Soft & Control Technology s.r.o.

Battery powered wireless telemetric systems

of BaWiT series

Type series BaWiT- A/B/C/D/E

System User Manual

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Content

1 Concept

ATmega	Processor produced by ATMEL.
CAN 2.0	Controller Area Network – bus type.
EEPROM	Electric Erasable/Programmable Read Only Memory – data storing without need of power supply
FTDI	Type of circuit necessary for conversion between USB and BaWiT
LOADER	Program providing execution of main SW
RTC	Real Time Clock – Circuit of real time
SD karta	Secure Digital card – memory card for data storing without need of power supply
SRAM	Static Random Access Memory – Operating memory of processor
TTL	Circuit operating with transistor logic
Uniwire	Interface with one wire for bidirectional communication
USART0	Signature of BaWiT interface
XAD	External Analog to Digital Converter – AD converter
XDataFlash	External DataFlash – Memory type produced by ATMEL for data storing without need of power supply
XMODEM	Type of protocol for simple communication
Metering	Metering system – calibrated and verified measuring apparatuses as commercial meters
Systém	Set of various elements, which in total produce results
BaWiT	Battery powered wireless telemetric system **(Ba**ttery **Wi**reless **T**elemetry Systems)
RFi	Radio module for wireless communication in 868MHz band
TAV	Technological address of data point

2 Introduction

Telemetric system of BaWiT type series (**Ba**ttery **Wi**reless **T**elemetry Systems – Battery powered wireless telemetric system, series number SCT8xxx) is intended for universal purposes in all industrial areas with emphasis on low energy consumption, wide communication capabilities and ability to withstand difficult conditions in aggressive environment.

Powering of device by batteries enables to realize applications also in areas, where it is not possible or effective to use power supplying from mains and in metering applications. Though it maintain many properties of classic monitoring and controlling systems.

2.1 Implemented functionality of BaWiT A/B/C/E

Systems have implemented program equipment, which provides:

- data measuring and acquisition
- processing of measured data according to configuration for each individual parameter
- supervising of individual variable value limits
- searching for minimum and maximum (hourly, daily, other) within measured variables and following archiving
- communication with master system via implemented wireless or cable interface

Variables configured for archiving are stored in file system of internal memory or inserted SD card. Variable source in the system can be:

- analogue inputs
- binary impulse, reader inputs
- variables readout via RS485, RS232 interface
- wireless acquisition by radio module in 868MHz band (RFi)
- internally generated (e.g. power supply manager, language SPL™ and others)

According to customer requirements, transferred data to master system can be in set transfer intervals or immediately when the request occurs. For data transfer it is possible to use standard transfer protocols (IEC60870-5-101, IEC60870-5-104, protocol SSP – SCT SERVICE PROTOCOL) or other with optional data encryption. Possible transfer ways:

- GSM/GPRS network (except BaWiT C)
- Radio network in 868MHz band (power 500mW with range up to 4km)
- RS485 or RS232 link

System contains SPL™ language interpreter, which enables its user besides configuration also define various links and calculations between measured variables, evaluation and controlling of active elements in technology. However the system itself manages power supplying and other necessary processes to maintain optimal operation and that system lifetime will be as durable as possible.

At the same time the system dispose by special archive types intended for system diagnostics. Based on these data it is possible to back analyze operational of the device as well as all sub-devices.

As the time synchronization of technology with master system is very important for telemetric systems, it is not only possible to synchronize time standardly during data transfer, but also option of time synchronization by integrated GPS module is present.

2.2 Implemented functionality of BaWiT D

BaWiT-D is simplified version of system, mostly intended for processing of impulse or voltage inputs from various devices not only in industry. Typical use:

- processing of 4 independent impulse inputs with cable disconnection detection
- measuring of 4 analogue inputs
- possibility to connect of one power output or two passive outputs
- transfer of processed data to master system by RFi or cable interface:
  - RS485
  - RS232
  - USB

BaWiT-D with cable interface (the most often USB) in connection with PC can operate as access point to radio network of all BaWiT systems. This is the way, hot it is possible to access any device in the network and administer its configuration, view archived and actual data. Access to network is protected by password.

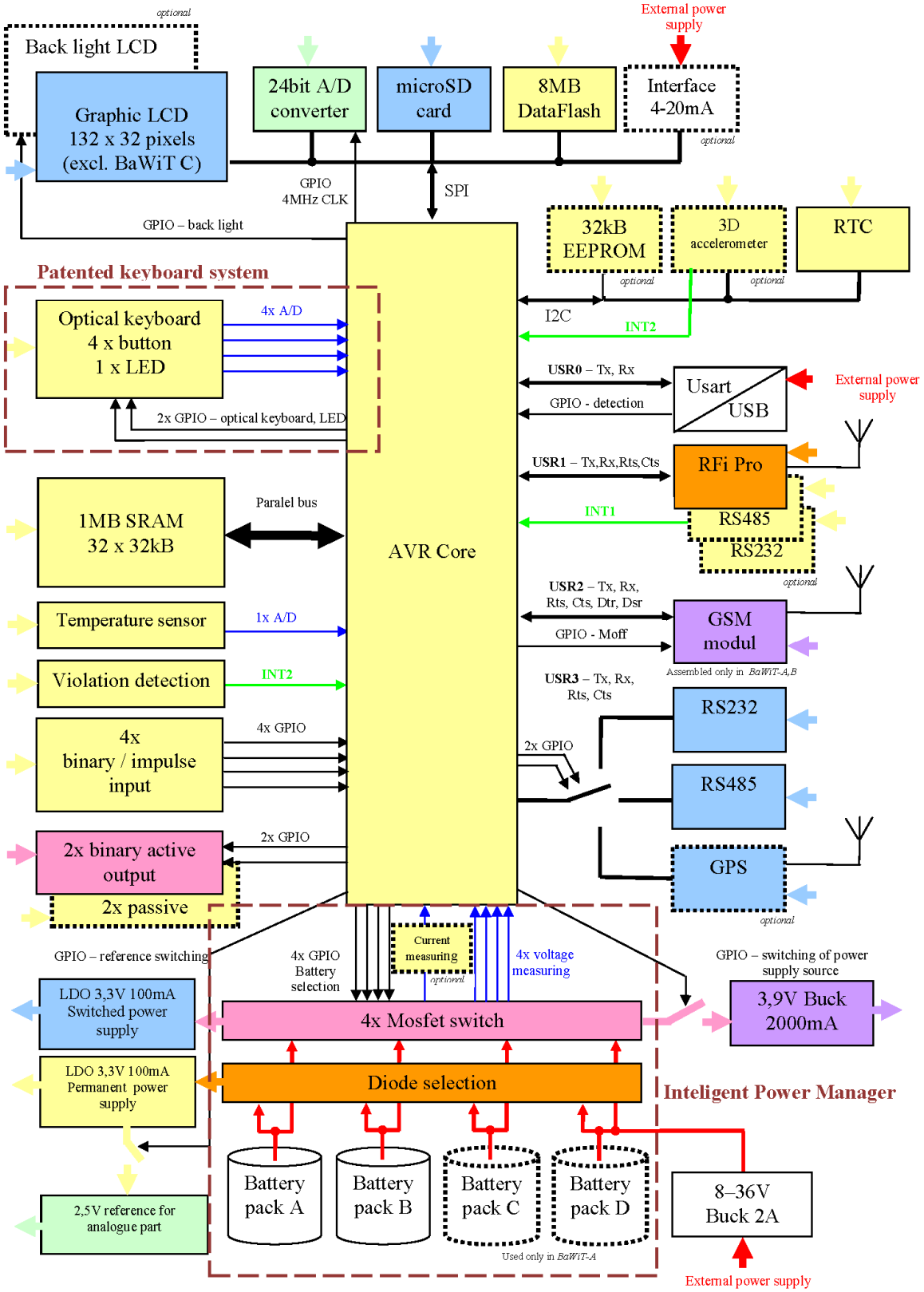
Integrated module RFi ensures continuous accessibility of device in radio network at low poer consumption (LPR) what provides long system lifetime (up to 10 years).

2.3 Configuration modules

Internal logic of the system is build on several modules (objects, time diagrams, devices, data points, transfer routes), which establish one control entity. Whole system configuration is created dynamically. Object sets global BaWiT settings. Execution of main control processes is based on time diagrams and various events. Data points define which values from measuring will be processed. Transfer routes defines the way of data transfer to master system.

2.4 Block diagrams

2.4.1 BaWiT – A/B/C



The core of the system is created by ATMEL 8-bit microprocessor of RISC architecture. External memory peripherals as Data Flash 8MB, microSD card, optional serial EEPROM 32 kB and 1MB SRAM which is accessible in 32kB blocks are connected to processor. Real time is taken from RTC module.

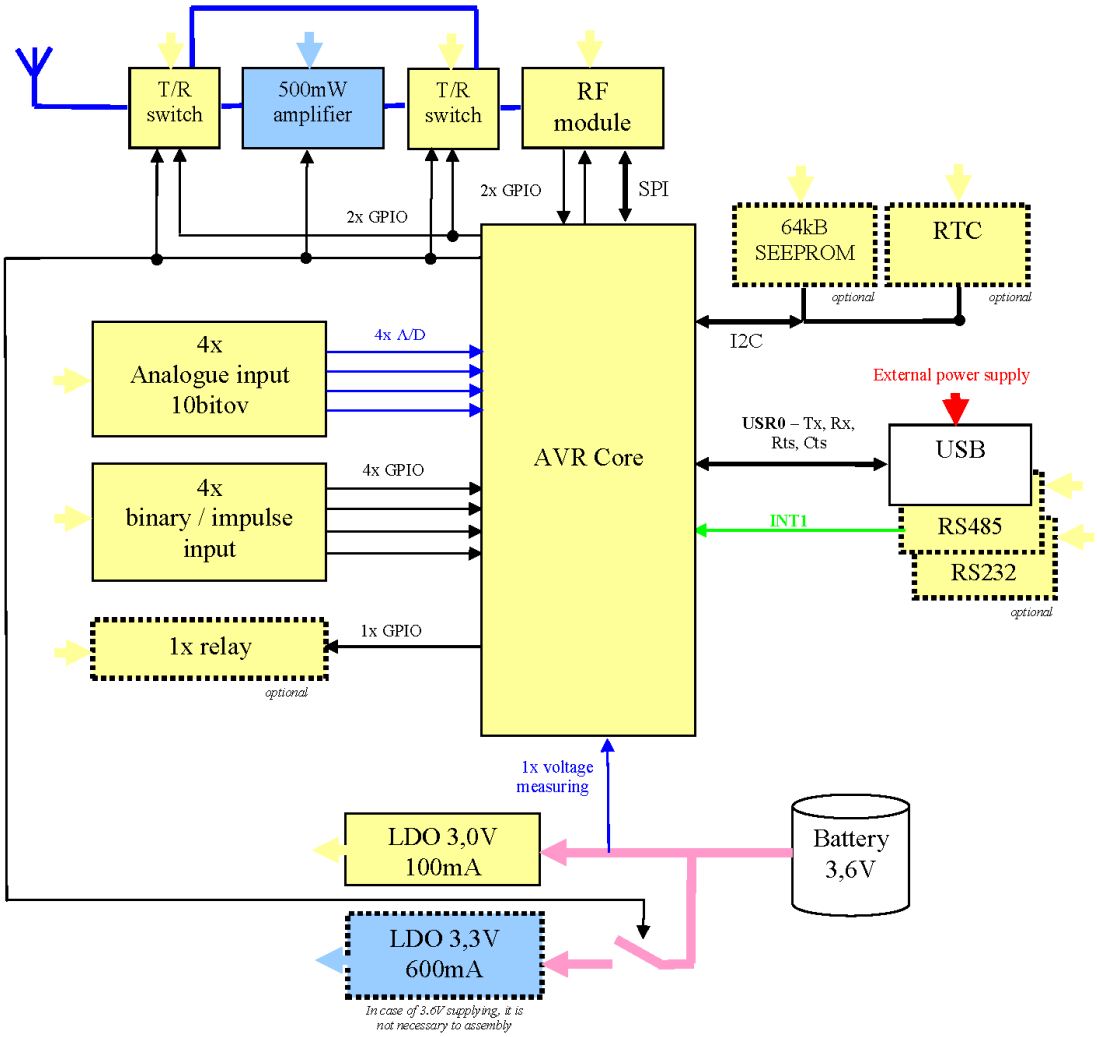
Module contains communication interface USB, which is used to system reconfiguration by PC. System is capable to contain communication radio module RFi, communication interface RS485 or RS232 according to customer requirements. Device contains USART, where it is possible to connect RS232 or RS485 or optional GPS module for actual position coordinates and accurate time.

3D accelerator is other optional module. This module detects movement in three axis. Whole system is equipped with following peripherals: 24 bit AD converter, optional 4 – 20mA current loop, temperature sensor – termistor, detection of device violation, 4 binary or impulse inputs, 2 binary active or passive outputs.

For user communication with module the system is equipped with graphical display with 132 x 32 pixels resolution and optical keyboard with indication led signalizing for presenting of pressed key acceptation.

System can be powered by batteries and/or by external power supply. Power Manager intelligently defines selection of battery cell, which will be actually used at given conditions. External power supplying is available with DC voltage in 8 – 24 V range.

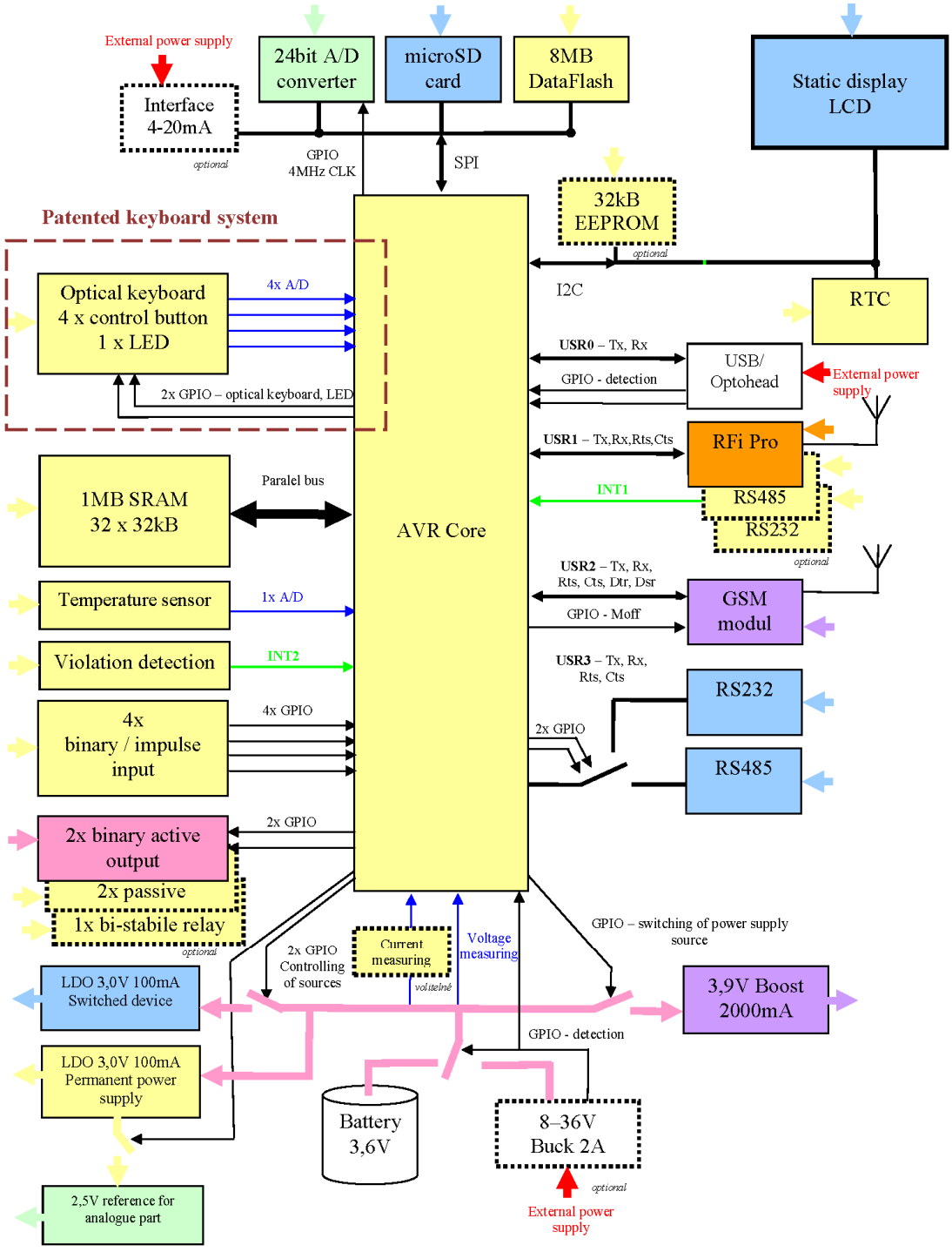
2.4.2 BaWiT – D



The core of the system is 8-bit microprocessor ATMEL of RISC architecture. Processor is connected to optional external serial memory EEPROM 64kB and real time module RTC.

Module contains communication interface USB device or RS485 or RS232. The system is equipped for wireless communication with radio module RFi. The system is equipped with following peripherals: 4 x 10 bit AD converter, 4 binary/impulse inputs and one optional bi-stabile relay.

2.4.3 BaWiT – E


External power supply
Interface 4-20mA
optional
24bit A/D converter
microSD card
8MB DataFlash
Static display LCD
GPIO 4MHz CLK
SPI
32kB EEPROM
optional
I2C
RTC
Patented keyboard system
Optical keyboard 4 x control button 1 x LED
4x A/D
2x GPIO – optical keyboard, LED
USR0 – Tx, Rx
GPIO - detection
USB/ Optohead
External power supply
USR1 – Tx,Rx,Rts,Cts
RFi Pro
INT1
RS485
RS232
optional
1MB SRAM 32 x 32kB
Paralel bus
AVR Core
USR2 – Tx, Rx, Rts, Cts, Dtr, Dsr
GPIO - Moff
GSM modul
Temperature sensor
1x A/D
Violation detection
INT2
USR3 – Tx, Rx, Rts, Cts
RS232
4x binary / impulse input
4x GPIO
2x GPIO
RS485
2x GPIO
2x binary active output
2x passive
1x bi-stabile relay
optional
2x GPIO Controlling of sources
Current measuring
Voltage measuring
GPIO – switching of power supply source
LDO 3,0V 100mA Switched device
3,9V Boost 2000mA
GPIO - detection
LDO 3,0V 100mA Permanent power supply
Battery 3,6V
8–36V Buck 2A
optional
External power supply
2,5V reference for analogue part

The core of the system is 8-bit microprocessor ATMEL of RISC architecture. Processor is connected to following external memory peripherals: Data Flash 8MB, microSD card, optional serial EEPROM 32 kB a 1MB SRAM accessible in 32kB blocks. Real time is taken from RTC module.

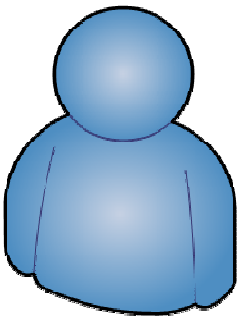
Module contains communication interface USB device and interface for connection of optohead. These devices are also capable to be used for system configuration by PC. System can contain communication radio module RF or communication interfaces RS485 or RS232 according to customer requirements. Wireless communication is provided by equipped GSM module. Device contains USART, which is connectable to RS232 or RS485 interface.

The system is equipped with following peripherals: 24 bit AD converter, optional output current loop 4 – 20mA, temperature sensor termistor, detection of device violation, 4 binary/impulse inputs, 2 binary active / passive outputs or one bi-stabile relay.

For user communication the system is equipped with static display and optical keyboard, which contains LED indication of pressed key acceptation.

System can be powered by batteries and/or by external power supply. External power supplying is available with DC voltage in 8 – 24 V range.

3 User interface of the device



The system is provided with user interface for easy communication consisting of:

- Display (graphical/static)
- Keyboard

3.1 Display variants

GRAPHIC

BaWiT - A/B/C

STATIC

BaWiT - E

3.2 Meaning of individual keyboard keys

KEY_UP

Move up

KEY_ESC

Cancel request

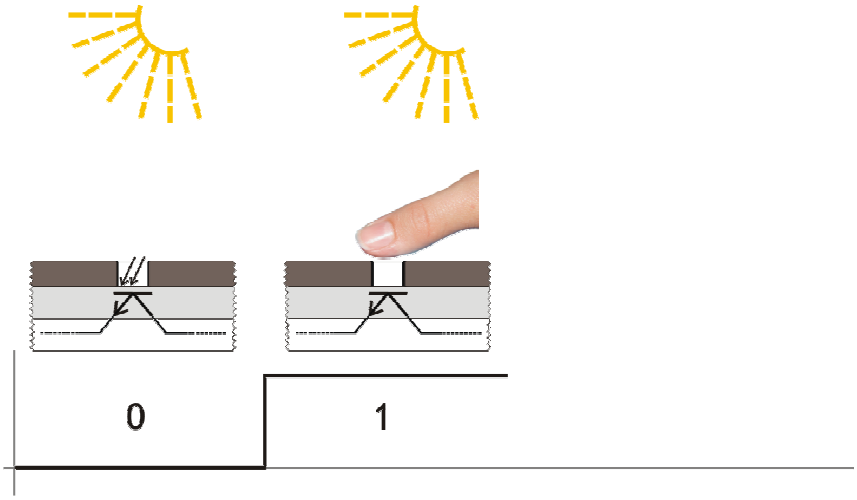
KEY_DOWN

Move down

KEY_ENTER

Confirmation of request

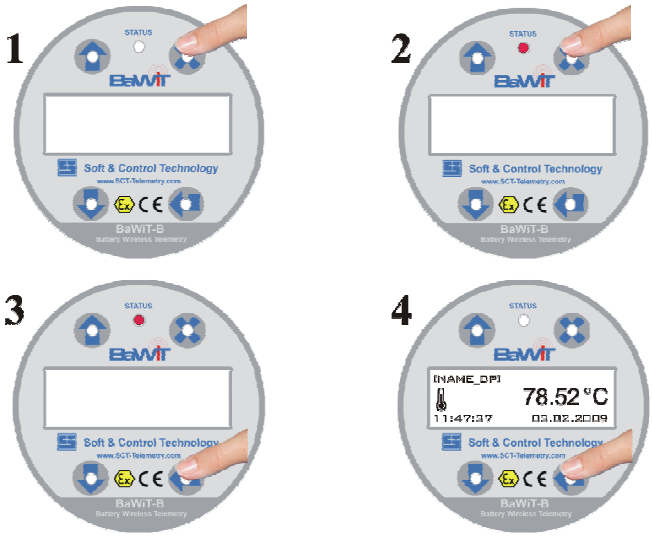
3.3 Keyboard principle



The keyboard is based on light changes (contactless sensing) providing enclosure of system housing. The keyboard is operating and accepting the requests in defined range of light intensity to prevent external interference and from this reason it is necessary to maintain correct light when using the keyboard. Light conditions are in wide range when human eye can see the device display.

3.4 Menu for BaWiT – A/B/C with graphical display

3.4.1 Unlocking of Keyboard

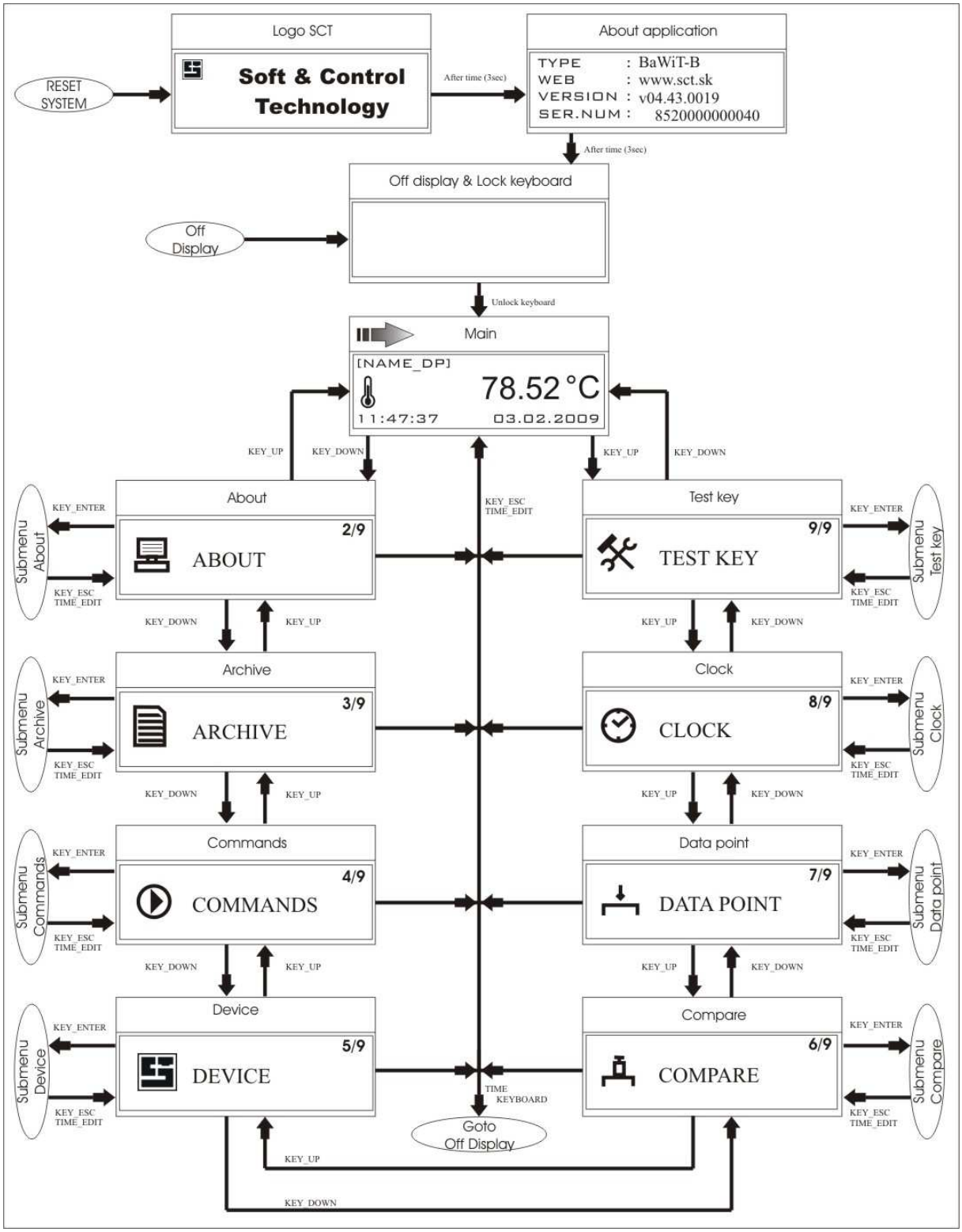


To unlock keyboard press and hold KEY_ESC to lid the LED_KEY. When the LED_KEY is lid confirm keyboard unlocking by pressing KEY_ENTER within short time interval. After unlocking the keyboard the LED_KEY will blinks while the display will starts and BaWiT enters main presentation mode (Main).

3.4.2 Menu Overview

<table>
<tr><td rowspan="11"><u>Logo Manufacturer</u>
Logo of the manufacturer</td><td rowspan="11"><u>About application</u>
Information about application</td><td rowspan="11"><u>Off display & lock keyboard</u>
Display turned off and keyboard is locked</td><td><u>Main</u>
Main presentation menu</td><td></td></tr>
<tr><td><u>About</u>
Information about application</td><td></td></tr>
<tr><td><u>Archive</u>
Archive menu for presentation of individual data point archives</td><td></td></tr>
<tr><td rowspan="4"><u>Commands</u>
Basic commands</td><td><u>Transfer</u>
Activation of transfer</td></tr>
<tr><td><u>Reset</u>
Reset of the system</td></tr>
<tr><td><u>Sleep</u>
Unit enters sleep mode</td></tr>
<tr><td><u>Switch off</u>
Switching off the system for 5 minutes and restarting</td></tr>
<tr><td><u>Device</u>
Devices – update of all configured devices</td><td></td></tr>
<tr><td><u>Compare</u>
Compares two data points simultaneously</td><td></td></tr>
<tr><td><u>Data point</u>
Menu Data Point for individual data point presentation</td><td></td></tr>
<tr><td><u>Clock</u>
Menu of the clock for date and time presentation</td><td></td></tr>
<tr><td><u>Test Key</u>
Test of keyboard – menu for test of keyboard functionality</td><td></td></tr>
<tr><td colspan="2">Executed after reset
This is executed after system restart</td></tr>
</table>

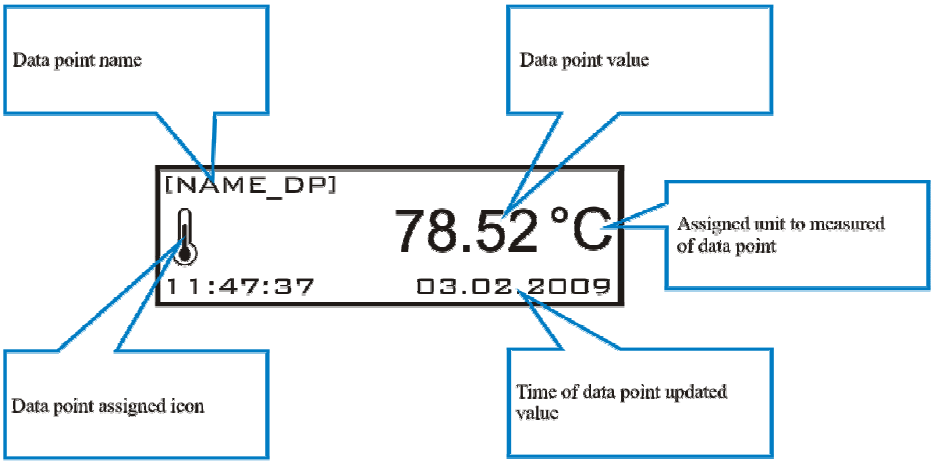
3.4.3 Main Menu



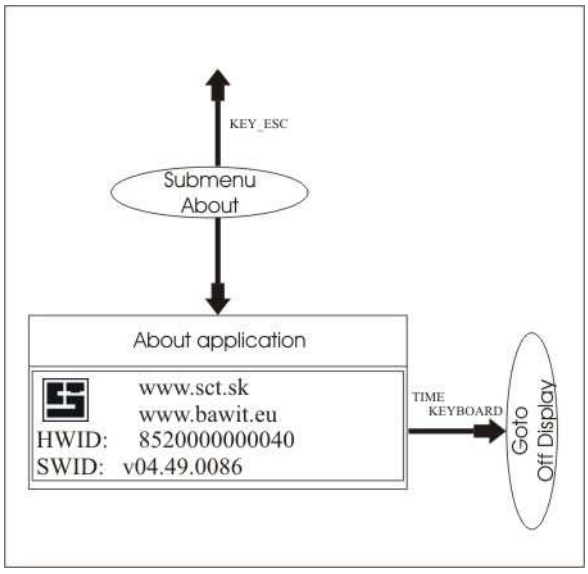
When BaWiT restarts, it will show for a short period of time (cca 3 sec) company logo (Logo SCT) and following this basic information (About application) – device type, web, software version and serial number are presented. After cca 3 sec BaWiT enters sleep mode (Off display & Lock keyboard), where the display is turned off and keyboard is locked.

3.4.4 „Main“ Menu

If the data points are configured and visualization of at least one data point is enabled, the „Main“ Menu periodically presents individual data points with internal of 4 sec. From this main menu it is possible to enter into individual menu items.

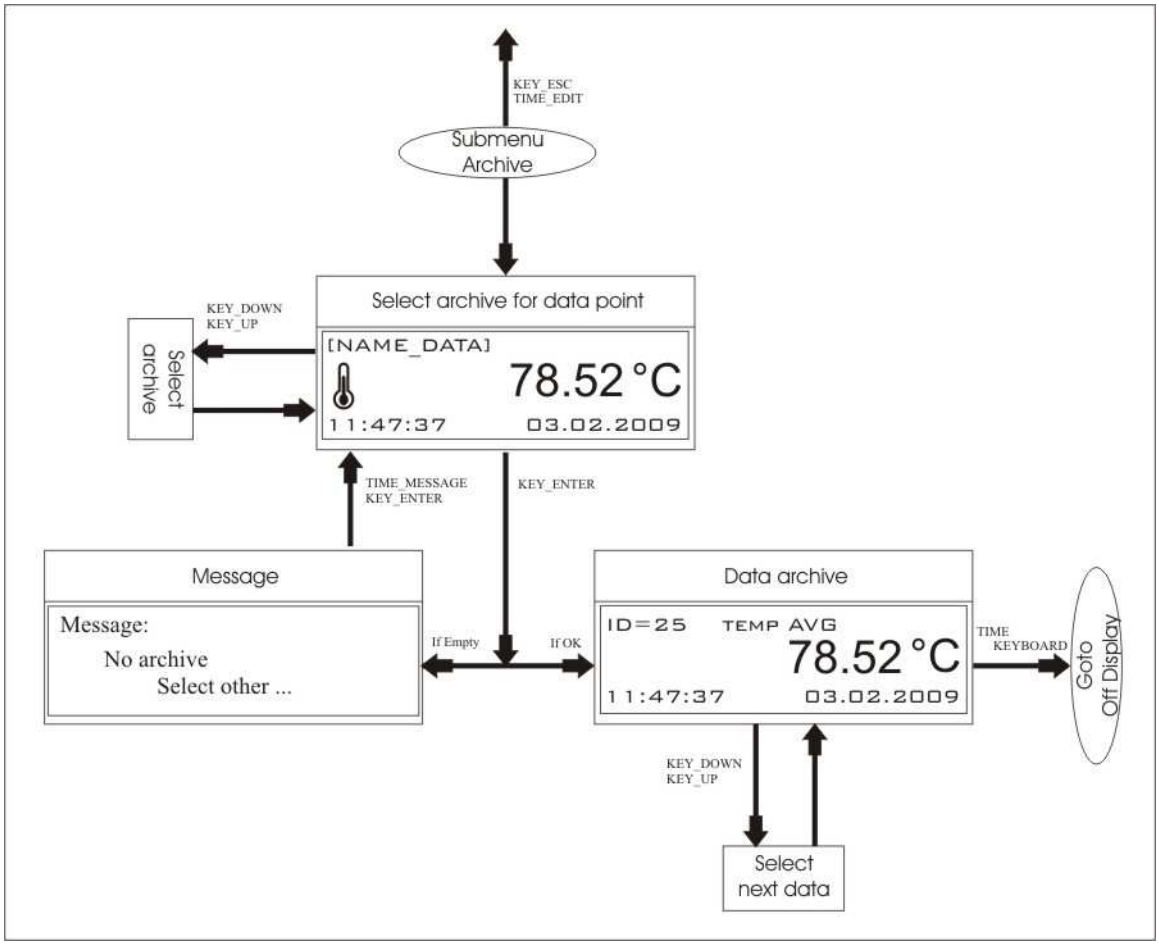


3.4.5 Menu „About“



Selection of item will present basic information like device type, company web, software version and serial number.

3.4.6 Menu „Archive“

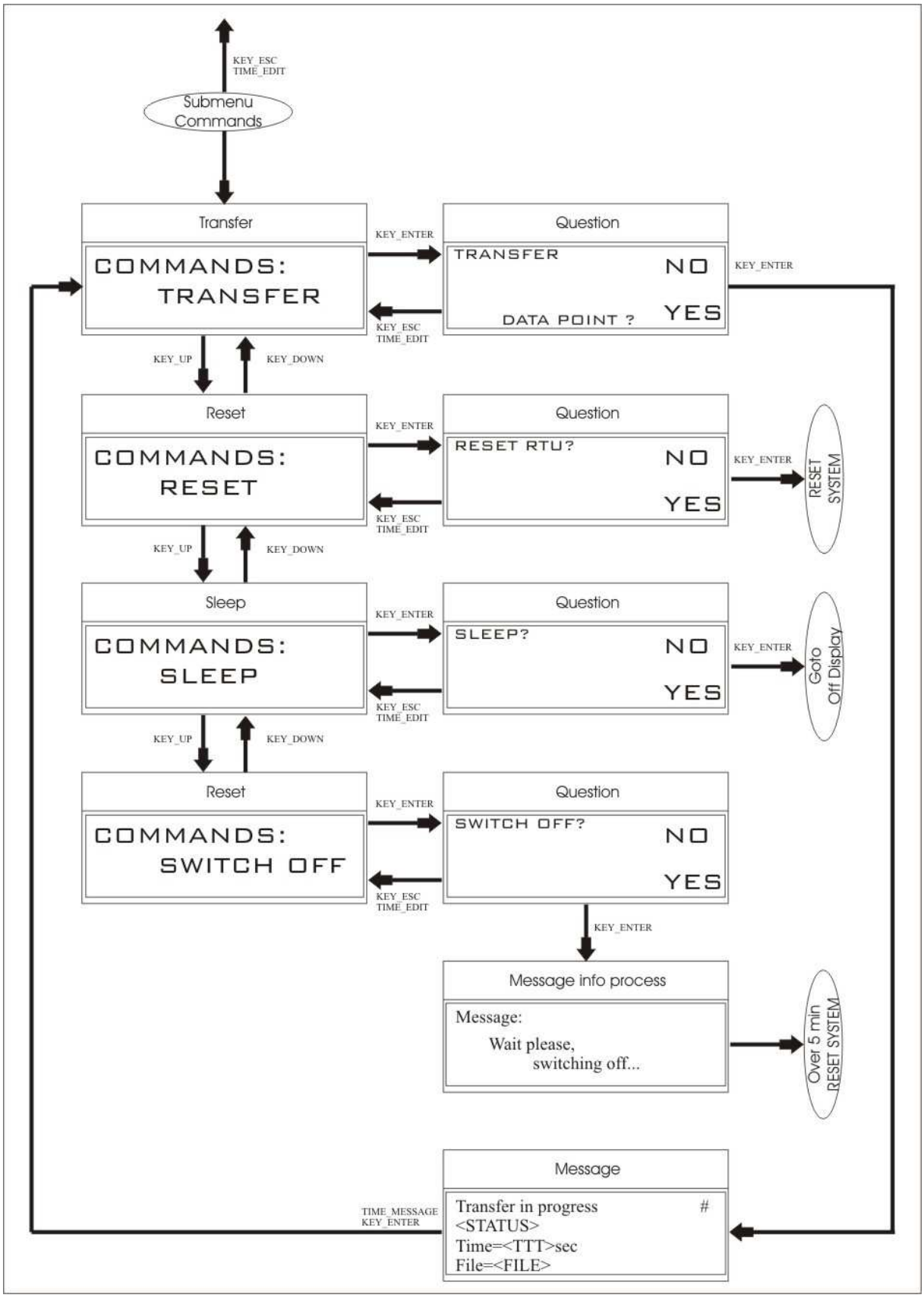


It is possible to view archives in „Archive“ menu, if data points are configured and archives for individual data points are created. After selection of data point for which we want to view the archive, the newest item in archive will be presented.

Meaning of displayed symbols:

- o ID – Archive serial number
- o TEMP AVG – Data point name
- o – Variable value in given time
- o – Time and date of item registration

3.4.7 Menu „Commands“



Submenu „Commands“ contains commands for basic BaWiT operation.

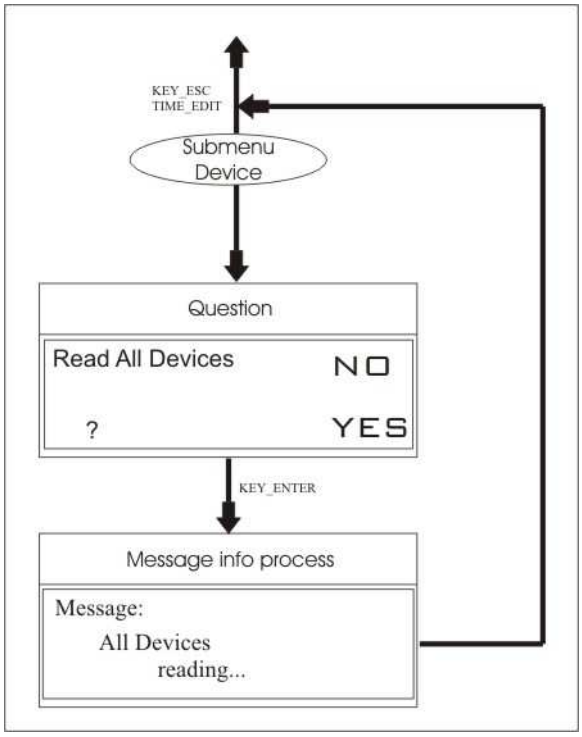
Commands:

- SLEEP - enters sleep mode (Off display & Lock keyboard),
- TRANSFER - activates transfer routes
- RESET - restarts RTU
- SWITCH OFF - Switching off the system for 5 minutes and restarting

Meaning of display symbols for message “Transfer in progress”:

<STATUS> Actual state of transfer activity
<TTT> Overall time of active transfer
<FILE> Name of transferred file

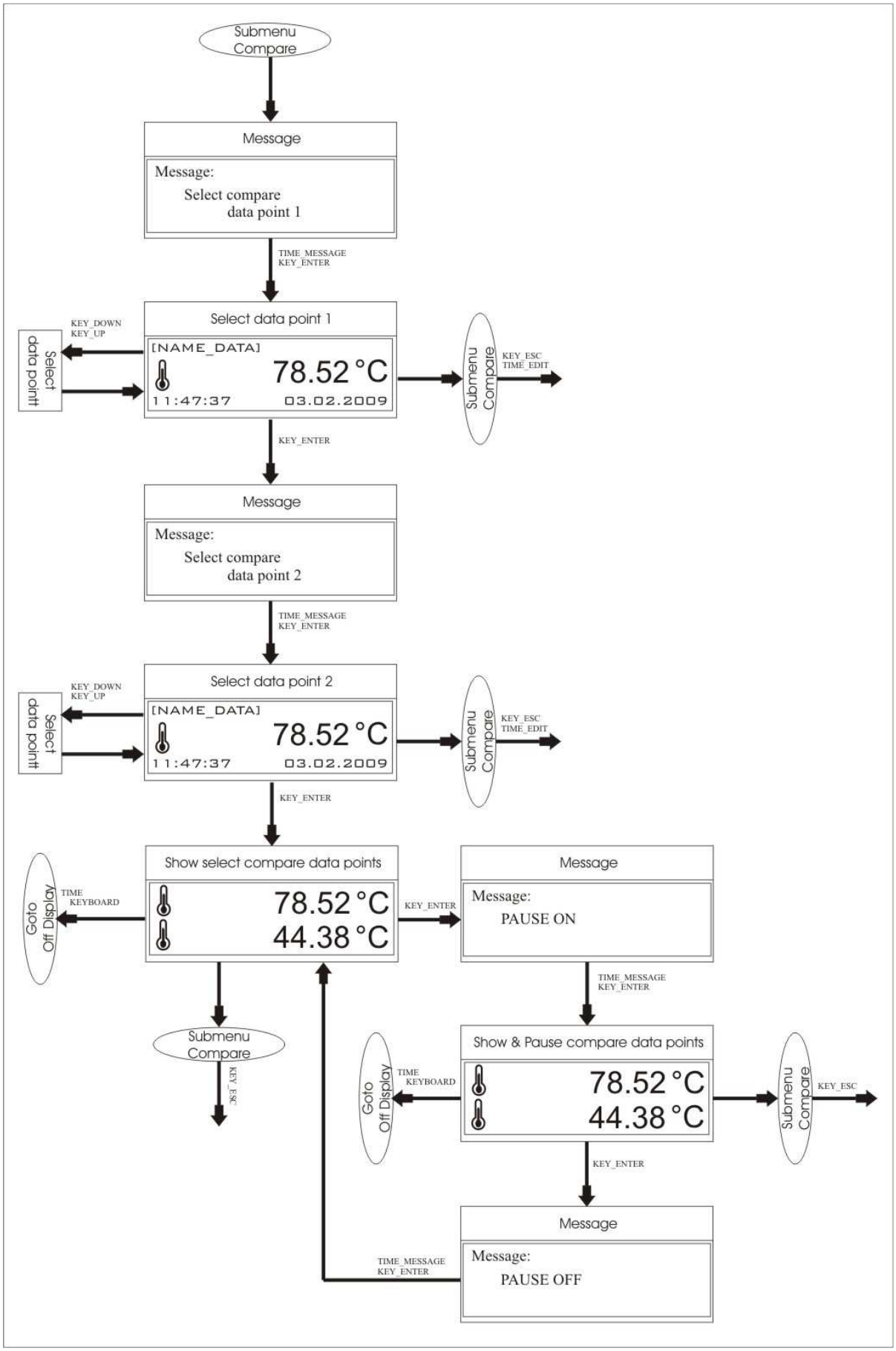
3.4.8 Menu „Device“



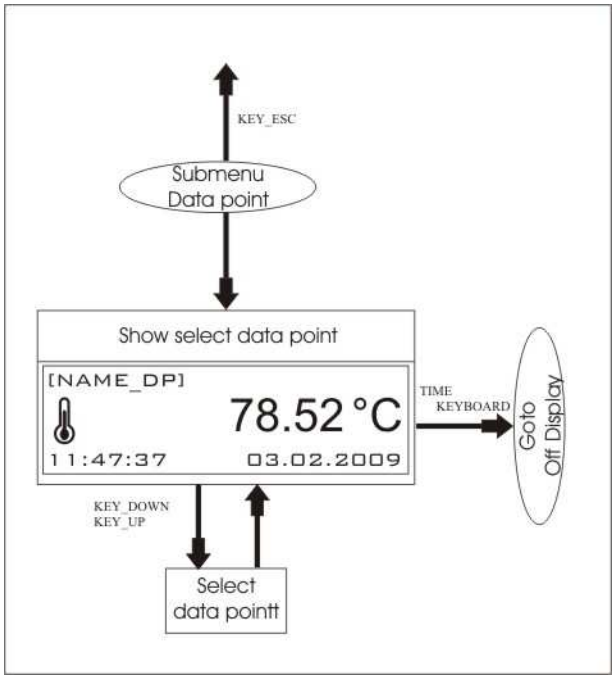
After selecting an item we can enter command to immediate update of all available configured devices.

3.4.9 Menu „Compare“

If data points are configured, it is possible to view two selected data points in one window within menu „Compare“. After selection of an item the BaWiT will ask to select data points to be simultaneously presented.

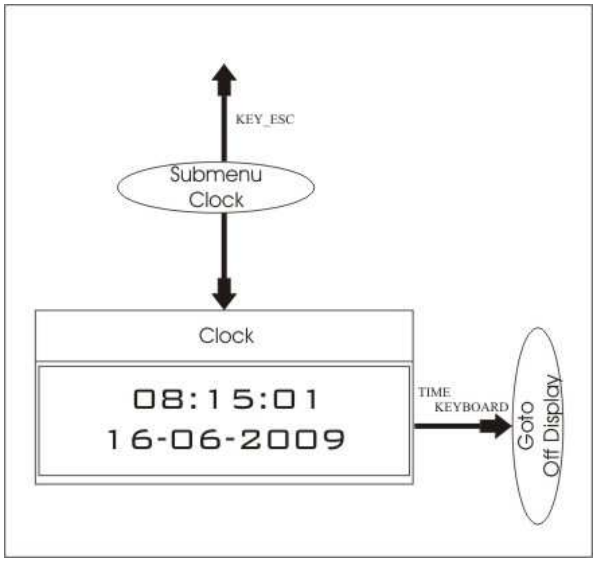

Submenu Compare
Message
Message:
Select compare data point 1
TIME_MESSAGE
KEY_ENTER
Select data point 1
KEY_DOWN
KEY_UP
Select data point
[NAME_DATA]
78.52 °C
11:47:37
03.02.2009
Submenu Compare
KEY_ESC
TIME_EDIT
KEY_ENTER
Message
Message:
Select compare data point 2
TIME_MESSAGE
KEY_ENTER
Select data point 2
KEY_DOWN
KEY_UP
Select data point
[NAME_DATA]
78.52 °C
11:47:37
03.02.2009
Submenu Compare
KEY_ESC
TIME_EDIT
KEY_ENTER
Show select compare data points
78.52 °C
44.38 °C
Goto Off Display
TIME
KEYBOARD
KEY_ENTER
Message
Message:
PAUSE ON
TIME_MESSAGE
KEY_ENTER
Submenu Compare
KEY_ESC
Show & Pause compare data points
78.52 °C
44.38 °C
Goto Off Display
TIME
KEYBOARD
Submenu Compare
KEY_ESC
KEY_ENTER
Message
Message:
PAUSE OFF
TIME_MESSAGE
KEY_ENTER

3.4.10 Menu „Data point“



If data points are configured it is possible to view individual data points in „Data point“ menu.

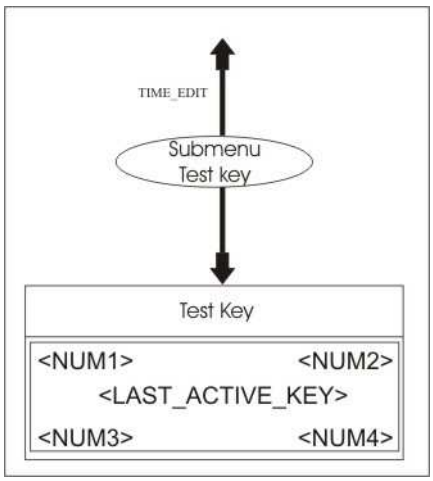
3.4.11 Menu „Clock“



Presentation of actual time and date in following format:

HH:MM:SS
DD-MM-YYYY

3.4.12 Menu „Test key“



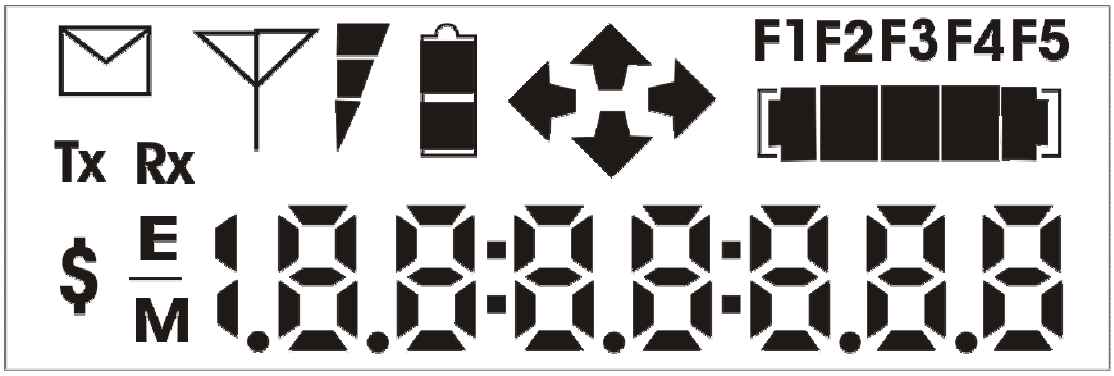
Menu “Test Key” tests keyboard functionality in given environment. This function is used for service purposes. Display presents electrical values of individual buttons. These values inform about actual light sensed by individual control buttons. Last recognized button is displayed in the middle of display. Each pressing of any button results in prolonging the keyboard test menu of RTU for 8 seconds. To exit test menu leave keyboard inactive for min. period of 8 seconds.

Meaning of the display symbols

<NUM1>	Electrical value of button KEY-UP
<NUM2>	Electrical value of button KEY-ESC
<NUM3>	Electrical value of button KEY-DOWN
<NUM4>	Electrical value of button KEY-ENTER
<LAST_ACTIVE_KEY>	Last recognized keyboard button

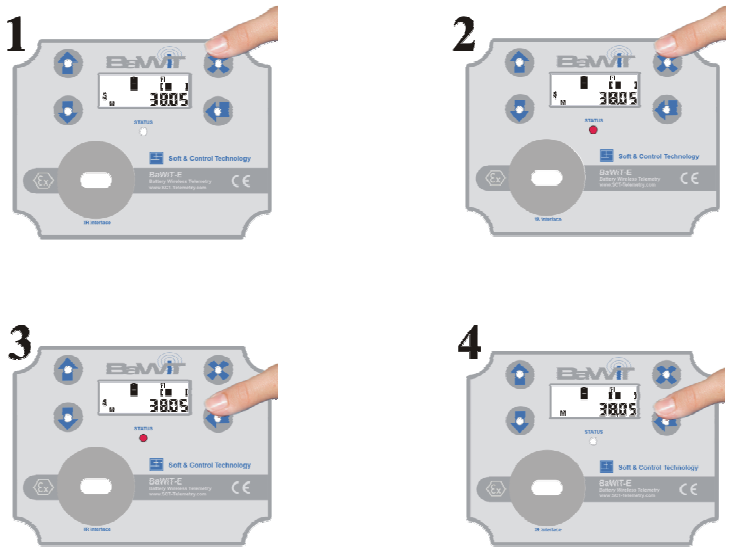
3.5 Menu BaWiT - E with static display

3.5.1 Meaning of symbols



Symbol	Meaning of symbol
-8.8.8-8.8.8-8.8.8	Presented value
E	Neighborhood of zero (recognition of zero)
M	Stabilization (recognition of stable value of measured variable)
$	Blocked keyboard
	GSM modem turned on
	GSM modem signal strength
	Battery state
	Connected optohead (EN 61107) or USB
Tx	Device transmits data via optohead (EN 61107) or USB
Rx	Device receives data via optohead (EN 61107) or USB
	Event indication
F1F2F3F4F5	Sign of presented data point according to configuration
	Bar Graph for presentation of measured variable state of limits

3.5.2 Keyboard unlocking

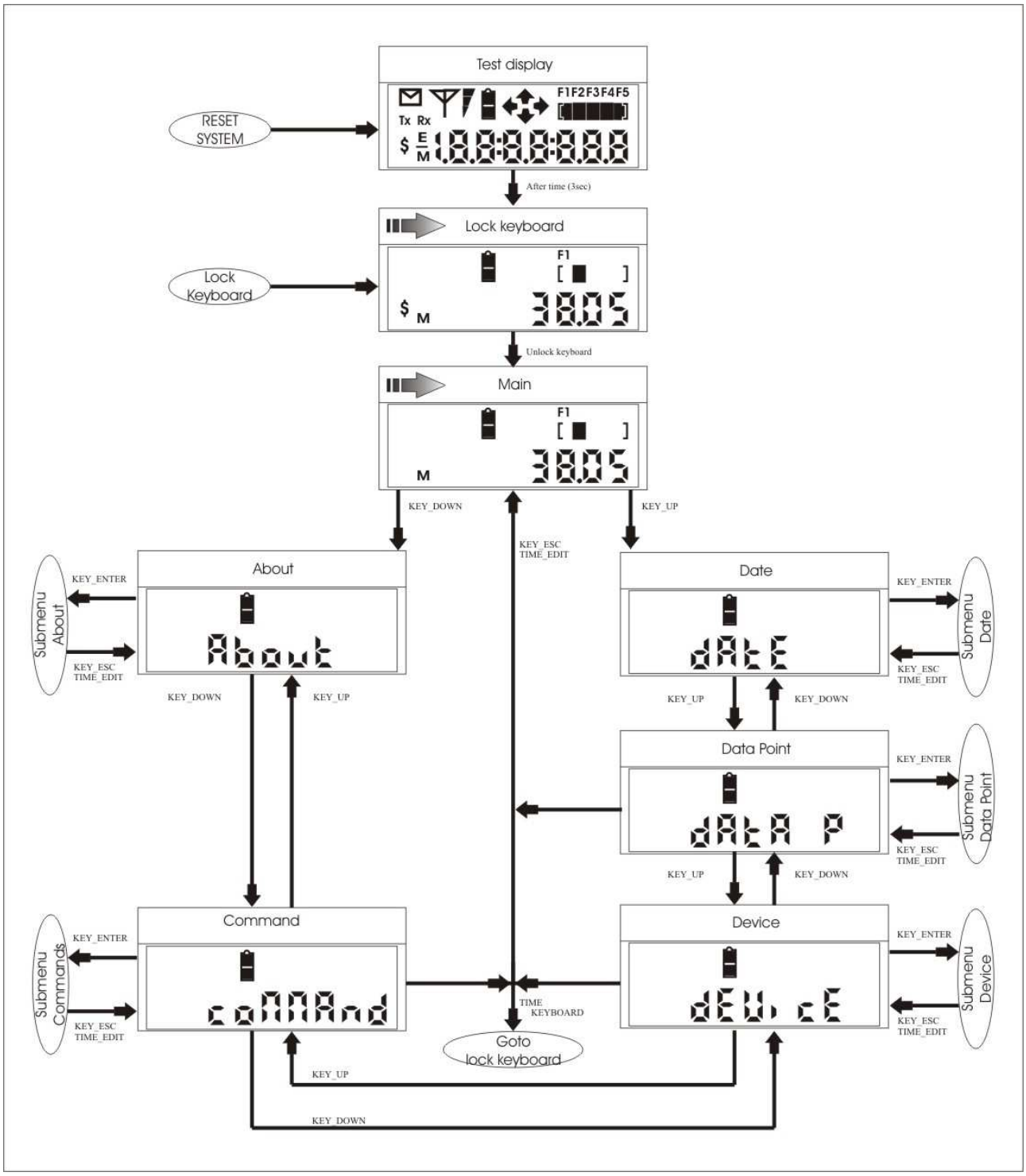


To unlock keyboard press and hold KEY_ESC to lid the LED_KEY. When the LED_KEY is lid confirm keyboard unlocking by pressing KEY_ENTER within short time interval. After unlocking the BaWiT enters main presentation mode (Main).

3.5.3 Menu Overview

<table>
<tr><td rowspan="7"><u>Test Display</u>
Test of the display</td><td rowspan="7"><u>Lock Keyboard</u>
Locking of keyboard</td><td rowspan="7"><u>Main</u>
Main presentation menu</td><td><u>About</u>
Application</td><td></td></tr>
<tr><td rowspan="4"><u>Command</u>
Basic command</td><td><u>Sleep</u>
Unit enters sleep mode</td></tr>
<tr><td><u>Transf</u>
Activation of transfer</td></tr>
<tr><td><u>Reset</u>
Reset of the system</td></tr>
<tr><td><u>Switch off</u>
Switching off the system and restarting</td></tr>
<tr><td><u>Device</u>
Devices – update of all configured devices</td><td></td></tr>
<tr><td><u>Data Point</u>
View Data Point – menu for presentation of individual points</td><td></td></tr>
<tr><td><u>Date</u>
Date and time presentation</td><td></td></tr>
</table>

3.5.4 Main Menu

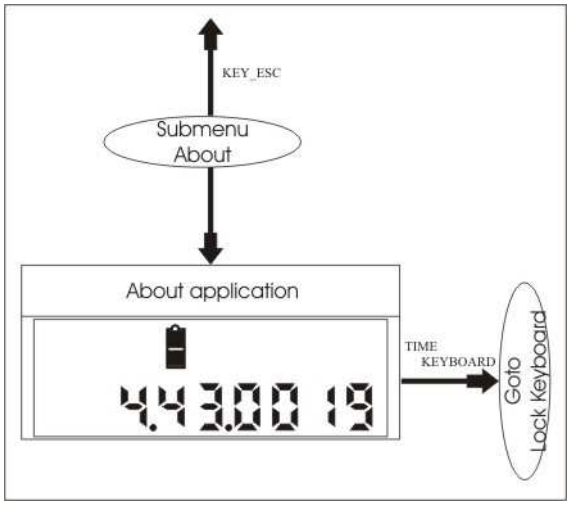


When BaWiT restarts, it will show for a short period of time (cca 3 sec) display test and enters sleep mode (Keyboard lock) where the keyboard is locked and display presents individual data points alternately.

3.5.5 Menu „Main“

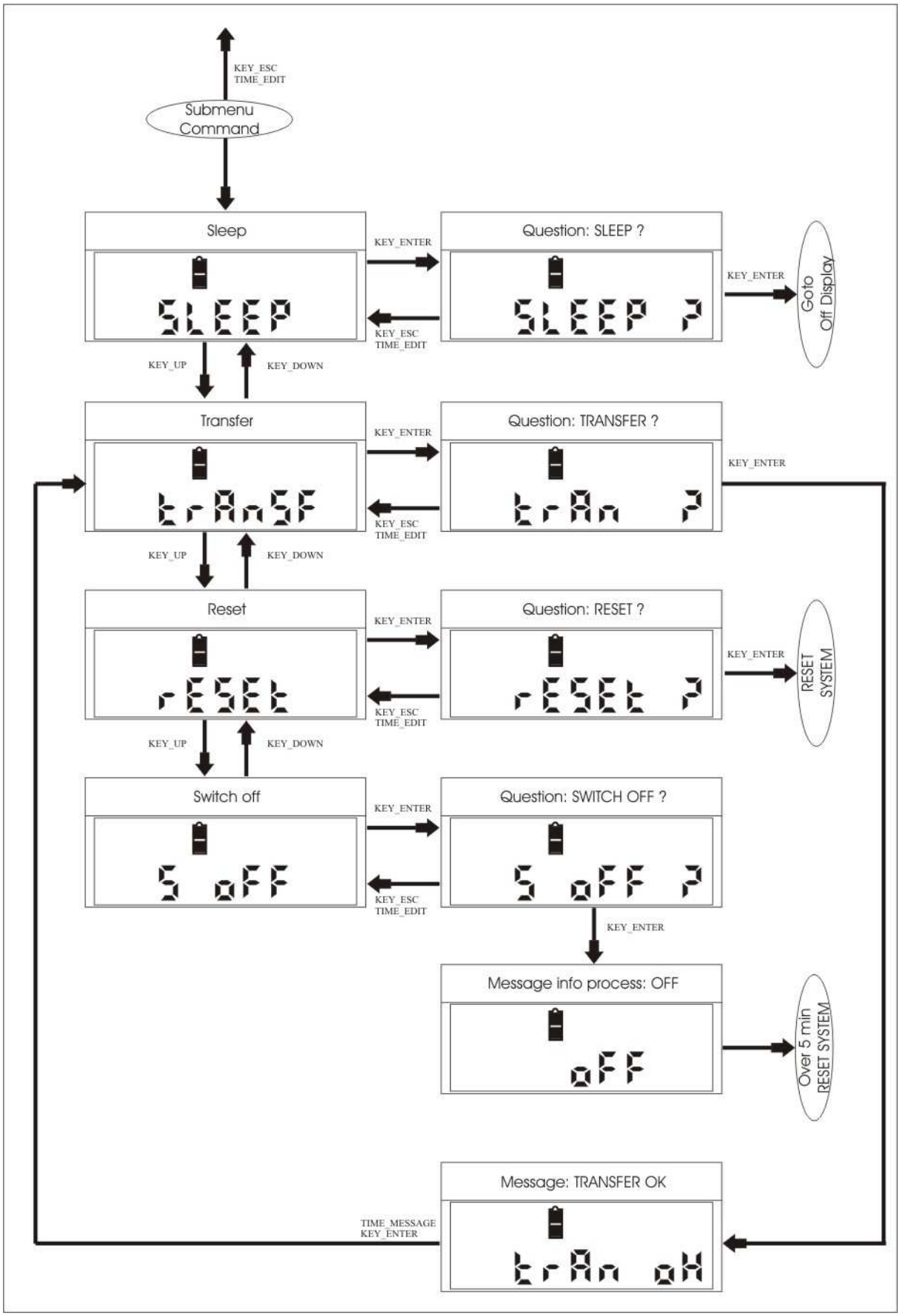
Individual data points are presented for cca 4 sec if these data points are configured and visualization of at least one data point is enabled. This the main menu and provides access to submenu items.

3.5.6 Menu „About“



Selection of item About will present software version.

3.5.7 Menu „Command“

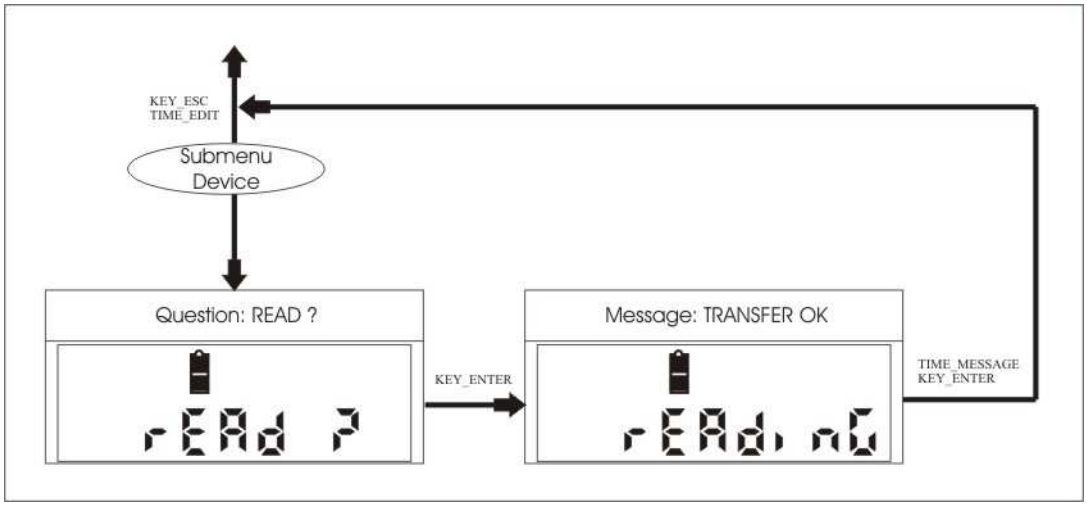


Submenu „Commands“ contains commands for basic BaWiT operation.

Commands:

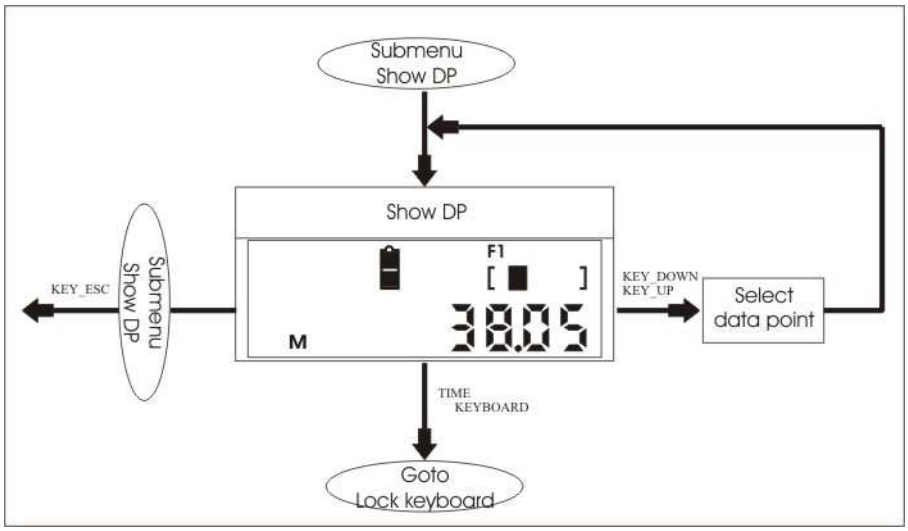
- SLEEP - enters sleep mode (Lock keyboard),
- TRANSFER - activates transfer routes
- RESET - restarts RTU
- SWITCH OFF - switching off the system for 5 minutes and restarting

3.5.8 Menu „Device“



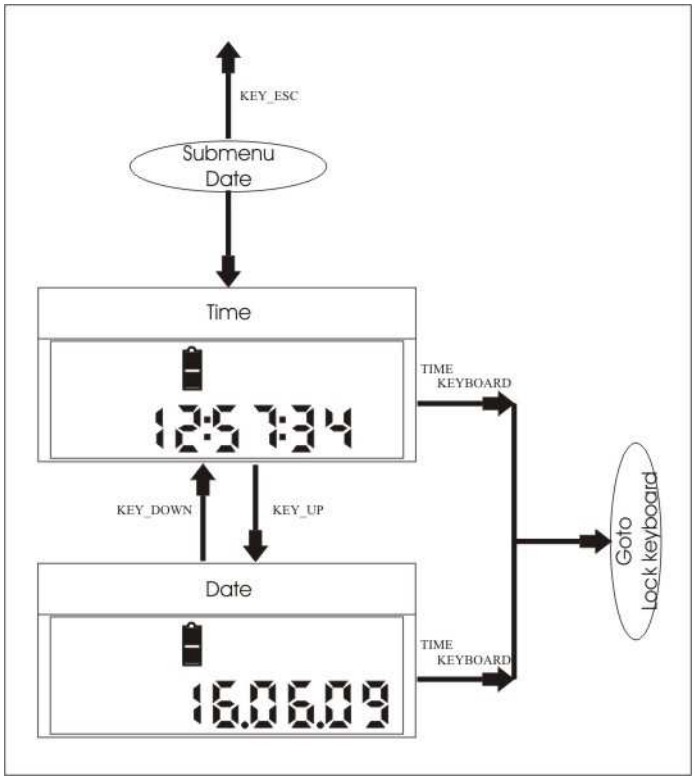
After selecting an item we can enter command to immediate update of all available configured devices.

3.5.9 Menu „Show DP“



It is possible to view individual data points in menu „Show DP“, if these data points are configured.

3.5.10 Menu „Date“



Presentation of actual time and date in following format: HH:MM:SS, DD.MM.YY

4 Overview of directories and files

Logic unit **0:/** contains following system files for: device configuration, logging of system operation, calibration, transferred and received files, etc. Logical unit **0:/** is established on FAT16 file system type. Memory medium is external Data Flash.

Directory	Description
0:\archconc	Directory for storing concentrated data. The data are stored in format described in section 8. The file name is based on object COA and data point IOA address.
0:\archives	Directory for storing proprietary archive data. The data are stored in format described in section 8. The file name is based on object COA and data point IOA address.
0:\config	Directory for storing configuration, calibration and list of users. Mandatory files: · Config.cf5 – RTU configuration · Calib.cf5 – Calibration of analog inputs · Users.cf5 – System users
0:\logs	Directory for storing system logs. Mandatory files: · System.log – System operation information. · Servis.srv (servis.idx) – Service information and its index file.
0:\logs\modem	Directory for storing communication log with modem. The file name consists of starting date of modem.
0:\spl	Directory for storing SPL logs.
0:\sw	Directory for storing SW. Mandatory file is appmain.bin (binary form of actual SW).
0:\tmp	Temporary directory for storing files during communication. Mandatory files are: · Tmp0.bin – for communication with COM0 · Tmp1.bin – for communication with COM1 · Tmp2.bin – for communication with COM2
0:\transfer	Directory for storing files for transfer and sent files. Further subdirectories are created based on transfer route ID and next are described for transfer route with ID=0.
0:\transfer\up0	Directory for files, which will be sent to transfer route with ID=0.
0:\transfer\upok0	Directory for files, which were transferred by transfer route with ID=0.
0:\transfer\dn0	Directory for files, which were transferred from transfer route with ID=0.
0:\transfer\upok0	Directory for files, which were processed from transfer route with ID=0.

5 System Configuration of BaWiT – A/B/C/E

5.1 RTU

Defines basic settings of device.

Item name	Parameter	Description
	id	id
Main RTu parameters	User type	User type
	Hour of day beginning	Hour of day beginning (used for day balance)
	Automatically adjust clock	Automatically adjust clock for daylight saving changes
	Time zone	Time zone
	Caption	RTU Caption
	Name	RTU Name
Display and Keyboard parameters	Key light profile	Key light profile
	Key unlock time	Key unlock time
	Disp Menu Return Time	Disp Menu Return Time
	Disp PowerOff Time	Disp PowerOff Time

5.1.1 Enumeration – parameter: Keyboard light profile

Name	Value	Description
Auto	0	Automatically recognizes environment light intensity.
Low Light	1	Low light level in the object.
Medium Light	2	Normal operational conditions of the lightning.
High Light	3	High light level in the object.

5.2 Time diagrams - Schedules

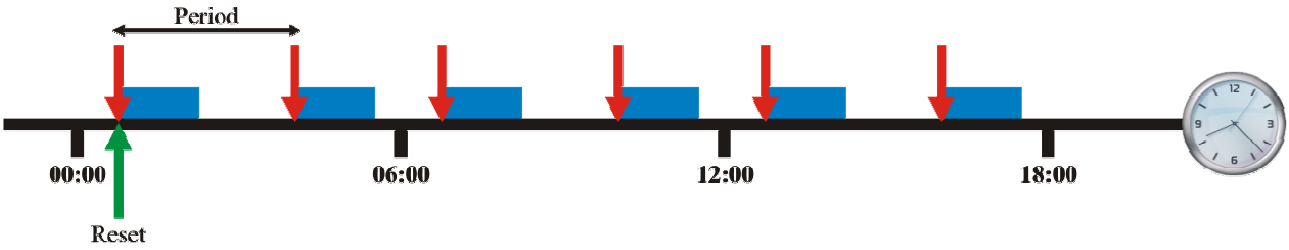
Schedules control operation of all the system. Synchronize when and how often will be individual actions performed.

Item name	Parameter	Description
	Id	Id
	Caption	Time schedule caption
	Type	Time schedule type
	Time from	Time from
	Time to	Time to
	Period	Period between two actions [hh:mm:ss.msec]

5.2.1 Enumeration for time diagram – parameter: Type

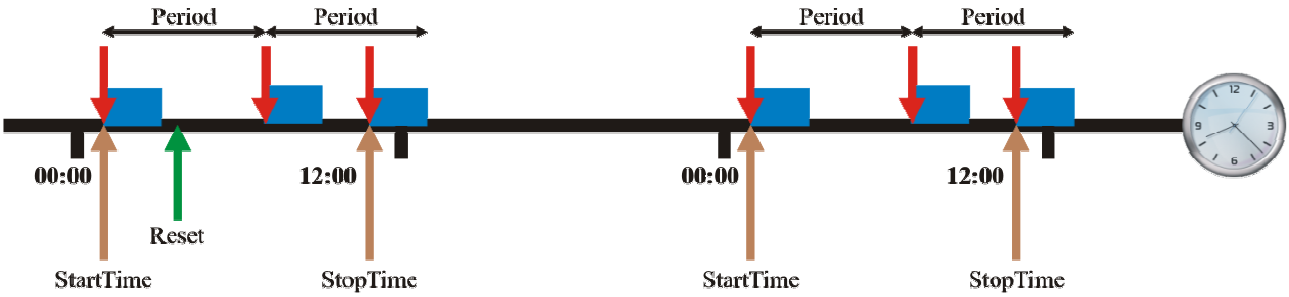
Name	Value	Description
Periodic	1	**Periodic**, operation is performed in regular intervals *Perioda* since start of the device, items *StartTime* and *EndTime* are irrelevant. Picture 5.2.1.1
Daily	2	**Daily**, The action is periodically performed each day between times *StartTime* and *StopTime* according to *Perioda* parameter. Picture 5.2.1.2
Weekly	3	**Weekly**, The action is periodically performed each week between times *StartTime* and *StopTime* according to *Perioda* parameter. Picture 5.2.1.2
Monthly	4	**Monthly**, The action is periodically performed each month between times *StartTime* and *StopTime* according to *Perioda* parameter. Picture 5.2.1.2

5.2.1.1 Picture of periodic time diagram process



Picture shows periodic time diagram process. Green arrow „Reset“ represent start of the system. Red arrow „Period“ represents execution of scheduled actions. Blue rectangle represents performing of individual actions. Period time diagram operates on principle, that since system restart (including) it performs scheduled actions in the same period.

5.2.1.2 Picture of cyclic time diagram process



Picture shows cyclic time diagram process. Green arrow “Reset” represent start of the system. Brown arrows “StartTime” and “StopTime” set the time, when the individual actions are periodically executed, what is shown by red arrows “Perioda”. Blue rectangle represents execution of individual actions. Repeat period starts with “StartTime” (including) and ends with “StopTime” (including).

5.3 Devices – Slave Devices

Devices define which peripherals and external devices will be serviced and the way of service. Analogue inputs, RTU internal temperature, inputs, outputs, communication interfaces and various external devices (e.g. BaWiT D, etc.) belong among devices.

Item name	Parameter	Description
	Id	Id
	Caption	Device caption
	Device type	Device type
	Device number	Device number (0, 1, ...)
	Device version	Device version
	Address	Device address
	Address COA	
	Address 2	Device address 2 (multichannel devices)
Timing	Time schedule	Time schedule for device handling
	Power saving time schedule	Time schedule for device handling in power saving mode
	Read timeout	Read timeout
	Retry interval on error	Retry interval on error read
	Number of retries on error	Number of retries on error read
	Device communication protocol	Device communication protocol
Port settings	Serial port	Serial port
	Baudrate	Baudrate
	Serial port settings	Serial port settings
	For switch 0 (RTU)	For switch 0 (RTU)
	For switch 1 (RTU)	For switch 1 (RTU)

5.3.1 Enumeration – parameter: Device type

Parameter defines the type of device.

Name	Value	Description
None	0	Non active
Analog In	2	Analog input
Binary In	3	
Analog Out	11	Analog output 4-20 mA
Binary Out	12	Digital output
Power manager	29	Device Power Manager
BaWiT	42	Slave BaWiT device
HART sensor	49	Device with HART protocol on serial link.
3axial sensor	50	
HALL sensor	51	
Moisture sensor	52	
PLC BIN8	53	
PLC AIN8	54	
PLC BOUT5	55	

5.3.2 Enumeration – parameter: Device Number

Parameter defines source ID, for example for analogs – which channel is used.

Decice type	Name	Value	Description
Analog In	Single Gain Channel 0	0	Channel no. 0 for single channel voltage measuring against the GND
	Single Gain Channel 1	1	Channel no. 1 for single channel voltage measuring against the GND
	Single Gain Channel 2	2	Channel no. 2 for single channel voltage measuring against the GND
	Single Gain Channel 3	3	Channel no. 3 for single channel voltage measuring against the GND
	Differential Channel 0	0	Channel no. 0 for differential voltage measuring
	Differential Channel 1	2	Channel no. 1 for differential measuring of voltage
Binary In	Channel 0	0	Channel no. 0
	Channel 1	1	Channel no. 1
	Channel 2	2	Channel no. 2
	Channel 3	3	Channel no. 3
Analog Out		0	
Binary Out	Simple Channel 0	0	Channel no. 0 for binary output.
	Simple Channel 1	1	Channel no. 1 for binary output.
	Bistabile	0	Channel no. 0 for Bi stabile relay.
	Simple with Power Channel 0	0	Channel no. 0 for output with power supplying.
	Simple with Power Channel 1	1	Channel no. 1 for output with power supplying.
Power manager		0	
BaWiT		0	
HART sensor		0	
3axial sensor		0	
HALL sensor		0	
Moisture sensor		0	
PLC BIN8		0	
PLC AIN8		0	
PLC BOUT5		0	

5.3.3 Enumeration – Parameter: Device Version

Parameter defines the method of device processing.

Device type	Name	Value	Description
Analog In	0 - Single Gain 1x	0	Measuring against GND
	1 - Single Gain 2x	1	Measuring against AGND, amplification 2x
	2 - Single Gain 4x	2	Measuring against AGND, amplification 4x
	3 - Single Gain 8x	3	Measuring against AGND, amplification 8x
	4 - Single Gain 16x	4	Measuring against AGND, amplification 16x
	5 - Single Gain 32x	5	Measuring against AGND, amplification 32x
	6 - Single Gain 64x	6	Measuring against AGND, amplification 64x
	7 - Single Gain 128x	7	Measuring against AGND, amplification 128x
	16 - Diff	16	Differential voltage measuring
	17 - Diff 2x	17	Differential voltage measuring
	18 - Diff 4x	18	Differential voltage measuring
Binary In	Basic	0	
Analog Out	Basic	0	
Binary Out	Simple	0	Binary output
	Bistabil	1	Bi stabile relay
	Simple with Power	2	Binary output
Power manager	Basic	0	
BaWiT	Basic	0	
HART sensor	Basic	0	
3axial sensor	Basic	0	
HALL sensor	Basic	0	
Moisture sensor	Basic	0	
PLC BIN8	Basic	0	
PLC AIN8	Basic	0	
PLC BOUT5	Basic	0	

5.3.4 Switch configuration – parameter: Dout0, Dout1

Each device has option to set two independent binary outputs to requested state before and after communication. This can controls for example external devices to make communication link available.

Bit	Description
0	Output number 0 - 15
1	
2	
3	
4	Value of output bit after switching.
5	Bit is set by communication with first available device in configuration.
6	Admittance to switch after communication.
7	Admittance to switch before communication.

5.4 Data Point – Datapoints

Data points define which values have to be processed from measuring.

Item name	Parameter	Description
	Id	Id
	Caption	Data point caption
	Name	Datapoint name (used to address points from SPL, e.g.)
	Data type	Data type
Source	Device type	Device type
	Device number	Device number (to distinguish between devices of same type)
	Device variable	Device variable
	Default value	Default data point value until it is read from device (NaN = first read value).
Calculation to physical values	X coordinate of point A	X coordinate of point A for calculation (from electrical to physical values)
	Y coordinate of point A	Y coordinate of point A for calculation (from electrical to physical values)
	X coordinate of point B	X coordinate of point B for calculation (from electrical to physical values)
	Y coordinate of point B	Y coordinate of point B for calculation (from electrical to physical values)
Hardware settings	Value inverting	Value inverting
	State accept timeout	Timeout for state accept (for analog timeout for value stabilization)
	Stabilized sensitivity range	Stabilized sensitivity range
	Zero sensitivity range	Zero sensitivity range
	HW low variable range	HW low variable range
	HW high variable range	HW high variable range
Limits supervising	User limits supervising	User limits supervising (min, max, ext min, ext max, ...)
	Activate transfers	Activate transfers in case of limits violation
	User low variable limit	User low variable limit
	User high variable limit	User high variable limit
	Sensitivity	Sensitivity
	Virtual limits intervals	Virtual limits intervals
	Transfers	Transfers mask for transferring actual value
Archiving	Archive type	Archive type
	Archive interval	Archive interval
	Archive mode	Archive mode
	Max number of records	Maximum number of archived values
User event	User event raising type	User event raising type
	User event index	User event index
Display settings	Show on display	Enable/disable showing on display
	Exponent	Exponent for showing on display (10 ^ this_value)
	Rounding-off	Value rounding for showing on display
	Measure unit	Measure unit of variable
	Icon	Icon showed on display

5.4.1 Data point enumeration – parameter: Data type

Parameter defines type of acquired variable.

Name	Value	Description
Digital	2	Digital value (1 bit)
Analog	4	Analog value (float 32bit)

5.4.2 Enumeration – parameter: Device type

Enumeration of data type is under chapter 5.3.1

5.4.3 Enumeration – parameter: Device number

Enumeration of data type is under chapter 5.3.2

5.4.4 Enumeration – parameter: Device variable

Parameter defines which device variable will be processed.

Device type	Name	Value	Description
Analog In	1 - CalibValue	0	Calibrated value of converter segments
	2 - PT100	1	Temperature sensor PT100
	3 - NI100	2	Temperature sensor NI100
	4 - PT1000	3	Temperature sensor PT1000
	5 - NI1000	4	Temperature sensor NI1000
	255 - AD Value	255	Measured segments of the converter
Binary In	Basic	0	Counter LO (0,0000...99999,9999)
		1	Counter HI (1000 * LO)
		2	Actual value of digital input
		3	Time of period [s]
		4	Actual frequency
Analog Out	Out value	0	
Binary Out	Out value	0	
Power manager	0 - BattVoltage	0	Power supply voltage
	0 - Temperature	11	RTU temperature
	16 - BattID	16	ID of connected power supply
	17 - BattCount	17	Number of connected power supplies
	19 - BattTotalTime0	19	Total time of connected power supply no. 0
	20 - BattTotalTime1	20	Total time of connected power supply no. 1
	21 - BattTotalTime2	21	Total time of connected power supply no. 2
	22 - BattTotalTime3	22	Total time of connected power supply no. 3

	48 - BattVoltage0	48	Voltage of power supply no. 0
	49 - BattVoltage1	49	Voltage of power supply no. 1
	50 - BattVoltage2	50	Voltage of power supply no. 2
	51 - BattVoltage3	51	Voltage of power supply no. 3
BaWiT			ID of read out data point
HART sensor	0 - PrimaryValue	0	PrimaryValue
3axial sensor	0 - gX	0	gX
	1 - gY	1	gY
	2 - gZ	2	gZ
	3 - g	3	g
HALL sensor	0 - Primary Value	0	Primary Value
Moisture sensor	0 - Moisture	0	Moisture
	1 - Temperature	1	Temperature
	2 - DewPoint	2	DewPoint
PLC BIN8	0 - Input 0	0	Input 0
	1 - Input 1	1	Input 1
	2 - Input 2	2	Input 2
	3 - Input 3	3	Input 3
	4 - Input 4	4	Input 4
	5 - Input 5	5	Input 5
	6 - Input 6	6	Input 6
	7 - Input 7	7	Input 7
PLC AIN8	0 - Input 0	0	Input 0
	1 - Input 1	1	Input 1
	2 - Input 2	2	Input 2
	3 - Input 3	3	Input 3
	4 - Input 4	4	Input 4
	5 - Input 5	5	Input 5
	6 - Input 6	6	Input 6
	7 - Input 7	7	Input 7
PLC BOUT5	0 - BOUT0 Value	0	BOUT0 Value
	1 - BOUT1 Value	1	BOUT1 Value
	2 - BOUT2 Value	2	BOUT2 Value
	3 - BOUT3 Value	3	BOUT3 Value
	4 - BOUT4 Value	4	BOUT4 Value

5.4.5 Enumeration – parameter: Inverting of value

Name	Value	Description
Normal	0	Normal
Invert	1	Invert

5.4.6 Enumeration – parameter: Method of supervising

Name	Value	Description
Rising HI	1	Exceeding the maximal limit in direction up
Falling HI	2	Exceeding the maximal limit in direction down
Rising LO	4	Exceeding the minimal limit in direction up
Falling LO	8	Exceeding the minimal limit in direction down

5.4.7 Enumeration – parameter: Activation of transfer & Assigning into the transfer

Name	Value	Description
Transfer ID0	1	
Transfer ID1	2	
Transfer ID2	4	
Transfer ID3	8	

5.4.8 Enumeration – parameter: Type of archiving

Parameter defines the method for data archiving of the data point.

Name	Value	Description
No archiving	0	No archivation, only actual variable value is kept.
All	1	All measured values are archived.
Minimum	2	Minimal values are archived during ArchiveInterval interval.
Maximum	3	Maximal values are archived during ArchiveInterval interval.
Average	4	Average values are archived during ArchiveInterval interval.
Value change	5	Entry is archived after value change by “configured value”.
Value in time	6	Recording of actual state in regular intervals according to ArchiveInterval.
Value in time balancing	7	Recording of actual state at time of StartOfDay from object configuration.

All read values are always checked for set HW limits. Appropriate bit in QD parameter is set according to exceeding the HW limits. If the parameter *LimitsSupervising* is set, corresponding user stations are checked and based on evaluation the appropriate bits in parameter QD – [STATUS_DP] are set.

5.4.9 Enumeration – parameter: Archive mode

Parameter defines memory mode for registering of archives.

Name	Value	Description
Infinite	0	**Infinite**, values are added to archive always at the end of the file unless the full capacity of medium is not reached.
Cyclic	1	**Cyclic**, actual file is renamed to file with same name with replaced last sign for "_" and operation continues with original file name.
Single shot	2	**Single use**, it is not possible to write any further to archive after reaching maximal number of items.

5.4.10 Enumeration – parameter: Condition of generating

Name	Value	Description
New value	1	New value
Minimum	2	Minimum
Maximum	4	Maximum
Ext minimum	8	Ext minimum
Ext maximum	16	Ext maximum
Value change	32	Value change
Stabilized value	64	Stabilized value

5.4.11 Enumeration – parameter: Enabling of presentation

Name	Value	Description
No	0	No
Yes	1	Yes

5.4.12 Enumeration – parameter: DispIcon

Parameter defines presentation of symbol for data point.

Name	Value	Icon	Display	Description
LOGO_SCT	0		G	SCT logo
TIMER	1		G	Analogue clocks symbol
THERMOMETER	2		G	Temperature indicator symbol (temperature variable)
ARCHIVE	3		G	Paper sheet symbol
SETUP	4		G	Spanner and hammer symbol
PRESSURE	5		G	Weight to surface symbol (pressure)
VOLTAGE	6		G	Electrical variable symbol
WEIGHT	7		G	Weight symbol (scale)
TERMINAL	8		G	Desktop PC symbol
COMMANDS	9		G	„PLAY“ symbol
IMPULSES	10		G	Impulses symbol
F1	129	**F1**	S	Symbol F1 - icon
F2	130	**F2**	S	Symbol F2 - icon
F3	131	**F3**	S	Symbol F3 - icon
F4	132	**F4**	S	Symbol F4 - icon
F5	133	**F5**	S	Symbol F5 - icon
G – Graphical display **S – Static display**				

5.5 Transfer routes – Master devices

Transfer routes define transfer configuration to master system. Maximal number of transfers is 8. Each transfer route has set HW, which is used for communication with master system. This HW is set according to parameter *Type*. If transfer route requires login (FTP, MAIL,...) it is necessary to enter login name and password.

If (at least one) transfer is configured, directory **`0:/transfer`** with additional subdirectories **`0:/transfer/up0`**, **`0:/transfer/down0`**, **`0:/transfer/upok0`**, **`0:/transfer/downok0`** for each transfer route will be created in file system. If the file transfer is activated, the file with actual values of analogues, digitals and non-transferred archives will be created in directory **`0:/transfer/up0`** with the name of file based on actual date and time of transfer route activation and all files from directory **`0:/transfer/up0`** will be transferred to server and will be moved to directory **`0:/transfer/upok0`**.

Item name	Parameter	Description
	Id	Id
	Caption	Transfer caption
Timing	Time schedule	Time schedule
	Power saving time schedule	Time schedule for power saving mode
	Application timeout	Application timeout
	Retry interval	Retry interval
	Number of retries	Number of retries
Connection settings	Type	Type
	Connection mode	Connection mode
	Cyclic/spontaneous communication	Cyclic/spontaneous communication
	Communication protocol	Communication protocol
	Connection string	IP address 255.255.255.255, or phone number
	Login for application layer	Login for application layer (FTP. SMTP, POP3)
	Password for application layer	Password for application layer (FTP. SMTP, POP3)
APN	APN Server	APN Server
	APN UserName	APN UserName
	APN Password	APN Password
	APN Timeout	APN Timeout for connecting to GPRS
Modem	PIN for SIM card	PIN for SIM card
	AT commands timeout	AT commands timeout
	Interval of AT command retry	Interval of AT command retry
	Number of AT command retries on error	Number of AT command retries on error
Serial port settings	Serial port	Serial port
	Baudrate	Baudrate
	Serial port settings	Serial port settings
	For switch 0 (RTU)	For switch 0 (RTU)
	For switch 1 (RTU)	For switch 1 (RTU)
Data points	Data points	

5.5.1 Enumeration – parameter: Type

Parameter defines type of established connection.

Name	Value	Description
4 - TCP	4	Establishes data GPRS connection via TCP protocol based on Protocol parameter.
6 - FTP	6	Establishes FTP connection via GPRS protocol based on Protocol parameter.
8 - SMS	8	Receiving and sending of SMS.

5.5.2 Enumeration – parameter: Connection mode

Parameter defines established connection mode.

Name	Value	Description
Master permanent	0	Transfer route is active during whole connection reception (SERVER).
Master Temporary	1	Transfer route is active according to time diagram, receives connection (SERVER).
Slave Permanent	2	Transfer route is established from BaWiT side, after establishing this connection is maintained during all period (CLIENT).
Slave Temporary	3	Transfer route is established from BaWiT side according to time diagram, connection is terminated after transferring all data (CLIENT).

5.5.3 Enumeration – parameter: Protocol

Parameter defines used protocol in the connection.

Transfer route type	Name	Value	Description
4 - TCP	0 - SSP	0	
5 - FTP	0 - Binary	0	
	2 - CSV	2	
8 - SMS	0 - Basic	0	

5.6 Routing

Item name	Parameter	Description
	Id	Id
	Destination logical address	Destination logical address
	Destination physical address	Destination physical address
	Channel	Channel
	PowerID	PowerID
	SpeedID	SpeedID
	Routing enabled	Routing enabled

5.7 Action

Item name	Parameter	Description
	Id	Unique identifier
	Caption	Action caption
	Type	Event type
	Index	Event index
	Log destination	Log destination (file on primary filesystem, serial port, display, file on secondary filesystem)
	Log ID	ID for directory creation for log file
	Max log size	Maximum size of all action logs
	Byte code	Byte code

5.8 Short text

Item name	Parameter	Description
	Id	Id
	Text	Text

5.9 Long text

Item name	Parameter	Description
	Id	Id
	Long text	Long text

6 Users

6.1 User's parameters

Item name	Parameter	Description
	Id	Id
	Login	User login
	User name	Full user name
	Password	User password
	Phone	User phone number

6.1.1 Enumeration – parameter: Rights

Name	Value	Description
Object entry	1	
User	1024	
Modify configuration	2048	
Administrator	4096	
Manufacturer	32768	

7 Calibration configuration

7.1 Calibration parameter

Item name	Parameter	Description
	Id	Id
	DeviceType	Device type
	DeviceNumber	Device number (to distinguish between devices of same type)
	DeviceVersion	Device variable
SampleSetup	SamplesCount	Samples Count
	SamplesInterval	Samples Interval
	FilterMode	Filter Mode
	CalibMode	Calculation of AD converter value to physical value (interpolation type)
	CalibSensitivity	Calibration value - ratio between physical and electrical value
	CalibZero	Physical calibration value which represents zero.
UserCalib	CalibUserZero	User zero value
	CalibUserZeroMax	High boundary (+) for physical variable nulification.
	CalibUserZeroMin	Low boundary (-) for physical variable nulification.
UserCalib 1	UserCalib 2	User Calib
	CalibTime	Calibration date and time
	CalibScale	
Calibration sheet	Sheet	Calibration sheet

7.1.1 Enumeration – parameter: Device type

You can find enumeration of data type in chapter 0

7.1.2 Enumeration – parameter: DeviceNumber

You can find enumeration of data type in chapter 0

7.1.3 Enumeration – parameter: DeviceVersion

You can find enumeration of data type in chapter 0

7.1.4 Enumeration – parameter: Filter mode

Name	Value	Description
Average Volatile	0	
Average	1	

7.1.5 Enumeration – parameter: CalibMode

Parameter defines calibration method.

Name	Value	Description
Linear (two calibration points)	0	Linear (two calibration points)
Interpolation	1	Interpolation

8 Command line

Command line is used via standard Hyperterminal, which is part of operating system. BaWiT is connected to PC with USB or optohead (only for BaWiT E) which emulate RS232. Correct COM port and communication parameters are set in Hyperterminal. Switching application in Hyperterminal into command line mode by entering <CR> - pressing the ENTER key. You can find overview of configuration files in chapter 5.

8.1 Supported commands for APPLICATIONS mode

8.1.1 Commands for controlling BaWiT

8.1.1.1 RESET

- **RESET** – Resets CPU. Executed immediately without Mode change.
- **RESET [APP/LDR/FLH/WHS/TST]** – Resets CPU and switches into selected operational mode.

8.1.1.2 INFO

- **/?** – Device information. (Also applicable /*). Respond is as following:
  - **STC BaWiT-B series AppMain**
  - **UID: 8100.01.01.01.0001**
  - **SW: v4.01.0002**

8.1.1.3 ECHO

- **ECHO** – Replies with actual state of local echo to terminal. State is also stored after device restart (turning off).
- **ECHO [1/0]** – Setting echo state, 0 – Turning off local echo, other character, number – Turning on local echo.

8.1.1.4 DEBUG

- **DEBUG** – Replies with actual state of debug output settings.
- **DEBUG [0/1/3/255]** – N debug dumps on serial port with selected number. Supported ports are 0, 1, 3. Port 255 is setting for disabling of debug dumps to all ports.
  - **DEBUG to COM0**

8.1.1.5 USART

- **USART [300/600/1200/2400/4800/9600/19200/38400/57600/115200/230400/460800/921600]** – Setting of communication rate at configuration port. If rate is not equal with one of the settings, default communication rate 9600 Bd will be set.

8.1.1.6 TIME

- **TIME** – Actual date and time.
- **TIME YYYY-MM-DD HH:MM:SS** – Setting date and time.
- **TIME YYYY-MM-DD HH:MM** – Setting date and time exc. seconds.
- **YYYY-MM-DD HH:MM:SS [MON/TUE/WED/THU/FRI/SAT/SUN]**

8.1.1.7 HELP

- **HELP** – List of commands.

8.1.1.8 XMODEM

Transfers files from/to BaWiT file system, this protocol doesn't support to enter file name directly in protocol, so it is necessary to define these parameters by calling XMODEM function in BaWiT.

After execution of XMODEM the BaWiT will be switched to this mode, if other side will not start communication within 16 seconds, the mode will be canceled.

- **XMODEM [Drive:][Path][FileName]** – switching into XMODEM for entered file. This file will be "set to zero" and is prepared for reception. If request from terminal is sent, the file **0:/xmodem/forsend.dat** will be used.
- **XMODEM** – switching to XMODEM for default values of file names, from the side of BaWiT for reception of file **0:/xmodem/receive.dat**, for sending file **0:/xmodem/forsend.dat**.

After execution of command, the following replies:
XMODEM receive to 0:/xmodem/receive.dat.
XMODEM sending from 0:/xmodem/forsend.dat.
At the end of transfer:
XMODEM end

8.1.1.9 TOFLASH

- **TOFLASH [Drive:][Path][FileName]** – Storing program file into DataFlash intended for this purpose. If the parameter is not set, the file **0:/SW/appmain.bin** will be used.

8.1.1.10 FROMFLASH

- **FROMFLASH [Drive:][Path][FileName]** – Reads stored program file from DataFlash into entered file. If the parameter is not set, the file **0:/SW/appread.bin** will be used. Size of the file is always 248 kB. SLEEP

8.1.1.11 SLEEP

- **SLEEP** – Setting the attribute to allow entering SLEEP mode.

8.1.1.12 BATT

- **BATT** – Actual battery state. Implemented in BaWiT.
- **BATT [0/1/2/3]** – Connects battery with selected ID.
- **BATT [254]** – Disconnects all the batteries.
- **BATT [255]** – Connects all the batteries.

8.1.1.13 BATTCHANGE

Registering of battery replacement

- **`BATTCHANGE ID Capacity [DateTime]`** – Registering of battery replacement. Implemented in BaWiT-B and BaWiT-C.

ID – battery ID (0, 1, 2, 3 depends on possible number of connected batteries)
Capacity – Nominal battery capacity in Ah.
DateTime – Non mandatory item, if missing, actual date and time will be used.

8.1.1.14 MODEM

- **`MODEM [Param]`** – Sending of entered command to modem.

8.1.2 Commands for operating with configuration

8.1.2.1 LOGIN

- **`LOGIN USR PWD`** – user login to station. Login is valid for command line.[1]

8.1.2.2 CONFIG

- **`CONFIG 1`** – View information about object configuration.
- **`CONFIG 3`** – View information about transfer routes configuration.
- **`CONFIG 5`** – View information about time diagrams configuration.
- **`CONFIG 6`** – View information about archive configuration.
- **`CONFIG CHECK`** – Configuration check and if change, copy to transfer route directory.
- **`CONFIG SEND`** – Copies one file of configuration to transfer route directory.

8.1.3 Commands for operation with data

8.1.3.1 MONIT

- **`MONIT`** – Writes text about actual monitoring of variables.
  - YYYY-MM-DD HH:MM:SS TAV=1 QD=00 V=123.456 <Variable Name>

[1] Not implemented.

8.1.4 File system commands

8.1.4.1 TYPE

- **`TYPE [Drive][Path][FileName] [HEX/TXT/EXT] [LineLen]`** – Writes file contents to terminal based on selected format. It is necessary to enter complete file path.
- **`TYPE [Drive][Path][FileName] [HEX/TXT/EXT] [N]`** – Writes formatted file content to terminal. If format not selected, the default format is TXT. It is necessary to enter complete path.
- **`TYPE [Drive][Path][FileName] EXT`** – Writes formatted file content according to file extension. It is necessary to enter complete path.
    - TAV:123 DT:YYYY-MM-DD HH:MM:SS VAL:123.456 ST:xFF S:xFF

8.1.4.2 FORMAT

- **`FORMAT [DRIVE]`** – Formats disk to file system FAT12/16/32 (automatically according to capacity). All disk data will be deleted.

8.1.4.3 DIR

- **`DIR`** – Writes content of actual directory on actual disk.
- **`DIR [Drive][Path]`** – Writes directory content based on selected path.

8.1.4.4 CD

- **`CD [Drive][Path]`** – Changes actual directory to selected (complete path must be entered).

8.1.4.5 COPY

- **`COPY [Drive][Path][FileName] [Drive][Path][FileName]`** – Copies file „file1“ to file „file2“.

8.1.4.6 RENAME

- **`RENAME [Drive][Path][FileNameOld] [Drive][Path][FileNameNew]`** – Moves and renames file „fileold“ to „filenew“.

8.1.4.7 MKDIR

- **`MKDIR [Drive][Path]`** – Makes directory with entered path. Complete path must be entered.

8.1.4.8 DEL

- **`DEL [Drive][Path][FileName]`** – Deletes selected file from file system.

8.1.5 Commands for MeterEnergy module

MeterEnergy module measures consumption.

8.1.5.1 BENERGY

- **`BENERGY`** – View of actual consumed energy for individual battery cells and active duration of device peripherals.

8.1.5.2 BCLR

Registering of battery replacement.

- **BCLR [0/1/2/3]** – Registering of battery replacement based on ID. Number of batteries is based on BaWiT type.
- **BATT [255]** – Registering of all batteries replacement.

8.1.5.3 BCURRENT

- **BCURRENT [ID]** – Reading out of actual set average current for peripheral based on ID for actual consumption calculation.
- **BCURRENT [255]** – Listing of actual set average currents for individual peripherals used for actual consumption calculation.
- **BCURRENT [ID] [VALUE]** – Setting of actual average current for given peripheral based on ID for actual consumption calculation by value VALUE.
- **BCURRENT [255] [0]** – Setting of producer default average currents to peripherals for actual consumption calculation.

8.1.5.4 BTEMP

- **BTEMP** – Presentation of actual operation registers for MeterEnergy module.

Peripheral code list for MeterEnergy module

Name	Value	Description
ECP_PRIMARY	0	CPU_SLEEP, RAM, 3AXI_SLEEP, DATA_FLASH_SLEEP, STATIC_DISPLAY
ECP_CPU	1	CPU_ACTIVE
ECP_KEYBOARD	2	Optical keyboard
ECP_3AXI	3	3D accelerometer
ECP_XAD	4	External AD converter
ECP_DATA_FLASH_READ	5	Data Flash read
ECP_DATA_FLASH_WRITE	6	Data Flash write
ECP_DIGI_OUT_00	7	Digital output 0
ECP_DIGI_OUT_01	8	Digital output 1
ECS_SECUNDARY	9	SDcard_SLEEP, GPS, USART., GRAPHIC_DISPLAY
ECS_SD_CARD_READ	10	SD card read
ECS_SD_CARD_WRITE	11	SD card write
ECS_MODEM	12	Modem

8.2 Supported commands for LOADER mode

8.2.1 Commands for controlling of BaWiT

8.2.1.1 RESET

- **RESET [APP/LDR/FLH/]** – CPU reset and switch to selected activity Mode.
- **RESET** – CPU reset. Performed immediately without Mode change.

RESET FLH – Reset CPU and setting FLH mode. In this mode the CPU is switched to FLH mode, image of main FLASH part will be copied to location *OldFlashFile* of the internal DataFlash.

- Following this, the CPU will copy location *NewFlashFile* from internal DataFlash to main location of FLASH CPU a CPU is switched to *WORKMODE_AP1* mode.
- **RESET APP** – Reset CPU and switch to *WORKMODE_AP1*, the number for application execution attempts is 8, if the execution is not successful after eighth attempt, the BaWit will automatically copy previous image of main location FLASH CPU from location *OldFlashFile* in internal DataFlash.

8.2.1.2 XMODEM

Transfers application file directly to main FLASH memory of CPU. This mode is activated automatically if other side doesn't establish communication within 60 seconds. This mode will be canceled and BaWiT enters application mode. Pressing CTRL+C will switch to command mode.

- **XMODEM** – switch to XMODEM. BaWiT is ready for receiving of binary file to main location of FLAS CPU.

8.2.1.3 INFO

- **/?** – Device information.
  - **STC BaWiT-B series loader**
  - **UID: 8100.01.01.01.0001**
  - **SW: v2.22.0008**

9 Controlling via SMS

It is possible to enter SMS commands in groups.

Commands are sent:

- Without password
  - RTU recognizes user by telephone number of transfer route
  - RTU has configured transfer route without security elements (e.g.: tel. number, password)
- With password
  - RTU has configured transfer route with security element: password
  - RTU has configured transfer route with security element: password and tel. number

9.1 Format of command

9.1.1 Format for data reading

„PASSWORD COMMAND?“

Parameter name	Meaning
PASSWORD	Password of transfer route. This password is not entered, if transfer route is has not this password set.
COMMAND	Action command or registry name

9.1.2 Format for data entry

„PASSWORD COMMAND=DATA“

Parameter name	Meaning
PASSWORD	Password of transfer route. This password is not entered, if transfer route is has not this password set.
COMMAND	Action command or registry name
DATA	Value to be set

9.2 Logic of command SMS processing

SMS file name: „DDHHMMSS.sms“

- DD – Day
- HH – Hour
- MM – Minute
- SS – Second

Format of SMS commands:

YYYY-MM-DD HH:MM:SS TELEPHONE_NUMBER CRLF TEXT_SMS

9.3 Commands

9.3.1 System commands

9.3.1.1 RESET=

- RTU restart.

Command RESET= can be entered only as last command, following commands are ignored.

ACTION	NOTE
Command	
reset=	
Response	
reset=OK	

9.3.2 Application commands

9.3.2.1 dp?

- Reads out group of data points (their actual value), which are assigned to selected transfer route.

ACTION	NOTE
Command	
dp?	
Response	DATA – Data read out
DATA	

9.3.2.2 dp.NAME?

- Reads out actual value of data point

ACTION	NOTE
Command	NAME – abbreviated data point name
dp.NAME?	
Response	NAME – abbreviated data point name u VALUE – data point value
dp.NAME =VALUE	

9.3.2.3 dp.NAME=VALUE

- Register of data point value, for example output control.

ACTION	NOTE
Command	NAME – abbreviated data point name VALUE – data point value
dp.NAME =VALUE	
Response	NAME – abbreviated data point name VALUE – data point value
dp.NAME =VALUE	

10 SPL Language

The system has integrated own SPL language. The operation is based on interpreter, which allows user to program own application code. It support various operations as follows: mathematical, logical, relational, operands for data points, configuration items, system values. Supports following types of data value: integers, real numbers, logical values. SPL language has own instruction set is analogy to assembler. There is built language super-structure at higher programming level above the SPL language for easier implementation of user code.

Overview of instructions		
Instructions of conditions		
Instruction	**Operand**	**Description**
END		Unconditional termination of action code execution
EQ	==	Tc &= (Src1 == Src2)
NE	!=	Tc &= (Src1 != Src2)
LT	<	Tc &= (Src1 < Src2)
LE	<=	Tc &= (Src1 <= Src2)
GT	>	Tc &= (Src1 > Src2)
GE	>=	Tc &= (Src1 >= Src2)
NEW		New condition, i++, c=0, T[i]=1 (T0=1, T1..7=0)
OR		Next cumulative item, c++, Tc[i]=1
ELSE		T[i]=!T[i], applies for last condition
ENDIF		if(i) i–
Operational instructions		
Instruction	**Operand**	**Description**
NOP		No operation
ENDC		Conditional termination of action code execution
MOV		Dst=Src1 (it is possible to replace for example Dst=Src1+0)
ADD		Dst=Src1 + Src2
SUB		Dst=Src1 - Src2
MUL		Dst=Src1 * Src2
DIV		Dst=Src1 / Src2
MOD		Dst=Src1 % Src2 (float -> int)
AND		Dst=Src1 & Src2 (float -> unsigned)
IOR		Dst=Src1 | Src2 (float -> unsigned)
XOR		Dst=Src1 ^ Src2 (float -> unsigned)
EE		Calling for (inserting to buffer) event Src1 with parameter Src2

11 System Configuration of BaWiT – D

BaWiT – D has individual configuration. Transfers, data points and devices are being configured. Output necessary power for RFi module, communication channel and logic address are configured for transfer route. Variables define which data will be processed from devices.

11.1 RTU

Defines basic settings of device.

Item name	Parameter	Description
	Id	Id
	User type	User type
	Hour of day beginning	Hour of day beginning (used for day balance)
	Automatically adjust clock	Automatically adjust clock for daylight saving changes
	Time zone	Time zone
	Caption	RTU Caption
	Name	RTU Name

11.2 Data points – Datapoints

Data points define which values have to be processed from measuring.

Item name	Parameter	Description
	Id	Id
	Caption	Data point caption
Destination Source	Data type	Data type
	Device type	Device type
	Device number	Device number (to distinguish between devices of same type)
	Device variable	Device variable
	Default value	Default data point value until it is read from device (NaN = first read value).
Calculation to physical values	X coordinate of point A	X coordinate of point A for calculation (from electrical to physical values)
	Y coordinate of point A	Y coordinate of point A for calculation (from electrical to physical values)
	X coordinate of point B	X coordinate of point B for calculation (from electrical to physical values)
	Y coordinate of point B	Y coordinate of point B for calculation (from electrical to physical values)
Hardware settings	Value inverting	Value inverting
	State accept timeout	Timeout for state accept (for analog timeout for value stabilization)

Limits supervising	User limits supervising	User limits supervising (min, max, ext min, ext max, ...)
	Activate transfers	Activate transfers in case of limits violation
	User low variable limit	User low variable limit
	User high variable limit	User high variable limit
	Sensitivity	Sensitivity
Archiving	Archive type	Archive type
	Archive interval	Archive interval
Display settings	Rounding-off	Value rounding for showing on display
	Measure unit	Measure unit of variable

11.2.1 Data point enumeration – parameter: Value type

Parameter defines type of acquired variable.

Name	Value	Description
Digital	2	Digital value (1 bit)
Analog	4	Analog value (float 32bit)

11.2.2 Enumeration – parameter: Device type

Parameter defines the type of device.

Name	Value	Description
None	0	Non active
Analog In	2	Analog input
Binary In	3	Digital input
Binary Out	12	Digital output
Power manager	29	Device Power Manager

11.2.3 Enumeration – parameter DeviceNumber

Parameter defines source ID, for example for analogs – which channel is used.

Device typ	Name	Value	Description
Analog In	Single Gain Channel 0	0	Channel no. 0 for single channel voltage measuring against the GND
	Single Gain Channel 1	1	Channel no. 1 for single channel voltage measuring against the GND
	Single Gain Channel 2	2	Channel no. 2 for single channel voltage measuring against the GND
	Single Gain Channel 3	3	Channel no. 3 for single channel voltage measuring against the GND
Binary In	Channel 0	0	Channel no. 0
	Channel 1	1	Channel no. 1
	Channel 2	2	Channel no. 2
	Channel 3	3	Channel no. 3
Binary Out	Simple Channel 0	0	Channel no. 0 for binary output.
	Simple Channel 1	1	Channel no. 1 for binary output.
	Bistabile	0	Channel no. 0 for Bi stabile relay.
	Simple with Power Channel 0	0	Channel no. 0 for output with power supplying.
	Simple with Power Channel 1	1	Channel no. 1 for output with power supplying.
Power manager		0	

11.2.4 Enumeratiom – parameter: Device version

Parameter defines the method of device processing.

Device type	Name	Value	Description
Analog In	0 - Single Gain 1x	0	Measuring against GND
Binary In	Basic	0	
Analog Out	Basic	0	
Binary Out	Simple	0	Binary output
	Bistabile	1	Bi stabile relay
	Simple with Power	2	Binary output
Power manager	Basic	0	

11.2.5 Enumeration – parameter: Device variable

Parameter defines which device variable will be processed.

Device type	Name	Value	Description
Analog In	1 - CalibValue	0	Calibrated value of converter segments
	2 - PT100	1	Temperature sensor PT100
	3 - NI100	2	Temperature sensor NI100
	4 - PT1000	3	Temperature sensor PT1000
	5 - NI1000	4	Temperature sensor NI1000
	255 - AD Value	255	Measured segments of the converter
Binary In	Basic	0	Counter LO (0,0000...99999,9999)
		1	Counter HI (1000 * LO)
		2	Actual value of digital input
		3	Time of period [s]
		4	Actual frequency
Analog Out	Out value	0	
Binary Out	Out value	0	
Power manager	0 - BattVoltage	0	Power supply voltage
	0 - Temperature	11	RTU temperature
	16 - BattID	16	ID of connected power supply
	17 - BattCount	17	Number of connected power supplies
	19 - BattTotalTime0	19	Total time of connected power supply no. 0
	48 - BattVoltage0	48	Voltage of power supply no. 0

11.2.6 Enumeration – parameter: Inverting of value

Name	Value	Description
Normal	0	Normal
Invert	1	Invert

11.2.7 Enumeration – parameter: Method of supervising

Name	Value	Description
Rising HI	1	Exceeding the maximal limit in direction up
Falling HI	2	Exceeding the maximal limit in direction down
Rising LO	4	Exceeding the minimal limit in direction up
Falling LO	8	Exceeding the minimal limit in direction down

11.2.8 Enumeration – parameter: Activation of transfer & Assigning into the transfer

Name	Value	Description
Rising HI	1	Exceeding the maximal limit in direction up
Falling HI	2	Exceeding the maximal limit in direction down
Rising LO	4	Exceeding the minimal limit in direction up
Falling LO	8	Exceeding the minimal limit in direction down

11.2.9 Enumeration – parameter: Type of archiving

Parameter defines the method for data archiving of the data point.

Name	Value	Description
No archiving	0	No archiving, only actual variable value is kept.
All	1	All measured values are archived.
Minimum	2	Minimal values are archived during ArchiveInterval interval.
Maximum	3	Maximal values are archived during ArchiveInterval interval.
Average	4	Average values are archived during ArchiveInterval interval.
Value change	5	Entry is archived after value change by “configured value”.
Value in time	6	Recording of actual state in regular intervals according to ArchiveInterval.
Value in time balancing	7	Recording of actual state at time of StartOfDay from object configuration.

All read values are always checked for set HW limits. Appropriate bit in QD parameter is set according to exceeding the HW limits. If the parameter *LimitsSupervising* is set, corresponding user stations are checked and based on evaluation the appropriate bits in parameter QD – [STATUS_DP] are set.

11.3 Transfer routes – Transfers

Item name	Parameter	Description
	Id	Id
Connection settings	Communication protocol	Communication protocol
	Connection string	IP address 255.255.255.255, or phone number

11.3.1 Enumeration – parameter: Used communication protocol

This parameter defines used protocol in the connection.

Name	Value	Description
0 - SSP	0	

11.4 Routing

Item name	Parameter	Description
	Id	Id
	Destination logical address	Destination logical address
	Destination physical address	Destination physical address
	Channel	Channel
	PowerID	Power ID
	SpeedID	Speed ID
	Routing enabled	Routing enabled

11.5 Users

Item name	Parameter	Description
	Id	Id
	Login	User login
	User name	Full user name
	Password	User password
	Rights	User rights

11.5.1 Enumeration – parameter: Rights

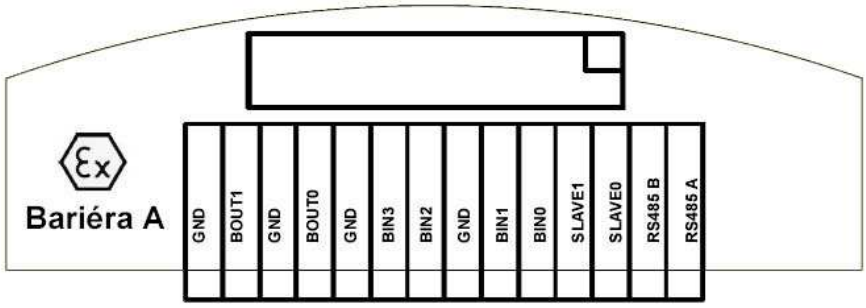
Name	Value	Description
Object entry	1	
User	1024	
Modify configuration	2048	
Administrator	4096	
Manufacturer	32768	

12 Overview of products

Graphical overview of products	
BaWiT - A	**BaWiT - B**
	
BaWiT - C	**BaWiT - D**
	
BaWiT - E	
	

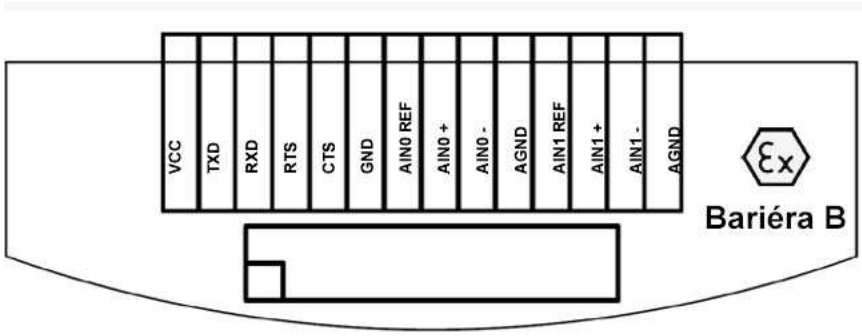
13 Electrical connection

13.1 BaWiT – A/B/C



GND – Signal ground **BOUT0, BOUT1 – Binary outputs** **BIN0 - BIN3 – Binary, impulse, frequency inputs** **RS485 A/B – RS485 Master interface** **SLAVE 0/1 – common contact for Slave interface**		**SLAVE 0**	**SLAVE 1**
	RS485	RS485 A	RS485 B
	RS232	RS232 TXD*	RS232 RXD*
	4-20mA	Loop +	Loop -

- **TXD is output signal and RXD is input signal of the device**

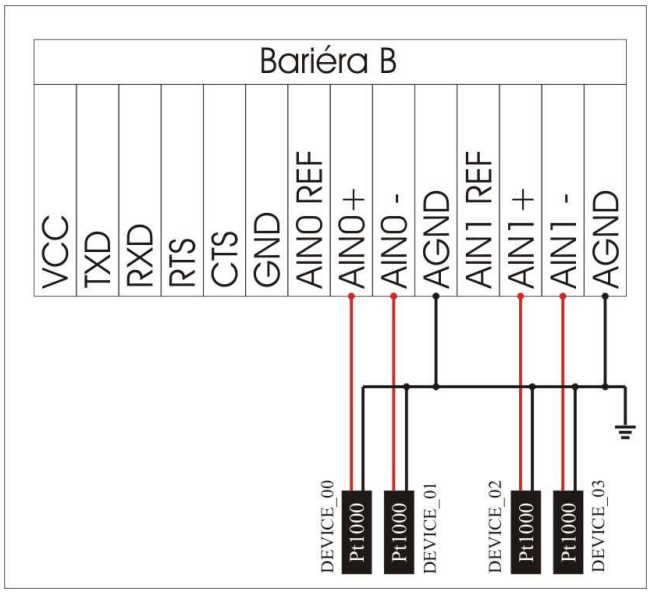


VCC – Permanent power supply 3,3V / 250mA **TXD* – Signal TXD RS232 master** **RXD* – Signal RXD RS232 master** **RTS* – Signal RTS RS232 master** **CTS* – Signal CTS RS232 master** **GND – Signal ground**	A/D 0	**AIN0 REF** – Output of reference voltage **AIN0+** - positive terminal for measuring **AIN0-** - negative terminal for measuring **AGND** – Analogue ground
	A/D 1	**AIN1 REF** – Output of reference voltage **AIN1+** - Positive terminal for measuring **AIN1-** - Negative terminal for measuring **AGND** – Analogue ground

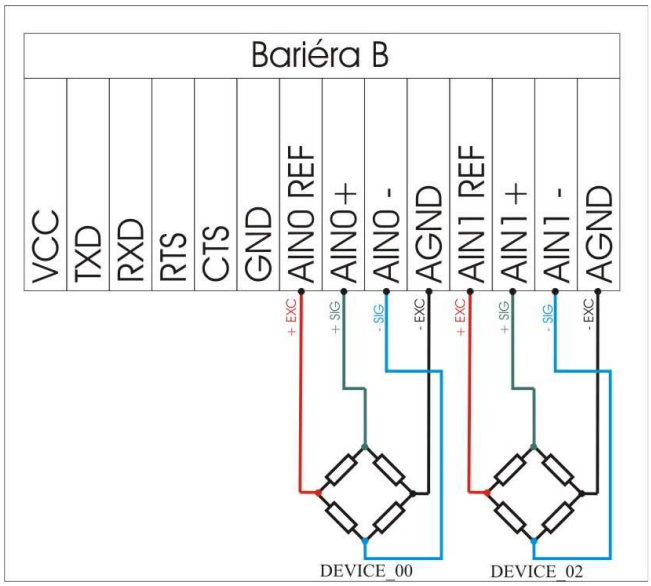
- **TXD, RTS are output signals and RXD, CTS are input signals of the interface**

13.1.1 Analog interface

13.1.1.1 Connection of PT100/NT100/PT1000/NT1000 sensors

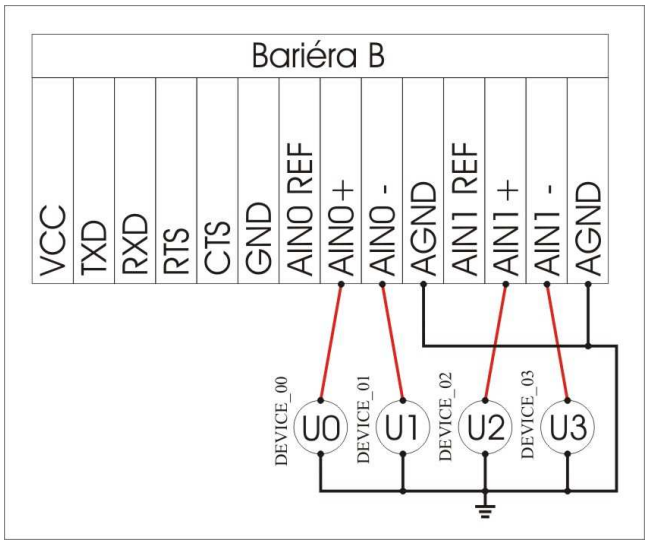


13.1.1.2 Bridge connection – 4-wire



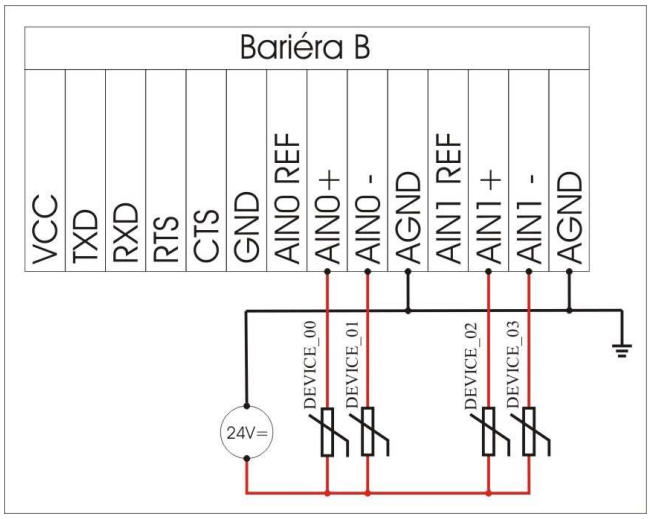
13.1.1.3 Connection of four voltage inputs with common ground

Input operational range depends on device HW configuration.

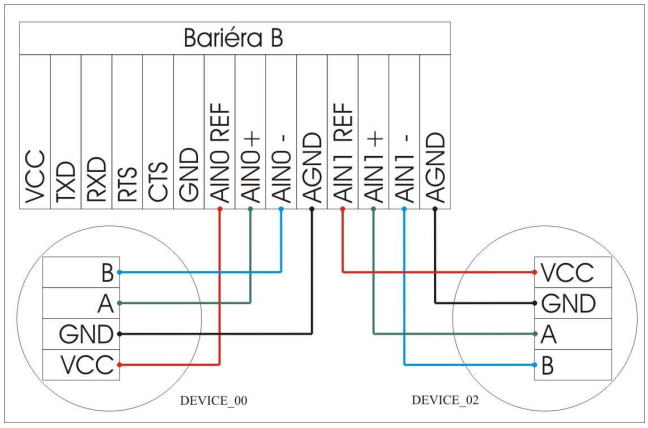


13.1.1.4 Connection of 4-20mA links with external power supplying of sensors

System BaWiT is capable to measure 4-20mA input currents but the requirement is external power supplying of sensors generating measured current. Current is being measured on internal shunts.

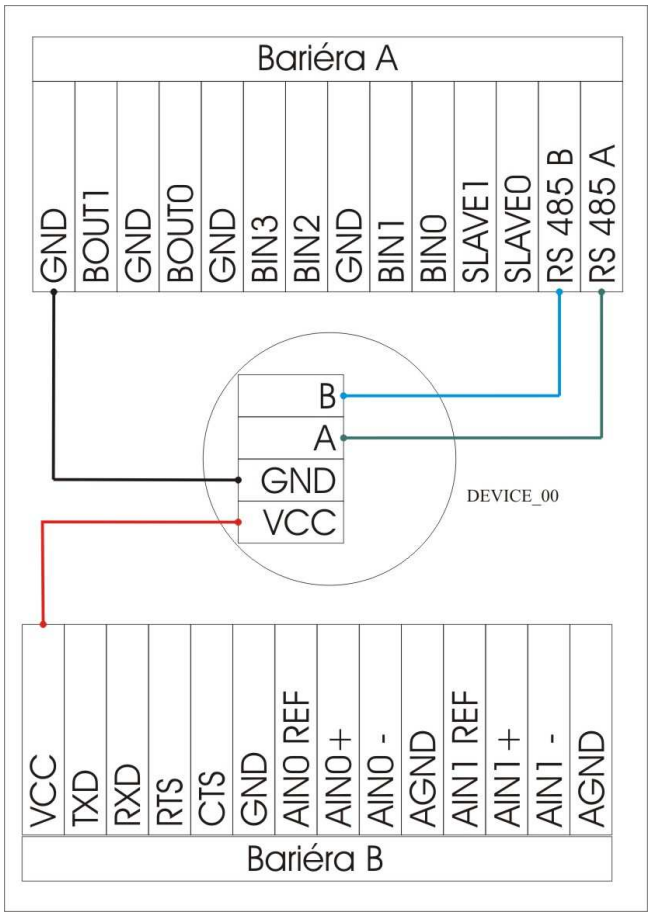


13.1.1.5 Connection of analog HALL probe

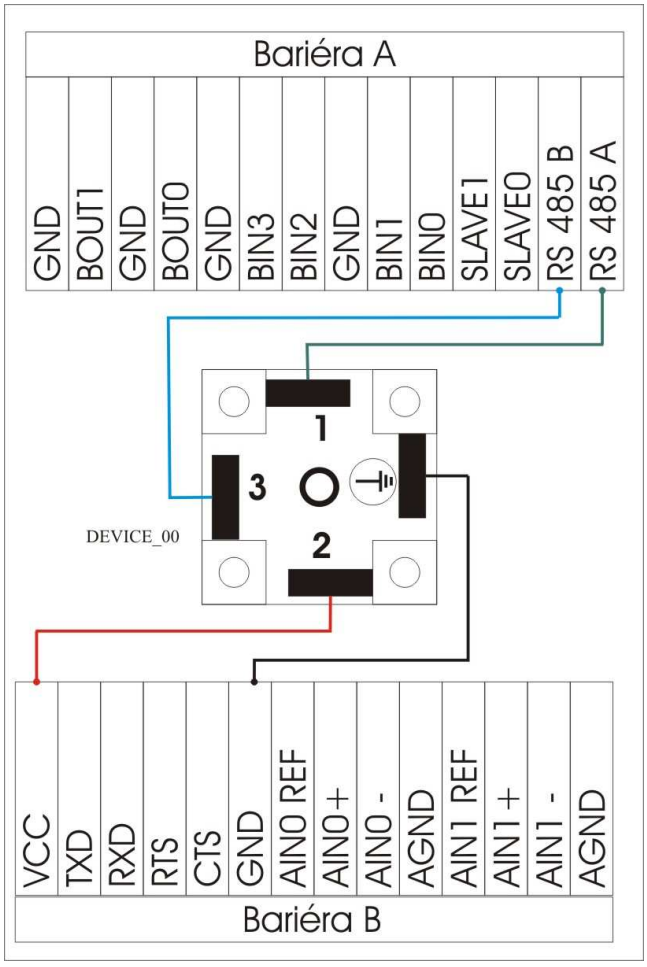


13.1.2 Interface RS485

13.1.2.1 Connection of digital HALL probe



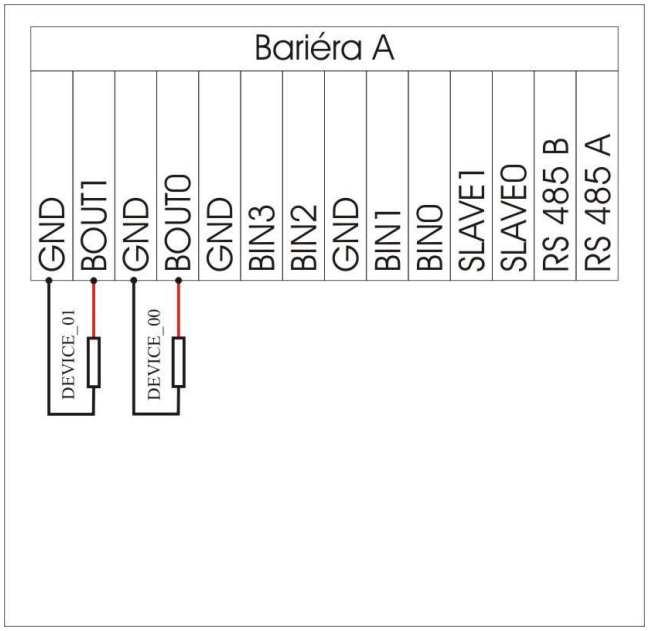
13.1.2.2 Connection of temperature sensor SCT2711/SCT2712



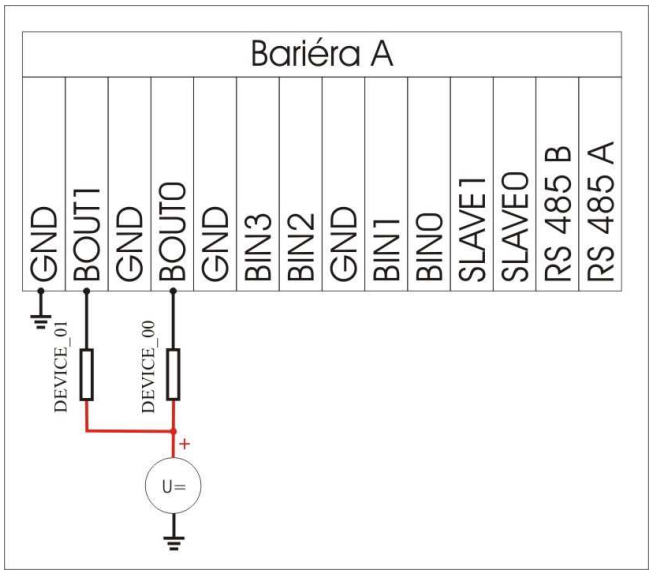
13.1.3 Binary outputs

The system has two binary outputs, which can be configured as active (mosfet switches power supply of BaWiT to output)

13.1.3.1 Connection of active binary outputs



13.1.3.2 Connection of passive binary outputs

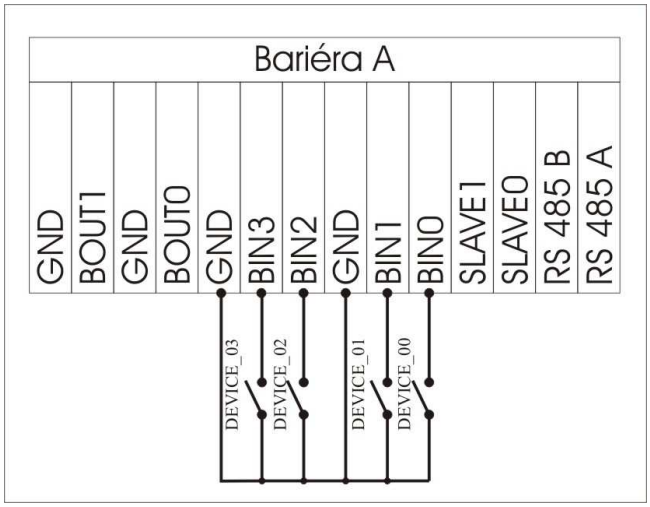


13.1.4 Binary inputs

The system has four binary inputs.

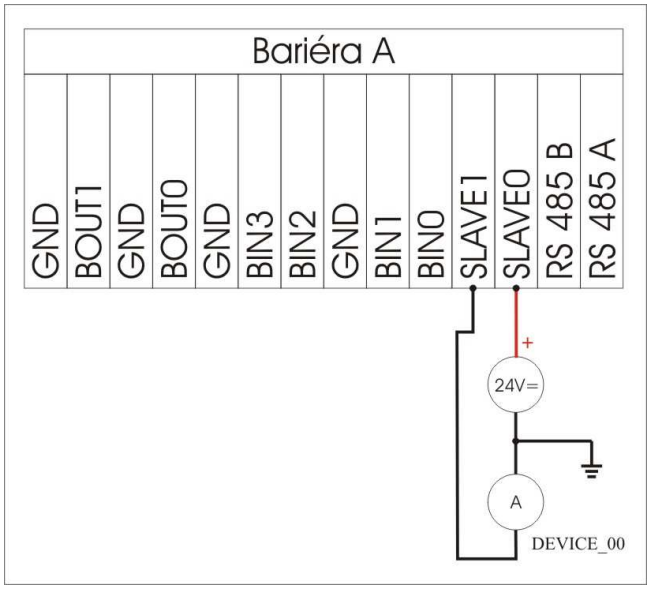
13.1.4.1 Connection of binary/impulse inputs

Binary inputs are active so the switch contact is sufficient as input. Inputs are powered directly by BaWiT system.



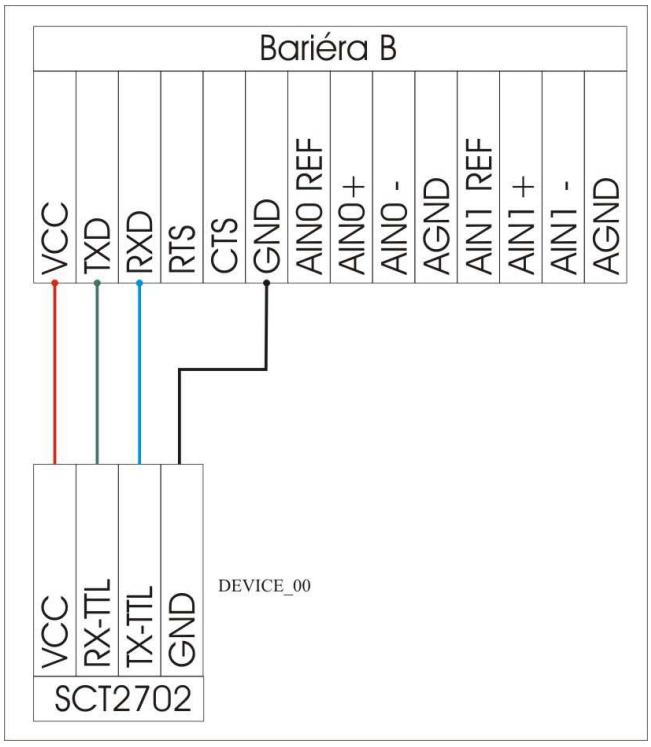
13.1.5 Interface 4-20mA

Interface 4-20mA is standard current loop. The BaWiT limits current from external power supply according to value of primary measured variable.

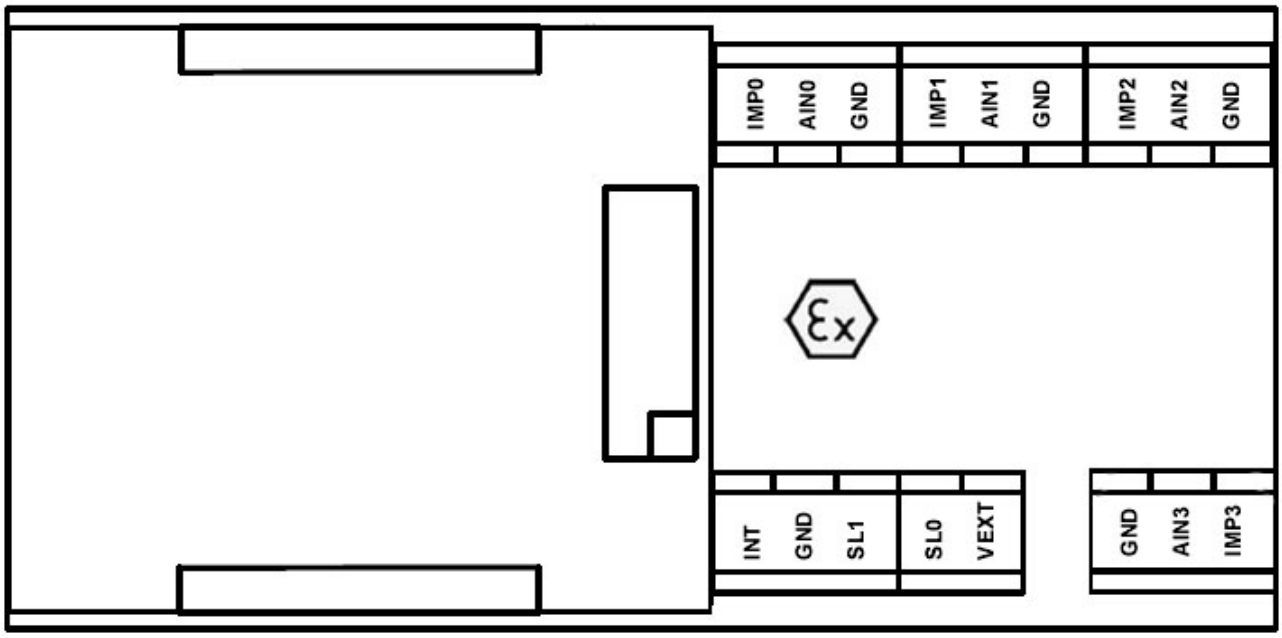


13.1.6 Interface TTL232

13.1.6.1 Connection of pressure sensor SCT2702



13.2 BaWiT – D

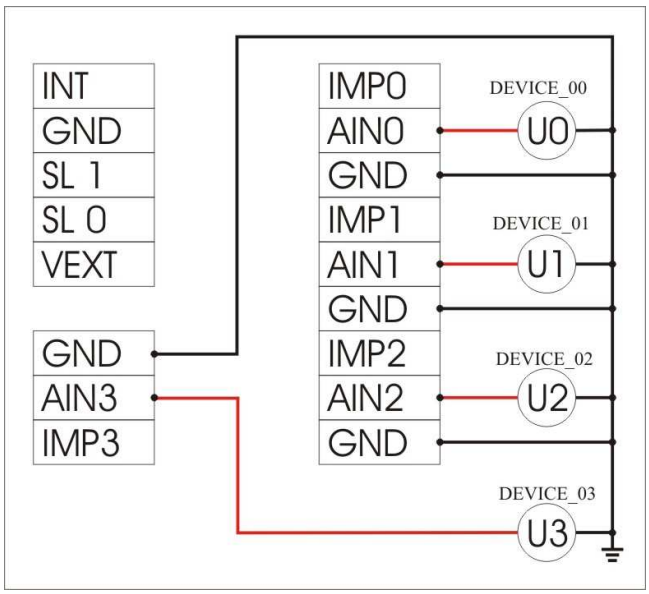


GND – Signal ground
VEXT – Input for extern power supply
IMP0 – IMP3 – Binary, impulse, frequency inputs
AIN0 – AIN3 – Analogue inputs, detection of cable disconnection
SL 0/1 – common terminal for Slave interface
INT – Interrupt from device to master system

	SL0	**SL1**
RS485	RS485 A	RS485 B
RS232	RS232 TXD	RS232 RXD
USB	DM	DP

13.2.1 Analogue interfaces

It is possible to connect 4 analogue voltage inputs with common ground to system BaWiT. Operational range if input depends on device HW configuration.

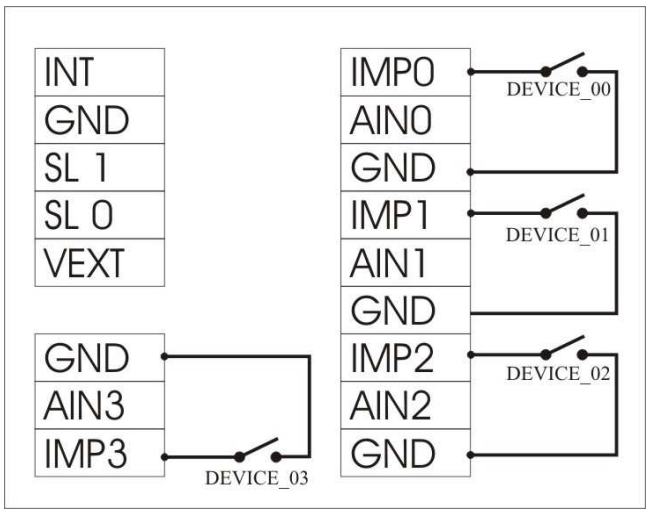


13.2.2 Binary inputs

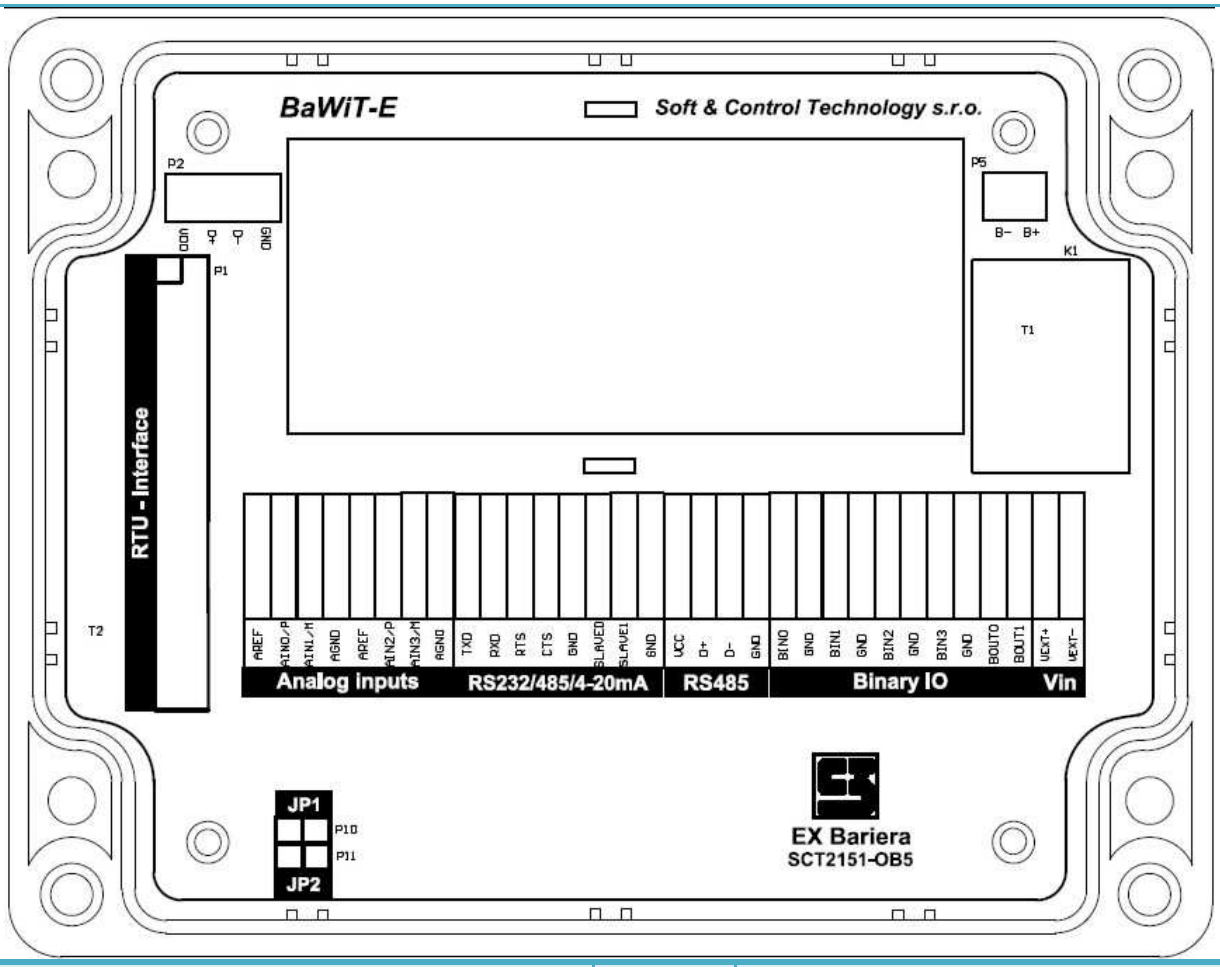
System has four binary inputs.

13.2.2.1 Connection of binary/impulse inputs

Binary inputs are active so the switch contact is sufficient as input. Inputs are powered directly by BaWiT system.



13.3 BaWiT – E

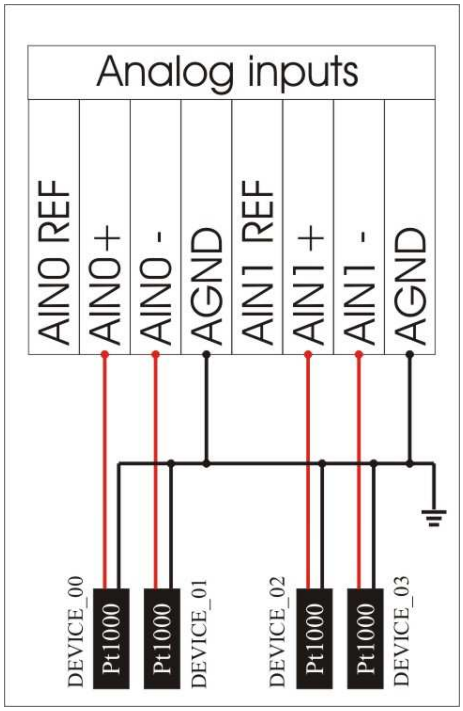


TXD – Signal TXD RS232 master
RXD – Signal RXD RS232 master
RTS – Signal RTS RS232 master
CTS – Signal CTS RS232 master
GND – Signal ground
BOUT0, BOUT1 – Binary outputs
BIN0 - BIN3 – Binary, impulse, frequency inputs
RS485 A/B – RS485 Master interface
SL 0/1 – common terminal for Slave interface
VEXT+ - terminal for external power supply

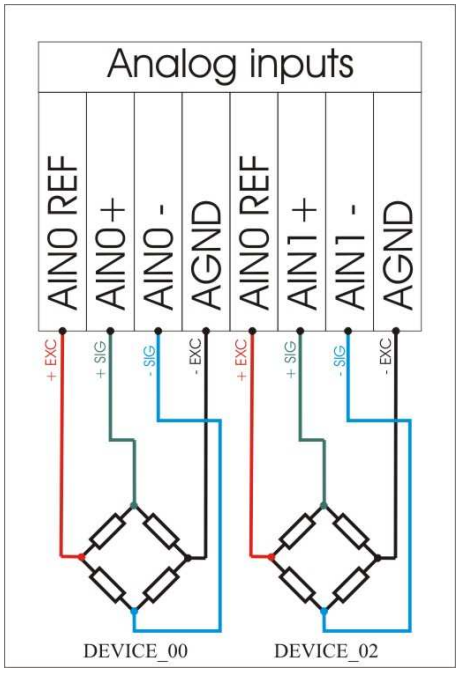
A/D 0	**AIN0 REF – Output of reference voltage** **AIN0+ - Positive measurement terminal** **AIN0- - Negative measurement terminal** **AGND – Analog ground**	
A/D 1	**AIN1 REF** – Output of reference voltage **AIN1+** - Positive measurement terminal **AIN1-** - Negative measurement terminal **AGND** – Analog ground	
	SLAVE 0	**SLAVE 1**
RS485	RS485 A	RS485 B
RS232	RS232 TXD	RS232 RXD
4-20mA	Loop +	Loop -

13.3.1 Analogue interfaces

13.3.1.1 Connection of PT1000 sensors

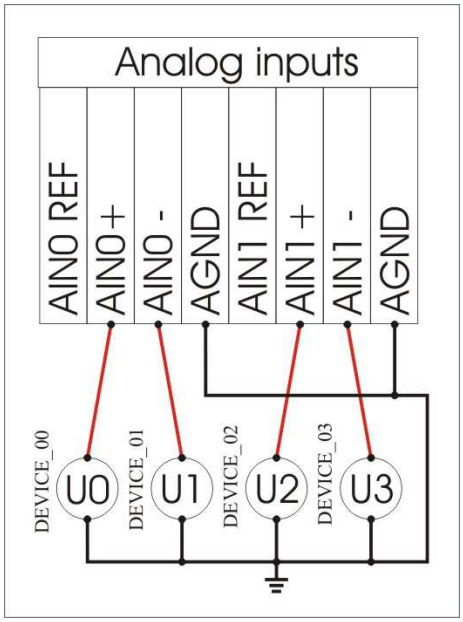


13.3.1.2 Bridge connection – 4-wire



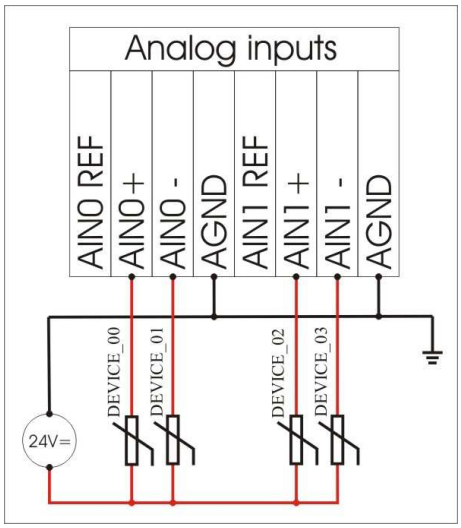
13.3.1.3 Connection of four voltage inputs with common ground

It is possible to connect 4 analog voltage inputs with common ground to the system BaWiT. Input operational range depends on device HW configuration.

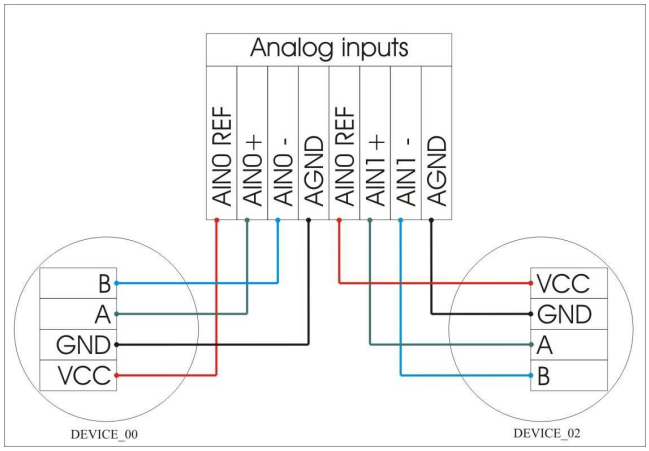


13.3.1.4 Connection of 4-20mA links with external power supplying of sensors

System BaWiT is also capable of measuring 4-20mA current inputs where the condition is external power supplying of sensors generating measured current. Current is measured by internal shunt.

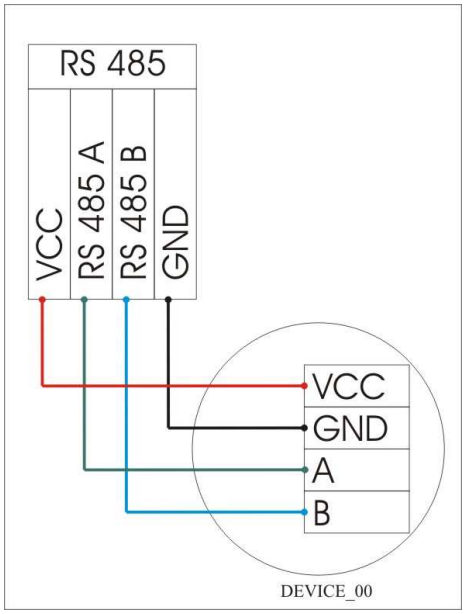


13.3.1.5 Connection of analog HALL probe

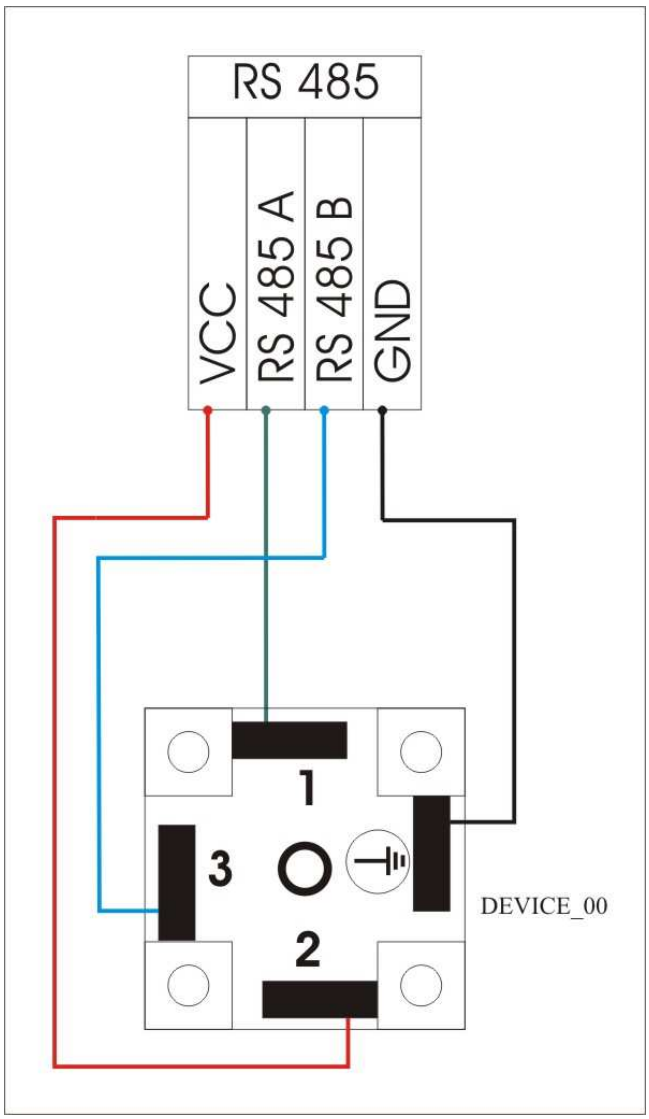


13.3.2 Interface RS485

13.3.2.1 Connection of digital HALL probe



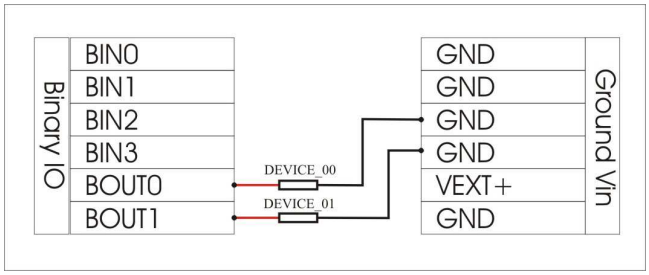
13.3.2.2 Connection of temperature sensor SCT2711/SCT2712



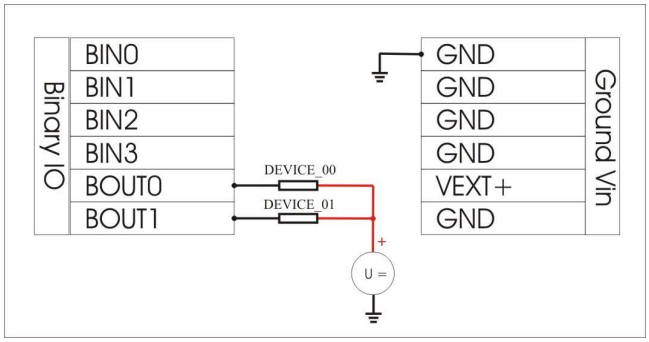
13.3.3 Binary inputs

The system has two binary outputs, which can be configured as active (MOSFET switching power supply of BaWiT to output) or as one switching contact with bi-stabile relay (250V/10A). Each output is connected to one of the terminal blocks.

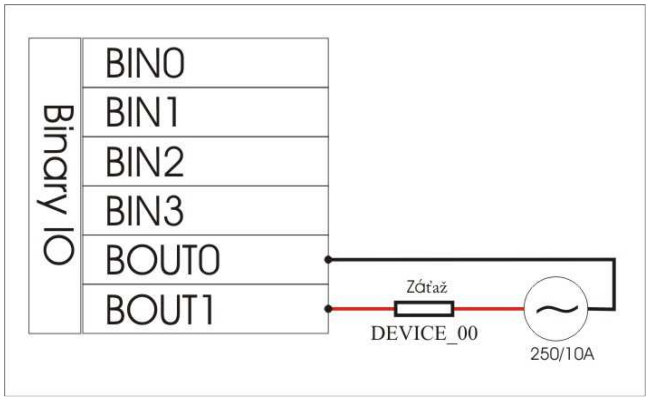
13.3.3.1 Connection of active binary outputs



13.3.3.2 Connection of passive binary outputs



13.3.3.3 Connection of binary outputs as switching contact of relay

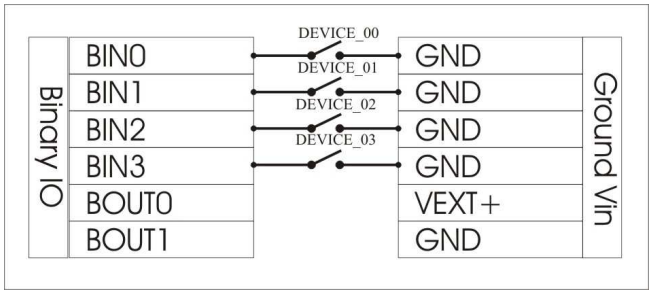


13.3.4 Binary inputs

The system has four binary inputs.

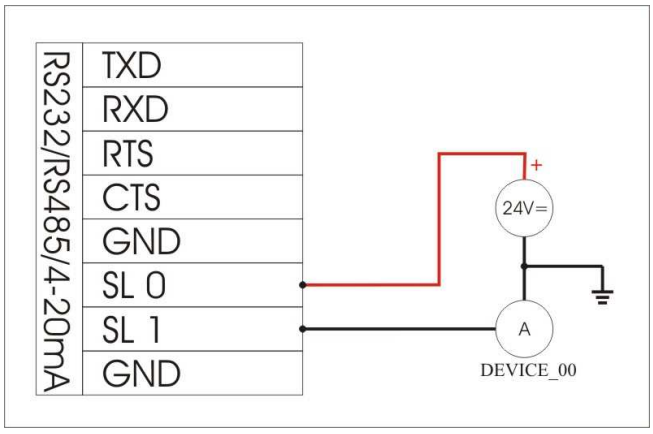
13.3.4.1 Connection of binary/impulse inputs

Binary inputs are active so for input the switching contact is sufficient. Inputs are powered directly by BaWiT system.



13.3.5 Interface 4-20mA

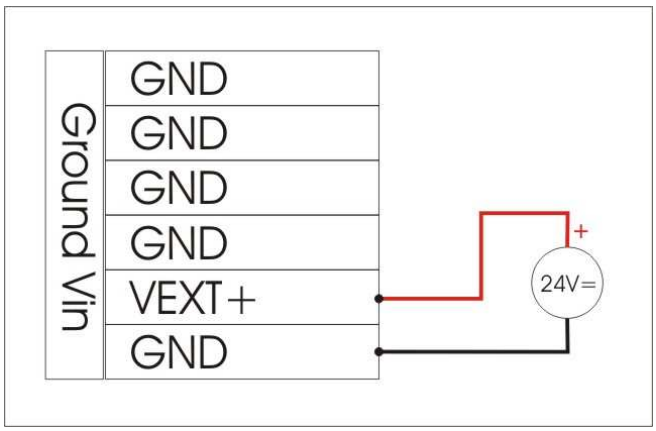
Interface 4-20mA is standard current loop, where BaWiT limits current from external power supply according to value of primary measured variable.



13.3.6 External power supply of the system

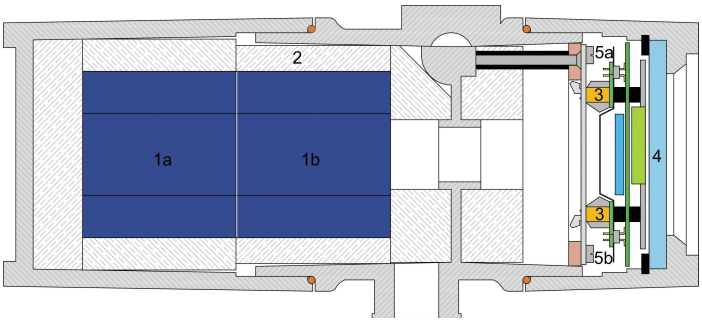
In case, that system BaWiT is in baterryless operation, it is possible to connect external power supply

.

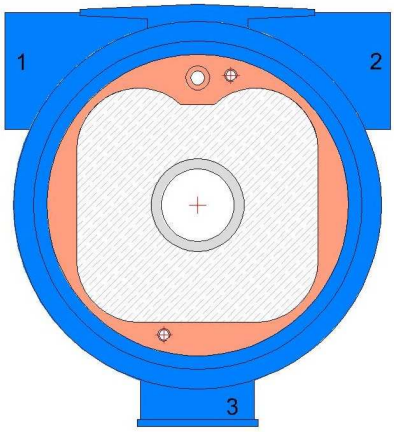


14 Mechanics

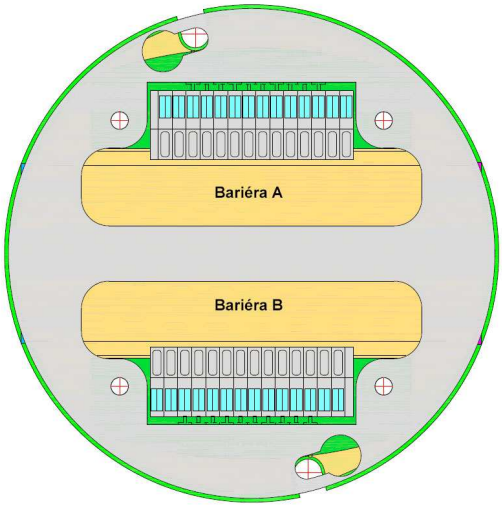
14.1 BaWiT – A



1. Batteries
2. Insulation and antishock material
3. Antishock silentblocks
4. Glass visor
5. Barrier

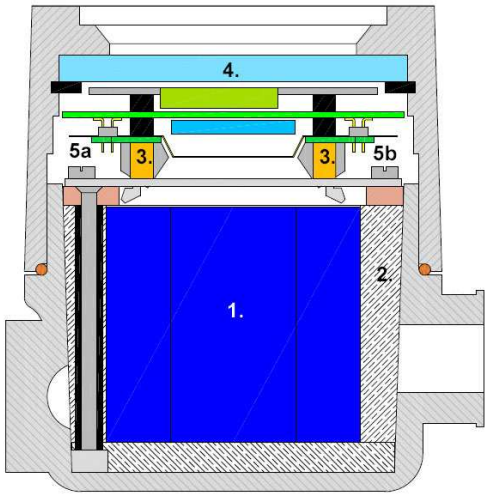


1. Blind with connector for GSM antenna
2. Blind with connector for RFi / GPS antenna
3. Opening for cable bushing or integrated sensor of physical variable

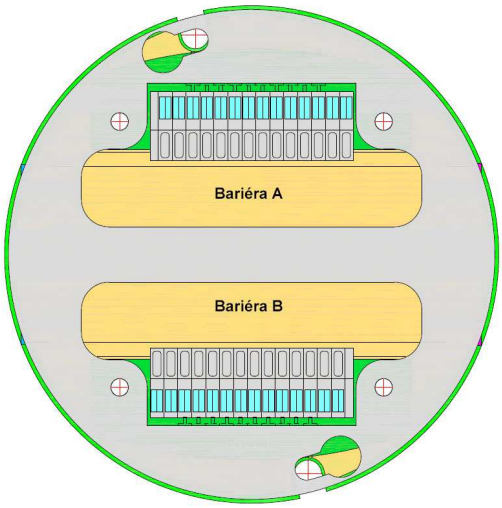


- **Barrier A:** binary inputs and outputs, RS485 master and interfaces to master system
- **Barrier B:** analog inputs, RS232 master

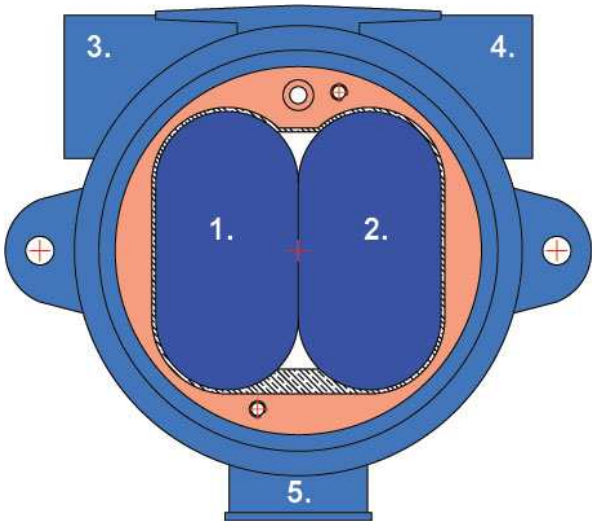
14.2 BaWiT – B



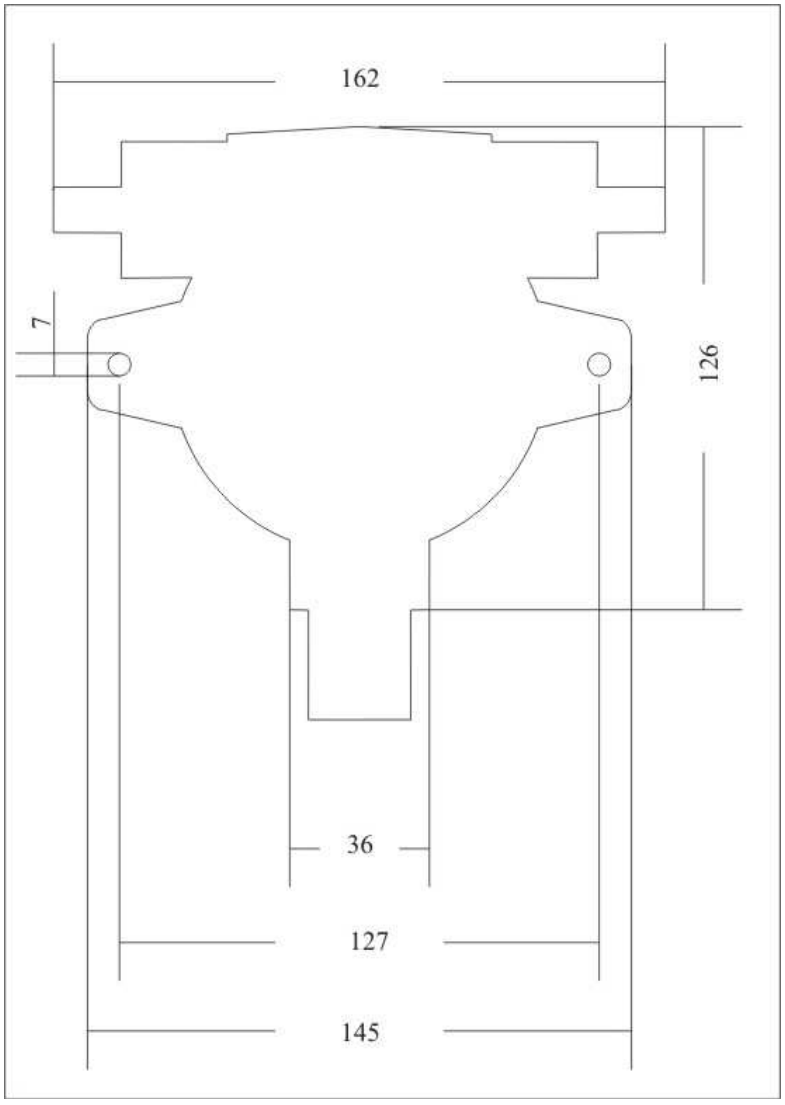
1. Batteries
2. Insulation and antishock material
3. Antishock silentblocks
4. Glass visor
5. Barrier



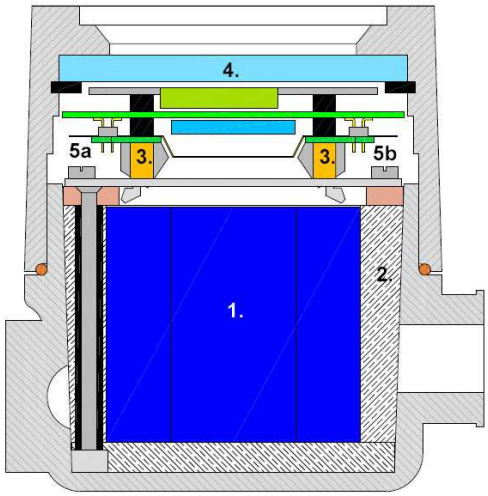
- **Barrier A:** binary inputs and outputs, RS485 master and interfaces to master system
- **Barrier B:** analog inputs, RS232 master



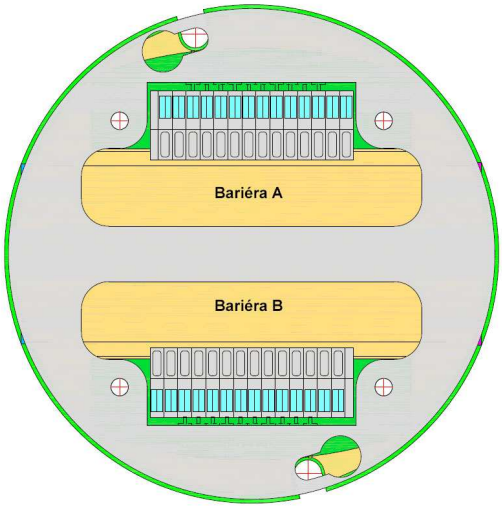
1. Battery A
2. Battery B
3. Blind with connector for GSM antenna
4. Blind with connector for RFi / GPS antenna
5. Opening for cable bushing or integrated sensor of physical variable


162
7
126
36
127
145

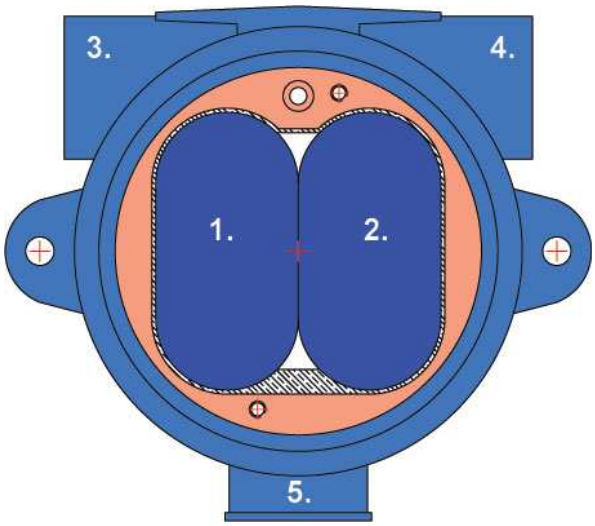
14.3 BaWiT – C



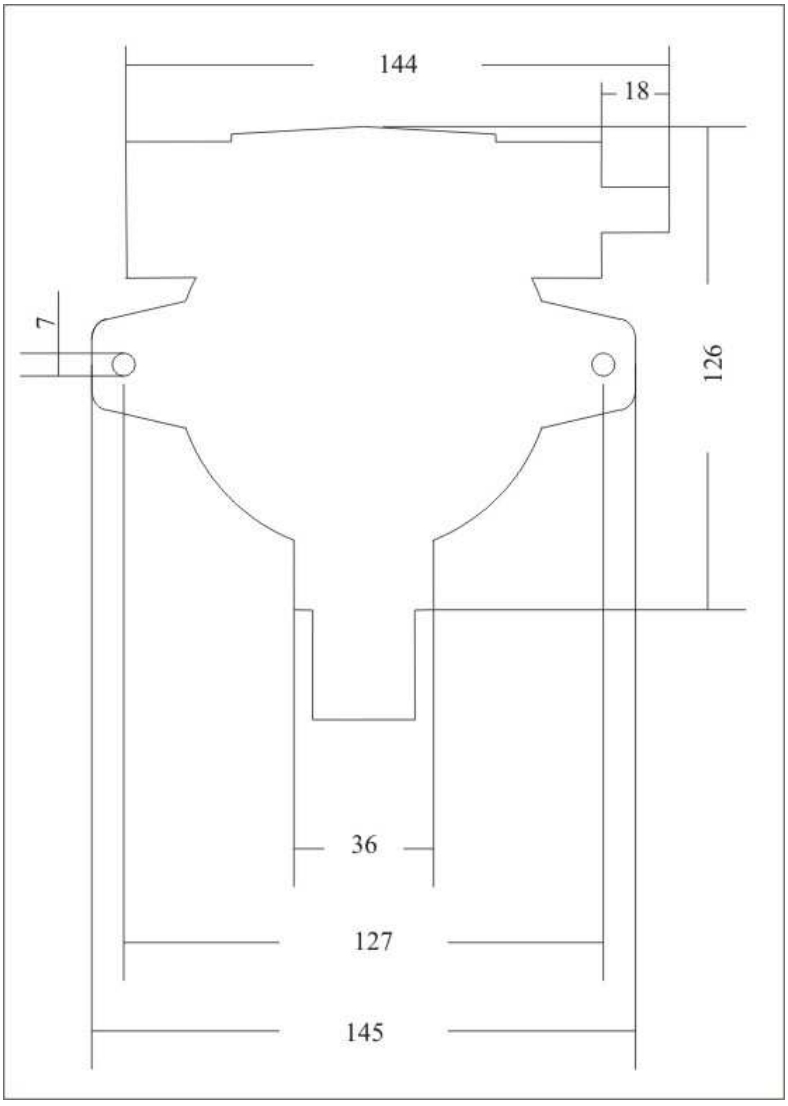
1. Batteries
2. Insulation and antishock material
3. Antishock silentblocks
4. Glass visor
5. Barrier



- **Barrier A:** binary inputs and outputs, RS485 master and interfaces to master system
- **Barrier B:** analog inputs, RS232 master



1. Battery A
2. Battery B
3. Blind with connector for GSM antenna
4. Blind with connector for RFi / GPS antenna
5. Opening for cable bushing or integrated sensor of physical variable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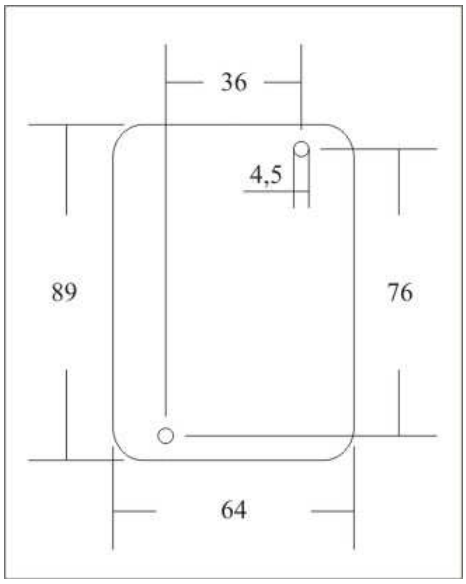
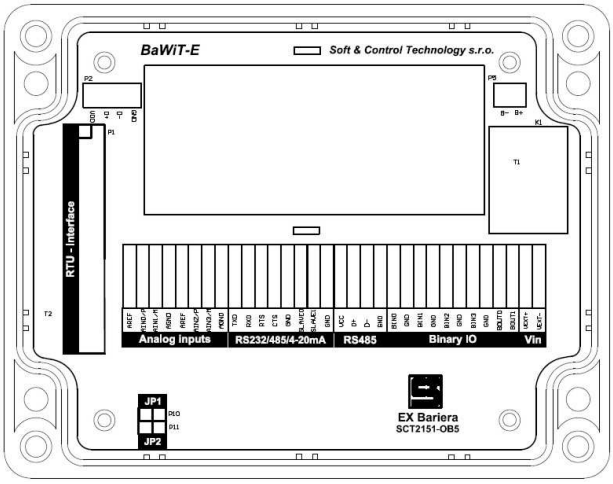
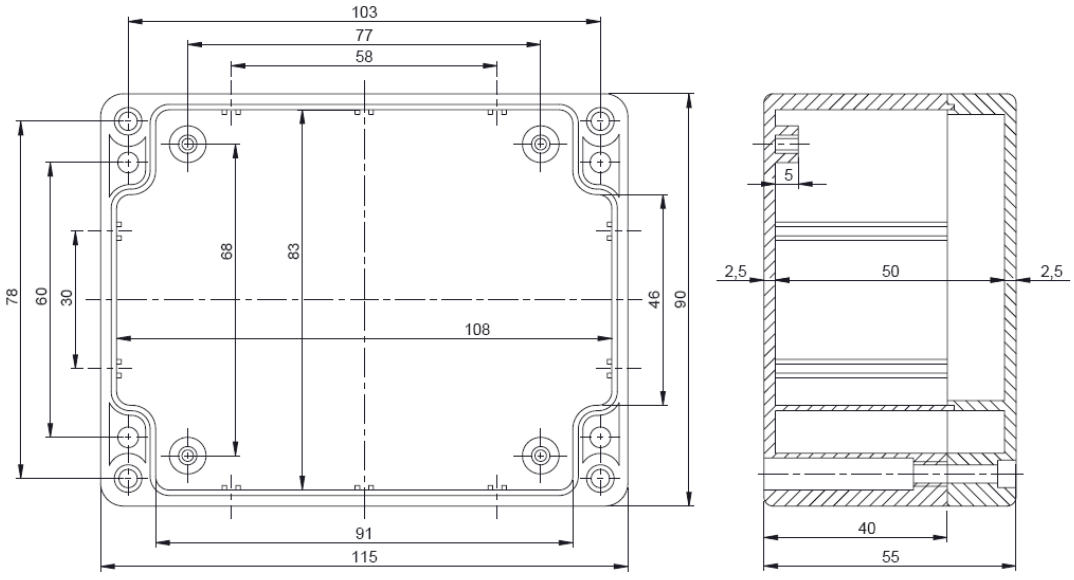
14.4 BaWiT – D



14.5 BaWiT – E


BaWiT
STATUS
Soft & Control Technology
BaWiT-E
IR interface


BaWiT-E
Soft & Control Technology s.r.o.
RTU - interface
Analog Inputs
RS232/485/4-20mA
RS485
Binary IO
Vin
JP1
JP2
EX Bariera
SCT2151-OB5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