Events
事件记录
...Exit Events
退出事件记录
Events Stored
事件记录数
Event ID
事件编号
Event Info
事件内容
Mem. Circular
循环保存
Memory 90%
90%容量警告
Clear Warnings List
清除警告
Language
语言

7.4.2 Push-buttons Functionality

Two push-buttons “DOWN”, “UP” are used:

- to move into the Menus and the Sub-Menus
- to change the value of a selected parameter

The Menus and Sub-Menus are not “circular” so the “UP” push-button has no effect when pressed on the first entry of a Menu or of a Sub-Menu and the “DOWN” push-button has no effect when pressed on the last entry of a Menu or of a Sub-menu.

The “ENTER” push-button is used:

- to enter and exit the Menus and the Sub-menus
  (pressed on Menus and Sub-Menus and on Exits of Menus and Sub-Menus)
- to select a parameter
  (pressed the first time on Parameter)
- to set the value of a parameter
  (pressed on Parameter (value) after setting the new value)
- to launch a command
  (pressed on Command)

After pressing the “ENTER” push-button to set a parameter (even if the value is not changed) the current position into the Setup and View Mode Menus goes to the “nearer” Exit of Menu and Sub-Menu.

Section 8: Modbus RTU Interface

8.1 Modbus Standard References

MODBUS over serial line specification and implementation guide V1.0.
Available from www.modbus.org/specs.php.

MODBUS application protocol specification V1.1b.
Available from www.modbus.org/specs.php.

8.2 Modbus Communication Features

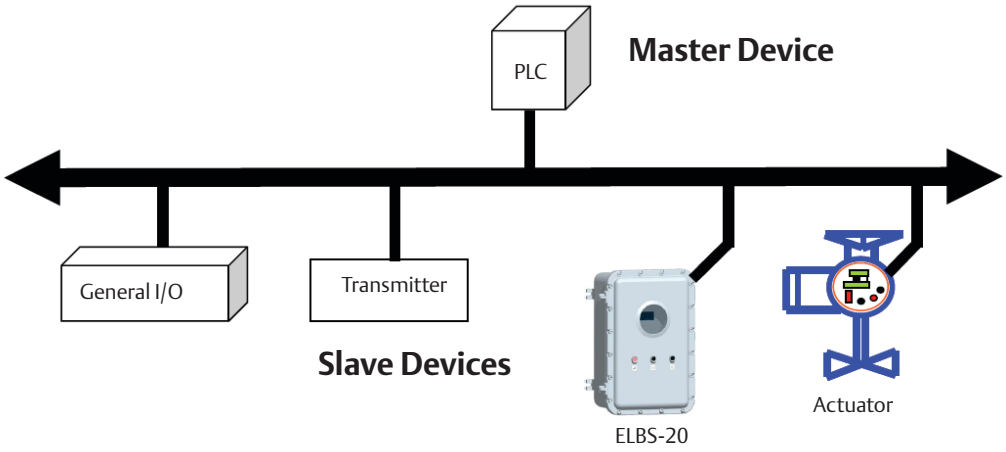
Communication Protocol	: Modbus RTU.
Transmission Technology	: RS-485 (isolated) half duplex.
Network Topology	: Line (bus) structure.
Transmission Medium	: Twisted pair + reference signal, screened copper cable.
Data Rate	: 600 1200 2400 4800 9600 19200 38400 bit/s
Device Number	: Max. 32 devices per segment. If more than 32 devices are present on the Bus, repeaters should be used.
Slave Address	: From 1 to 247 (address 0 reserved for broadcast messages), configurable via local operator interface or serial interfaces.
Bus Access	: Polling between masters and slaves.
Electrical Power	: ELBS-20 powered (only when External Power Supply is applied).
Bus Termination	: Configurable via local operator interface or serial interfaces.
Temperature	: ELBS-20 temperature range
EMC Protections	: ELBS-20 EMC protection
Baud Rate	: Configurable via local operator interface or serial interfaces
Addressing	: Configurable via local operator interface or serial interfaces
Parity	: Configurable via local operator interface or serial interfaces
Bits per byte	: 1 Start bit 8 Data bits, least significant bit sent first 1 Bit for Even/Odd parity; no bit for no parity; 1 Stop bit with parity; 2 Stop bits without parity
Error Check Field	: Cyclical Redundancy Check (CRC)

8.3 Modbus Wirings

The maximum number of master and slave devices in a bus segment is 32 without repeaters. The maximum cable length depends on the speed of transmission. Higher is the speed shorter should be the cable length.

The figure below shows a MODBUS RTU configuration with 1 master device and different slave devices.

Figure 17



8.3.1 Modbus RS485 Transmission Mode

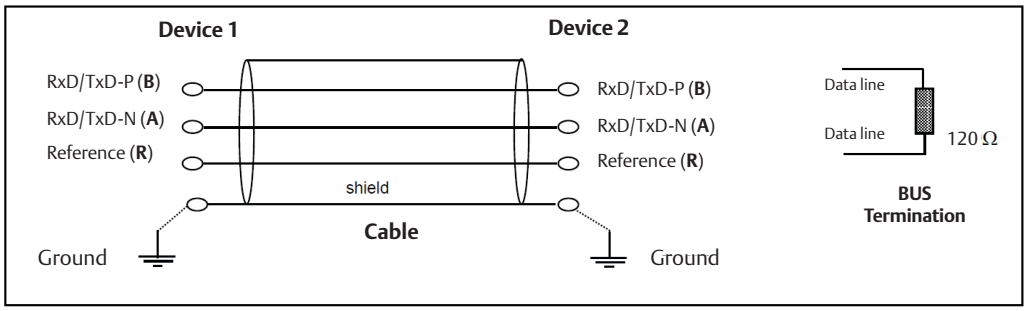
The ELBS-20 Modbus RTU module uses a half-duplex, multidrop, serial communication line RS485. The module communicates with the masters via RS485 interface.
Transmission speed from 600 bit/sec to 38400 bit/sec is available. One unique transmission speed is allowed for all devices on the bus when the system works.

All devices are connected in a bus structure. Up to 32 stations (master and slaves) can be connected in one segment. Repeaters should be used to extend the number of devices on one bus. Addresses range is from 1 to 247. Address 0 is reserved for broadcast messages.

The bus must be terminated by a resistor of 120 Ω at the beginning and at the end of each segment. Only two terminations in one bus segment must be provided. To ensure error-free operation, and to increase driving capability, pull-up and pull-down resistors should be provided on the termination network. The maximum cable length depends on the transmission speed.

The data lines must not be reversed. To avoid polarity inversion, it is suggested to use different colors for each data line. Use of shielded cable is mandatory for having high system immunity against electromagnetic disturbs. The data lines should be kept separate from all other cables. It should be laid in separate, conductive and earthed cable trunking. It must be ensured that there is not voltage difference between individual nodes of bus.

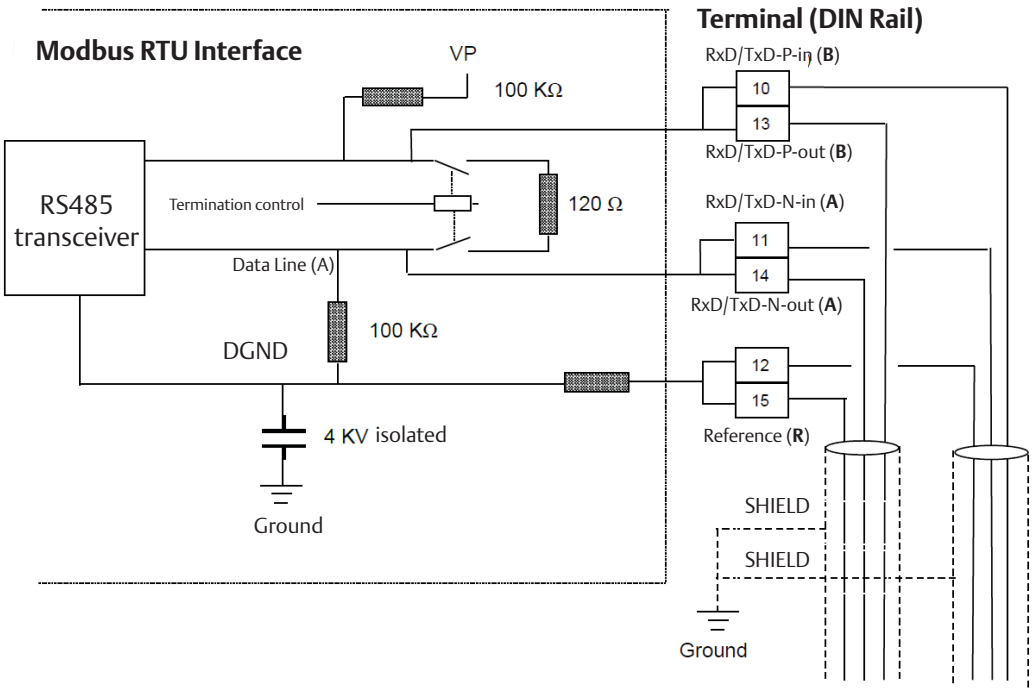
Figure 18



The Modbus RTU interface takes its electrical supply from the ELBS-20 power supply. The RS485 bus transceiver is isolated from the “other” electronics. The bus termination, located inside the device, should be used only if the device is at the beginning or at the end of the bus segment and if there is no external termination.

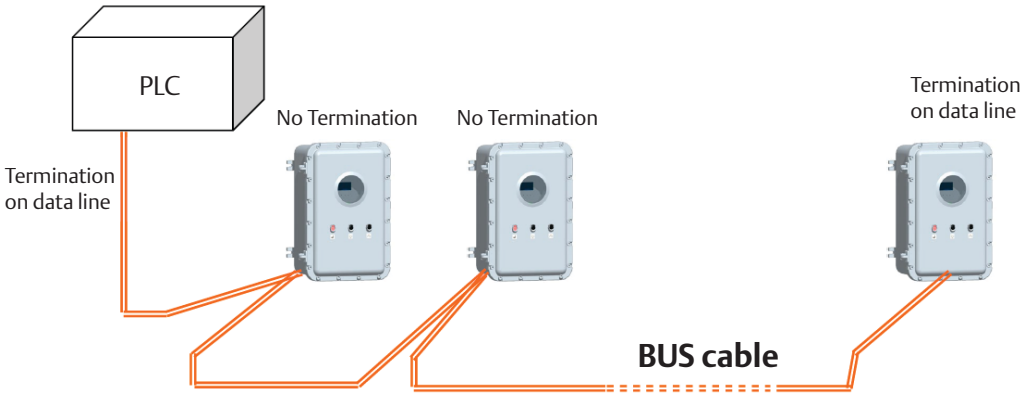
The figure below shows the MODBUS wiring.

Figure 19



The figure below shows the bus with an ELBS-20 at the end of the bus segment.

Figure 20



8.4 Modbus Function Description

The following paragraph describes the input and output messages of ELBS-20 Modbus RTU Interface. In all cases it is called “input signal” a data flowing from the ELBS-20 to the bus, vice versa it is called “output signal” a data flowing from the bus to the ELBS-20.

The following functions are supported by ELBS-20 Modbus RTU Interface:

Table 11.

Function Code	Modbus Name
03	Read Holding Registers
06	Preset Single Register
16 (10 Hex)	Preset Multiple Registers

For the full list of the Holding Register of the ELBS-20 see Section 8.5.

8.4.1 Function Code 03 (0x03) Read Holding Registers

- **References 4x**

This function code is used to read the contents of a contiguous block of holding registers (from 1 to 125) in a slave device.

The ELBS-20 Modbus RTU Interface has implemented 315 holding registers.

If quantity of registers requested is less than 1 or more than 125, Exception Code 03 (0x03) is generated.

If the combination of the starting address and the quantity of registers requested is more than 314, Exception Code 02 (0x02) is generated.

If an error occurs while the slave device is performing the action requested in the query, Exception Code 04 (0x04) is generated.

Broadcast messages are not allowed.

The Pressure and the Position values are not updated during the execution of the Safety Action.

Example of a request to read Holding Registers with address 0 -1 from device 13:

Table 12. Request

Field Name	Value (HEX)
Address	0D
Function Code	03
Start address Hi	00
Start address Lo	00
Quantity of Register Hi	00
Quantity of Register Lo	02
CRC	-

Table 13. Response

Field Name	Value (HEX)
Address	0D
Function Code	03
Byte Count	04
Holding Register 0 Value Hi	-
Holding Register 0 Value Low	-
Holding Register 1 Value Hi	-
Holding Register 1 Value Low	-
CRC	-

8.4.2 Function Code 06 (0x06) Write Single Register

- **References 4x**

This function code is used to write a value of a single holding register in a remote device.

The ELBS-20 Modbus RTU Interface has implemented 315 holding registers.

If address of register is more than 314, Exception Code 02 (0x02) is generated.

If value of register is out of range (see Section 8.5 for details), Exception Code 03 (0x03) is generated.

If an error occurs while the slave device is performing the action requested in the query, Exception Code 04 (0x04) is generated.

Only read register discharges new value without generating Exception Codes.

Broadcast messages are allowed, no response is generated after a broadcast request.

Example of a request to write Holding Register with address 0 in the field device 15:

Table 14. Request

Field Name	Value (HEX)
Address	0F
Function Code	06
Register address Hi	00
Register address Lo	00
Register Value Hi	00
Register Value Lo	02
CRC	-

Table 15. Response

Field Name	Value (HEX)
Address	0F
Function Code	06
Register Address Hi	00
Register Address Lo	00
Register Value Hi	00
Register Value Lo	02
CRC	-

8.4.3 Function Code 16 (0x10) Write Multiple Registers

This function code is used to write a block of contiguous registers in a slave device. The ELBS-20 Modbus RTU Interface has implemented 315 Holding Registers.

If quantity of registers is less than 1 or more than 125, Exception code 03 (0x03) is generated.

Exception Code 03 (0x03) is also generated if byte count field is not twice of the value of quantity of registers.

If starting address or its combination with quantity of registers is more than 314, Exception Code 02 (0x02) is generated.

If an error occurs while the slave device is performing the action requested in the query, Exception Code 04 (0x04) is generated.

Only read register discharges new value without generating Exception Codes.

Broadcast messages are allowed, no response is generated after a broadcast request.

Example of a request to write holding registers with address 0 – 3 to device 2:

Table 16. Request

Field Name	Value (HEX)
Address	02
Function Code	10
Starting Address Hi	00
Starting Address Lo	00
Quantity of Registers Hi	00
Quantity of Registers Lo	03
Byte Count	06
Register Value Hi (address 0)	00
Register Value Lo (address 0)	04
Register Value Hi (address 1)	01
Register Value Lo (address 1)	F4
Register Value Hi (address 2)	00
Register Value Lo (address 2)	0A
CRC	-

Table 17. Response

Field Name	Value (HEX)
Address	02
Function Code	10
Starting Address Hi	00
Starting Address Lo	00
Quantity of Registers Hi	00
Quantity of Registers Lo	03
CRC	-

8.4.4 Function Code 72 (0x48) Read Event Data

This function code is used to read the stored event data of the ELBS-20.

If an error occurs while the slave device is performing the action requested in the query or if the requested "Event ID" is not available (less than 1 or greater than 1000), Exception Code 03 (0x03) is generated. Broadcast messages are not allowed.

The ELBS-20 stores up to 1000 event data. Each event is composed 115 samples (2 bytes per sample) for each applied sensor (Pressure and optionally Position).

Only one sample out of two is sent on the Modbus interface so it must be considered the time between two data is calculated as follows:

Time between 2 data = sampling rate * 2;

The ELBS-20 Modbus Interface allows reading only the samples of one sensor (Pressure or Position) per time.

The Following table lists the fields that must be used for Read Data Event Query:

Table 18.

Field Name	Bytes	Range Value	Description
Event ID	2	1-1000	It identifies the events: 1 = last event "Stored Events" = oldest event
Sensor Type	1	0, 1	0: Pressure Sensor 1: Position Sensor

The following table lists the fields that are returned in a Read Data Event Response:

Table 19.

Field Name	Bytes	Range Value	Description
Event ID	2	1-1000	It identifies the events: 1 = last event "Stored Events" = oldest event
Sensor Type	1	0-1	0: Pressure Sensor 1: Position Sensor
Event Type	1	1-6	1 - pressure value decreases of a pre-set amount - EVENT 1 2- pressure reaches the low value limit - EVENT 2 3- pressure value increases of a pre-set amount - EVENT 3 4- pressure reaches the high value limit- EVENT 4 5- pressure drop exceeds the pre-set speed drop data acquisition – EVENT 5 6- pressure drop exceeds the pre-set speed drop valve control – EVENT 6
Max Sensor Value	2	0 – 10000	It indicates the value of the Sensor that correspond to 20 mA. (0 = 0.0, 10000 = 1000.0) The Pressure unit is bar. The Position Unit is % (100% = fully open, 0% = fully closed).
Sample Time	2	2 - 600	It indicates the sample time between to data of a Read Data Event Response (2 = 0.2 second, 600 = 60.0 seconds).
Year	2	2000 - 3000	Year of the event occurrence.
Month	1	1-12	Month of the event occurrence.
Day	1	1-7	Day of the event occurrence (1 = Monday, 7 = Sunday).
Hour	1	0-23	Hour of the event occurrence.
Minute	1	0-59	Minute of the event occurrence.
Second	1	0-59	Second of the event occurrence.
Samples Decimal Digits	1	0-2	It indicates how many decimal digits must be considered for the value of the sample (ex. "Samples Decimal Digit" = 1 and "Sample" = 450 => Sample value = 45.0).
Samples	230	0-1000	Each sample is two bytes (High byte first).

Example of a request of Read Data Event to device 2 (ELBS-20) for “Event ID” = 5 and Sensor type = Pressure.

Table 20. Request

Field Name	Value (HEX)
Address	02
Function Code	48
Event ID	5
Sensor Type	0
CRC	-

Table 21. Response

Field Name	Value (HEX)
Address	02
Function Code	48
Byte Count	53
Slave ID	00
Run Indicator Status	00
Event ID (2 bytes)	-
Sensor Type (1 byte)	-
Event Type (1 byte)	-
Max Sensor Value (2 bytes)	-
Sample Time (2 bytes)	-
Year (2 bytes)	-
Month (1 byte)	-
Day (1 byte)	-
Hour (1 byte)	-
Minute (1 byte)	-
Second (1 byte)	-
Samples Decimal Digits (1 byte)	-
Samples (230 bytes)	-
CRC	-

8.4.5 Function Code 101 (0x65) Read Alarms and Warnings Logs

This function code is used to read the stored alarms and warnings of the ELBS-20.

If the requested “Alarms/Warnings” is not available (different from 1 or 2), Exception Code 03 (0x03) is generated. Broadcast messages are not allowed.

The ELBS-20 stores up to 50 Alarms Logs and up to 50 Warnings Logs.

The ELBS-20 Modbus Interface allows reading 25 Alarms or Warnings Logs per time.

The Following table lists the fields that must be used for Read Alarms and Warnings Logs Query:

Table 22.

Field Name	Bytes	Range Value	Description
Alarms/Warnings	1	1, 2	1 = Alarms 2 = Warnings
Log Part	1	0, 1	0 = 25 most recent 1 = 25 least recent

The following table lists the fields that are returned in a Read Data Event Response:

Table 23.

Field Name	Bytes	Range Value	Description
Alarms/Warnings	1	1, 2	1 = Alarms 2 = Warnings
Log Part	1	0, 1	0 = 25 most recent 1 = 25 least recent
Alarm ID or Warning ID #1	1	-	#1 is the most recent out of 25 See tables on the next page
Status #1	1	0,1	0 = Cleared 1 = Activated
Date and Time #1	4	-	Byte 1 = LSB Elapsed seconds from 01-Jan-2000
Alarm ID or Warning ID #2	1	-	#2 is the second most recent out of 25 See tables on the next page
Status #2	1	0,1	0 = Cleared 1 = Activated
Date and Time #2	4	-	Byte 1 = LSB Elapsed seconds from 01-Jan-2000
Alarm ID or Warning ID #25	1	-	#25 is the least recent out of 25 See tables on the next page
Status #25	1	0,1	0 = Cleared 1 = Activated
Date and Time #25	4	-	Byte 1 = LSB Elapsed seconds from 01-Jan-2000

Table 24.

Alarm Id	Alarm Type (*)
0	NONE
1	RESET
2	AI1_PR
3	CONF
4	SLEEP
5	SAEC

(*) See Section 6.4 for Details

Warning ID	Warning Type (*)
0	NONE
1	RESET
2	MEM_90
3	TEMP
4	MAINT
5	AI2_PO
6	INTER
7	V_EX_D
8	V_EX_A
9	SVC1
10	SVC2
11	RL1
12	RL2
13	BAT_D
14	BAT_A
15	FL_P
16	MR_P
17	MR_I
18	FL_I

Example of a request of Read Alarms/Warnings Log for the 25 most recent Alarms ("Alarms/Warnings" = 1 and "Log Part" = 0).

Table 25. Request

Field Name	Value (HEX)
Address	02
Function Code	65
Alarms/Warnings	1
Log Part	0
CRC	-

Table 26. Response

Field Name	Value (HEX)
Address	02
Function Code	65
Byte Count	98
Alarms/Warnings	1
Log Part	0
Alarms ID #1	3
Status #1	0
Date and Time #1	05525F17
Alarms ID #2	3
Status #2	1
Date and Time #2	5525B12
Alarms ID #25	0
Status #25	0
Date and Time #25	00000000
CRC	-

8.4.6 Exception Codes

When a master sends a request to a slave, it expects a response. The following cases may occur:

- The slave receives the request and returns the normal response.
- The slave does not receive the request and no response is returned. In this case the master waits for a certain time (timeout) and then it restarts with a new request.
- The slave receives the request but is detects a communication error (CRC). In this case the slave does not return a response; the master waits for a certain time (timeout) and then it restarts with a new request.
- The slave receives the request without communication error, but it cannot process the data. In this case the slave returns an Exception Error message that describes the error.

The ELBS-20 Modbus RTU Interface has implemented the following Exception Codes:

Table 27.

Exception Code	Name	Description
01	Illegal Function Code	The function code requested is not supported in the slave device selected.
02	Illegal Data Address	The data address contained in the request message is not allowable in the slave device, or the combination of reference number and transfer length is invalid.
03	Illegal Data Value	A value contained in the request data field is not valid for the slave device.
04	Slave Device Failure	An error occurred while the slave device was performing the action requested by the request.
06	Slave Device Busy	The slave device is busy. The master should retransmit the request later.

8.5 Holding Registers Map

See Section 6 for details about the parameters.

Table 28.

Address	Name	Range	Units	R/W	Description (for full description see Section 6)
0	Pressure	0 - 10000	bar	R	0 = 0,00
1	Reserved	0	-	R	-
2	Reserved	0	-	R	-
3	Position	0 - 1000	%	R	0 = 0,0 %
4	Temperature	-	°C	R	signed
5	Humidity	0 - 1000	%	R	0 = 0,0
6	Alarms Active	0 - 65535	-	R	Number of the active alarms
7	Warnings Active	0 - 65535	-	R	Number of the active warnings
8	Alarms Status	0 - 65535	-	R	bit: 0 = not active, 1 = active **b0** Pressure Transducer Problem **b1** Power Supply Alarm **b2** Wrong Configuration **b3** Sleep Operating Mode **b4** S.A. Electrical Circuits Alarm **b5-b15** Spare - Not Used
9	Reserved	0 - 65535	-	R	bits
10	Warnings Status	0 - 65535	-	R	bit: 0 = not active, 1 = active **b0** Event Memory 90% **b1** Temperature **b2** Battery Maintenance Required **b3** Position Transducer Problem **b4** Interface Card Problem **b5** External Power Supply Default **b6** External Power Supply Auxiliary **b7** Battery Power Supply Default **b8** Battery Power Supply Auxiliary **b9** SVC1 Circuit Problem **b10** SVC2 Circuit Problem **b11** RL1 Circuit Problem **b12** RL2 Circuit Problem **b13** Flash Process Card **b14** MRAM Process Card **b15** MRAM Interfaces Card
11	Warnings Status	0 - 65535	-	R	bit: 0 = not active, 1 = active **b0** Flash Interfaces Card **b1-b15** Spare - Not Used
12	Reserved	0 - 65535	-	R	bits
13	Date	-	-	RW	dd/mm (BCD format)
14	Date	-	-	RW	yyyy (BCD format)
15	Time	-	-	RW	00:hh (BDC format)

Address	Name	Range	Units	R/W	Description (for full description see Section 6)
16	Time	-	-	RW	mm:ss(BCD format)
17	Operating Mode	0 - 4	-	RW	0 = SLOW, 1 = VC, 2 = ACQ, 3 = VC+ACQ, 4 = SLEEP
18	Safety Action Done	0 - 2	-	R	0 = No, 1 = Yes, 2 = Active
19	Safety Action Source	0 - 3	-	R	0 = None, 1 = Dig. Input, 2 = Command, 3 = Event
20	Safety Action Date	-	-	R	dd/mm (BCD format)
21	Safety Action Date	-	-	R	yyyy (BCD format)
22	Safety Action Time	0	-	R	00:hh (BDC format)
23	Safety Action Time	0	-	R	mm:ss (BCD format)
24	Reserved - Not Used	0	-	R	-
25	Reserved - Not Used	0	-	R	-
26	Reserved - Not Used	0	-	R	-
27	Reserved - Not Used	0	-	R	-
28	Reserved - Not Used	0	-	R	-
29	Reserved - Not Used	0	-	R	-
30	Reserved - Not Used	0	-	R	-
31	Reserved - Not Used	0	-	R	-
32	Reserved - Not Used	0	-	R	-
33	Reserved - Not Used	0	-	R	-
34	Reserved - Not Used	0	-	R	-
35	Reserved - Not Used	0	-	R	-
36	Reserved - Not Used	0	-	R	-
37	Reserved - Not Used	0	-	R	-
38	Reserved - Not Used	0	-	R	-
39	Reserved - Not Used	0	-	R	-
40	Reserved - Not Used	0	-	R	-
41	Reserved - Not Used	0	-	R	-
42	Reserved - Not Used	0	-	R	-
43	Reserved - Not Used	0	-	R	-
44	Reserved - Not Used	0	-	R	-
45	Reserved - Not Used	0	-	R	-
46	Reserved - Not Used	0	-	R	-
47	Reserved - Not Used	0	-	R	-
48	Reserved - Not Used	0	-	R	-
49	Reserved - Not Used	0	-	R	-
50	Reserved - Not Used	0	-	R	-
51	Reserved	0 - 1	-	R	-
52	Reserved	0 - 65535	-	R	-
53	High Pressure Limit	20 - 10000	bar	RW	20 = 2,0
54	Low Pressure Limit	0 - 10000	bar	RW	0 = 0,0
55	Drop Enabled	0 - 1	-	RW	0 = No, 1 = Yes
56	Valve Control Pressure Drop Rate	1 - 9999	bar/min	RW	1 = 0,1
57	Data Acquisition Pressure Drop Rate	1 - 9999	bar/min	RW	1 = 0,1
58	Pressure Increase	1 - 9999	bar/min	RW	1 = 0,1
59	Pressure Decrease	1 - 9999	bar/min	RW	1 = 0,1
60	Sampling Rate	2 - 600	sec	RW	2 = 0,2

Address	Name	Range	Units	R/W	Description (for full description see Section 6)
62	SVC Enabled	0 - 2	-	RW	0 = None, 1 = SVC1, 2 = Both
63	Relay Enabled	0 - 2	-	RW	0 = None, 1 = RL1, 2 = Both
64	Delay	0 - 500	#samples	RW	-
65	Duration	1 - 360	seconds	RW	-
66	Integrity Check SVC Enabled	0 - 1	-	RW	0 = No, 1 = Yes
67	Integrity Check SVC Time	0 - 24	Hours	RW	-
68	SVC1 Status	0 - 1	-	R	0 = Bad, 1 = Ok
69	SVC2 Status	0 - 1	-	R	0 = Bad, 1 = Ok
70	Start Manual Integrity Check SVC	0 - 1	-	RW	1 = Start
71	Integrity Check RL Enabled	0 - 1	-	RW	0 = No, 1 = Yes
72	Integrity Check RL Time	0 - 24	Hours	RW	-
73	RL1 Contacts	0 - 1	-	RW	0 = NC, 1 = NO
74	RL2 Contacts	0 - 1	-	RW	0 = NC, 1 = NO
75	RL1 Status	0 - 1	-	R	0 = Bad, 1 = Ok
76	RL2 Status	0 - 1	-	R	0 = Bad, 1 = Ok
77	Start Manual Integrity Check RL	0 - 1	-	RW	1 = Start
78	External Power Supply Applied	0 - 1	-	R	0 = No, 1 = Yes
79	External Power Supply Status Default	0 - 1	-	R	0 = Bad, 1 = Ok
80	External Power Supply Status Auxiliary	0 - 1	-	R	0 = Bad, 1 = Ok
81	Reserved	0 - 1000	-	R	-
82	Reserved	0 - 1000	-	R	-
83	Battery Pack Power Supply Applied	0 - 1	-	R	0 = No, 1 = Yes
84	Dual Battery Pack	0 - 1	-	R	0 = No, 1 = Yes
85	Battery Off Voltage	0 - 100	V	R	0 = 0,0
86	Battery On Voltage	0 - 100	V	R	0 = 0,0
87	Reserved	0 - 1	-	R	-
88	Battery Pack Status Default	0 - 1	-	R	0 = Bad, 1 = Ok
89	Voltage Battery Pack Default	0 - 1000	V	R	0 = 0,00
90	Battery Pack Status Auxiliary	0 - 1	-	R	0 = Bad, 1 = Ok
91	Voltage Battery Pack Auxiliary	0 - 1000	V	R	0 = 0,00
92	Reserved	0 - 255	-	R	-
93	Pressure Signal	0 - 1	-	RW	0 = 0 - 20 mA, 1 = 4 - 20 mA
94	Pressure Minimum	0	bar	R	0 = 0,0
95	Pressure Maximum	100 - 10000	bar	RW	100 = 10,0
96	Reserved	1 - 200	-	R	-
97	Reserved	0 - 1	-	R	-
98	Reserved	0 - 65535	-	R	-
99	Reserved	0 - 1	-	R	-
100	Reserved	0 - 65535	-	R	-

Address	Name	Range	Units	R/W	Description (for full description see Section 6)
101	Reserved	0 - 1	-	R	-
102	Reserved	0 - 65535	-	R	-
103	Reserved	0 - 1	-	R	-
104	Reserved	0 - 65535	-	R	-
105	Reserved	0 - 1	-	R	-
106	Reserved	0 - 65535	-	R	-
107	Reserved	0 - 1	-	R	-
108	Reserved	0 - 65535	-	R	-
109	Reserved	0 - 1	-	R	-
110	Reserved	0 - 1	-	R	-
111	Reserved	0 - 1	-	R	-
112	Reserved	0 - 1	-	R	-
113	Reserved	0 - 1	-	R	-
114	Reserved	0 - 1	-	R	-
115	Position Sensor Enabled	0 - 1	-	RW	0 = No, 1 = Yes
116	Position Signal	0 - 1	-	RW	0 = 0 - 20 mA, 1 = 4 - 20 mA
117	Position Operating Mode	0 - 1	-	RW	0 = Normal, 1 = Reverse
118	Reserved	1 - 200	-	R	-
119	Reserved	0 - 1	-	R	-
120	Reserved	0 - 65535	-	R	-
121	Reserved	0 - 1	-	R	-
122	Reserved	0 - 65535	-	R	-
123	Reserved	0 - 1	-	R	-
124	Reserved	0 - 65535	-	R	-
125	Reserved	0 - 1	-	R	-
126	Reserved	0 - 65535	-	R	-
127	Reserved	0 - 1	-	R	-
128	Reserved	0 - 65535	-	R	-
129	Reserved	0 - 1	-	R	-
130	Reserved	0 - 65535	-	R	-
131	Reserved	0 - 1	-	R	-
132	Reserved	0 - 1	-	R	-
133	Reserved	0 - 1	-	R	-
134	Reserved	0 - 1	-	R	-
135	Reserved	0 - 1	-	R	-
136	Reserved	0 - 1	-	R	-
137	DO1 Function	0 - 16	-	RW	0 = SOV C., 1 = S.ACT., 2 = OFF, 3 = ARMED, 4 = ALARM, 5 = ACQ., 6 = WARN., 7 = V.E.KO, 8 = V.B.KO, 9 = B.MNT., 10 = S.A.DONE, 11 = SVC KO, 12 = RL KO, 13 = HEATER (*), 14 = EVENT2, 15 = EVENT4, 16 = EVENT6.
138	Reserved	0 - 16	-	R	-
139	DO1 Operating Mode	0 - 1	-	RW	0 = Make, 1 = Break
140	DO1 Status	0 - 1	-	R	0 = Active, 1 = Not Active

Address	Name	Range	Units	R/W	Description (for full description see Section 6)
141	DO2 Function	0 - 16	-	RW	0 = SOV C., 1 = S.ACT., 2 = OFF, 3 = ARMED, 4 = ALARM, 5 = ACQ., 6 = WARN., 7 = V.E.KO, 8 = V.B.KO, 9 = B.MNT., 10 = S.A.DONE, 11 = SVC KO, 12 = RL KO, 13 = HEATER (*), 14 = EVENT2, 15 = EVENT4, 16 = EVENT6.
142	Reserved	0 - 16	-	R	-
143	DO2 Operating Mode	0 - 1	-	RW	0 = Make, 1 = Break
144	DO2 Status	0 - 1	-	R	0 = Active, 1 = Not Active
145	DO3 Function	2 - 16	-	RW	2 = OFF, 3 = ARMED, 4 = ALARM, 5 = ACQ., 6 = WARN., 7 = V.E.KO, 8 = V.B.KO, 9 = B.MNT., 10 = S.A.DONE, 11 = SVC KO, 12 = RL KO, 13 = HEATER (*), 14 = EVENT2, 15 = EVENT4, 16 = EVENT6.
146	Reserved	2 - 16	-	R	-
147	DO3 Operating Mode	0 - 1	-	RW	0 = Make, 1 = Break
148	DO3 Status	0 - 1	-	R	0 = Active, 1 = Not Active
149	DO4 Function	2 - 16	-	RW	2 = OFF, 3 = ARMED, 4 = ALARM, 5 = ACQ., 6 = WARN., 7 = V.E.KO, 8 = V.B.KO, 9 = B.MNT., 10 = S.A.DONE, 11 = SVC KO, 12 = RL KO, 13 = HEATER (*), 14 = EVENT2, 15 = EVENT4, 16 = EVENT6.
150	Reserved	2 - 16	-	R	-
151	DO4 Operating Mode	0 - 1	-	RW	0 = Make, 1 = Break
152	DO4 Status	0 - 1	-	R	0 = Active, 1 = Not Active
153	DO5 Function	2 - 16	-	RW	2 = OFF, 3 = ARMED, 4 = ALARM, 5 = ACQ., 6 = WARN., 7 = V.E.KO, 8 = V.B.KO, 9 = B.MNT., 10 = S.A.DONE, 11 = SVC KO, 12 = RL KO, 13 = HEATER (*), 14 = EVENT2, 15 = EVENT4, 16 = EVENT6.
154	Reserved	2 - 16	-	R	-
155	DO5 Operating Mode	0 - 1	-	RW	0 = Make, 1 = Break
156	DO5 Status	0 - 1	-	R	0 = Active, 1 = Not Active
157	DO6 Function	2 - 16	-	RW	2 = OFF, 3 = ARMED, 4 = ALARM, 5 = ACQ., 6 = WARN., 7 = V.E.KO, 8 = V.B.KO, 9 = B.MNT., 10 = S.A.DONE, 11 = SVC KO, 12 = RL KO, 13 = HEATER (*), 14 = EVENT2, 15 = EVENT4, 16 = EVENT6.
158	Reserved	2 - 16	-	R	-
159	DO6 Operating Mode	0 - 1	-	RW	0 = Make, 1 = Break
160	DO6 Status	0 - 1	-	R	0 = Active, 1 = Not Active
161	DO7 Function	2 - 16	-	RW	2 = OFF, 3 = ARMED, 4 = ALARM, 5 = ACQ., 6 = WARN., 7 = V.E.KO, 8 = V.B.KO, 9 = B.MNT., 10 = S.A.DONE, 11 = SVC KO, 12 = RL KO, 13 = HEATER (*), 14 = EVENT2, 15 = EVENT4, 16 = EVENT6.
162	Reserved	2 - 16	-	R	-
163	DO7 Contacts	0 - 1	-	RW	0 = NC, 1 = NO
164	DO7 Operating Mode	0 - 1	-	RW	0 = Make, 1 = Break
165	DO7 Status	0 - 1	-	R	0 = Active, 1 = Not Active

Address	Name	Range	Units	R/W	Description (for full description see Section 6)
166	DI1 Function	0 - 7	-	RW	0 = OFF, 1 = SLOW EN, 2 = S.A.C., 3 = CLR.M., 4 = VC EN, 5 = ACQ EN, 6 = I.C.SVC, 7 = I.C.RL
167	Reserved	0 - 7	-	R	-
168	DI1 Active If	0 - 1	-	RW	0 = Absent, 1 = Present
169	Reserved	0 - 1	-	R	-
170	DI1 Status	0 - 1	-	R	0 = Low, 1 = High
171	DI2 Function	0 - 7	-	RW	0 = OFF, 1 = SLOW EN, 2 = S.A.C., 3 = CLR.M., 4 = VC EN, 5 = ACQ EN, 6 = I.C.SVC, 7 = I.C.RL
172	Reserved	0 - 7	-	R	-
173	DI2 Active If	0 - 1	-	RW	0 = Absent, 1 = Present
174	Reserved	0 - 1	-	R	-
175	DI2 Status	0 - 1	-	R	0 = Low, 1 = High
176	DI3 Function	0 - 7	-	RW	0 = OFF, 1 = SLOW EN, 2 = S.A.C., 3 = CLR.M., 4 = VC EN, 5 = ACQ EN, 6 = I.C.SVC, 7 = I.C.RL
177	Reserved	0 - 7	-	R	-
178	DI3 Active If	0 - 1	-	RW	0 = Absent, 1 = Present
179	Reserved	0 - 1	-	R	-
180	DI3 Status	0 - 1	-	R	0 = Low, 1 = High
181	Reserved	0 - 7	-	R	-
182	Reserved	0 - 7	-	R	-
183	Reserved	0 - 1	-	R	-
184	Reserved	0 - 1	-	R	-
185	Reserved	0 - 1	-	R	-
186	Reserved	0 - 7	-	R	-
187	Reserved	0 - 7	-	R	-
188	Reserved	0 - 1	-	R	-
189	Reserved	0 - 1	-	R	-
190	Reserved	0 - 1	-	R	-
191	Analog Output Enabled	0 - 1	-	RW	0 = No, 1 = Yes
192	Analog Output Selected	0 - 1	-	RW	0 = Position, 1 = Pressure
193	Analog Output Supply	0 - 1	-	RW	0 = Internal, 1 = External
194	Analog Output Operating Mode	0 - 1	-	RW	0 = Normal, 1 = Reverse
195	Analog Output Value	0 - 2000	mA	R	0 = 0,00
196	Reserved	0 - 4095	-	R	-
197	Reserved	0 - 4095	-	R	-
198	Bluetooth Enabled	0 - 1	-	RW	0 = No, 1 = Yes
199	Bluetooth Type	0 - 1	-	R	0 = Short, 1 = Long
200	Bluetooth Name		-	R	Bluetooth Name (MSB)
201	Bluetooth Name		-	R	-
202	Bluetooth Name		-	R	-
203	Bluetooth Name		-	R	-
204	Bluetooth Name		-	R	-
205	Bluetooth Name		-	R	Bluetooth Name (LSB)
206	RS232 Enabled	0 - 1	-	RW	0 = No, 1 = Yes
207	RS485 Enabled	0 - 1	-	RW	0 = No, 1 = Yes
208	RS485 Termination Active	0 - 1	-	RW	0 = No, 1 = Yes
209	Modbus Enabled	0 - 1	-	R	0 = No, 1 = Yes
210	Modbus Address	1-247	-	R	-

Address	Name	Range	Units	R/W	Description (for full description see Section 6)
211	Modbus Baud Rate	0 - 6	-	R	0= 600 bps, 1= 1200 bps, 2 = 2400 bps, 3 = 4800 bps, 4 = 9600 bps, 5 = 19200 bps, 6 = 38400 bps
212	Modbus Parity	0 - 2	-	R	0 = Odd, 1 = Even, 2 = None
213	Modbus Termination Active	0 - 1	-	R	0 = No, 1 = Yes
214	Reserved	0 - 65535	-	R	-
215	Reserved	0 - 65535	-	R	-
216	Reserved	0 - 65535	-	R	-
217	Reserved	0 - 65535	-	R	-
	DI2 Active If	0 - 1	-	RW	0 = Absent, 1 = Present
218	Reserved	0 - 65535	-	R	
	DI2 Status	0 - 1	-	R	0 = Low, 1 = High
219	Reserved	0 - 65535	-	R	-
	Reserved	0 - 7	-	R	-
220	Last Battery Maintenance Date	-	-	R	dd/mm (BCD format)
221	Last Battery Maintenance Date	-	-	R	yyyy (BCD format)
222	Next Battery Maintenance Date	-	-	R	dd/mm (BCD format)
223	Next Battery Maintenance Date	-	-	R	yyyy (BCD format)
224	Battery Maintenance Period	1 - 5	Years	RW	-
225	Reserved	0 - 1	-	R	-
226	Reserved	2 - 2000		R	-
227	Reserved	0 - 1	-	R	-
228	Start Test Safety Action	0 - 1	-	RW	0 = No, 1 = Start
229	Device Type	0 - 1	-	R	0 = ELBS-20, 1 = ELBS-30
230	Manufacturer	0	-	R	0 = Biffi
231	Serial Number	ASCII	-	R	Serial Number (MSB)
232	Serial Number	ASCII	-	R	-
233	Serial Number	ASCII	-	R	-
234	Serial Number	ASCII	-	R	-
235	Serial Number	ASCII	-	R	-
236	Serial Number	ASCII	-	R	-
237	Serial Number	ASCII	-	R	-
238	Serial Number	ASCII	-	R	Serial Number (LSB)
239	FW Interface	ASCII	-	R	FW Interfaces Card (MSB)
240	FW Interface	ASCII	-	R	FW
241	FW Interface	ASCII	-	R	FW
242	FW Interface	ASCII	-	R	FW Interfaces Card (LSB)
243	FW Process	ASCII	-	R	FW Process Card (MSB)
244	FW Process	ASCII	-	R	FW
245	FW Process	ASCII	-	R	FW
246	FW Process	ASCII	-	R	FW Process Card (LSB)
247	Tag Name	ASCII	-	R	Tag Name (MSB)
248	Tag Name	ASCII	-	R	-
249	Tag Name	ASCII	-	R	-
250	Tag Name	ASCII	-	R	-

Address	Name	Range	Units	R/W	Description (for full description see Section 6)
251	Tag Name	ASCII	-	R	-
252	Tag Name	ASCII	-	R	-
253	Tag Name	ASCII	-	R	-
254	Tag Name	ASCII	-	R	Tag Name (LSB)
255	Reserved - Not Used	0	-	R	-
256	Reserved - Not Used	0	-	R	-
257	Reserved - Not Used	0	-	R	-
258	Reserved - Not Used	0	-	R	-
259	Reserved - Not Used	0	-	R	-
260	Reserved - Not Used	0	-	R	-
261	Reserved - Not Used	0	-	R	-
262	Reserved - Not Used	0	-	R	-
263	Reserved - Not Used	0	-	R	-
264	Reserved - Not Used	0	-	R	-
265	Reserved - Not Used	0	-	R	-
266	Reserved - Not Used	0	-	R	-
267	Reserved - Not Used	0	-	R	-
268	Reserved - Not Used	0	-	R	-
269	Reserved - Not Used	0	-	R	-
270	Reserved - Not Used	0	-	R	-
271	Reserved - Not Used	0	-	R	-
272	Reserved - Not Used	0	-	R	-
273	Reserved - Not Used	0	-	R	-
274	Reserved - Not Used	0	-	R	-
275	Reserved - Not Used	0	-	R	-
276	Reserved - Not Used	0	-	R	-
277	Reserved - Not Used	0	-	R	-
278	Reserved - Not Used	0	-	R	-
279	Reserved - Not Used	0	-	R	-
280	Reserved - Not Used	0	-	R	-
281	Reserved - Not Used	0	-	R	-
282	Events Stored	0 - 1000	-	R	-
283	Reserved	0 - 1000	-	R	-
284	Event ID	1 - 1000	-	RW	-
285	Event Info - Type	0 - 6	-	R	0 = NONE, 1 = EVENT1, 2 = EVENT2, 3 = EVENT3, 4 = EVENT4, 5 = EVENT5, 6 = EVENT6
286	Event Info - Date	-	-	R	dd/mm (BCD format)
287	Event Info - Date	-	-	R	yyyy (BCD format)
288	Event Info - Time	-	-	R	00:hh (BDC format)
289	Event Info - Time	-	-	R	mm:ss (BCD format)
290	Memory Circular	0 - 1	-	RW	0 = No, 1 = Yes
291	Memory Alarm 90%	0 - 1	-	RW	0 = Off, 1 = On
292	Clear Events Memory	0 - 1	-	W	0 = Null, 1 = Clear
293	Alarm Info - ID	1 - 50	-	RW	Select a Number between 1 to Alarms Active (register # 6).
294	Alarm Info - Type	0 - 6	-	R	0 = NONE, 1 = RESET, 2 = AI1_PR, 3 = POW_S, 4 = CONF, 5 = SLEEP, 6 = SAEC
295	Alarm Info – Activated/Cleared	0 - 1	-	R	0 = Cleared, 1 = Activate

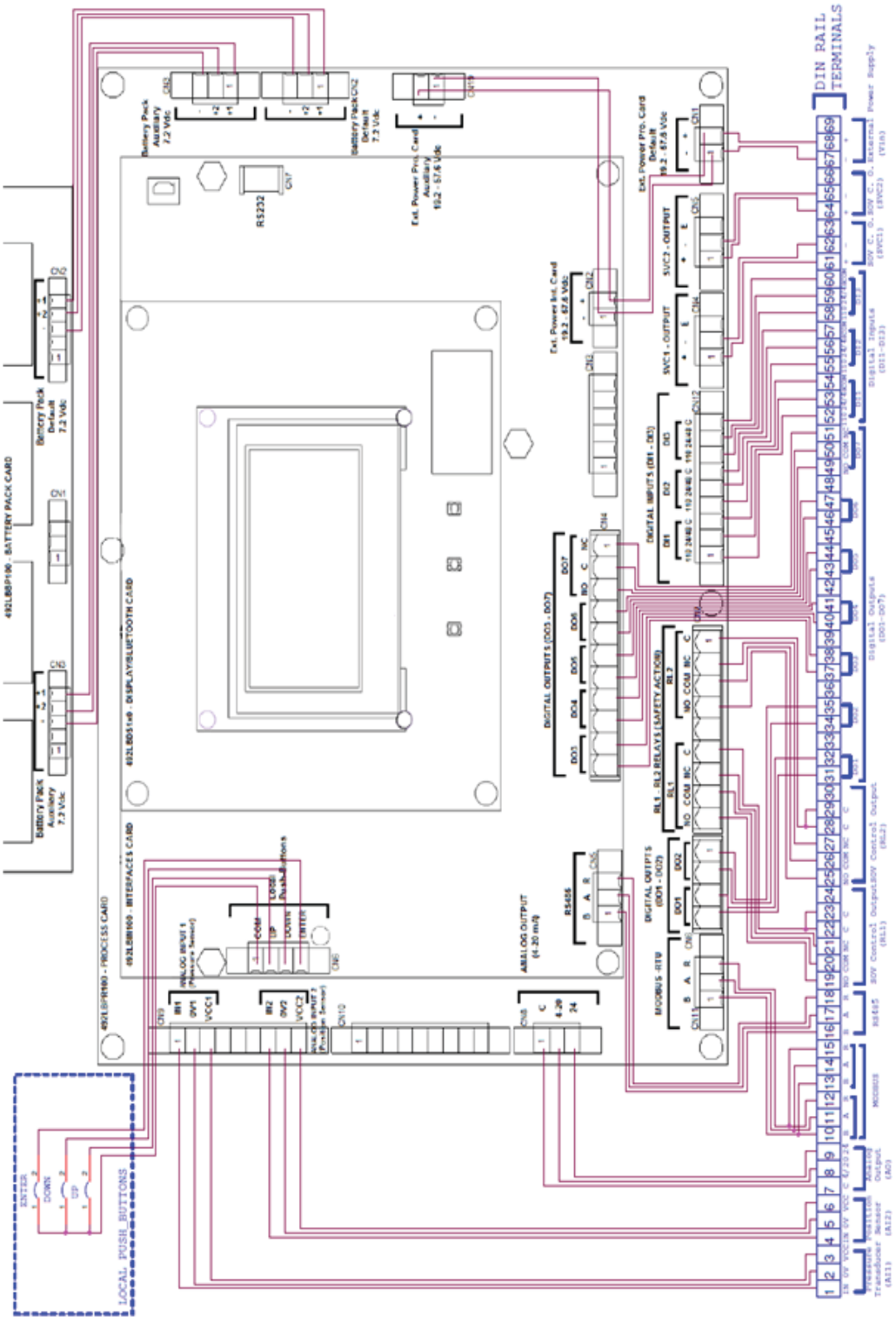
Address	Name	Range	Units	R/W	Description (for full description see Section 6)
296	Alarm Info - Date	-	-	R	dd/mm (BCD format)
297	Alarm Info - Date	-	-	R	yyyy (BCD format)
298	Alarm Info - Time	-	-	R	00:hh (BDC format)
299	Alarm Info - Time	-	-	R	mm:ss (BCD format)
300	Clear Alarms List	0 – 1	-	W	0 = Null, 1 = Clear
301	Warning Info - ID	1 – 50	-	RW	Select a Number between 1 to Warnings Active (register # 7).
302	Warning Info - Type	0 – 17	-	R	0 = NONE, 1 = RESET, 2 = MEM90, 3 = TEMP, 4 = MAINT, 5 = AI2_PO, 6 = INTER, 7 = V_EX_D, 8 = V_EX_A, 9 = SVC1, 10 = SVC2, 11 = RL1, 12 = RL2, 13 = BAT_D, 14 = BAT_A, 15 = FL_P, 16 = MR_P, 17 = MR_I, 18 = FL_I
303	Warning Info – Activated/Cleared	0 - 1	-	R	0 = Cleared, 1 = Activate
304	Warning Info - Date	-	-	R	dd/mm (BCD format)
305	Warning Info - Date	-	-	R	yyyy (BCD format)
306	Warning Info - Time	-	-	R	00:hh (BDC format)
307	Warning Info - Time	-	-	R	mm:ss (BCD format)
308	Clear Warnings List	0 - 1	-	W	0 = Null, 1 = Clear
309	Reserved	0 - 1	-	R	-
310	Reserved	0 - 1	-	R	-
311	Reserved	0 - 1	-	R	-
312	Reserved	0 - 1	-	R	-
313	Reserved	0 - 1	-	R	-
314	Reserved	0 - 1	-	R	-

NOTE:
(*): The value “13” can be set only to the “DO7 Function” Holding Register. If the value “13” has been sent to other “DOx Function” Holding Registers, the value is discarded and the previous one is restored.

Section 9: Typical Connections

9.1 Signals Description

Figure 21



The previous figure shows the typical “internal” wiring diagram of the ELBS-20 (connection with DIN RAIL Terminals, Battery Pack Card and Local Push-Buttons).

The following table describes the “standard” signals on the DIN RAIL Terminals that are the ones available for the customers’ connections.

This Table is valid for the “standard” configuration of the ELBS-20, without any additional part (AC/DC converter, Surge Suppressor, etc.).

For configuration different from the “standard” one, refer to the specific wiring diagram provided by Biffi.

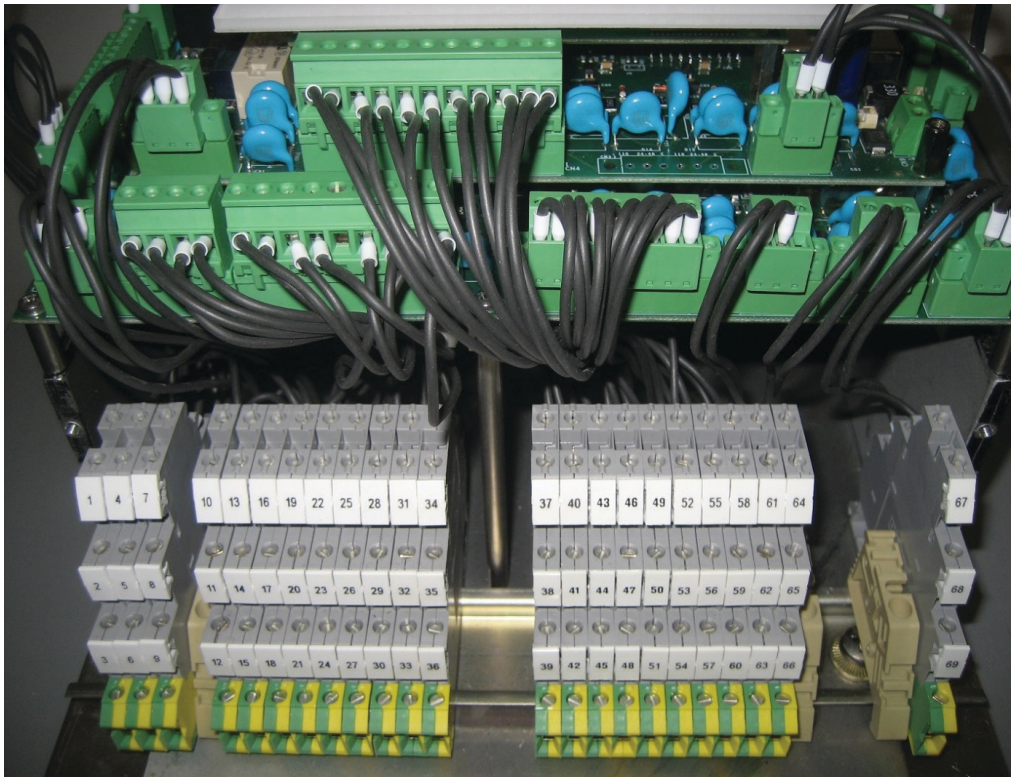
Table 29.

Type	No.	Signal Name	Description
Pressure Transducer (AI1)	1	AI1-IN	Input for the Pressure Sensor 0 - 20 mA or 4 - 20 mA Output. See Section 5.2.6 for details
	2	AI1-0 V	0V/GND for the 3-wires Pressure Sensors. Section See Section 5.2.6 for details.
	3	AI1-VCC	14.5 V DC Output for the Pressure Sensor. Section See Section 5.2.6 for details.
Position Sensor (AI2)	4	AI2-IN	Input for the Position Sensor 0 - 20 mA or 4 - 20 mA Output. See Section 5.2.7 for details.
	5	AI2-0 V	0 V/GND for the 3-wires Position Sensors. See Section 5.2.7 for details.
	6	AI2-VCC	14.5 V DC Output for the Position Sensor. See Section 5.2.7 for details.
MODBUS	10, 13	MODBUS-B	Modbus data line B (+). See Section 8 for details.
	11, 14	MODBUS-A	Modbus data line A (-). See Section 8 for details.
	12, 15	MODBUS-R	Modbus Reference line. See Section 8 for details.
RS485	16	RS485-B	RS485 data line B (+). See Section 5.2.1 for details.
	17	RS485-A	RS485 data line A (-). See Section 5.2.1 for details.
	18	RS485-R	RS485 Reference line. See Section 5.2.1 for details.
SOV Control Output (RL1)	19	RL1-NO	Normally Open Contact of the RL1 (SOV Control Output). If used it must be connected with the power supply (+) dedicated to the SOV. See Section 5.2.8 for details.
	20	RL1-COM	This pin must be connected with the SOV (+).
	21	RL1-NC	Normally Closed Contact of the RL1 (SOV Control Output). If used it must be connected with the power supply (+) dedicated to the SOV. See Section 5.2.8 for details.
	22	RL1-C	This pin must be connected with the SOV (-). See Section 5.2.8 for details.
	23	RL1-C	This pin must be connected to the power supply (-) dedicated to the SOV. See Section 5.2.8 for details.
	24	-	Spare terminal.
SOV Control Output (RL2)	25	RL2-NO	Normally Open Contact of the RL2 (SOV Control Output). If used it must be connected with the power supply (+) dedicated to the SOV. See Section 5.2.8 for details.
	26	RL2-COM	This pin must be connected with the SOV (+).
	27	RL2-NC	Normally Closed Contact of the RL2 (SOV Control Output) If used it must be connected with the power supply (+) dedicated to the SOV. See Section 5.2.8 for details.
	28	RL2-C	This pin must be connected with the SOV (-). See Section 5.2.8 for details.
	29	RL2-C	This pin must be connected to the power supply (-) dedicated to the SOV. See Section 5.2.8 for details.
	30	-	Spare terminal.

Type	No.	Signal Name	Description
Digital Outputs (DO1-DO7)	31	DO1	Configurable relay dry contact. See Section 5.2.5 for details.
	32		
	33	-	Spare terminal.
	34	DO2	Configurable relay dry contact. See Section 5.2.5 for details.
	35		
	36	-	Spare terminal.
	37	DO3	Configurable relay dry contact. See Section 5.2.5 for details.
	38		
	39	-	Spare terminal.
	40	DO4	Configurable relay dry contact. See Section 5.2.5 for details.
	41		
	42	-	Spare terminal.
	43	DO5	Configurable relay dry contact. See Section 5.2.5 for details.
	44		
	45	-	Spare terminal.
	46	DO6	Configurable relay dry contact. See Section 5.2.5 for details.
	47		
	48	-	Spare terminal.
	49	DO7-NO	Normally Open Contact of the relay associated to DO7. DO7 is configurable. See Section 5.2.5 for details.
	50	DO7-COM	Normally Open Contact of the relay associated to DO7. DO7 is configurable. See Section 5.2.5 for details.
	51	DO7-NC	Normally Open Contact of the relay associated to DO7. DO7 is configurable. See Section 5.2.5 for details.
Digital Inputs (DI1-DI3)	52	DI1-110	Dedicated “110” Terminal of the configurable DI1 digital input. See Section 5.2.4 for details
	53	DI1-24/48	Dedicated “24/”48 Terminal of the configurable DI1 digital input. See Section 5.2.4 for details.
	54	DI1-COM	Dedicated “C” Terminal of the configurable DI1 digital input. See Section 5.2.4 for details.
	55	DI2-110	Dedicated “110” Terminal of the configurable DI2 digital input. See Section 5.2.4 for details.
	56	DI2-24/48	Dedicated “24/”48 Terminal of the configurable DI2 digital input. See Section 5.2.4 for details.
	57	DI2-COM	Dedicated “C” Terminal of the configurable DI2 digital input. See Section 5.2.4 for details.
	58	DI3-110	Dedicated “110” Terminal of the configurable DI3 digital input. See Section 5.2.4 for details.
	59	DI3-24/48	Dedicated “24/”48 Terminal of the configurable DI3 digital input. Section See 5.2.4 for details.
	60	DI3-COM	Dedicated “C” Terminal of the configurable DI3 digital input. See Section 5.2.4 for details.
SOV Control Output (SVC1)	61	+SVC1	Positive Output of SVC1 SOV Control Output. See Section 5.2.8 for details.
	62	-SVC1	Negative Output of SVC1 SOV Control Output. See Section 5.2.8 for details.
	63	-	Spare terminal.
SOV Control Output (SVC2)	64	+SVC2	Positive Output of SVC2 SOV Control Output. See Section 5.2.8 for details.
	65	-SVC2	Negative Output of SVC2 SOV Control Output. See Section 5.2.8 for details.
	66	-	Spare terminal.
External Power Supply (Vin)	67	-Vin	Negative Input of the External Power Supply. See Section 5.2.2 for details.
	68	+Vin	Negative Input of the External Power Supply. See Section 5.2.2 for details
	69	-	Spare terminal.

The picture below shows the standard layout of the ELBS-20 DIN Rail Terminals.

Figure 22



9.2 Typical Connections Example

9.2.1 Example 1 – Typical Connection

This example shows the ELBS-20 used as a “stand-alone” device.

- The ELBS-20 is not connected to any other equipment (DCS, Logic Solver, PLC, etc.).
- External Power Supply is not available and the ELBS-20 uses the Battery Pack as power supply.
- The ELBS-20 monitors the pressure of the line (external pressure transducer).
- The ELBS-20 manages a low power consumption SOV to initiate the Safety Action.

Figure 23

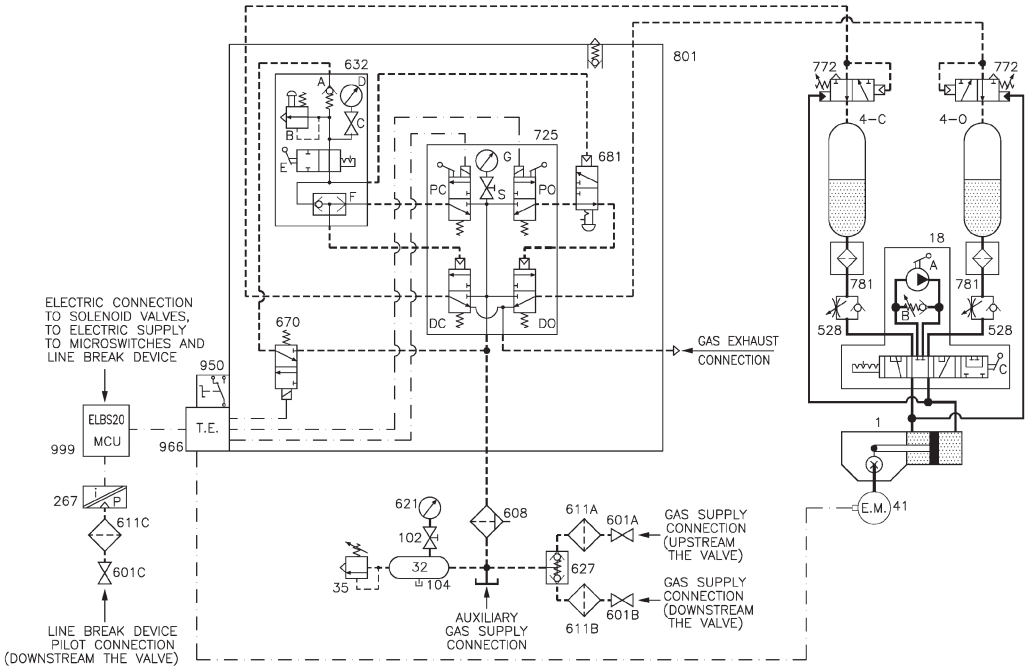
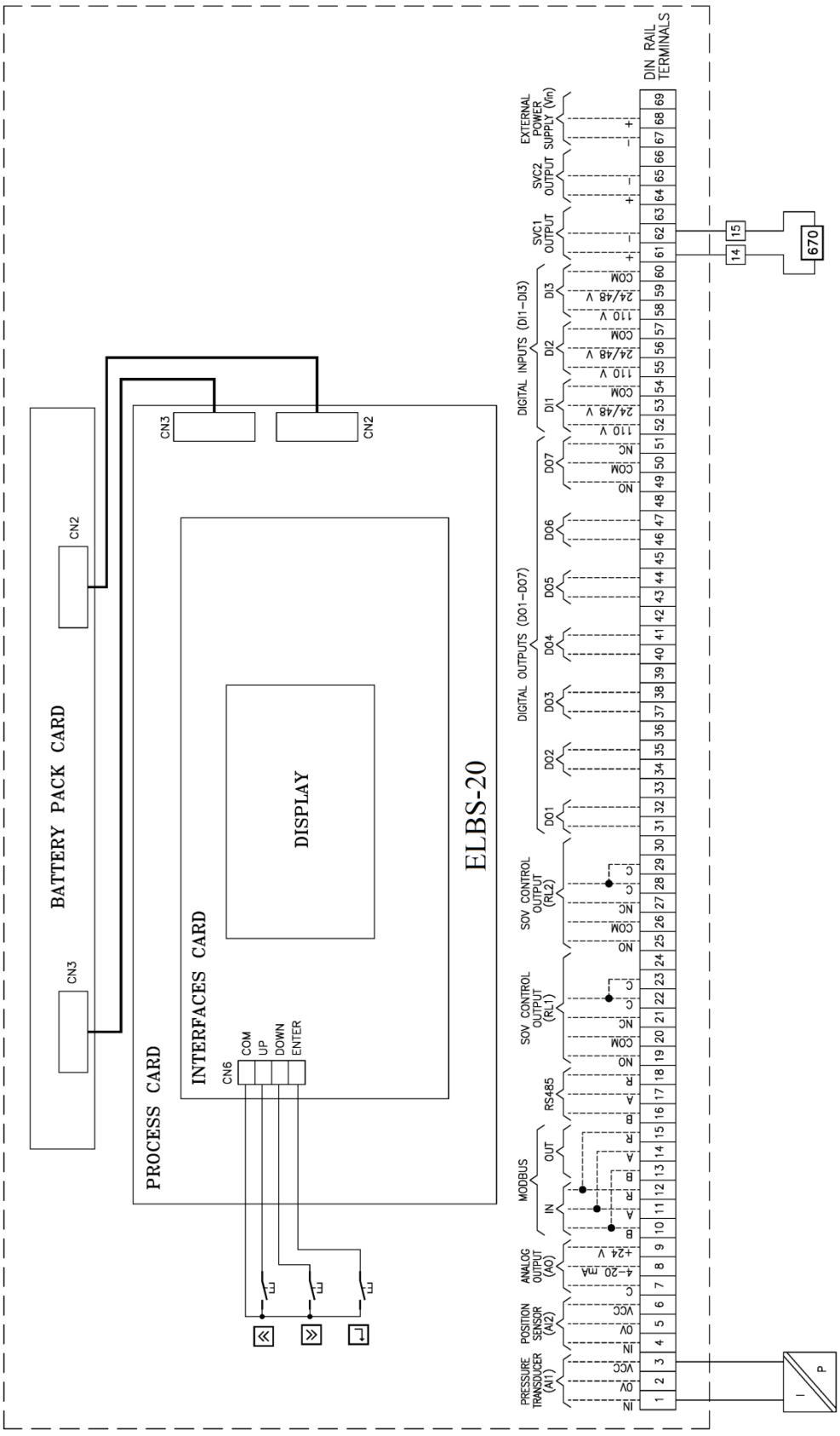


Figure 24


ELBS-20
PROCESS CARD
INTERFACES CARD
DISPLAY
BATTERY PACK CARD
CN2
CN3
CN6
COM
UP
DOWN
ENTER
DIN RAIL TERMINALS
EXTERNAL POWER SUPPLY (Vm)
SVC2 OUTPUT
SVC1 OUTPUT
DIGITAL INPUTS (DI1–DI3)
DIGITAL OUTPUTS (DO1–DO7)
SOV CONTROL OUTPUT (RL2)
SOV CONTROL OUTPUT (RL1)
RS485
MODBUS
ANALOG OUTPUT (AO)
POSITION SENSOR (AI2)
PRESSURE TRANSDUCER (AI1)
670

9.2.2 Example 2 – Typical Connection

This example shows the ELBS-20 in a remote connection application.

- The ELBS-20 is connected to another equipment (DCS, Logic Solver, PLC, etc.).
  - MODBUS
  - Digital Inputs
  - Digital Outputs
  - Analog Output
- External Power Supply is available (the Battery Pack is used as back up).
- The ELBS-20 monitors both the pressure (external pressure transducer) and the position (external position sensor).
- The ELBS-20 manages two “standard” SOVs (Relay contacts are used) to initiate the Safety Action.

Figure 25

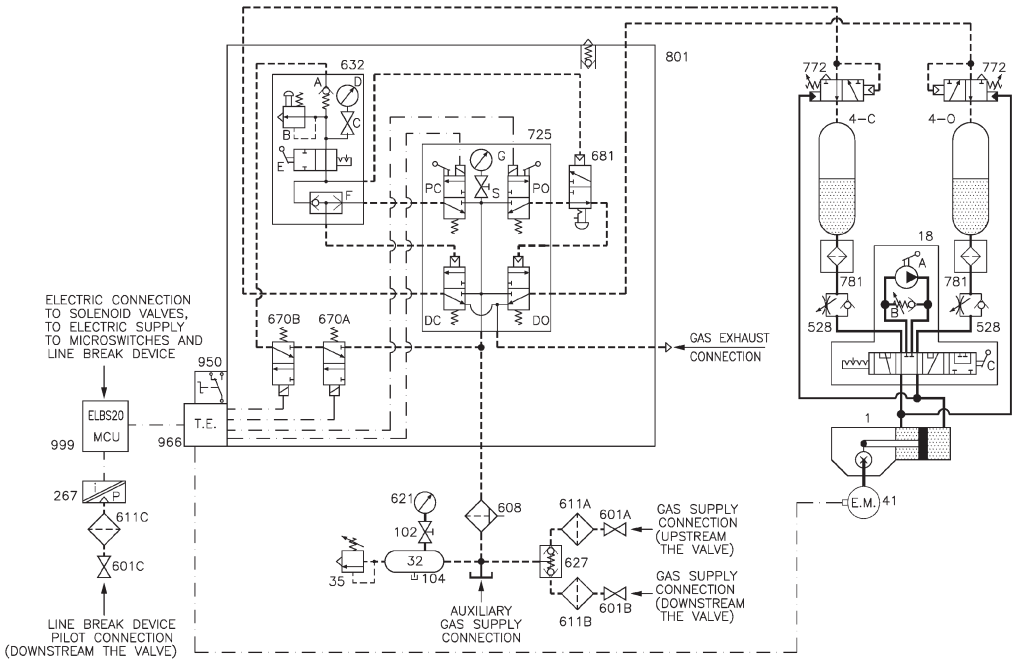
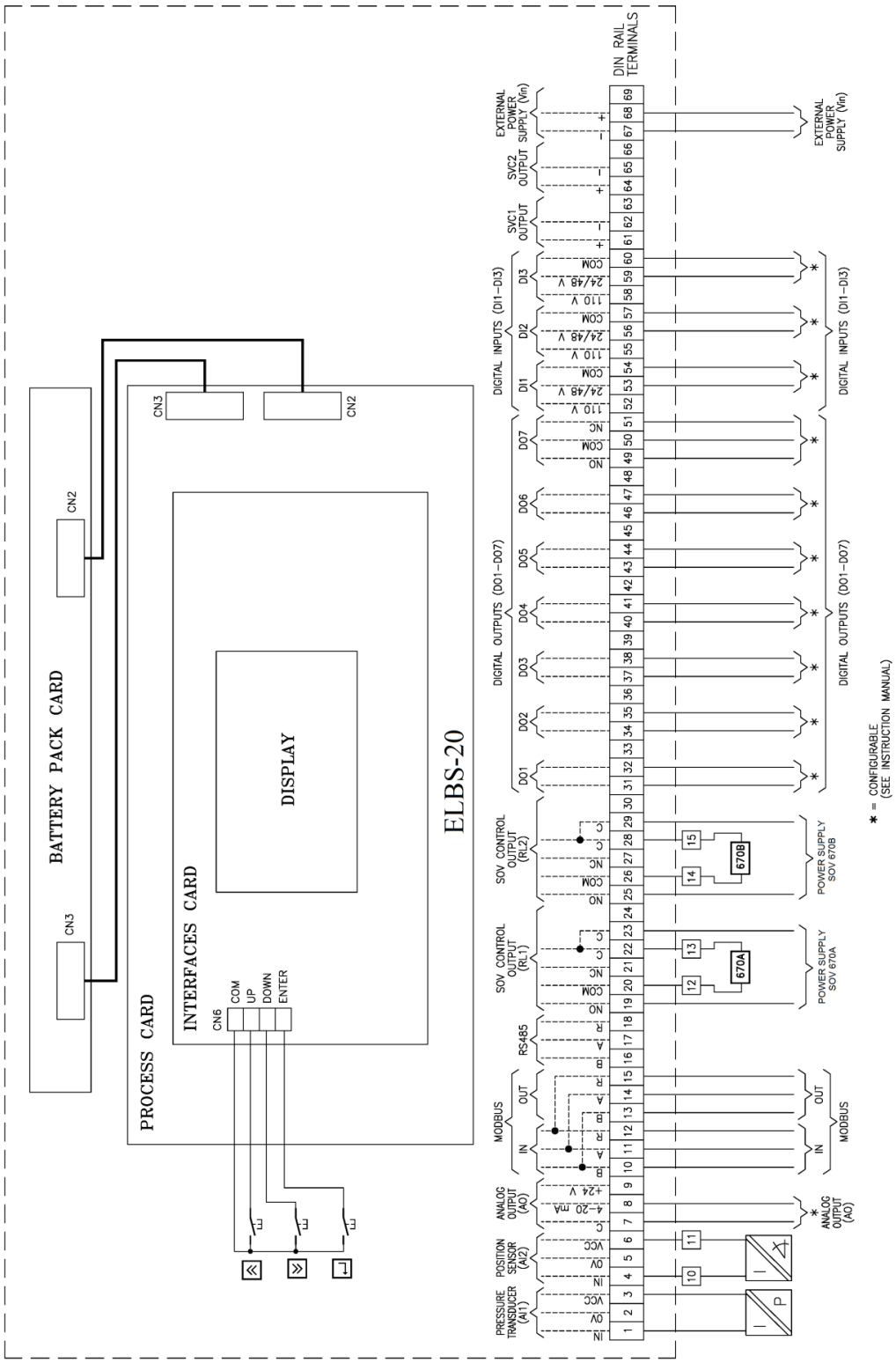


Figure 26


BATTERY PACK CARD
CN2
CN3
PROCESS CARD
CN3
CN2
INTERFACES CARD
DISPLAY
CN6
COM
UP
DOWN
ENTER
ELBS-20
DIN RAIL TERMINALS
EXTERNAL POWER SUPPLY (Vn)
SVC2 OUTPUT
SVC1 OUTPUT
DIGITAL INPUTS (DI1–DI3)
DIGITAL OUTPUTS (DO1–DO7)
SOV CONTROL OUTPUT (RL2)
SOV CONTROL OUTPUT (RL1)
POWER SUPPLY SOV 670B
POWER SUPPLY SOV 670A
RS485
MODBUS
ANALOG OUTPUT (AO)
POSITION SENSOR (AI2)
PRESSURE TRANSDUCER (AI1)
* = CONFIGURABLE (SEE INSTRUCTION MANUAL)

Section 10: Installation – Start-Up

If ordered as part of an actuator, the factory mounts the ELBS-20 device together with the actuator, makes connections (pneumatic, hydraulic and electrical) to the actuator, sets up and calibrates the instrument.

If ELBS-20 device is purchased separately, see the following instructions for mounting the ELBS-20 device.

⚠ WARNING

The ELBS-20 is not provided with specific means for lifting and transporting.
Manually move the ELBS-20 according to the effective rules of health and safety of the installation country.

⚠ WARNING

It is assumed that the installation, the setting, the commissioning, the maintenance and repair works are carried out by qualified personnel and checked by responsible specialists.

⚠ WARNING

The end user shall provide circuit-breakers and fuses in the marshalling cabinet of the control room, to switch off the Mains and any other voltage applied to ELBS-20 cabinet. Before opening the door of the ELBS-20 cabinet it is mandatory to check that any voltage (Mains or Control Voltages) is off. Breakers, fuses, differential breakers, in general any disconnecting device:

- Shall be in accordance with the local national standards and plant rules.
- Shall be sized to be in accordance to the maximum power accepted by the ELBS-20 interfaces.
- Shall be suitable located and easily reached.
- Shall be marked as the disconnecting device for the equipment.
- Shall not interrupt the protective earth conductor.

⚠ WARNING

Avoid personal injury or property damage from sudden release of process pressure or bursting of parts. Before proceeding with any Installation procedures:

- Always wear protective clothing, gloves, and eyewear to prevent personal injury.
- Personal injury or property damage may result from fire or explosion if natural gas is used as the supply medium and preventive measures are not taken. Preventive measures may include: remote venting of the unit, re-evaluating the hazardous area classification, ensuring adequate ventilation, and the removal of any ignition sources.
- Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

NOTICE

The installation must be carried out in accordance to the applicable standards IEC/EN 60079-14 and IEC/EN 60079-17 regarding the electrical installations in Hazardous Areas (other than mines) classified as Zones 1, 2 (gas) and Zones 21, 22 (dust) following IEC/EN 60079-10-1 and IEC/EN 60079-10-2 and any other applicable national standards and rules.

10.1 Installation in Ambient with Explosive Dusts

Special attention must do to these following points:

- before the assembly the joint surfaces must be greased
- the cable glands must have a protection degree at minimum IP66/68 (EN/IEC 60529)
- periodically verify the quantity of dust deposited on the enclosure and clean it in the case the quantity becoming more than 5 mm

10.2 Checks to be Performed Before Installation

⚠ WARNING

Before the installation it is mandatory to check if the nameplate associated to the extension for additional entry specifies the appropriate degree of protection and ambient temperature limits as requested by the Rules applicable to the plant/location where units are installed.

If ELBS-20 device is purchased separately, please proceed as follows before its installation:

1. The electrical supply cables must be suitable for the power rating (see the certificates delivered with the ELBS-20, if available, or the ELBS-20 nameplate);
2. Gather the necessary tools for the assembly and setting of the ELBS-20 controls;

If a long storage period has occurred, before installing the ELBS-20, please:

a. Check the installation of the plugs or cable glands on the cable entries.

b. Check whether the enclosure covers of the ELBS-20 body are cracked or broken.

c. Check the status of the Batteries.

3. Verify that the fixing elements (screws, nuts etc.) used for fastening the ELBS-20 cabinet can sustain at least four times the weight of the ELBS-20 unit;

Example: for the EJB-51 cabinet (Al) the fixing elements must be able to sustain at least 160 kg.

10.3 Battery Pack First Connection

⚠ WARNING

If the device is located in hazardous area a "hot permit" must be obtained before opening the explosion proof enclosures. Moreover, the area must be cleaned from explosive mixture since batteries and power supply could generate electrical spark and cause explosion.

Follow the procedure describes at Section 12 “Battery Maintenance”.

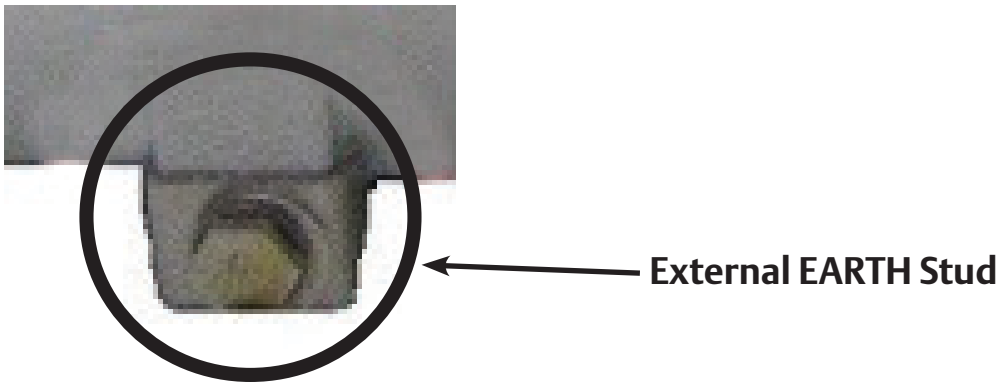
10.4 Cables and Electrical Connections

10.4.1 Cables Connection

The sealing of cables and/or conduit entries must be carried out in accordance with National Standards or the Regulatory Authorities that have certified the ELBS-20s. Method of sealing and cable glands must be approved and separately certified for use in hazardous areas.

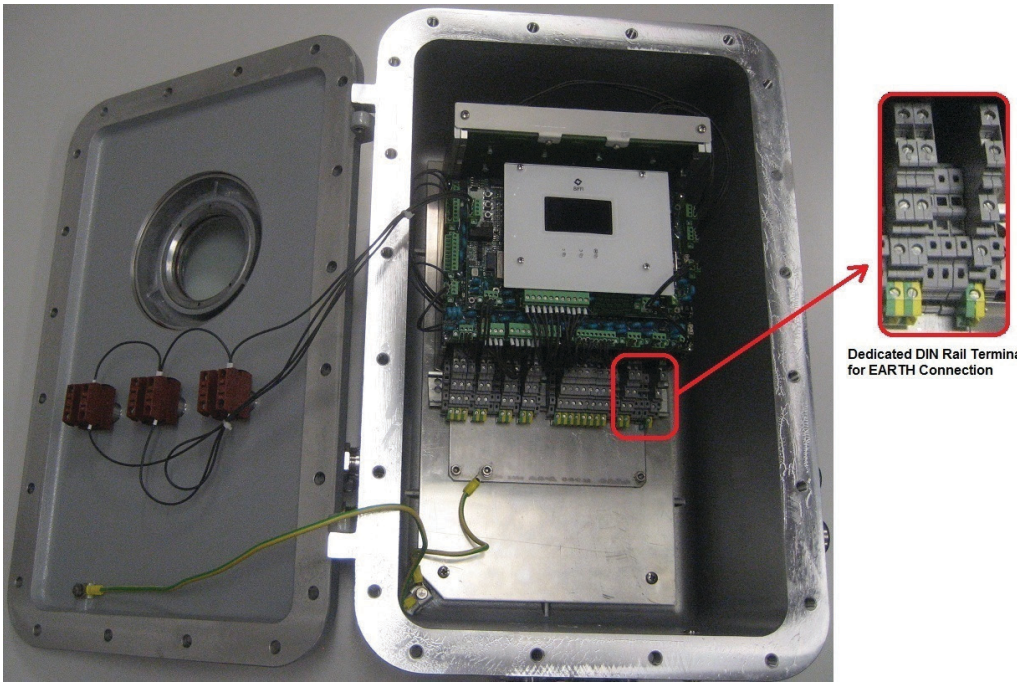
The ELBS-20 enclosure must be connected to the EARTH trough the External EARTH stud.

Figure 27



For the earth connection of the cables dedicated DIN RAIL TERMINALS are provided.

Figure 28



NOTICE

- To prevent any water infiltration through the line cable conduits, be sure the cable glands used have the minimum degree of protection required by the plant.
- If rigid conduits make the connection, we suggest placing a flexible pipe connection between the conduit and the terminal board.

To guarantee weatherproof and explosion-proof fit, screw the cable glands tightly (at least 5 turns) and block them with a thread sealant. The use of a thread sealant is necessary in case of explosion-proof capability.

If some parts of the cable glands have been removed during work on the cable entries put them back into place now to avoid losing the dismantled parts.

NOTICE

The cables MUST be selected considering the maximum Temperature of the cable indicated on the label fixed to the ELBS-20 Enclosure.

10.4.2 Cables Requirements – EMC Protection

The table below resumes the specifications of the cables, for connecting with the ELBS-20.

Particularly there is indicated if a cable needs to be armoured or shielded.

“Shielded” must be considered as a more strict condition than “Armoured”.

It is possible to use a shielded cable instead of a required armoured cable, but it is not possible to use an armoured cable instead of a required shielded cable.

Table 30.

CONNECTION TYPE	CABLES REQUIREMENT (Armoured or Shielded)
External Power Supply	None
SOV Control Outputs (SVC1 – SVC2)	Max Length 3 mt.
SOV Control Outputs (RL1 – RL2)	None
Digital Input	None
Digital Output	None
MODBUS	Shielded (see Section 8.3.1 for details).
RS485	Shielded (same connection of the MODBUS cable).
Analog Output	Shielded. Maximum Load (cable + termination resistance) = 300 ohm.
Analog Input	Shielded. Max Length 3 mt.
RS232	See [1] for details.

10.4.3 Wires Dimensions

Before making any connection with the ELBS-20 checks the electrical parameters present (voltage and current limits) on the nameplate and in this manual. All the connections are available on DIN RAIL TERMINALS; the ones with the sensors are usually at Biffi' care).

Max dimension of the wires: 2.5 mm^2 for the standard DIN Rail Terminals.

The dimension of the wires must respect the current regulations of the installation country.

10.4.4 Unused entries

⚠ WARNING

Replace the plastic plugs, install on the unused entries certified explosion-proof plugs and block with a thread sealant to guarantee the tightening. Not performing the above prescription will invalidate the safety protection in case of presence of hazardous atmospheres.

10.5 Start-up Procedure

⚠ WARNING

If the device is located in hazardous area a "hot permit" must be obtained before opening the explosion proof enclosures. Moreover, the area must be cleaned from explosive mixture since batteries and power supply could generate electrical spark and cause explosion.

In this section is described a step-by-step procedure for installing the ELBS-20.

All the points must be performed in the order they appear.

1. **Configure the SLEEP Operating Mode.** This operation must be performed before connecting the ELBS-20 (pneumatic or hydraulic and electrical connections) for avoiding that the ELBS-20 is in an operating mode that can cause a not desired Safety Action (VC or VC + ACQ).
   a. Verify that the ELBS-20 connections (hydraulic or pneumatic and electrical) do not allow to the ELBS-20 to perform the Safety Action.
   b. Apply a supply source to ELBS-20: Battery Pack (see Section 10.3) or External Power Supply.
   c. Use the Local Operator Interface for setting the SLEEP Operating Mode if it is not already set.
2. **Connect the ELBS-20 according to the Wiring Diagram.**
   a. Realize the hydraulic or pneumatic and electrical connection according to the Wiring Diagram.
3. **Configure the ELBS-20 parameters.** This operation can be performed by using the Local Operation Interface or one of the other available Interfaces of the ELBS-20 (they must be enabled by using the Local Operator Interface).

4. **Verify Pressure and Position (optional sensor) values.** This operation is performed for checking the sensors connection and that the value of the read pressure and position are aligned with the expected ones.
   a. Set the Operating Mode as SLOW. The ELBS-20 cannot perform the Safety Action, but it can read the signals of the sensors.
   b. Use one of the available interfaces for checking the value of Pressure (value between “HP Limit” and “LP Limit”) and of the Position (if the Position Sensor is present and enabled).
5. **Check the Integrity of the Safety Action Electrical Circuit.** This operation is performed for verifying the integrity of the electrical circuits dedicated to the Safety Action.
   a. If SVC1 or SVC2 are configured as SOV Control Output (“SVC_Enabled”), launch the “Start Manual I.C. SVC” command and verify the status of the selected SOV Control Output is “Ok” (“SVC1 Status” and “SVC2 Status”).
   b. If RL1 or RL2 are configured as SOV Control Output (“Relays_Enabled”), launch the “Start Manual I.C. RL” command and verify the status of the selected SOV Control Output is “Ok” (“RL1 Status” and “RL2 Status”).
6. **Test the Safety Action.** This operation will cause a valve full stroke from the “Normal Position” to the “Safe Position”. **It can be performed only if the valve full stroke is allowed.**
   a. Set the Operating Mode as VC or VC + ACQ.
   b. Launch the “Start Test Safety Act.” command. The Safety Action is performed according to the set parameters and at the end of its execution the ELBS-20 enters to Slow Sampling (SLOW) Operating Mode (see Section 5.1.2.7 for details).
7. **Perform the Position Limits Calibration (optional).** See Section 10.6 for details dealing with this operation. **This procedure can be performed only if the valve full stroke is allowed.**
8. **Clear the Event Memory, the Alarm List and the Warning List.** This operation is performed for not having Events, Alarms or Warnings saved before the installation (factory calibration or previous tests).
   a. Launch the “Clear Event Memory” command (see Section 6).
   b. Launch the “Clear Alarms List” command (see Section 6).
   c. Launch the “Clear Warnings List” command (see Section 6).
9. **Set the desired Operating Mode.** If VC or VC+ACQ are set and no Alarms are active the ELBS-20 can perform the Safety Action (see Section 5.1.2.7).
10. **Disabled the Configuration Interfaces not used in the future.** This operation is not mandatory but recommended only when the Battery Pack is present as unique power source. When the ELBS-20 is waken-up (ENTER push-button), it supplies all the enabled Configuration Interfaces. This operation allows saving the batteries for the next waking up.

10.6 Position Limits Calibration (Optional)

In this section it is described the optional procedure for calibrating the position sensor limits.

This procedure allows the ELBS-20 to accept a tolerance on the retransmission current corresponding to the position limits.

If this procedure it is not performed the ELBS-20 considers 0 mA – 20 mA or 4 mA – 20 mA (according with the “Pos. Signal” setting) as current values corresponding to the position limits (Fully Closed and Fully Open).

Depending on the setting of the “Pos. Signal” parameter two different procedures must be performed.

This procedure can be performed only if the valve full stroke is allowed.

POSITION LIMITS CALIBRATION PROCEDURE (“Pos. Signal” = “4 - 20 mA”)

Do not perform this procedure if the “Pos. Signal” parameter is set as “0 - 20 mA”.

1. Move the actuator for reaching the position corresponding to the 20 mA transmission.
2. Launch the “Start 20 mA Calibration” command (see Section 6).
3. Wait until the command it is successfully performed.
4. Move the actuator for reaching the position corresponding to the 4 mA transmission.
5. Launch the “Start 4 mA Calibration” command (see Section 6).
6. Wait until the command it is successfully performed.

POSITION LIMITS CALIBRATION PROCEDURE (“Pos. Signal” = “0 - 20 mA”)

1. Move the actuator for reaching the position corresponding to the 20 mA transmission.
2. Launch the “Start 20 mA Calibration” command (see Section 6).
3. Wait until the command it is successfully performed.
4. Move the actuator for reaching the position corresponding to the 0 mA transmission.
5. Launch the “Start 0 mA Calibration” command (see Section 6).
6. Wait until the command it is successfully performed.

Section 11: Restore Valve Control

After the execution of the Safety Action (see Section 5.1.2.7), the ELBS-20 enters in the Slow Sampling (SLOW) Operating Mode.

The ELBS-20 cannot initiate another Safety Action, if the Valve Control conditions are not restored.

Two different procedures must be followed to restore the Valve Control, depending on the selection of DO1 and/or DO2 as SOVs Controls Outputs.

Procedure without DO1 and DO2 selected as SOVs Control Outputs

In this case one or more outputs between SVC1, SVC2, RL1 and RL2 are set as SOVs Control Output.

SVC1, SVC2, RL1 and RL2 initiate the Safety Action and after a settable time ("Duration" parameter) return to their initial status so for restoring the Valve Control the following steps must be followed:

- Verify that the Safety Action is completely finished.
- Move the pipeline valve from the "safe position" to the "normal position" by doing all the necessary operations (ex. re-arm hand return valves).
- Verify that the Pressure value, read by the ELBS-20, is between the "HP Limit" and the "LP Limit" and stable (no drop of pressure).
- Set the Operating Mode of the ELBS-20 as VC or VC + ACQ.

Procedure with DO1 and DO2 selected as SOVs Control Outputs

DO1 and DO2 when used as SOV Control Outputs (see Section 6.2), when the Safety Action is finished, do not change their status but it is necessary to "manually" reset them. The procedure below must be followed.

- If DO1 is used as SOV Control Outputs, set the function of DO1 as "OFF" for forcing its commutation.
- If DO2 is used as SOV Control Outputs, set the function of DO2 as "OFF" for forcing its commutation.
- Move the pipeline valve from the "safe position" to the "normal position" by doing all the necessary operations.
- Verify that the Pressure value, read by the ELBS-20, is between the "HP Limit" and the "LP Limit" and stable (no drop of pressure).
- Set the Operating Mode of the ELBS-20 as VC or VC + ACQ.
- If DO1 is used as SOV Control Outputs, restore the function of DO1 as "SOV CONTROL".
- If DO2 is used as SOV Control Outputs, restore the function of DO2 as "SOV CONTROL".

Section 12: Battery Maintenance and First Installation

⚠ WARNING

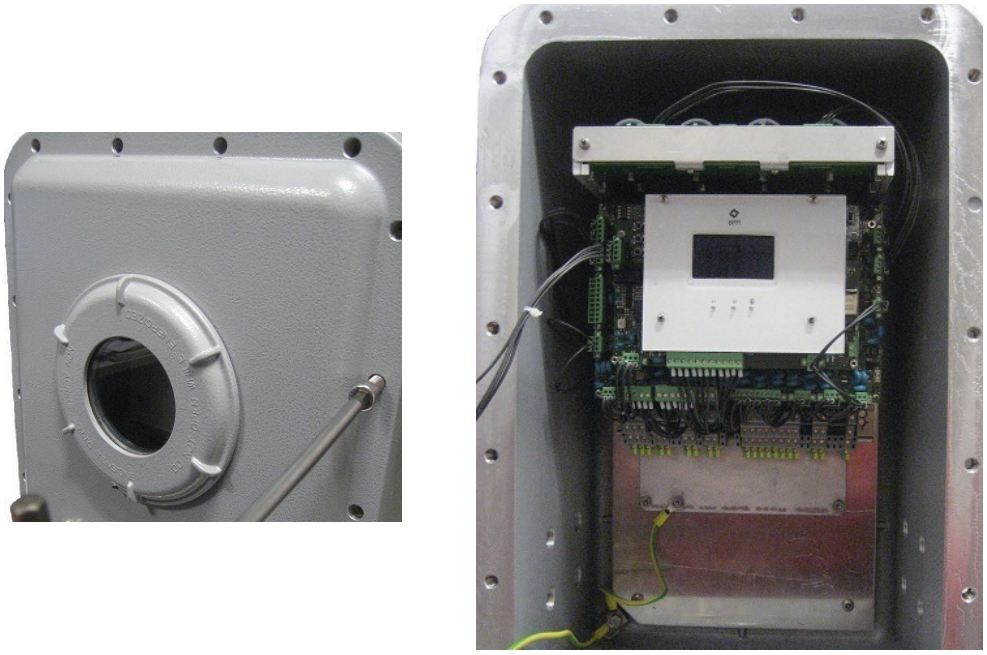
If the device is located in hazardous area a "hot permit" must be obtained before opening the explosion proof enclosures. Moreover, the area must be cleaned from explosive mixture since batteries and power supply could generate electrical spark and cause explosion.

In this section is described a step-by-step procedure for the Replacement or the First Installation of the Battery Packs. All the points must be performed in the order they appear.

It is assumed that the configuration of the ELBS-20 is correct; the Battery Packs declared ("V.Bat.Applied", "V.Bat.Dual") are actually used. See Sections 5.2.2.2, 6 and 7 for details.

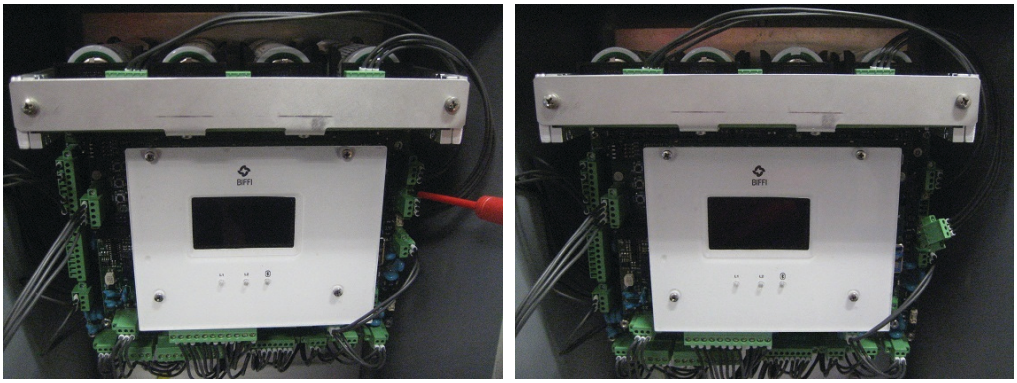
1. Set to SLEEP the Operating Mode of the ELBS-20 (see Sections 6 and 7).
2. Open the cabinet of the ELBS-20 (8 mm Allen key for the EJB51 cabinet).

Figure 29



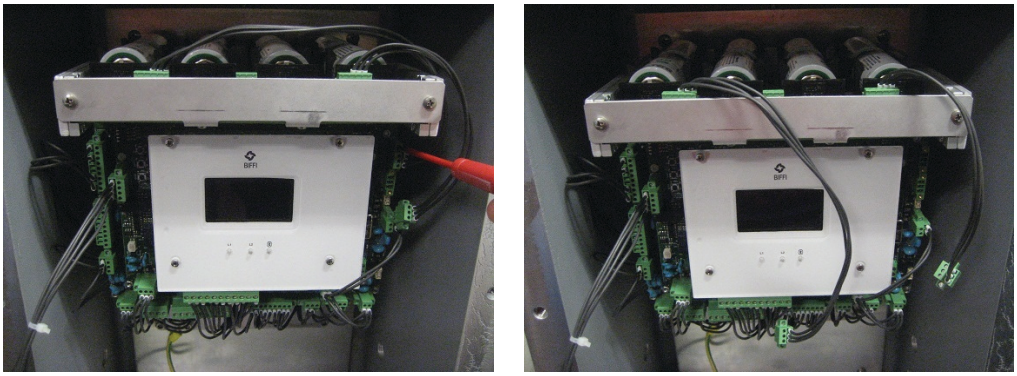
3. Loosen the two screws fixing CN2 of the Process Card (see Section 4.2.1) and remove the connector.

Figure 30



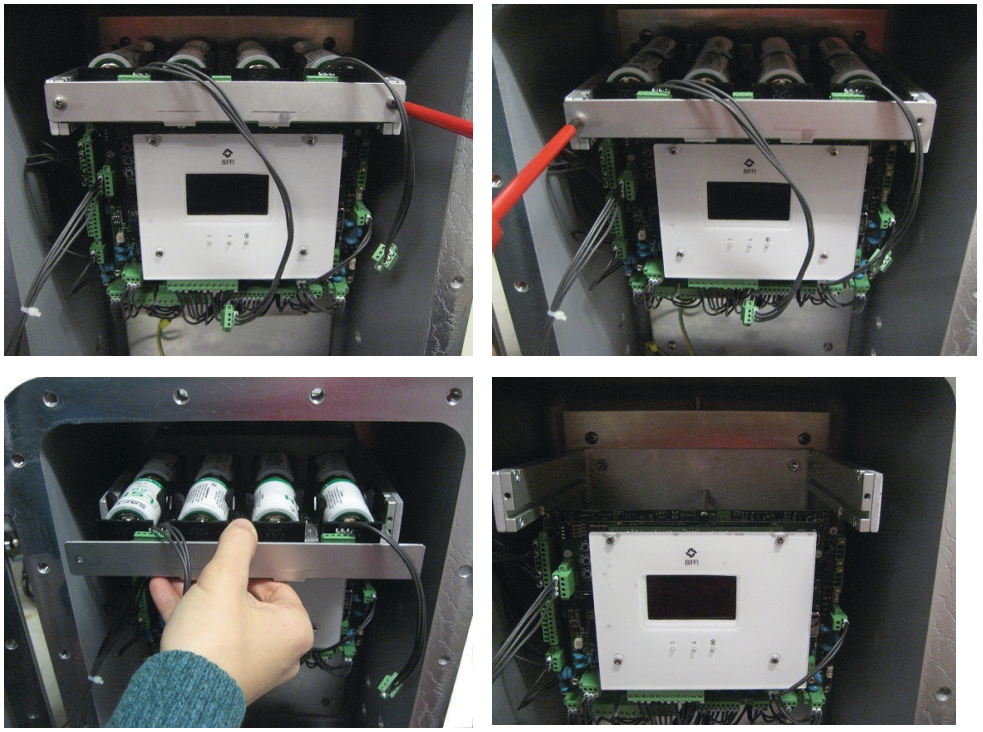
4. Loosen the two screws fixing CN3 (if wired) of the Process Card (see Section 4.2.1) and remove the connector.

Figure 31



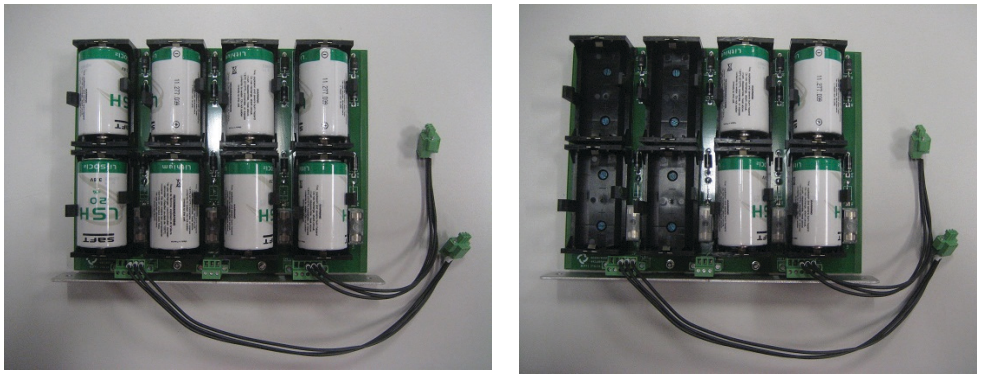
5. Loosen the two screws fixing the Battery Pack Card and remove it.

Figure 32



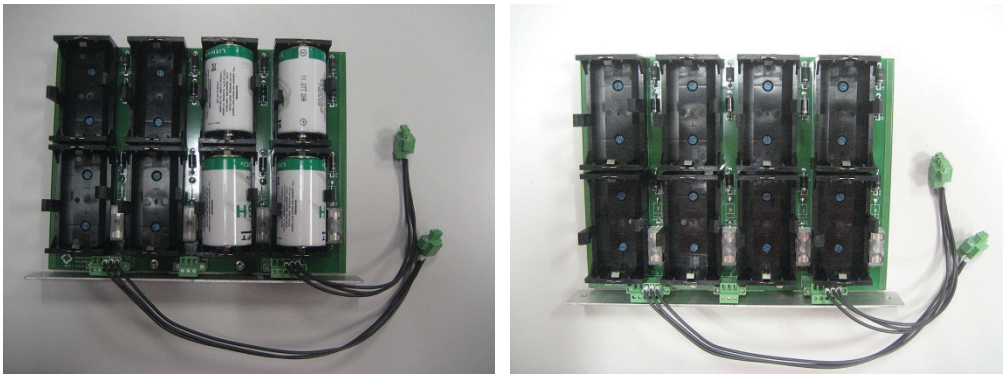
6. Remove the Battery Cells (if present) of the Auxiliary Battery Pack.

Figure 33



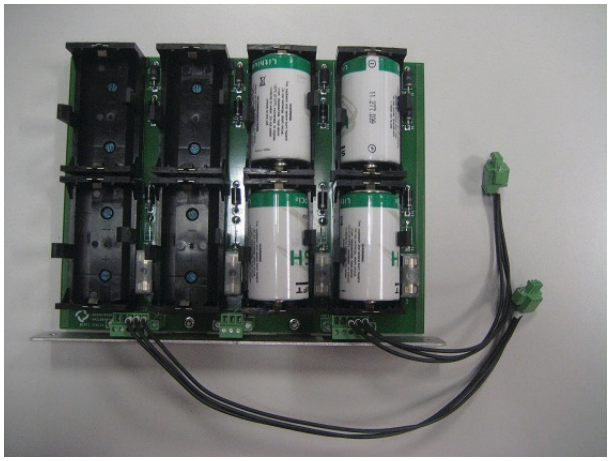
7. Remove the Battery Cells (if present) of the Default Battery Pack.

Figure 34



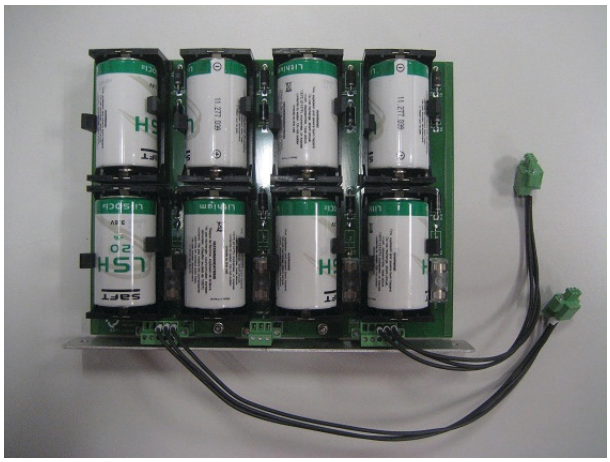
8. Put the four “new” Battery Cells of the Default Battery Pack into the dedicated Battery Holder (see Section 4.2.2). Be careful at the battery cells polarity.

Figure 35



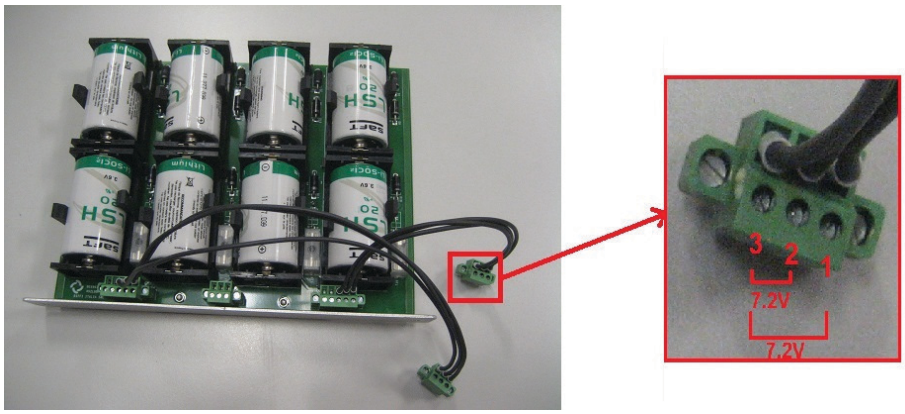
9. If used, put the four “new” Battery Cells of the Auxiliary Battery Pack into the dedicated Battery Holder (see Section 4.2.2). Be careful at the battery cells polarity.

Figure 36



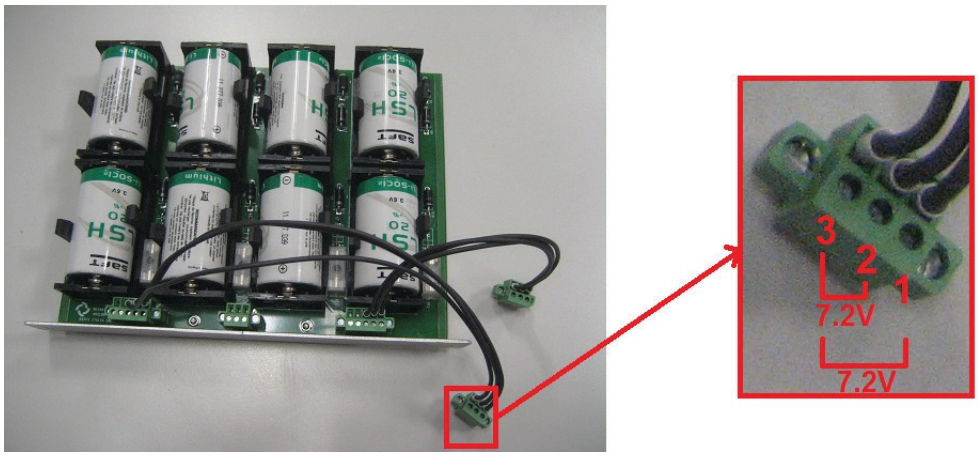
10. Measure (by a Multimeter) the voltage on the 3 wires connector of the cable of the Default Battery Pack and verify the voltage between the pins 1-3 and 2-3. The voltage should be about 7.2 Volt.

Figure 37



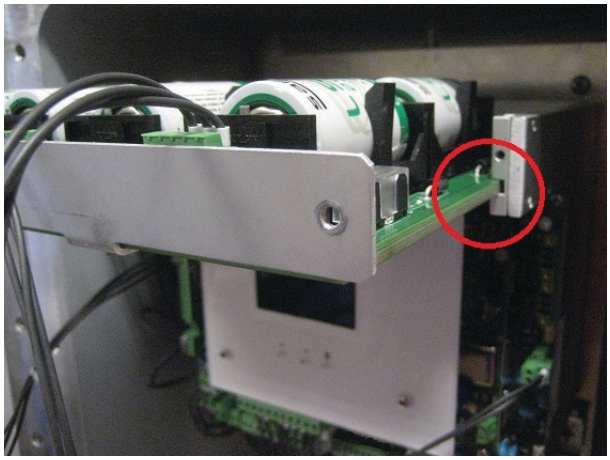
11. If used, measure (by a Multimeter) the voltage on the 3 wires connector of the cable of the Auxiliary Battery Pack and verify the voltage between the pins 1-3 and 2-3. The voltage should be about 7.2 Volt.

Figure 38



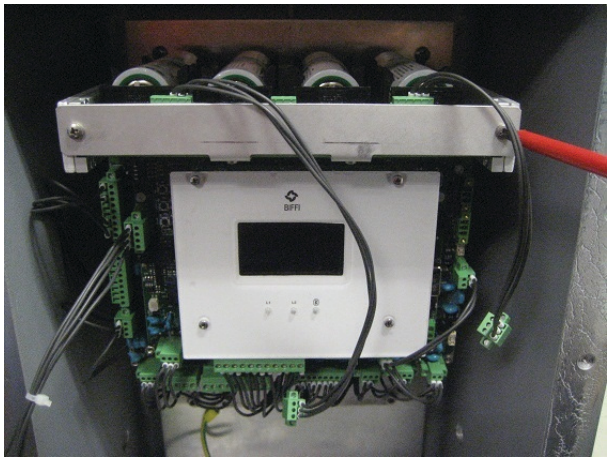
12. Insert the Battery Pack Card into its dedicated leads.

Figure 39



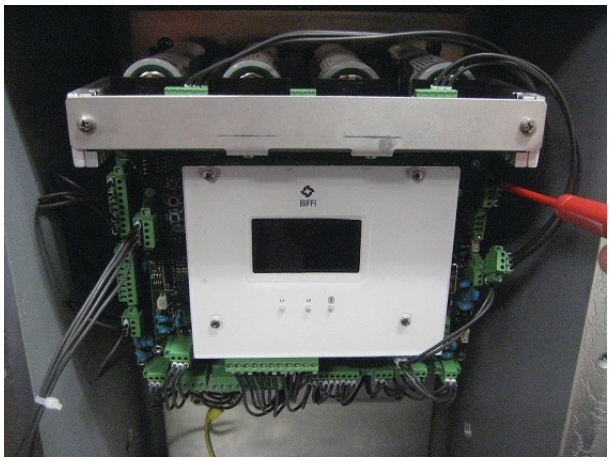
13. Fasten the two screws of the Battery Pack Card.

Figure 40



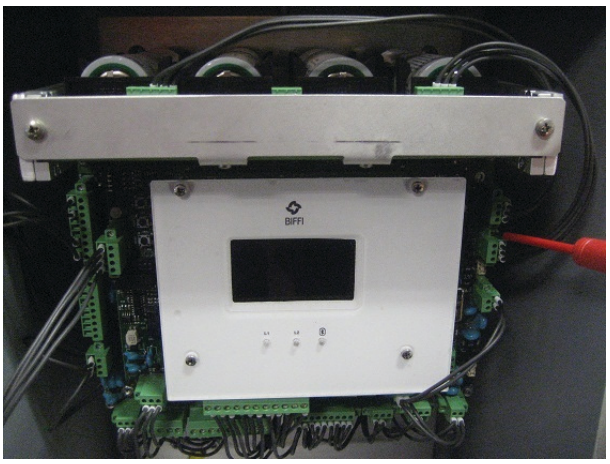
14. If used, connect the 3 wires connector of the Auxiliary Battery Pack to CN3 of the Process Card and fasten its screws.

Figure 41



15. Connect the 3 wires connector of the Default Battery Pack to CN2 of the Process Card and fasten its screws.

Figure 42



16. Verify the date of the ELBS-20. If it is not the present one, set it to the right value.
17. Launch the “Update Battery Maintenance Command verify that the status of the used Battery Packs is “OK” (see Sections 6 and 7) and that the “Next. Batt. Maint.” parameter is correctly updated (see Sections 6 and 7).
18. Close the cabinet of the ELBS-20 (8 mm Allen key for the EJB51 cabinet).
19. Enter the desired Operating Mode of the ELBS-20 (see Sections 6 and 7).

Section 13: Parts List

This section includes the drawings and the part list of the General Assembly and of the Spare Parts of the ELBS-20.

NOTICE

When ordering spare parts, please indicate the serial number embossed on the device nameplate.

NOTICE

When ordering spare parts, please refer to the marked part list items on the attached drawings.

13.1 General Assembly

Figure 43

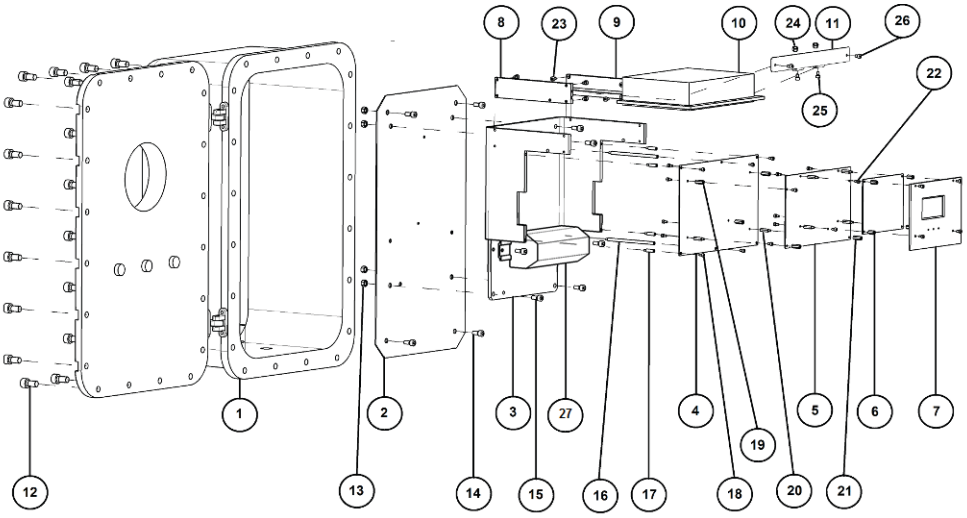


Table 31.

Pos.	Description	Qty
1	CABINET MOD. EJB51 (*)	1
2	EJB51 INTERNAL PLATE (*)	1
3	ELBS-20 CARDS BRACKET	1
4	PROCESS CARD	1
5	INTERFACES CARD	1
6	DISPLAY/BLUETOOTH CARD	1
7	DISPLAY/BLUETOOTH CARD MASK	1
8	BATTERY PACK LEFT BRACKET	1
9	BATTERY PACK RIGHT BRACKET	1
10	BATTERY PACK CARD (opt.)	1
10.1	BATTERY CELLS (opt.)	4 or 8
11	BATTERY PACK FRONTAL EXTRACTOR	1
12	VTCEI M10x35 – AISI 316 for EJB51 (*)	20
13	NUT M6 – AISI 316	4
14	VTCP M6x10 – AISI 316	4
15	VTCEI M6x14 – AISI 316 – AISI 316	6
16	SPACER M-F M4-M3 H100 – AISI 316	4
17	SPACER M-F M4-M3 H16 – AISI 316	2
18	VTCP M3x6 – AISI 316	16
19	SPACER NYLON F-F 4-40 UNC H16 – AISI 316	3
20	SPACER M-F M3-M3 H16 – AISI 316	6
21	SPACER F-F M3-M3 H12	6
22	SCREW NYLON 4-40 UNC – AISI 316	6
23	VTCEI M4x6 – AISI 316	8
24	NUT M3 (opt.) – AISI 316	2
25	VTCP M3x10 (opt.) – AISI 316	2
26	VTCP M4x6 – AISI 316	2
27	DIN RAIL TERMINALS BAR	1

NOTES:
(*): the EJB51 cabinet is normally provided when the following ordering options are selected: Cabinet Material = A and Cabinet Electrical Certification = B (see Section 16 for details).

13.2 General Assembly

Figure 44

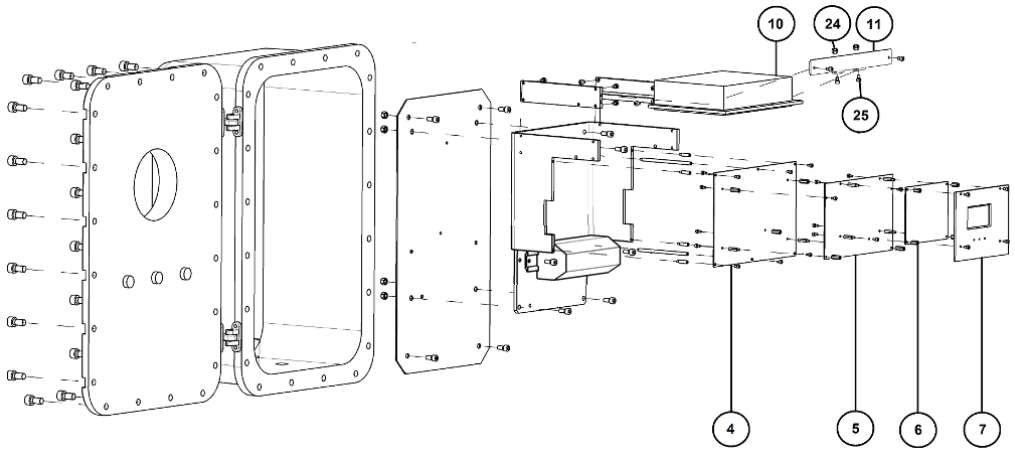


Table 32.

Pos.	Description	Qty
4	PROCESS CARD	1 *
5	INTERFACES CARD	1 *
6	DISPLAY/BLUETOOTH CARD	1 *
7	DISPLAY/BLUETOOTH CARD MASK	1 *
10	BATTERY PACK CARD (opt.)	1 **
10.1	BATTERY CELLS (opt.)	4 or 8 ***
11	BATTERY PACK FRONTAL EXTRACTOR (opt.)	1 **
24	NUT M3 (opt.) – AISI 316	2 **
25	VTCP M3x10 (opt.) – AISI 316	2 **

NOTES:
(*): Available as a unique code (292ELBS100) completed with spacers and screws already mounted.
(**): Available as unique code (292LBBP100).
(***): Contact Biffi for the shipment availability.

Section 14: Decommissioning

Figure 45 Disposal and recycling

At the end of the life of ELBS-20, the device must be disassembled.

⚠ WARNING

Do not dump non-biodegradable products, lubricants and non-ferrous (rubber, PVC, resins, etc.) into the environment. Dispose of all such materials as indicated in the following table.

Table 33.

Subject	Hazardous	Recyclable	Disposal
Electrical and electronic equipment	Yes	Yes	Use specialist recyclers.
Glass	No	Yes	Use specialist recyclers.
Metals	No	Yes	Use licensed recyclers.
Plastics	No	Yes	Use specialist recyclers.
Rubber (seals and o-rings)	Yes	No	May require special treatment before disposal, use specialist waste disposal companies.
Battery Cells	Yes	No	May require special treatment before disposal, use specialist waste disposal companies.

⚠ WARNING

Do not reuse parts or components which appear to be in good condition after they have been checked or replaced by qualified personnel and declared unsuitable for use.

NOTICE

In all cases check local authority regulation before disposal.

Section 15: Troubleshooting

Table 34.

No.	Detected problem	Actions to be performed
1	THE ELBS-20 DOES NOT SWITCH ON WHEN THE EXTERNAL POWER SUPPLY IS APPLIED	• Verify the Power supply value on the dedicated DIN rail terminals • Verify that the wiring is correct • Verify the fuses F1 and F2 of the Process Card (see Section 4.2.2) • Verify the fuse F1 of the Interfaces (see Section 4.2.2)
2	THE ELBS-20 DOES NOT WAKE UP WHEN THE ENTER PUSH-BUTTON IS PRESSED (BATTERY PACK AS POWER SUPPLY SOURCE)	• Verify the fuses F1-F2 and F3-F4 (only when the auxiliary battery pack is present) of the Battery Pack Card (see Section 4.2.2) • Verify that the wiring is correct • Try the Emergency Push-Buttons (see Section 5.2.1.1)
3	LOCAL PUSH-BUTTONS DO NOT WORK CORRECTLY	• Verify that the wiring is correct • Try the Emergency Push-Buttons (see Section 5.2.1.1)
4	THE ELBS-20 CANNOT PERFORM THE SAFETY ACTION	• Verify that the wiring is correct • Verify the configuration of the SOVs Control Outputs
5	THE ELBS-20 GETS NO PRESSURE INDICATION	• Verify that the pressure sensor is not damaged • Verify the mechanical connection of the Pressure Sensor • Verify that the wiring is correct • that the ELBS-20 is not in SLEEP operating mode
6	THE ELBS-20 GETS A WRONG PRESSURE INDICATION	• Verify the consistency of the parameters dealing with the Pressure Sensor
7	THE ELBS-20 GETS NO POSITION INDICATION	• Verify that the position sensor is not damaged • Verify the mechanical connection of the Position Sensor • Verify that the wiring is correct • Verify that the Position Sensor is enabled • Verify that the ELBS-20 is not in SLEEP operating mode
8	THE ELBS-20 GETS A WRONG POSITION INDICATION	• Verify the consistency of the parameters dealing with the Pressure Sensor • Perform the “Position Limits Calibration” (see Section 10.6)
9	THE DIGITAL OUTPUTS DO NOT WORK CORRECTLY.	• Verify that the wiring is correct • Verify the configuration of the Digital Outputs
10	THE DIGITAL INPUT DO NOT WORK CORRECTLY	• Verify that the wiring is correct • Verify the configuration of the Digital Inputs
11	PROBLEM WITH THE RS232 COMMUNICATION	• Verify the RS232 cable (see [1]) • Verify that the port is enabled
12	PROBLEM WITH THE RS485 COMMUNICATION	• Verify that the wiring is correct • Verify the termination setting • Verify that the port is enabled
13	PROBLEM WITH THE BLUETOOTH COMMUNICATION	• Verify that the port is enabled

No.	Detected problem	Actions to be performed
14	PROBLEM WITH THE MODBUS COMMUNICATION	• Verify that the wiring is correct • Verify the termination setting • Verify that the port is enabled • Verify the consistency of the parameters dealing with the MODBUS port
15	PROBLEM WITH THE ANALOG OUTPUT RETRANSMISSION	• Verify that the wiring is correct • Verify that the port is enabled • Verify the consistency of the parameters dealing with the ANALOG OUTPUT interface
16	PROBLEM WITH RL1	• Verify if the RL1 warning is active • Verify that the wiring is correct • Verify the coil of the SOV • Verify the fuse F3 of the Process Card (see Section 4.2.2)
17	PROBLEM WITH RL2	• Verify if the RL2 warning is active • Verify that the wiring is correct • Verify the coil of the SOV • Verify the fuse F4 of the Process Card (see Section 4.2.2)
18	PROBLEM WITH SVC1	• Verify if the SVC1 warning is active • Verify that the wiring is correct • Verify the coil of the SOV
19	PROBLEM WITH SVC2	• Verify if the SVC2 warning is active • Verify that the wiring is correct • Verify the coil of the SOV

Section 16: Ordering Table

Refer to the Technical data sheet available at the Biffi website.

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