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HOME OF SENSOR TECHNOLOGY

Description

JOY
Fan Coil Thermostat

Subject to technical alteration

1 Revision

Revision	Date	Description
15	05.12.2018	From software version 2.0 Fancoil and HC variants merged into one document EnOcean type added

2 Table of contents

3 Device Type Overview

Fan Coil types

JOY Fan coil 5DO	(3 fan coil stages, 230V)
JOY Fan coil 5DO Modbus	(3 fan coil stages,230V)
JOY Fan coil EC AO2DO	(EC-fan coil 0-10V, 230V)
JOY Fan coil EC AO2DO Modbus	(EC-fan coil 0-10V, 230V)
JOY Fan coil EC 3AO	(EC-fan coil 0-10V, 24V)
JOY Fan coil EC 3AO Modbus	(EC-fan coil 0-10V, 24V)

HC types

JOY HC AO2DO	(6-way valve, 230V)
JOY HC AO2DO Modbus	(6- way valve, 230V)
JOY HC 3AO	(6- way valve, 24V)
JOY HC 3AO Modbus	(6- way valve, 24V)

SR types

JOY SR Fan coil EC 3AO Modbus	(EC-fan coil 0-10V, EnOcean, 24V)
JOY SR HC 3AO Modbus	(6- way valve, EnOcean, 24V)
JOY SR HC AO2DO Modbus	(6- way valve, EnOcean, 230V)

4 General

4.1 Introduction

This documentation applies to all device types! The chapters *Configuration parameter* list parameters that apply to all device types. Parameters/data points that are only intended for the Modbus types are marked accordingly!

4.2 Device description

Modern design, flush mounting room thermostat for individual temperature control in residential, industrial and business buildings. Depending on the version, the Fan Coil type is used to control a 3-stage fan or an EC fan coil (0-10V). This type is designed for two-pipe and four-pipe fan coil units with two-wire electric valves. The HC type is a pure thermostat. The SR version offers an additional EnOcean interface.
The valves are controlled with relays (two-level controller or PWM of a PI controller) in the 230V types and by a continuous 0..10V signal in the 24V types. Alternatively, with the HC type, a 6-way valve (Sauter or Belimo) can be actuated at the third 0..10 V output.
Operation is via touch-sensitive buttons. The device combines a modern design with a 2,5” LCD and a touch sensitive surface.

Fan coil type

HC (Heating/Cooling) type

4.3 Hardware Installation RS-485

JOY can be connected by means of twisted pair cables (line resistance 120 Ohm). Detailed information on installation and mounting can be obtained in the JOY product data sheet and the data sheet wiring_rs485_network.pdf.

4.4 RS485 Transceiver

Maximum number of bus participants without use of repeater is defined by the RS485 transceiver. The transceiver used in JOY enables a maximum of 32 devices per bus segment. This constraint is not a timing matter but only for current drive ability of the hardware!

4.5 Protocol

JOY is a Slave bus participant which is only allowed to send data upon request of the Master. The protocol corresponds to the defaults of:
- MODBUS application protocol specification V1.1
- MODBUS over Serial Line Specification & Implementation guide V1.0

4.6 SD-Card

MicroSD cards can be used to upload a new application or a new device configuration. The SD card slot is located in the housing cover. This must be removed to insert the MicroSD card.
Only cards formatted in FAT-file system are supported. NTFS and exFat are not supported!

4.7 Configuration software

Thermokon provides a configuration software free of charge which can be downloaded from Thermokon website. This software enables the user to create parameter files for the different available device types, which can be stored on a SD card. Remove housing cover from device, insert SD card and after power-on the device reads and stores a valid parameter file from SD card. Only configuration parameters are transferred to the device. **Afterwards, MicroSD card shall be removed!** All updated parameters are only available after a device reset. Start screen indicates if an valid parameter file is found on plugged-in MicroSD card!
Devices with integrated Modbus-interface can also be parameterized by using the Modbus interface.

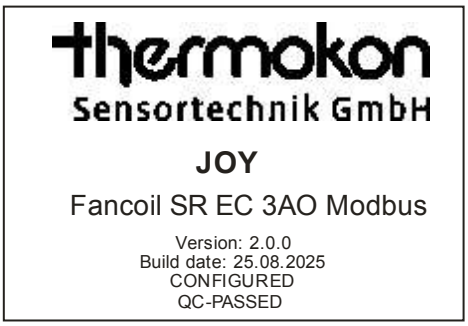
4.8 Bootloader

Because of an integrated bootloader a new application (update) can be uploaded by means of a SD card respectively modbus. To insert the SD card, the housing cover must be removed.
On Thermokon website you can find the corresponding files. The zip archives contain the corresponding firmware versions, a small README file (short info on firmware names, device types, etc.) and the software specification belonging to the version number. The sd-card update files have the extension *.s19, Modbus update files *.bin. In case of a downgrade it is strongly recommended to copy a configuration file suitable for the firmware version to the SD card in addition to the firmware file. This ensures that the appropriate configuration file is automatically loaded directly after firmware downgrade has been completed. This avoids instability due to incompatible firmware and configuration file versions.
If the boot loader is activated, the ring illumination blinks in a 1s cycle, while display is not triggered! After recognition of a SD card with a valid application the update process is started. Now, ring illumination blinks in a 300ms cycle. After a successful update process (Duration circa 20-30 seconds), the new application is started automatically. **Afterwards, MicroSD card shall be removed!**

For an update via Modbus interface Thermokon provides a Thermokon Bootloader (from version 2.0.0), which is available on request.

4.9 Start screen

After power-up or switching from standby to normal mode (button ON/OFF) a start screen is faded in for about 5s, showing information about device type and application firmware version.



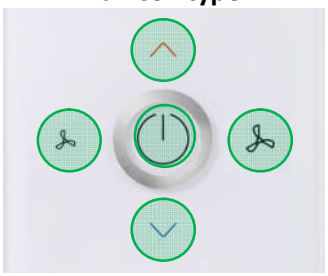
Picture 1: View main screen

5 Operation

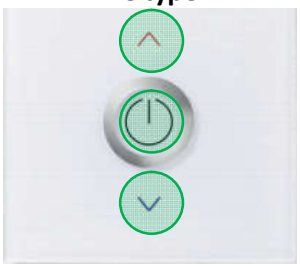
5.1 Main Menu

Keys

Fan coil type



HC type



Single key actuation releases an action. A long keypress causes a cyclic value change in a 1s cycle, after approx. 3s the cycle increases.

Configuration parameter

Special function ON/OFF Button (See Chapter 9.1, Parameter)

The center key can be configured with different functionalities. A short key press triggers the special function. A long key press still triggers the ON/standby (Off) (See Chapter 7.2, Standby) function, except if function *Locked* is set. In this case the key is completely locked. When using a keycard switch, the ON / OFF (Standby) function via button is not possible.

Linking the key to the occupancy state excludes the use of a digital input as a occupancy detector!

Modbus

Holding register

Release of keys (See Chapter 9.2, Parameter)

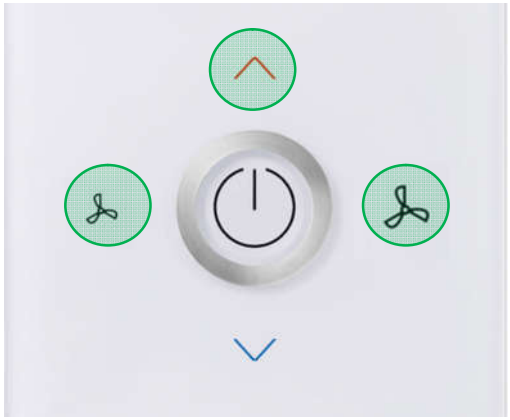
Keys can be locked/unlocked via Modbus at runtime.

5.2 Parameter Menu

Enter Parameter Menu

Simultaneous actuation of marked keys for at least 5s. The key combination can be locked by parameter *Lock parameter menu* (address 124, See Chapter 9.1), so that a user cannot modify parameters at run time.

Fan coil type



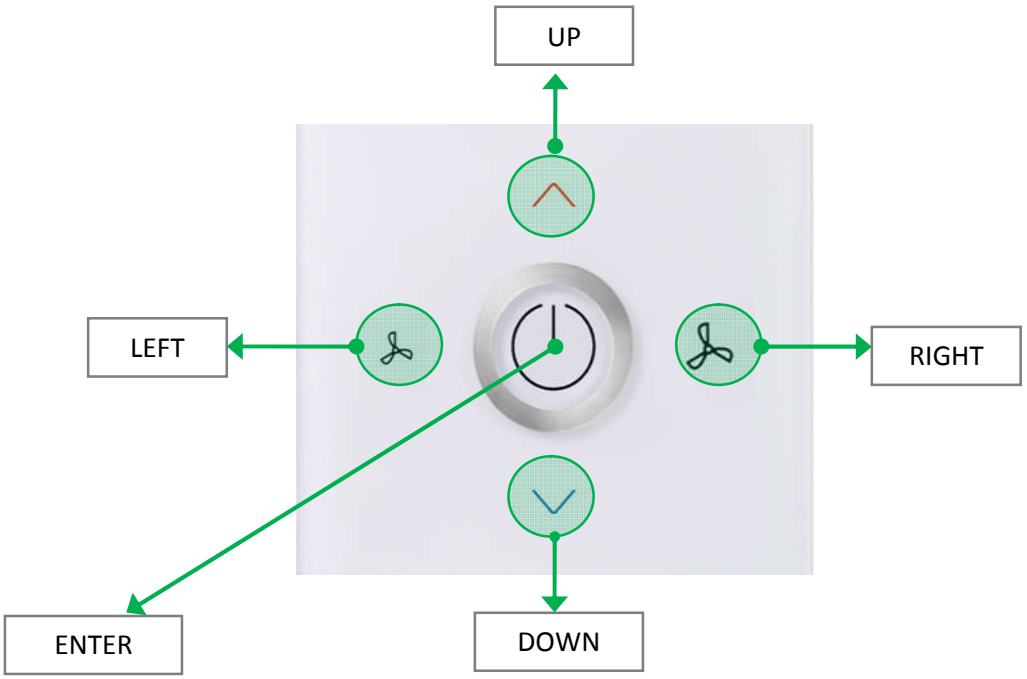
Picture 2 Key combination Fan coil type for invoking parameter menu

HC type

Picture 3 Key combination HC type for invoking parameter menu

Keys

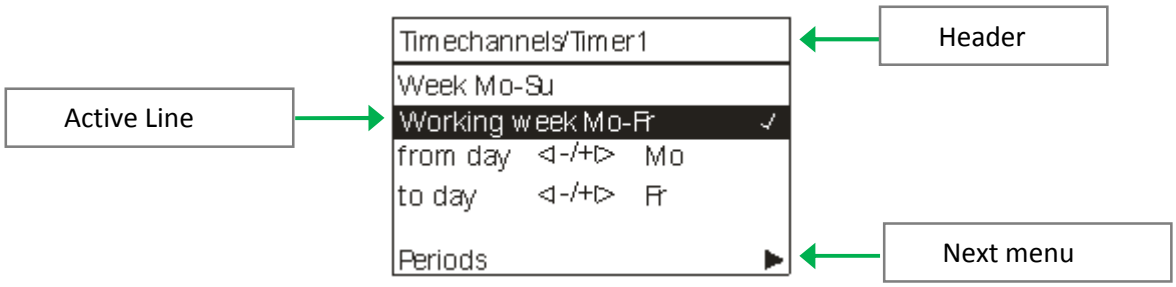
The device is operated in parameter mode with keys specified below:



Picture 4 Keys in parameter menu

Navigation

Navigation in menus is made via the keys UP, DOWN, LEFT, RIGHT and ENTER. The menus are build-up hierarchically. Highest level is the main menu. From main menu the user can jump to different submenus. From there, further submenus can be entered. **To return to previous level, the header must be selected and key LEFT must be actuated afterwards.**
The keys UP/DOWN are used for selection of a menu line. The currently selected menu line is displayed inverted. A modification of a value can only be made in the selected menu line.



Picture 5: Menu page example

The following symbols are used in the menu and enable a better orientation during navigation through the menus:

Value Change

◁-/+▷ The value can be changed by means of keys LEFT(-)/RIGHT(+). No selection via ENTER key necessary.

Invoke next Menu

▶ The next menu can be invoked by means of key RIGHT.

Selection of Display Value

✓ The symbol is faded-in if corresponding value is selected. Parameters for which no symbol ◁-/+▷ for value change is shown can be selected with key ENTER.

Leaving the parameter menu

The parameter menu can be left by selecting the header in main window of the parameter menu and then pressing the LEFT key. An automatic return to the main menu occurs after 10 minutes without user action.

5.3 Modbus settings

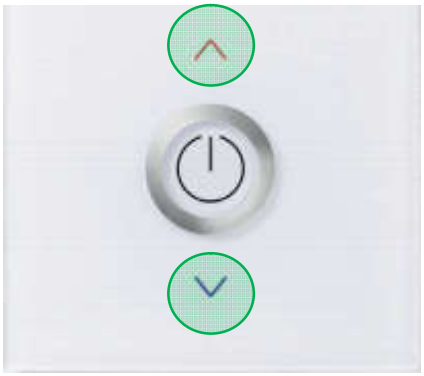
The menu for setting the Modbus parameters is invoked by simultaneously pressing the keys marked below for at least 3s. The key combination must be called directly from the main screen. The LEDs of the ring light up when the key combination has been detected by device.

The menu is enabled during the first 60 minutes after the supply voltage is switched on, as long as the device is not actively integrated in a Modbus communication. As soon as the device receives a valid Modbus telegram addressed to the device, access to the menu is blocked. Without valid communication, the access will be blocked after 60 minutes!

Fan coil type

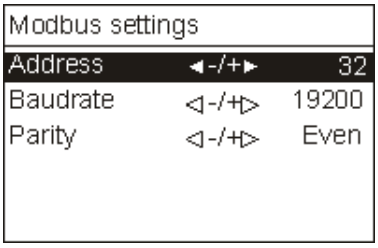
Picture 6 Key combination Fan coil type for invoking modbus settings menu

HC-Variante



Picture 7 Key combination HC type for invoking modbus settings menu

Following menu appears:



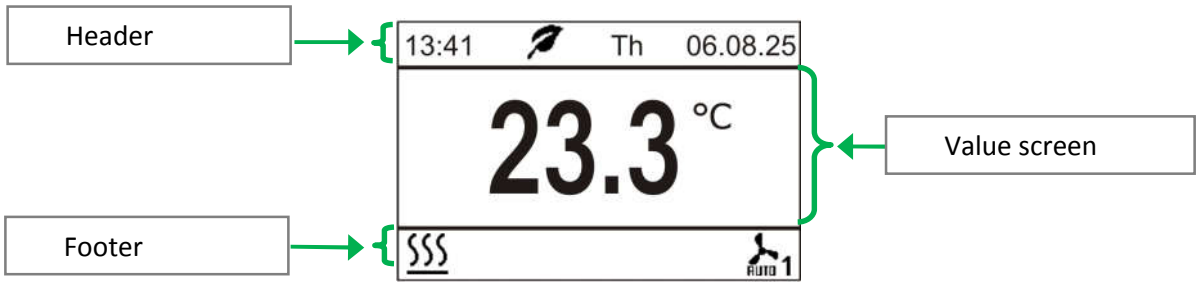
Picture 8 Modbus settings menu

Parameter	Value range
Address	1-247 Default: 32
Baudrate	9600Bd 19200Bd (Default) 38400Bd 57600Bd
Parity	None Odd Even (Default)

6 Screen

6.1 Main Screen

The main screen is divided in three fields: header, value screen and footer.



Picture 9: View main screen

Header

The header is designed for displaying time, weekday and date. In addition an info symbol is displayed upon requirement or depending on certain states/modes.

Picture 10: Main screen header

The positions are pre-defined and cannot be changed.

Info Symbols

ECO-Mode

Alarm

Value Screen

Unit temperature Selection °C/°F (See Chapter 7.5)

As default the value screen shows the room temperature measured by an integrated sensor. If an external temperature sensor is connected and the input is configured accordingly, this value will be indicated in the display. It can be parameterized if room temperature, set point or set point offset shall be displayed.

Picture 11: Temperature display in value range

Upon actuation of any arrow key the display of the value screen changes and shows the associated sub menu. The display switches back to standard screen after 3s without key actuation.

Display of Set point

Picture 12 Display of set point adjustment

After actuation of the arrow keys for set point adjustment, the display screen changes to the set point adjustment screen. Another actuation of one of the two arrow keys modifies the value.
There are three options available for the adjustment mode of the set point. It is possible to adjust the value as an offset value, as an effective value or in stages. As for the display in stages, the values -3, -2, -1, 0, 1, 2, 3 are indicated (See Chapter 9.1, Parameter).

Display of fan coil stages

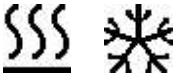
Picture 13 Display of fan coil stage adjustment

After actuation of any arrow key for fan coil stage adjustment, the indication of the value screen changes to fan coil stage adjustment screen. Another actuation of any arrow key switches the fan stage.

Footer symbol

In the footer, symbols for process-oriented states such as heating, cooling, room occupancy, window contact etc. are displayed. The symbols are divided into symbol groups. Only one symbol per group can be displayed at the same time. The symbols can be optionally switched on or off (See Chapter 9.1, Parameter)

Symbol Groups

Occupancy	
Window contact/dew point	
Heating/cooling	
Fan coil stage	
Active time channel	

Five fields are available.

Picture 14: Main screen footer example

Moreover, the positions of the symbols can be freely chosen.

A frost protection preset received via EnOcean (Profile A5-20-12, DB0.1…DB0.0 Enum=3) is indicated by a snowflake symbol at the position of the Heating / Cooling icon.

Configuration parameters (**See Chapter 9.1 Function group Display**)

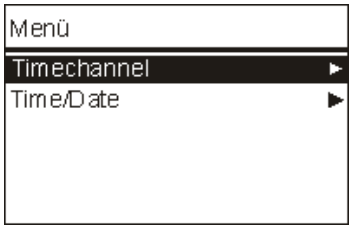
Display main screen

Display footer symbol 1-5

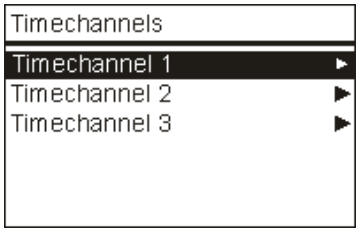
Display set point adjustment

6.2 Parameter screen

The following menu description refers to the Modbus type. A more detailed explanation of the menus of versions without Modbus can be found in the corresponding data sheets!



Picture 15 Overview parameter menu of modbus type



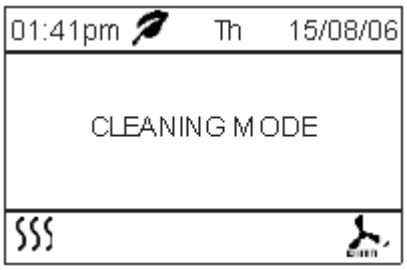
Picture 16 Menu „Timechannel selection“

6.3 Diagnostic menu

To access the diagnostics menu, select the header in the startscreen of the parameter menu, and press the ENTER key. Here you will find various information, such as device type, software version, state of the inputs and outputs and controller state (current manipulated variable). The Modbus variants indicate whether the Joy communicates via Modbus.

6.4 Cleaning mode

By actuating key  for at least 3s, cleaning mode can be entered. All keys are locked. Cleaning mode remains active for 20s.
A short key press invokes the menu for selecting fan coil stages.



Picture 17: Cleaning mode screen

7 Functions

7.1 Common settings

Configuration parameters (**See Chapter 9.1, Function group Common**)

Lock parameter menu
Invocation of the parameter menu can be locked

Language
Selection german/english

Brightness background illumination LCD/ Brightness ring

Device state after Power ON (Standby or Device ON)
Start up state of the device after power on (STANDBY/ON/last state).
If the *last state* is selected, the previous operating state, standby or device ON is restored

Device values after Power ON
Select whether occupancy, setpoint offset and fan stage will resume their last value or be reset after power on.

Maximum load heating/cooling
Serves to optimize the self-heating compensation when the load is switched. When selecting the value, the maximum possible load current in amperes due to the heating/cooling valve and the fan level must be taken into account.

Modbus

Holding Register

Device On/Off - Standby
Standby mode can be activated by key or via Modbus.

7.2 Operating modes

Standby

Triggered by Modbus (See Chapter 9.2, Parameter) or key. In standby mode, the controller is not active and the display is off. The keys, except the ENTER key, are locked. Frost and heat protection remain active! It can only be switched to standby mode if no keycard function is used!

ECO

In ECO mode, the dead band between heating and cooling is automatically set to the configured ECO deadband (default 10K) and the PWM time is doubled when using the controller in PI mode. If a section with ECO mode is active, the ECO symbol is displayed in the header of the main screen.
When the ECO mode is active, the value of the setpoint offset is not taken into account. The ECO mode can be activated / deactivated by the time channels or with the Modbus devices via the bus! The last modified presetting determines the state.

Keycard

The operation of the keys is disabled, the display is switched off and the controller regulates to the setpoints of the "room unoccupied" status (reduction of setpoint heating by value in parameter setpoint offset presence and increase setpoint cooling by corresponding value).

Occupancy

When occupancy mode is used, a distinction is made between OCCUPIED/UNOCCUPIED. OCCUPIED is the comfort mode. In state UNOCCUPIED, the setpoint is lowered (heating) or increased (cooling) by value of parameter *Set point adjustment occupancy.*

Comfort

In comfort mode, the controller works with the heating and cooling setpoint calculated from the *basic setpoint* and *deadband comfort*.

Overview

Comfort (Device ON)

Control in normal operation

Switching takes place via:
ON / OFF button
(long press)

Modbus default

(Device OFF) Standby

Controller OFF
Keys locked (Exception ON/OFF)
Display OFF
Frost und Heat protection active

When returning to comfort mode, all states are restored

From comfort to ECO mode is switched via time channels
ECO can also be set directly via Modbus

ECO

Timed lowering operation
(e.g., night setback)
Factory default
ECO dead band +10 corresponds to:
Set point Heating -5 K | Cooling +5 K
PWM cycle x2 (PI-controller)

ECO mode can be switched directly on or off via Modbus.
Set point offset is reset to 0

Presence state “OCCUPIED” can override ECO mode (address136)

The presence change takes place via:
Digital input
(configured as presence contact)
keystroke
Modbus default

Occupancy

(occupied/unoccupied)

→ Set point adjustment occupancy
Factory default
Set point Heating -2K | Cooling +2K
Behavior set point offset configurable

The presence change takes place via:
Digital input
(configured as keycard switch)

Keycard (Occupancy +)

(occupied/unoccupied)
→ Set point adjustment occupancy
+ Display OFF
+ Keys locked (Exception ON/OFF Button)
Factory default
Set point Heating -2K | Cooling +2K
Behavior set point offset configurable

Standby is not possible in interaction with the key card function (Presence +)

7.3 Time and Date

Overview

The room thermostat has a real-time clock, which calculates time and date automatically. Time and date can be updated during operation by a supervisory system via Modbus.

Konfiguration

Format time
Display in 24h-, 12h- (am / pm) mode or display OFF.

Format date
Display OFF or in german or english mode.

Daylight saving
Activation / deactivation of automatic daylight saving time.

Modbus

Holding Register

Hour, minute, day, month and year can be updated via Modbus.

7.4 Time Channel

Overview

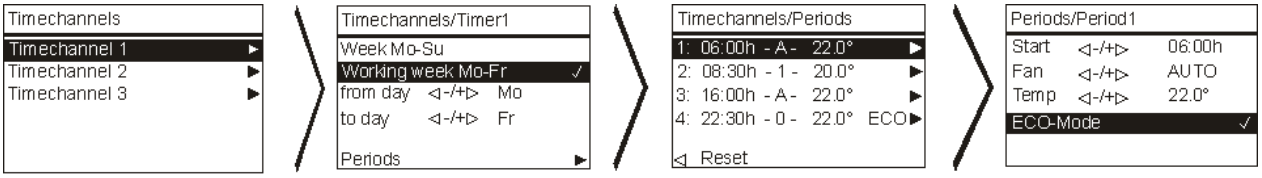
There are 3 time channels available including 4 periods, which can be freely programmed. For each time channel a set of weekdays can be selected. Start time, set point, fan coil stage and ECO mode can be parameterized for every period.

Table 1: Structure of a Time Channel

Time Channel		
Weekday mask	**Periods**	**Parameter**
Complete week Mo-So Working week Mo-Fr From day to day	1 - 4	Start time
		Fan coil stage
		Set point heating
		ECO mode

A period is activated, if start time and weekday are in conformance with the parameterized start time and weekday mask. A period remains active until conditions of another period are fulfilled. Active set point can be overriden over Modbus by means of register *Basic set point* (address 255).
Time channels are prioritized. Channel 3 has the highest priority.

Menu time channel



(1) **(2)** **(3)** **(4)**

Picture 18: Menu "Selection of Time Channel"

(1) Timechannel selection
(2) Weekday selection
(3) Overview/Selection of timechannel period
Index time period / start time / fan coil stage / set point/ info ECO-Mode
(4) Configuration of timechannel period

Changes of the time channel are stored by return from menu (2) to menu (1) actuating key LEFT.

Configuration parameter

Start
The start time can be changed in 15-minute steps.

Fan
Fan coil stage selection between OFF, Stage 1, Stage 2, Stage 3 and AUTOMATIC (5DO type) resp. between OFF and AUTOMATIC (EC type).

Set Point
The set point can be adjusted in the range 0°C to 50°C.

ECO-Mode
See Chapter 7.15, operating mode: ECO

7.5 Temperature

Overview

By default the value of the internal sensor is used as actual value for the internal controller. The universal input can be parameterized as a sensor input for an external temperature sensor. In this case, the external sensor value is used as actual value and is displayed on main screen. The measuring range of the sensors is 0..50 ° C, with a resolution of 0.1 °. For both sensors a calibration to compensate self-heating is possible.

Configuration parameter

Offset internal sensor
Temperature compensation of self-heating of the internal temperature sensor

Offset external sensor
Temperature compensation of self-heating of the external NTC10K

Unit temperature
Selection °C/°F (See Chapter 9.1, Parameter)

Modbus

Input Register

Internal temperature sensor

External temperature sensor

7.6 Inputs

Overview

The Modbus type of the device has 2 inputs, the type without Modbus 3 inputs. Input 1 is a universal input for connecting potential-free contacts or an NTC10K sensor (low voltage). For 230V powered devices, input 2 is a 230V input (**Caution !! Please pay attention to the connection diagram!**), for devices with 24V supply it is a low voltage input for connecting potential-free contacts. The additional input of the devices without Modbus (input 3) is also a low-voltage input for potential-free contacts. Internal input states are OR-linked when configured as window, dew point and occupancy contact with the associated Modbus registers. In change-over configuration, the corresponding Modbus register overrides the internal change-over state!

Table 2: Overview of possible combinations

Input 2 230V (3AO type: Input 2)	**Input 3** (3AO type: Input 3) (not available with Modbus device)	**Input 1 Universal** (3AO type: Input 1)
Change-Over DI Dew point contact Window contact	Window contact	Ext. Sensor (NTC10k)
		Window contact
		Dew point contact
		Occupancy contact
		Keycard switch
		Ext. sensor EnOcean
	Dew point contact	Ext. Sensor (NTC10k)
		Window contact
		Dew point contact
		Occupancy contact
		Keycard Switch
		Ext. sensor EnOcean
	Occupancy contact	Ext. Sensor (NTC10k)
		Window contact
		Dew point contact
		Keycard Switch
		Ext. sensor EnOcean
	Keycard Switch	Ext. Sensor (NTC10k)
		Window contact
		Dew point contact
		Occupancy contact
		Ext. sensor EnOcean
Occupancy contact	Change-Over DI	Ext. Sensor (NTC10k)
		Window contact
		Dew point contact
		Keycard Switch
		Ext. sensor EnOcean
	Window contact	Ext. Sensor (NTC10k)
		Window contact
		Dew point contact
		Keycard Switch
		Ext. sensor EnOcean
	Dew point contact	Ext. Sensor (NTC10k)
		Window contact
		Dew point contact
		Keycard Switch
		Ext. sensor EnOcean
	Keycard Switch	Ext. Sensor (NTC10k)
		Window contact

		Dew point contact
		Ext. sensor EnOcean
Not used	Change-Over DI	Ext. Sensor (NTC10k)
		Window contact
		Dew point contact
		Occupancy contact
		Keycard Switch
		Ext. sensor EnOcean
	Window contact	Ext. Sensor (NTC10k)
		Change-Over DI
		Change-Over Sensor (NTC10k)
		Window contact
		Dew point contact
		Occupancy contact
		Keycard Switch
		Ext. sensor EnOcean
	Dew point contact	Ext. Sensor (NTC10k)
		Change-Over DI
		Change-Over Sensor (NTC10k)
		Window contact
		Dew point contact
		Occupancy contact
		Keycard Switch
		Ext. sensor EnOcean
	Occupancy contact	Ext. Sensor (NTC10k)
		Change-Over DI
		Change-Over Sensor (NTC10k)
		Window contact
		Dew point contact
		Keycard Switch
		Ext. sensor EnOcean
	Keycard Switch	Ext. Sensor (NTC10k)
		Change-Over DI
		Change-Over Sensor (NTC10k)
		Window contact
		Dew point contact
		Occupancy contact
		Ext. sensor EnOcean

Configuration parameter

Input 1 universal input (low voltage)
NTC10K or a potential-free contact

Input 2 (AO2DO=230V, 3AO=low voltage)
Potential-free contakt. **ATTENTION 230V! Note connection diagram!**

Input 3 (low voltage), only types without modbus!
Potential-free contact

Modbus

Input Register

State input 1 universal (Address 519)

State input 2 (Address 520)

7.7 Outputs

Overview

The outputs are assigned with fixed functions. Depending on the device type, these can be manually overridden in different ways. Thus, the digital outputs can only be overridden manually in conjunction with the controller mode (see chapter Controller). The analog outputs for heating and cooling, however, can be used freely.
The output or outputs for the fan stages can only be used in conjunction with the fan level.

Configuration parameter

Effective direction of relay heating/cooling *(5DO-, EC AO2DO-type!)*
Effective direction can be changed for the two relay heating and cooling to adapt to the existing actuator (normaly open or normaly closed).

Effective direction of analog output heating/cooling *(EC 3AO-, HC 3AO-type!)*
Effective direction can be changed for the two analog outputs heating and cooling to adapt to the existing actuator (normaly open or normaly closed).

Type 6-way valve
In addition to various 6-way valve types, it can be selected whether the control value of the heating or cooling controller is additionaly output on the 6-way valve output as a steady 0-10V signal. When selecting *0: 0-10V steady signal heating and cooling*, the 6-way valve output runs in heating and cooling as 0-10V signal!
If a 6-way valve type is selected for the EC 3AO type, the two outputs heating and cooling simultaneously output the signal converted to the configured 6-way valve type!

Modbus

Holding Register

Preset output heating/cooling *(EC 3AO-, HC 3AO-type)*
The outputs are decoupled from the internal controller and can be controlled by the higher-level system (BMS). In order to display a symbol (heating/cooling) with the output, the manual mode must be activated (0xFF01 = heating or 0xFF02 = cooling) via Register *Default controller mode*.

Preset output 6-way valve *(HC 3AO-, HC AO2DO-type)*
The output is decoupled from the internal controller and can be controlled by the higher-level system (BMS) as a 0-10V steady signal output. In order to display a symbol (heating / cooling) with the output, the manual mode must be activated via the tab *Default controller mode* (0xFF01 = heating or 0xFF02 = cooling). Possible application is the control of a volumetric flow controller.

Input Register

Output heating/cooling/6-way valve
State of relays (on/off) resp. value 0..100% as 0..10V

7.8 Alarm (Modbus only!)

It´s possible to fade-in an alarm symbol in the header line of the display. This symbol is at the same position as the ECO symbol. As the alarm symbol has a higher priority, the ECO symbol is overridden. If an alarm is active, the background illumination of the LCD is blinking.

Picture 19: Header with faded-in alarm symbol

Modbus

Holding Register

Default Alarm
Turn ON/OFF alarm signal in the display.

7.9 Set point

Overview

The active set point is determined by configuration of the time channels. If no time channel is configured the configuration parameter *Set point after reset* is used. The user can modify values in defined limits. The Modbus type enables the option to configure the set point according to your needs and/or to indicate the set point from a supervisory system at runtime.

Configuration Parameter

Set point after reset
After a restart of the device this value is used as set point until a new set point or a Modbus default is activated.

Adjustment range of set point
Determines the limits of the set point adjustment range. When selecting the display of the set point adjustment (register 113) as stage display – 3…+3 this parameter must be set to the value of the set point offset of stage 3!
Example: *Set point step range* = 1K and Stage 3 is equivalent to 3K => enter this value!! Take care of the scaling!

Set point step range
Determines the step size of the set point offset upon changes at the device by a user.

Dead band comfort/Dead band ECO-mode
Determines the deadband in comfort mode respectively in ECO-mode.

Set point adjustment occupancy
When using the occupancy function by a digital input or via Modbus, the configured value is automatically deducted from the heating set point or added to the cooling set point in UNOCCUPIED state.
The Occupied / Eco override parameter can be used to parameterize how the occupancy state affects when the controller is in ECO mode.

Frost Protection/Heating Protection
By use of the window function (reduction of energy consumption) through a digital input or via Modbus, in case “Window open” the heating and cooling set points are set to the configured values.
A frost protection preset received via EnOcean (Profile A5-20-12) is indicated by a snowflake symbol at the position of the Heating / Cooling icon.

Behavior of set point offset at occupancy change
Behavior of the set point offset value when occupancy state changes. Select whether the offset is (1) retained, (2) reset or (3) restored at occupancy change. If set point offset value should be restored, value is set to zero during UNOCCPIED state and previous value is restored after switching to the OCCPUPIED state.

Modbus

Holding Register

Basic Set point
This register is designed for the set point default by a supervisory system. Cooling and heating setpoints are calculated internally from this basic set point and the deadband depending on the mode (normal / ECO). With the value -1 (factory setting), this data point is deactivated and the internal value (setpoint after reset or setpoint of the active time channel section) determines the setpoint.

Set point Offset
External default for override of internal set point offset.

Input Register

Set point heating/cooling
Output of the active heating set point / cooling set point. It depends on the specification of the basic set point (timechannel, Modbus), the setpoint offset (user, Modbus) and the mode (Comfort/ECO, occupied /unoccupied). The value changed at last determines the set point, that means if the time channel is active, the setpoint changes if a new value is written via the register *basic setpoint* (address 255) or if a new time channel period becomes active.

Set point offset
Output of the internal offset specified by the user setting at JOY or via the set point offset register (address 256). The value changed at last determines the setpoint, e.g. an offset set by the user would be overwritten with the next update of the setpoint offset register (address 256).
If the KEYCARD or occupancy function is used, the behavior of the set point offset depends on the parameter *Behavior setpoint offset during occupancy change* (135). The ECO mode has no influence on the setpoint offset. If neither function is used, the setpoint offset will be reset when ECO mode is activated.

Basic set point
Current set point of the controller. Can be the internal setpoint after reset, the Modbus preset (register 255, basic set point) , or the setpoint of the active time channel period.

7.10 Fan stages

Types

Three fan stages (5DO)
Three outputs for controlling up to three fan stages. The switching on and off behavior of the stages depends on the operating mode of the active controller. If the controller operates as a two-point-controller, the stages are switched as a function of the parameterized threshold values for fan levels 1/2/3. If the fan level is switched off manually, the controller is deactivated and the outputs are switched off. With the PI controller, the stages are output in dependence on the manipulating variable of the controller:

3 stages	2 stages	1 stage
Stage 3: y > 66%	-	-
Stage 2: y > 33%	Stage 2: y >= 50%	-
Stage 1: y > 0%	Stage 1: y > 0%	Stage 1: y > 0%

EC fan (EC AO2DO, EC 3AO)
A 0-10V output is used to control an EC fan. The speed of the fan can be changed manually via the keys. The number of steps to adjust the speed between 0 and 100% is configurable. If the fan is switched off manually, the controller is deactivated and the outputs are switched off.

HC version (HC AO2DO, HC 3AO)
A stage can be specified via Modbus to display a fan symbol. Therefor the fan symbol in the footer must be activated.

Configuration parameter

Number of fan coil stages *(5DO-type!)*
Up to 3 outputs to control 3 fan stages

Threshold stage 1/2/3 *(5DO-type!)*
The value configured determines the threshold between set point and actual value at which the individual fan stages are switched on when controller is active. For example using the default setting (threshold value fan stage 1 = 0), fan stage 1 is started instantly if a control deviation occurs. It has to be considered that a hysteresis for the on/off switching of the fan stages is activated (+/-0.3°C) to prevent flickering of the outputs!
Only two-point controller!

Maximum fan coil value (100%) at temperature deviation *(EC AO2DO-, EC 3AO-type!)*
If a two-point controller is activated the parameterized value is the deviation of set point from actual value at which the output of the fan coil unit has reached 100%. Below this value the output value is calculated linear to the deviation and is output in the configured stages.
Only two-point controller!

Steps fan coil control *(EC AO2DO-, EC 3AO-type!)*
Determines the number of steps and thus the step size of the fan stage control.

Fan coil minimum, Fan coil maximum *(EC AO2DO-, EC 3AO-type!)*
The calculation of the stages is made between minimum and maximum value. A minimum value greater than 0 will allow the fan to run even if there is no heating or cooling request.

Fan coil assignment
Optionally, the fan can optionally be allocated to heating or cooling controller or to both at the same time.

Start-up time fan coil
To guarantee a save start-up of the fan, a period of time can be configured in which the fan starts with the highest possible stage available.

Fan start with manipulated variable > x (>0% - >20%)
When set, the fan only runs if the heating or cooling valve is activated and the manipulating variable has exceeded the value parameterized here (Address 129).
Example: 20% => Fan starts with a manipulating variable >20%.

Keys Fan stage with / without AUTO
Select whether the user can only switch manual steps or additionally AUTOMATIC mode.

Modbus

Holding Register

Fan coil stage

Input Register

State fan coil stage

7.11 Keycard Switch

If Keycard is not inserted the device is set into the ECO-mode. The operation of the keys is locked, display is switched-off and controller uses set point defaults of UNOCCUPIED-state (lowering set point heating by value of register *Set point adjustment standby* (address 25) and increasing set point cooling accordingly). If no keycard is inserted, the key ENTER can be used to switch on the unit and activate the comfort mode. For further information on the interaction of the keycard-, occupancy-function and ECO mode, please refer to annex.

7.12 Occupancy

Overview

The occupancy function can be activated via the configuration of a digital input, the ON / OFF key or via Modbus or EnOcean. If the key and Modbus and / or EnOcean are used at the same time, the last modified value determines the output value. The digital input has a higher priority. When the occupancy function is activated, the occupancy symbol is automatically displayed if the symbol has been assigned a position in the footer.

Configuration parameter

Occupied/ ECO override
The occupancy state OCCUPIED may override an active ECO mode. The controller disables ECO mode and operates in OCCUPIED state as long as the occupancy state is OCCUPIED. By switching back to state UNOCCUPIED, the ECO mode is restored.
In the other case, the occupancy state has no influence with the ECO mode active.

Modbus

Holding Register

Default Occupancy
Occupied/Unoccupied

Input Register

Occupancy state

7.13 Dewpoint

Overview

An active dew point contact blocks the cooling controller. The dew point function is activated via the configuration of a digital input or via Modbus default. The specification via Modbus is OR-linked with the internal status.
When the dew point is active, the dew point symbol "dew point active" is automatically displayed if the symbol has been assigned a position in the footer.

Modbus

Holding Register

Default dewpoint

Input Register

State dewpoint

7.14 Window Contact

Overview

When the window contact is active (window open = reduction of energy consumption active), the set points for heating and cooling are automatically set to frost- respectively heat-protection. The fan state changes to automatic mode and, after exiting the energy lock mode, resumes the previous state.
The window contact function is activated via configuration of a digital input or via Modbus or via EnOcean. The default via Modbus is linked by an OR-function to the internal state.
When the function is activated, the window symbol is automatically displayed in the "window open" state if a position has been assigned to the icon in the footer line. Heating and cooling controllers control the frost protection or heat protection setpoint.

Modbus

Holding Register

Default window contact

Input Register

State window contact

7.15 Change-Over

Overview

Via a change-over contact heating or cooling mode is forced with a 2-pipe system. The change-over function is activated via configuration of a digital input, via Modbus or via EnOcean. A digital input activated as a change-over contact deactivates Modbus value (register 256)/EnOcean.
If the input is configured as a make contact, the heating mode is enabled with an open contact and accordingly the cooling mode when it is closed. If a change-over sensor is selected, the cooling mode is enabled from a temperature of <19 ° and the heating mode from a temperature of> 28 ° C.
Attention: When using the change-over function, the outputs heating (terminal 5) and cooling (terminal 4) are controlled in parallel!

Modbus

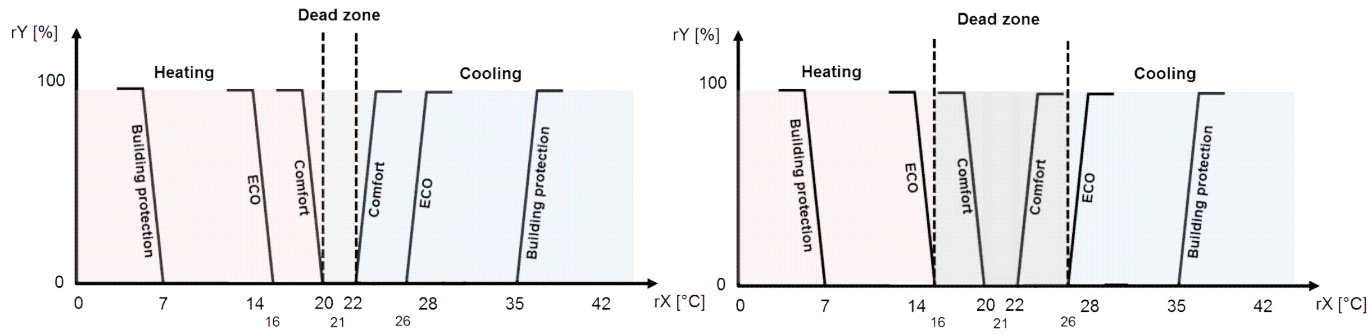
Holding Register

Default change-over
Heating, cooling or not used

7.16 Controller

Overview

The device has a PI or two-point controller for heating and cooling. The manipulated variable is output via the outputs.



Picture 20: Two-step control with hysteresis

The controller starts after a cold start (power supply on) of the device with a 30-second delay.

PI-controller
The time response of the PI-controller is determined by parameters Xp and Tn. Due to the proportional band, the control variable reacts instantly on a control deviation while the integral portion is only occurring with the time of action. The resulting control variable is output as a pulse-width modulated or steady signal (3AO version) to the outputs.

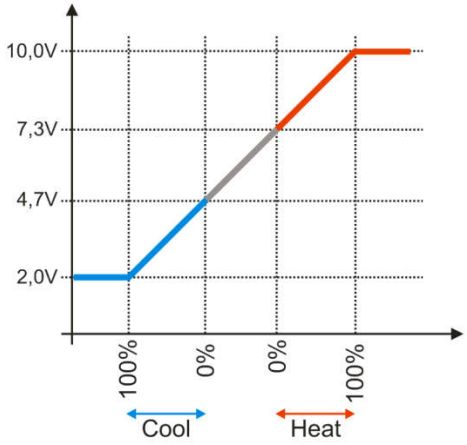
Two-point controller
If value goes below set point less half of hysteresis treshold, the controller switches-on the heating output. In case value exceeds set point plus hysteresis threshold, the controller switches-off the heating output. As for cooling, it acts accordingly.

Valve Protection Function
In order to guarantee that the valves are also fully functional when not in use for a longer period of time, the room thermostat has a valve protection function. The valve protection is only started, when corresponding valve (heating or cooling) has not been triggered for more than 96 hours. The time is

fixed to Friday at 11:00am (heating valve) and 11:15am (cooling valve). The corresponding valve is switched on for 5 minutes.
The valve protection function can be disabled.

6-Way valve

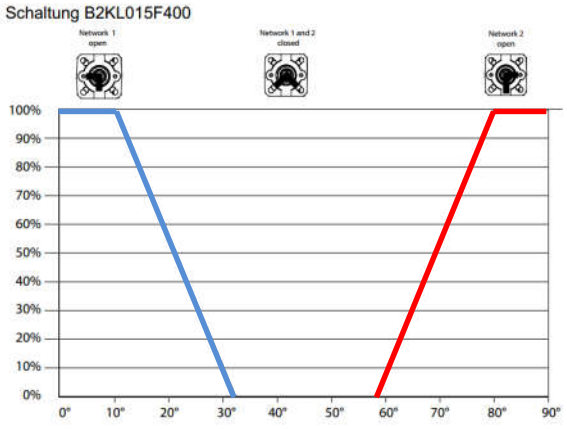
2-10V (e.g. BELIMO® 6-Way valve)
The control variable of the integrated PI controller is converted into the voltage values shown below according to the characteristic curve of the valve.



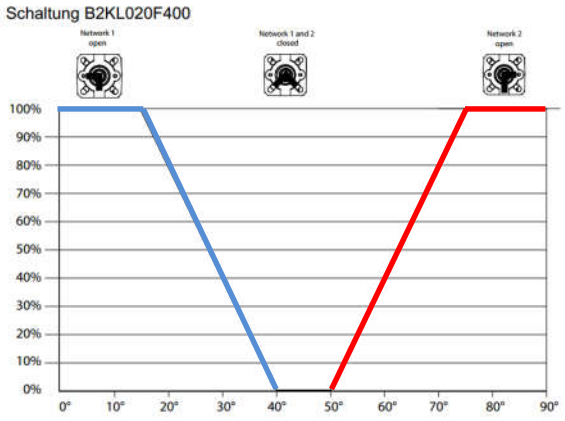
Standard
100…0% cooling ⇒ 2,0…4,7V
0…100% heating ⇒ 7,3…10,0V

Inverted
Heating/cooling sequence inverted

0-10V (e.g. SAUTER 6-Way valve)
The control variable of the integrated PI controller is converted into the voltage values shown below according to the characteristic curve of the valve. The characteristic curves of the output are designed for the two nominal sizes DN15 and DN20. The output characteristic curve is calculated according to the characteristic curve B2KL015F400 for the valve with nominal diameter DN15 resp. the characteristic curve B2KL020F400 for the valve with nominal diameter DN20. Please see SAUTER datasheet 58.001, B2KL: 6-way-ball valve with male thread, PN16).



Picture 21 Characteristic curve for nominal width DN15 (extract from SAUTER product data sheet 58.001)



Picture 22 Characteristic curve for nominal width DN20 (extract from SAUTER product data sheet 58.001)

When the inverted types are selected, heating and cooling are reversed.

Configuration parameter

Controller hysteresis
Determines the ON/OFF behavior of the two-point controller. The heating controller is switched ON if value falls below set point less half of the hysteresis and heats until actual value of set point plus half of hysteresis is exceeded. The hysteresis prevents the "flickering" of the actuator if actual value is within the value of set point.
Not used with PI-controller

Controller mode after device reset
Determines the startup mode of controller after restart. With selection *1: heating*, the controller can only work in states OFF and HEAT, with option *2: cooling* in OFF and COOL.

Valve protection release
Release/Lock of the valve protection

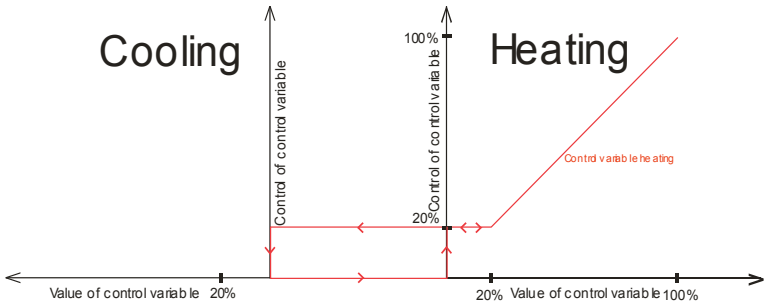
Proportional band Xp heating/cooling
The proportional band determines the deviation at which the controller outputs the maximum control variable (100%). A small Xp relates to a stronger controller intervention of the proportional band with lower deviations, but increases the tendency to oscillate.
Only relevant when using the PI controller.

Reset time Tn heating/cooling
Time passing by until the Integral-part produces the same control amplitude as produced directly in case of the Proportional band. To increase the integral part of the controller the reset time must be reduced.
Only relevant when using the PI controller.

Minimum manipulating variable
Minimum value in percent.

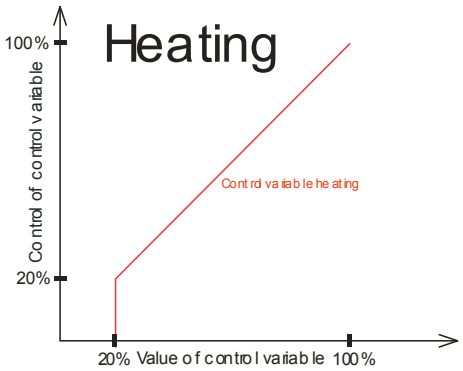
Maximum manipulating variable
Maximum value in percent.

Mode Selection manipulating variable
a) Mode selection manipulating variable = 0
Ymin = 20%



The minimal control variable at the output remains unchanged until the controller changes the operating mode

b) Mode selection manipulating variable = 1
Ymin = 20%



The control variable is only sent to the output, if the calculated value of the control variable is bigger than the minimal control variable

PWM cycle time
Cycle time of the PI-controller ouput signal. The ON/OFF time of the digital outputs is calculated as a function of the manipulating variable.
Example: PWM time = 30min, manipulating variable y = 50% => T_{on} = 15min, T_{off} = 15min
Only relevant when using the PI controller and existing digital outputs (device types FC and HC).

Heating controller type
Heating controller can be configured as PI- or Two-point-controller.

Cooling controller type
Cooling controller can be configured as PI- or Two-point-controller.

Minimum runtime controller output (5DO, EC AO2DO, HC AO2DO-type)
After switching on, the heating or cooling output always remains in the ON-state for the minimum runtime, regardless of the controller's request / manipulated variable.
If the controller mode switches between heating / cooling during active monitoring of the minimum running time, the outputs are switched over after a configurable delay has elapsed and the monitoring of the minimum runtime is restarted.

Delay time controller mode change *(5DO, EC AO2DO, HC AO2DO-type)*
Delay time between the change of the two controller modes heating and cooling. The output of the new mode will be released only after the time has expired.

Modbus

Holding Register

Default controller mode
In automatic mode, the controller controls the heating and cooling setpoint. In mode *only heating*, the controller operates in automatic mode and only controls the heating setpoint. Cooling is deactivated. In

cooling mode vice versa. In addition, it is possible to override the two controller outputs manually (not with the 3AO version! See the description of register *Default output heating / cooling*). If one of the outputs is set to manual mode the corresponding symbol in display is faded-in and internal controller is deactivated.

Input Register

Manipulating variable of controller
Unit %

Controller mode feedback
Active controller mode

8 EnOcean

Attention: chapter only concerns SR variants.

8.1 Overview

With Joy SR up to 20 radio channels with different functions can be used. A channel can be configured as a receive channel, as a send channel or as a message server (for bidirectional SAB communication).

8.2 Functional groups

The profiles used are divided into functional groups.

SRW/SRG Window contact and window handle. Up to five sensors can be learned-in. Both act on the window contact function (reduction of energy consumption) and are linked to the digital inputs or the Modbus default.
Attention: To learn-in the window handle, the handle must be turned from the closed position to the open position and back again!

VFG Wireless sensor for changeover specification. As an alternative to the digital input, a radio changeover sensor can be learned-in.

EXT/WRF Receive channel: Room temperature preset by an external room temperature sensor. Overrides the internal temperature sensor. Max. one sensor is possible.
Send channel: The associated WRF profile is sent.

OCC Up to three motion sensors can be learned-in and affect the room occupancy function. The last modified value of the configured presets (Modbus, EnOcean, key on the JOY) is accepted. If several EnOcean motion sensors have been learned-in, the "ROOM UNOCCUPIED" value will only be accepted once all sensors have signaled "ROOM UNOCCUPIED".

KEY Controls the internal keycard feature. When learning-in a key card switch, it should be noted that the card must not be plugged in AND pulled during the learn-in process, but that after inserting or removing the card it is necessary to wait **at least 5 seconds** until the second action is performed with the card. Only then the switch is assigned to the key card function (function group display switches to KEY), otherwise it is learned-in as a radio switch (function group RPS).

SUP A higher-level controller that overrides the internal functions.

SAB Up to six valve actuators (SAB) can be learned-in, one of these channel can be used with the bath function. The other channels can be used optionally for heating or cooling. For each SAB channel, an offset for the set point can be configured via Modbus. Further information see chapter EnOcean configuration.

OUT These are telegrams sent by Joy. The function can be used to map an EnOcean temperature controller.

8.3 Supported Profiles

Receive profiles

EnOcean-EEP	Type	Direction	Description	Thermokon Device	Max. Number of	Abbreviation LCD/ funktional group
F6-02-01	RPS	Rx	EnOcean switch	Diverse	1	RPS
D5-00-01	1BS	Rx	Window contact	SRW01	max.5	SRW
F6-10-00	RPS	Rx	Window handle	SRG02		SRG
A5-02-06	4BS	Rx	Temperature sensor 10-50°C	SR65 VFG, SR65 TF, SR65 AKF, SR65	1	VFG
A5-02-16	4BS	Rx	Temperature sensor 0-80°C			VFG
A5-02-05	4BS	Rx	Temperature sensor 0-40°C	SR04, LC-SR04, SR07, SR65	1	EXT
A5-10-03	4BS	Rx	Temperature, set point	SR07P, SR04P, SR06 2T/2T+		WRF
A5-07-01	4BS	Rx	Occupancy sensor (Occ)	SR-MDS Solar, SR-MOC Solar, SR-MOW Solar	max. 3	OCC
A5-08-01	4BS	Rx	Occupancy sensor (Occ, light, temperature)	SR-MDS		OCC
F6-04-01	RPS	Rx	Keycard switch	SR-KCS02, SR-KCS	1	KEY
A5-20-01	4BS	Rx/Tx	Valve actuator	SAB+, SAB05	max. 6	SAB
A5-20-12	4BS	Rx	Higher level controller (Fan, set point, controller, energy hold-off/dewpoint, Occup)		1	SUP

Sender profiles

Overview

The sender channels transmit after a value change or cyclically every 15 minutes. After sending a value, sending is disabled for 5s so as not to send any fast value change.

EnOcean-EEP	Type	Direction	Description	Thermokon Device	Max. Number of	Abbrev. LCD
A5-10-01	4BS	Tx	Room operating unit (Fan,temperature, set point, occupancy)		1	WRF
A5-10-05	4BS	Tx	Room operating unit (Temperature, set point, occupancy)			WRF
A5-11-02	4BS	Tx	Temperature controller (Fan, set point, alarm, controller state, energy hold-off, occupancy)		1	OUT
A5-20-01	4BS	Rx/Tx	SAB		max. 6	SAB

Profile description

A5-10-01

EnOcean Byte	Information/Data
ORG	A5
Data byte 3	Fan stage 255: Auto 200: Stage 0 175: Stage 1 155: Stage 2 70: Stage 3
Data byte 2	Set point offset Depends on parameter *Adjustment range of set point* 0…255 = Set point range-…+
Data byte 1	Temperature 255…0 = 0-+40°C
Data byte 0	Bit 3 -> Learn bit (0=key pressed) Bit 0 -> Occupancy (unoccupied = 0/occupied = 1)

A5-10-05

EnOcean Byte	Information/Data
ORG	A5
Data byte 3	Not used
Data byte 2	Set point Offset Depends on parameter *Adjustment range of set point* 0…255 = Set point range -…+
Data byte 1	Temperature 255…0 = 0-+40°C
Data byte 0	Bit 3 -> Learn bit (0=key pressed) Bit 0 -> Occupancy (Unoccupied = 0/Occupied = 1)

A5-11-02

EnOcean Byte	Information/Data
ORG	A5
Data byte 3	Manipulating variable Y of controller 0…255 = 0…100%
Data byte 2	Fan stage 0: Stage 0 Manual 1: Stage 1 Manual 2: Stage 2 Manual 3: Stage 3 Manual 16: Stage 0 Automatic 17: Stage 1 Automatic 18: Stage 2 Automatic 19: Stage 3 Automatic 255: Not used
Data byte 1	Set point effective Basic set point + set point offset 0…255 = 0-51,2°C
Data byte 0	Bit 7 -> Alarm Bit 6-5 -> Controller mode (1:Heating, 2:Cooling, 3:Off) Bit 4 -> Controller state (0:Automatic,1:Manual) Bit 3 -> Learn bit (0=key pressed) Bit 2 -> Reduce energy consumption (1:Window contact/Dewpoint active,0:not active) Bit 1-0 ->Occupancy (0:Occupied, 1:unoccupied, 3:frost protection)

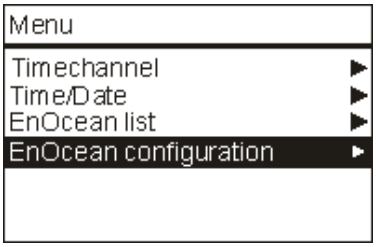
A5-20-01

EnOcean Byte	Information/Data
ORG	A5
Data byte 3	Manipulating variable Y of controller (Heating/Cooling with PI-controller) 0…255 = 0…100% Set point (Bath-function, Heating/Cooling with two-point controller) 0…255 = 0…40°C
Data byte 2	Temperature 255…0 = 0-+40°C Heating/Cooling function: internal sensor Bath function: Preset by assigned receive channel, internal sensor JOY, external sensor JOY
Data byte 1	Bit 7 -> not used Bit 6 -> not used Bit 5 -> not used Bit 4 -> not used Bit 3 -> Reduction of energy consumption ON/OFF Bit 2 -> Set point selection: Manipulating variable/Temperature set point Bit 1 -> Heating/cooling Bit 0 -> RCU
Data byte 0	Bit 3 -> Learn bit (0=key pressed)

8.4 Operation

Menu

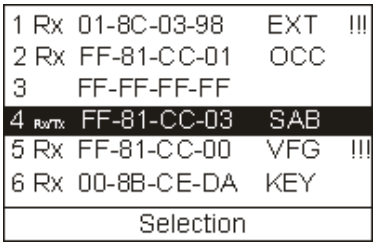
Two additional menu items appear with SR-type. The *EnOcean list* is a simple list representation of the EnOcean devices that have been learned-in. In addition to the list you can find more information about the channels as described below. *EnOcean configuration* is a password-protected area in which i.a. sensors and actuators can be learned-in/-out.



Picture 23 Main menu SR-type

EnOcean list

All learned-in sensors/actuators are listed. In addition, the info menu of a channel with information about profile, ID, errors, RSSI, etc. can be called. Use the UP / DOWN keys to select the channel. The ENTER key calls up the info menu of the channel. Use the LEFT / RIGHT keys to exit the list.

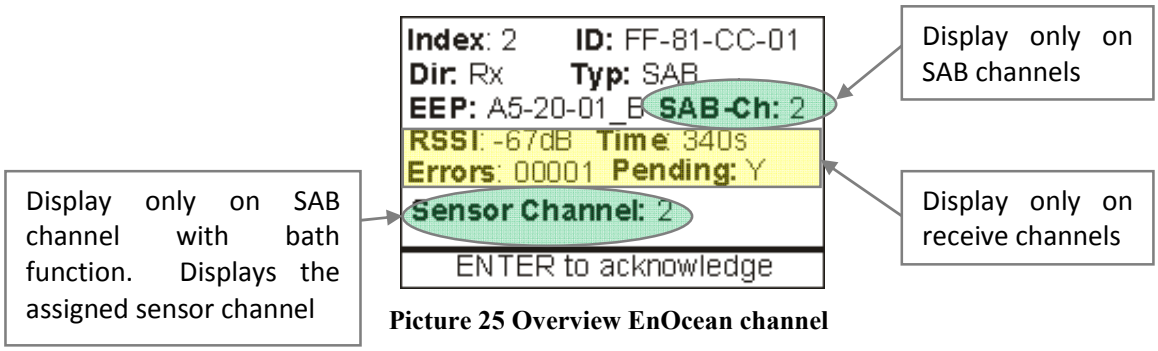


Picture 24 EnOcean list

The information about the individual channels is shown in short form in the following order from left to right:

Index channel / direction / EnOcean-ID/ functional group/ error indication

The exclamation mark **!!!** indicates an error which has not yet been acknowledged. The error handling is explained in more detail in chapter 8.5.



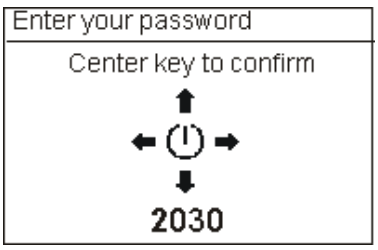
Picture 25 Overview EnOcean channel

ID	For a receive channel/message server the ID of the sensor, for a transmission channel the base ID plus index of the transmission channel
Dir	Channel direction. Rx=Receive channel, Tx=Transmission channel, Rx/Tx=Message Server
Typ	Corresponds to the function group from chap. 8.2
EEP	EnOcean Equipment Profile. In the SAB profile, the selected mode of operation is shown with a letter behind it: H-heating, K-cooling, B-bath.
SAB-Ch	Displays the SAB channel for assigning the Modbus registers
RSSI	Signal strength
Time	Time since last radio telegram received
Errors	Number of errors
Pending	Indicates a pending sensor failure

If the energy saving mode of the corresponding SAB function is active, an E is displayed in the bottom line.
Which items are displayed depends on the type of the channel.

EnOcean configuration

Login menu

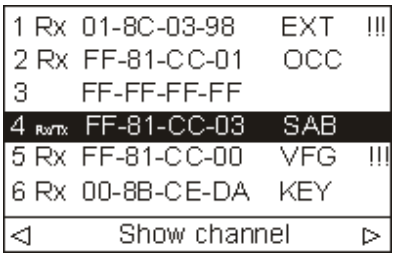


Picture 26 Login screen

Navigation with the UP / DOWN key to change the number. LEFT / RIGHT to select the number to be edited. The currently selected number is displayed in bold. Use ENTER to accept. The login remains unlocked until 10 minutes after the last key press.

Password: 2030

Channel list
After successful login, the channel list is displayed.

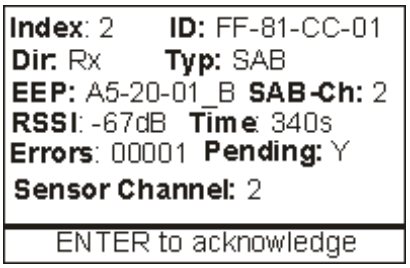


Picture 27 Channel list

In the footer, various menu items can be selected with the LEFT / RIGHT keys. The corresponding menu item is selected with the ENTER key.

Exit
Return to the parameter menu overview.

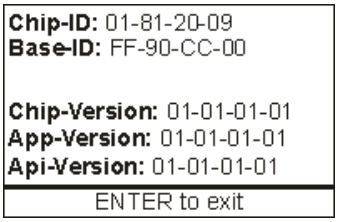
Show channel



Picture 28 Menu Show channel

The descriptions of the individual points can be found in the chapter EnOcean List. Occurred or pending errors can be acknowledged with the ENTER key.

Device info



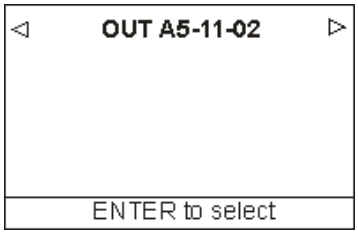
Picture 29 Device info

Detailed information about the EnOcean chip

Delete channel
Deleting a channel must be confirmed with the ENTER key. Any other key exits the menu without deleting.

Learn sensor
The selected channel is set to learn mode. The displayed ID is 00-00-00-00 and blinks. After receiving a valid learn-in telegram from a supported sensor, the fields direction, ID and functional group are automatically filled in. The learning mode can be aborted with the ENTER key or is aborted after receiving an unauthorized learn-in telegram.

Set actor
Under this item, the selected channel can be set up as a send channel or as a message server for embedding an SAB.



Picture 30 Set actor channel

With the keys LEFT / RIGHT the options can be selected and accepted with the ENTER key.

OUT/WRF (Send channel Tx)
Triggering a learn telegram with the ENTER key. Exit with UP / DOWN / LEFT / RIGHT. Supported profiles:

- OUT A5-11-02
- WRF A5-10-05
- WRF A5-10-01

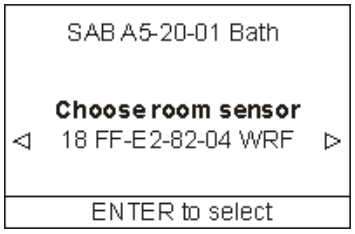
SAB (Message Server)

For controlling a SAB valve actuator. There are three functions to choose from.

Bath

With the bath function, the JOY can be used as a gateway between a wireless temperature sensor or externally connected sensor and a SAB to control a second room in addition to the control of its own control loop. Example application is a hotel room with bath. The JOY controls the room and the SAB controls the bathroom radiator.

The SAB works in self-controlled mode and receives set point and temperature from JOY. An EnOcean room sensor from the channel list (must be learned-in before!) or an external sensor (connected to the universal input of the JOY, configured as external temperature sensor EnOcean (NTC10k)) can be selected as temperature sensor:



Picture 31 Select room sensor for SAB with bath-function

Following profiles are allowed as EnOcean-sensor:

A5-02-05	Room sensor (Temperature 0-40°C)	SR04, LC-SR04, SR07, SR65	EXT
A5-10-03	(ROP) Temperature, set point	SR07P, SR04P, SR06 2T/2T+	WRF

If an error occurs with an assigned EnOcean room sensor, the SAB is put into self-controlled mode. If the values of an assigned external sensor are invalid, the temperature value of the internal JOY sensor is sent!

For an EnOcean room sensor with set point adjuster, the received value is adapted to the set point adjustment range of the JOY and offset to the heating set point of the JOY.

Example:

Heating set point JOY:= 22°C (Basic set point – half dead band).
Set point adjustment range JOY: +-3K
Set point at EnOcean-room sensor: Maximum position = +3K
=> SAB set point setting = 22°C + 3K = 25°C

If the external sensor is selected, the set point value of the JOY control loop is used.

An offset can be configured which is added to the SAB set point to set a higher set point in the bath than in the room.

Heating/cooling

The SAB gets the manipulating variable from devices with PI controller. If a two-point controller is configured, it gets set point and actual temperature value and works in self-controlled mode.

SAB's, separated by function (heating / cooling / bath), can be put into energy-saving mode (60 minutes wake-up interval) via Modbus.

After selecting the profile respectively the room sensor, the system returns to the list display. The corresponding channel now flashes to indicate readiness for learning. After receiving a SAB learn-in telegram, the channel is updated. When a learn-in message is received which does not correspond to the SAB profile, the learning process is aborted.

8.5 Error handling

Error detection

Errors are generated after 45 minutes without receiving a radio telegram from a learned-in sensor. Exception are SAB channels in reduction of energy consumption-mode. Errors are only triggered after 16.5 hours. No errors are generated for senders with ORG bytes 0xF6 and 0xD5.

Error management

Error types

Errors are stored internally and divided into:

no error	pending error	error gone, not acknowledged

The error display is active if one of the conditions of 2) and 3) is fulfilled. State 3) is set automatically with 2) and remains until the error is acknowledged. A gone error does not limit the function of the device.

Error counter

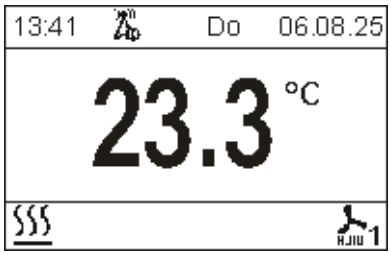
The error counter is incremented for each error that has occurred. It is always counted when the status changes from "no error" to "pending error". This means that an error that persists permanently remains at 1 until the maximum timeout time has been reached (currently 65535s = 18h). Then the error counter is set to 65535 (signed = -1).

Error display

Currently existing errors are displayed in the main screen. As soon as the error no longer exists, the display is deactivated again. In the list views, the display with the three exclamation marks remains until the error has been acknowledged.

Main screen

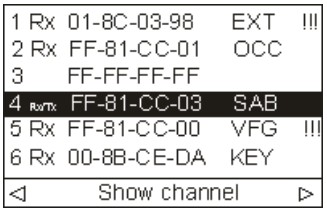
The main screen will display a pending error with the symbol  in the header!



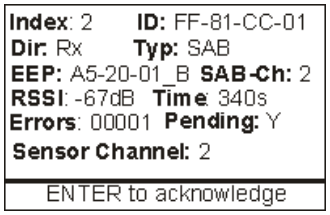
Picture 32 Error display

Parameter menu

In the parameter menu, the list of learned-in sensors/actuators can be selected. Sensors in error state will be marked in the list with 3 exclamation marks at the end of the line. The acknowledgment of an error is only possible in the password-protected area *EnOcean configuration*. A pending error is acknowledged in the *Info Sensor* menu with the ENTER key.



Picture 33 EnOcean list



Picture 34 Overview EnOcean channel

Modbus

Register 538, Error list EnOcean

When reading out the register, if there is no error, the value -1 = 0xFFFF is output. In the case of pending errors, an encoding following the scheme specified below is output and the error is subsequently reset internally (reading is equalized with acknowledgment by the user).

Error coding:

Bit 0-7 – channel
Bit 8-14 – type identification
Bit 15 – error pending=1/gone=0

Type identification:

Index	Abbreviation
0	SRW
1	SRG
2	VFG
3	EXT
4	WRF
5	KEY
6	OCC
7	SAB
8	SUP
9	OUT
A	RPS
B	JEX
C	JOY

Example:
- Error coding for channel 1, Picture 31 (Error pending): 8301
- Error coding for channel 5, Picture 31 (Error gone): 0205

In addition, the error counter of the associated channel is buffered. The value must be read out via register 539 directly afterwards.
The next read access to the register returns the next existing error.

Register 539, Error counter EnOcean

Error counter of the last error read out via register 538. The register must be read immediately following register 538.

Acknowledgement

Manual

A manual acknowledgment of the error is possible in the *Info Sensor* submenu of the password-protected *EnOcean configuration* menu. If there is an error, the user gets the option "ENTER to acknowledge" in the footer.

Modbus

Reading out the register 538, *Error list EnOcean*, automatically acknowledges the error read out before.

Error handling

The internal reaction to a sensor failure depends on the profile used.

EXT – Reset to internal temperature sensor value
WRF - Reset to internal temperature sensor value

VFG – The changeover mode is deactivated until the next radio telegram is received
OCC – If all of the learned-in sensors (up to 3) are in error state, the occupancy mode is deactivated. Comfort mode is active.
SUP - All default values are reset. Controller and fan coil stage are switched to automatic mode. Comfort mode is active.
SRW/SRG – The last state is retained until acknowledgment or error correction.

8.6 Configuration file SD-Card

Overview

The SD card can be used to read a configuration from the JOY. The SD card can be plugged in during configuration or it can be inserted after completing the configuration. If an SD card is inserted during the configuration, each learn-in / learn-out process is stored directly in the file. If the SD card is inserted after configuration, the configuration file is automatically created on the card after restart (file name: confEo_b.csv). **Attention: There must not be a file named confEo.csv on the SD card. In this case, the device configuration is deleted and the data from the found file is adopted.**
Only the configuration of the receive channels can be done with a SD card. A configuration file can be created with the Thermokon tool uConfig. This allows sensors to be learned-in without using the LRN buttons of the respective sensors.
Note: It is not possible to set up Tx- or Rx/Tx-connections automatically. For this, the usual learn-in process with sending a learn telegram is still necessary !!

Configuration file structure

The configuration file is structured according to the following scheme and is saved in csv-format:

- Name: confEo.csv
- EnOcean-configuration file header:
  - JOY;EnOcean;Version_0200
- List:

Channel	EnOcean-ID	EEP	Direction	SAB sensor channel	SAB offset	SAB channel
1-20	i.e. FF051290	**Tx:** A5-11-02 A5-10-01 A5-10-05 **Rx/Tx:** A5-20-01_H (Rx/Tx) A5-20-01_C (Rx/Tx) A5-20-01_B (Rx/Tx) **Rx:** F6-02-01 F6-04-01 F6-10-00 D5-00-01 A5-02-05 A5-02-06 A5-02-16 A5-07-01 A5-08-01 A5-10-03 A5-10-05 A5-20-12	Rx, Tx, Rx/Tx	1-20 21 = Ext. 22 = Int. 0xFF	-10 - +10	1-6

Note: In the file all numbers are encoded in hex format !!!

EO-Channel EnOcean channel index

EnOcean-ID	ID of the learned-in sensor (in Rx and Rx/Tx direction), or the ID of the send channel of the JOY (Tx)
EEP	Profile identifier of the sensor / actuator. Special feature of the SAB channels: The appendix _H for the heating function, _C for the cooling function and _B for the bath function indicates the mode of operation.
Direction	Rx-, Tx- or bidirectional (Rx/Tx) channel
SAB sensor channel	Valid only when using a channel with the SAB bath function. Assigns a sensor to the SAB that provides it with the required values (temperature, setpoint). The types WRF and EXT (see table type identification) can be assigned as external EnOcean sender on channels 1-20, as well as on channel 21 the external sensor of the JOY (analog input) and on channel 22 the internal temperature sensor of the JOY. 0xFF means that no sensor is assigned.
SAB offset	Valid only when using a SAB channel implementing the bath function. Offset, which is calculated on the set point value of the JOY. Exception: Default values by internal sensor.
SAB channel	Assigned SAB Modbus channel (s. Modbus Holding *Register 137-143*).

Configuration

SAB offset
Only for the bath function. For each SAB channel, an offset can be configured, which is added to the setpoint default of the JOY. Exception: Internal sensor assigned.

Modbus

Holding register

EnOcean-Wake-Up
Sets the send interval of the broadcast channels.

Heating/cooling/bath reduction of energy consumption
The SABs can be put into energy-saving mode. The send interval of the SABs is set to 60 minutes.

Input Register

SAB channel 1-6 value of manipulating variable
Feedback of the internal SAB manipulating variable value

SAB Kanal 1-6 temperature
Feedback of the internal SAB temperature value

9 Modbus register reference

9.1 Parameters (all device types)

Function group	Parameter	Device types	Factory setting	Min	Max	Unit	Description	Modbus protocol address
Keys	Special function ON/OFF Button		no special function	--	--	--	0: no special function (ON/OFF active) 1: toggle occupancy 2: occupied 3: unoccupied 255 (=0xFF): key locked (ON/OFF locked)	115
Main screen	Display main screen		room temperature	--	--	--	0: room temperature 1: base set point 2: set point offset	10
	Footer symbol 1		no symbol	--	--	--	0: no symbol 1: heating/cooling 2: occupancy 3: window contact/dew point 4: fan coil stage 5: time channel	11
	Footer symbol 2			--	--	--		12
	Footer symbol 3			--	--	--		13
	Footer symbol 4			--	--	--		14
	Footer symbol 5			--	--	--		15
	Display set point adjustment		set point offset	--	--	--	0: set point offset 1: base set point 2: set point stages (z.B. -3,-2, -1, 0, +1, +2,+3)	114
Common settings	Lock parameter menu		invocation released	--	--	--	0: invocation released 1: invocation locked	124
	Language		german	--	--	--	0: german 1: english	3
	Brightness background illumination LCD		90%	0	100	%	0-100 = 0-100%	16
	Brightness ring		20%	0	100	%	0-100 = 0-100%	17
	Device state after Power ON		Device ON	--	--	--	0: standby 1: last state (standby/Device ON) 2: Device ON	130
	Device values after Power ON		Last values	--	--	--	0: last values 1: reset values	131
Time/Date	Format time		24h	--	--	--	0: 24h(pm) 64 (=0x40): 12h(am) 255 (=0xFF): not displayed	7
	Format date		TT.MM.JJ				0: DD.MM.YY 1: YY/MM/DD 255 (=0xFF): not displayed	8

	Daylight saving		deactivated	0	1	--	0: deactivated 1: activated (CET)	97
Timechannel	Timechannel 1 weekdays		0	0	0x7F	--	Bit0: monday Bit1: tuesday Bit2: wednesday Bit3: thursday Bit4: friday Bit5: saturday Bit6: sunday Example: 7 ≙ $0x0F_{hex}$ = monday, tuesday, wednesday, thursday	34
	Timechannel 1 start hour period 1		0	0	23	h		35
	Timechannel 1 start minute period 1		0	0	59	min		36
	Timechannel 1 set point period 1		21	0	50	°C	0-500 ≙ 0,0 – 50,0°C	37
	Timechannel 1 fan coil stage period 1	5DO	4	0	4	--	0: off 1: stage 1 2: stage 2 3: stage 3 4: automatic	38
		EC AO2DO, EC 3AO	1	0	1	--	0: off 1: automatic	
		HC, HC3AO	--	--	--	--	not used	
	Timechannel 1 ECO mode period 1		0	0	1	--	0: ECO mode OFF 1: ECO mode ACTIVE	39
	Timechannel 1 period 2							40-44
	Timechannel 1 period 3							45-49
	Timechannel 1 period 4							50-54
	Timechannel 2							55-75
	Timechannel 3							76-96
Temperature	Offset internal sensor		0	0	15	°C	0-150 ≙ 0,0 - 15,0°C	4
	Offset external sensor		0	0	15	°C	0-150 ≙ 0,0 - 15,0°C	5
	Unit temperature		°C	--	--	--	1: °Celsius 2: °Fahrenheit	6
Set point	Set point after reset		21	0	50	°C	0-500 ≙ 0,0 – 50,0°C	20
	Adjustment range of set point		3	0	10	°C	0-100 ≙ 0,0 – 10,0°C	21
	Set point step range		0,5	0	10	°C	0-100 ≙ 0,0 – 10,0°C	22
	Dead band comfort		2	0	15	°C	0-150 ≙ 0,0 – 15,0°C	23
	Dead band ECO mode		10	0	15	°C	0-150 ≙ 0,0 – 15,0°C	24
	Set point adjustment occupancy		2	0	15	°C	0-150 ≙ 0,0 – 15,0°C	25
	Frost protection		7	0	15	°C	0-150 ≙ 0,0 – 15,0°C	26
	Heat protection		35	0	50	°C	0-500 ≙ 0,0 – 50,0°C	27

	Behaviour of set point offset at occupancy change		keep value	--	--	--	0: keep value 1: reset value 2: reset value while unoccupied, restore on return to occupied	135
Controller	Controller hysteresis		1	0	15	°C	0-150 ≙ 0,0 – 15,0°C	28
	Controller mode after device reset		auto	--	--	--	0: off 1: heating 2: cooling 3: auto 17 (=0x11): auto heating using both digital outputs 18 (=0x12): auto cooling using both digital outputs	29
	Valve protection release		released	--	--	--	0: locked 1: released	33
	Mode selection manipulating variable		minimum manipulating variable remains until mode change	--	--	--	0 - minimum manipulating variable remains until mode change 1 – the manipulating variable is not output until the minimum manipulating variable has been reached	106
	PWM cycle time		30	5	60	min		107
	Heating controller type		PI controller	--	--	--	0 - PI controller 1 – two-point-controller	108
	Cooling controller type		PI controller	--	--	--	0 - PI controller 1 – two-point-controller	109
	Proportional band Xp heating		2	0	10	°C	0-100 ≙ 0,0 – 10,0°C	102
	Reset time Tn heating		30	0	1000	min	0-1000 ≙ 0-1000min	103
	Minimum manipulating variable heating		0	0	100	%	0-100 = 0-100%	104
	Maximum manipulating variable heating		100	0	100	%	0-100 = 0-100%	105
	Proportional band Xp cooling		2	0	10	°C	0-100 ≙ 0,0 – 10,0°C	125
	Reset time Tn cooling		30	0	1000	min	0-1000 ≙ 0-1000min	126
	Minimum manipulating variable cooling		0	0	100	%	0-100 = 0-100%	127
	Maximum manipulating variable cooling		100	0	100	%	0-100 = 0-100%	128
	Minimum runtime controller output	5DO EC AO2DO HC AO2DO	0	0	60	min	0-60 = 0-60 min	146
	Delay time controller mode change	5DO EC AO2DO HC AO2DO	0	0	600	s	0-600 = 0-600 s	147

Outputs	Type 6-way valve	HC AO2DO, HC 3AO, EC 3AO	0-10V steady signal heating and cooling	--	--	--	0 – 0-10V steady signal heating and cooling = 6-way valve deactivated 20 – 2-10V (e.g. BELIMO) 21 – 2-10V inverted (e.g. BELIMO) 22 – 0-10V DN15 (e.g. SAUTER) 23 – 0-10V DN15 inverted (e.g. SAUTER) 24 – 0-10V DN20 e.g. (e.g. SAUTER) 25 – 0-10V DN20 inverted (z.B. SAUTER) 26 – 0-10V steady signal heating 26 – 0-10V steady signal cooling	2
	Maximum load heating	5DO EC AO2DO HC AO2DO	<2A	0	2	--	0: <2A 1: <4A 2: <6A	99
	Maximum load cooling	5DO EC AO2DO HC AO2DO	<2A	0	2	--	0: <2A 1: <4A 2: <6A	100
	Effective direction of relay heating	5DO EC AO2DO HC AO2DO	make contact	--	--	--	0: make contact 1: break contact	132
	Effective direction of relay cooling	5DO EC AO2DO HC AO2DO	make contact	--	--	--	0: make contact 1: break contact	133
	Effective direction of analog output heating	EC 3AO, HC 3AO	0-10V	0	1	--	0: 0-10V 1: 10-0V	148
	Effective direction of analog output cooling	EC 3AO, HC 3AO	0-10V	0	1	--	0: 0-10V 1: 10-0V	149
Fan	Number of fan coil stages	5DO	3	1	3	--	1: 1 stage 2: 2 stages 3: 3 stages	9
	Treshold stage 1 on	5DO	0	0	15	°C	0-150 ≙ 0,0 – 15,0°C	30
	Treshold stage 2 on	5DO	1,5	0	15	°C	0-150 ≙ 0,0 – 15,0°C	31
	Treshold stage 3 on	5DO	3	0	15	°C	0-150 ≙ 0,0 – 15,0°C	32
	Maximum fan coil value (100%) at temperature deviation	EC AO2DO EC 3AO	4	0	15	°C	0-150 ≙ 0,0 – 15,0°C	30
	Fan coil assignment	5DO EC AO2DO EC 3AO	heating/cooling	0	2		0: heating/cooling 1: heating 2: cooling	98
	Steps fan coil control	EC AO2DO EC 3AO	20% steps	1	5		1: 100% step 2: 50% steps 3: 33% steps 4: 25% steps 5: 20% steps	110

	Fan coil minimum	EC AO2DO EC 3AO	0	0	100	%	0-100 ≙ 0-100% (0-10V) Special case: $0x8xxx_{hex}$ = the minimum value corresponds to step 1. The step size of the control is calculated from the number of steps of the fan level control, the minimum and the maximum. Example: Steps fan coil control: 3 minimum: 50%, Maximum:70% ⇨ off=0% ⇨ stage1=50% ⇨ stage2=60% ⇨ stage3= 70%	111
	Fan coil maximum	EC AO2DO EC 3AO	0	0	100	%	0-100 ≙ 0-100% (0-10V)	112
	Start-up time fan coil	5DO EC AO2DO EC 3AO	1	0	30	s	0-30s ≙ 0 – 300	113
	Fan start with manipulated variable > x	5DO EC AO2DO EC 3AO	0	0	20		0-20 ≙ >0%->20%	129
	Key fan stage with/without AUTO	5DO EC AO2DO EC 3AO	with AUTO	--	--	--	0: with AUTOMATIC 1: without AUTOMATIC	134
Occupancy	Occupied/ ECO override		Occupancy state without effect on ECO mode	--	--	--	0: Occupancy state without effect on ECO mode 1: OCCUPANCY state overrides ECO mode	136
Inputs	Input 1 universal (low voltage)		Not used	--	--	--	0x00: Not used 0x01: External temperature sensor (NTC10k) 0x02: Change-Over sensor (NTC10k) 0x03: External temperature sensor EnOcean(NTC10k) 0x10: Change-Over NO (normally open) 0x11: Window contact NO 0x12: Occupancy contact NO 0x13: Dew point contact NO 0x14: Keycard switch NO 0x30: Change-Over NC (normally closed) 0x31: Window contact NC 0x32: Occupancy contact NC 0x33: Dew point contact NC 0x34: Keycard switch NC	18

	Input 2 (230V input for 230V types, low voltage for 24V types)		Not used	--	--	--	0: Not used 0x10: Change-Over NO (normally open) 0x11: Window contact NO 0x12: Occupancy contact NO 0x13: Dew point contact NO 0x30: Change-Over NC (normally closed) 0x31: Window contact NC 0x32: Occupancy contact NC 0x33: Dew point contact NC	19
	Input 3 (low voltage)	all devices without Modbus-interface	Not used	--	--	--	0: Not used 0x10: Change-Over NO (normally open) 0x11: Window contact NO 0x12: Occupancy contact NO 0x13: Dew point contact NO 0x30: Change-Over NC (normally closed) 0x31: Window contact NC 0x32: Occupancy contact NC 0x33: Dew point contact NC	--

9.2 Modbus Register

Info Register (read only, only Modbus types)

Function group	Name	Type	Factory setting	Min	Max	Unit	Description	Modbus Protocol adress
Info	Device type		--	--	--	--	0x0600 JOY Fancoil 5DO 0x0601 JOY Fancoil EC AO2DO 0x0602 JOY HC AO2DO 0x0604 JOY Fancoil EC 3AO 0x0605 JOY HC 3AO 0x0612 JOY SR HC AO2DO 0x0614 JOY SR Fancoil EC 3AO 0x0615 JOY SR HC 3AO	0
	Firmware		--	--	--	--	0xAABB –> AA = Major version, BB = Minor version Example: Version 2.0 => 0x0200	1

Modbus Holding Register (Modbus types only)

Function group	Parameter	Device types	Factory setting	Min	Max	Unit	Description	Modbus protocol address
Set point	Basic set point		data point inactive	-1	50	°C	0-500 ≙ 0,0 - 50,0°C 0xFFFF = -1 data point inactive	255
	Set point offset		0	0	15	°C	0-150 ≙ 0,0 - 15,0°	256
--	Default occupancy		data point inactive	-1	1	--	0: room unoccupied 1: room occupied -1 ≙ 0xFFFF: data point inactive	257
--	Default dew point		data point inactive	-1	1	--	0: dew point inactive 1: dew point active -1 ≙ 0xFFFF: data point inactive	258
--	Default window contact/ reduction of energy consumption		data point inactive	-1	1	--	0: window closed 1: window open -1 ≙ 0xFFFF: data point inactive	259
--	Default Change-Over		data point inactive	-1	1	--	0: heating mode (cooling locked) 1: cooling mode (heating locked) -1 ≙ 0xFFFF: data point inactive	260

--	Device On/standby (Off)		Ein	0	1	--	0: Device on 1: standby (off)	261
--	Release of keys		all keys released	0	2	--	0: all keys released 1: all keys locked 2: fan coil keys locked	262
--	Default alarm		alarm inactive	0	1	--	0: alarm inactive 1: alarm active	263
Time/Date	Time hour		12	0	23	h		264
	Time minute		0	0	59	min		265
	Date day		1	1	31	--		266
	Date month		1	1	12	--		267
	Date year		15	15	99	--		268

Controller	Preset Controller		AUTO	--	--	--	0: off 1: heating AUTO 2: cooling AUTO 3: AUTO 17 (=0x11): heating AUTO, both outputs (heating and cooling) are triggered in parallel *Control output only with 5DO, HC AO2DO, EC AO2DO* 18 (=0x12): cooling AUTO, both outputs (heating and cooling) are triggered in parallel *Control output only with 5DO, HC AO2DO, EC AO2DO* -256 (=0xFF00): outputs OFF(manual mode), frost- and heatprotection disabled -255 (=0xFF01): output heating ON (MANUAL Mode*)* , symbol heating is faded-in *Control output only with 5DO, HC AO2DO, EC AO2DO* -254 (=0xFF02): output cooling ON (MANUAL Mode) , symbol cooling is faded-in *Control output only with 5DO, HC AO2DO, EC AO2DO* -239 (=0xFF11 heating MANUAL, both outputs (heating and cooling) switched ON in parallel, symbol heating is faded-in *Control outputs only with 5DO, HC AO2DO, EC AO2DO* -238 (=0xFF12): cooling MANUAL, both outputs (heating and cooling) switched ON in parallel, symbol cooling is faded-in *Control outputs only with 5DO, HC AO2DO, EC AO2DO* 3AO types (EC 3AO, HC 3AO): The specifications of the manual modes (-255, -254, -239, -238) only control the symbol not the ouputs, see register 271 and 272	269

Fan coil	Preset Fan coil	EC AO2DO EC 3AO	AUTO	--	--	--	0-100 ≙ 0-100% MANUAL -256 (=0xFF00$_{hex}$) = AUTO	270
		HC AO2DO HC 3AO	off	0	3	--	0: off 1: stage 1 2: stage 2 3: stage 3	
		5DO	AUTO	0	4	--	0: off 1: stage 1 2: stage 2 3: stage 3 4: AUTO	
Outputs	Preset output heating	EC 3AO HC 3AO	data point inactive	--	--	--	0-100 (=0x00-0x64) ≙ 0-10V, no symbol -1(=0xFFFF): data point inactive, output is controlled by controller	271
	Preset output cooling	EC 3AO HC 3AO	data point inactive	--	--	--	0-100 (=0x00-0x64) ≙ 0-10V, no symbol -1 (=0xFFFF): data point inactive, output is controlled by controller	272
	Preset 6- way valve output	HC 3AO HC AO2DO	data point inactive	--	--	--	0-100 (=0x00-0x64) ≙ 0-10V, no symbol -1(=0xFFFF): data point inactive, output is controlled by controller	273
	Preset ECO mode		deactivate ECO mode	0	1	--	0: deactivate ECO mode 1: activate ECO mode	274

Modbus Input Register (Modbus types only)

Function group	Parameter	Device types	Factory setting	Min	Max	Unit	Description	Modbus protocol address
Set point	Set point heating		--	0	50	°C	0-500 ≙ 0-50,0°C	511
	Set point cooling		--	0	50	°C	0-500 ≙ 0-50,0°C	512
	Set point offset		--	0	15	°C	0-150 ≙ 0-15,0°C	513
	Basic set point		--	0	50	°C	0-500 ≙ 0-50,0°C	553
Temperature	Internal temperature sensor		--	0	50	°C	0-500 ≙ 0-50,0°C	514
	External temperature sensor		--	0	50	°C	0-500 ≙ 0-50,0°C 600 – no sensor detected	515
Outputs	Output heating	5DO EC AO2DO HC AO2DO	--	0	1	--	0: open 1: closed	516

		EC 3AO HC 3AO	--	0	100	%	0-100 (=0x00-0x64) ≙ 0-10V	
	Output cooling	5DO, EC AO2DO HC AO2DO	--	0	1	--	0: open 1: closed	517
		EC 3AO, HC 3AO	--	0	100	%	0-100 (=0x00-0x64) ≙ 0-10V	
Fan coil	State fan coil stage	5DO	--	--	--	--	0: off 1: stage 1 2: stage 2 3: stage 3 -255 (=0xFF01$_{hex}$): Auto stage 1 -254 (=0xFF02$_{hex}$): Auto stage 2 -253 (=0xFF03$_{hex}$): Auto stage 3	518
		EC AO2DO EC 3AO	--	--	--	--	0-100% ≙ 0-100% Manual -256..-156 (=0xFF00$_{hex}$-0xFF64$_{hex}$): Automatic with value in %	
Outputs	Output 6-way valve	HC AO2DO HC 3AO	--	--	--	--	0-100 (=0x00-0x64) ≙ 0-10V	
Inputs	State input 1		--	0	1	--	0: open 1: closed	519
	State input 2		--	0	1	--	0: open 1: closed	520
---	State occupancy		--	-1	1	--	0: room unoccupied 1: room occupied -1 ≙ 0xFFFF: data point inactive	521
---	State dew point		--	-1	1	--	0: dew point inactive 1: dew point active -1 ≙ 0xFFFF: data point inactive	522
---	State window contact/reduction of energy consumption		--	-1	1	--	0: window closed 1: window open -1 ≙ 0xFFFF: data point inactive	523
Controller	Manipulating variable controller		--	0	100	%	0-100 (=0x00-0x64) ≙ 0-10V	524
	Controller mode		--	0	2	--	0: off 1: heating 2: cooling	525
---	ECO mode		--	0	1	--	0: ECO mode inactive 1: ECO mode active	552

9.3 EnOcean enhancement

Configuration Register

Function group	Parameter	Device types	Factory setting	Min	Max	Unit	Description	Modbus protocol address
EnOcean	SAB offset Kanal 1	SR	0	-10	10	K	-100..+100 ≙ -10,0..+10,0°C	139
	EnOcean-Wake-up		15	1	60	min	1..+60 ≙ 1..60 minutes	145

Modbus Holding Register

Function group	Parameter	Device types	Factory setting	Min	Max	Unit	Description	Modbus protocol address
EnOcean	Heating reduction of energy consumption	SR	--	0	1	--	0: deactivated 1: activated	275
	Cooling reduction of energy consumption		--	0	1	--	0: deactivated 1: activated	276
	Bath reduction of energy consumption		--	0	1	--	0: deactivated 1: activated	277

Modbus Input Register

Function group	Parameter	Device types	Factory setting	Min	Max	Unit	Description	Modbus protocol address
SAB	SAB channel 1 value manipulating variable	SR	--	0	100	%	0..+100 ≙ -0..100%	526
	SAB channel 1 temperature		--	0	40	°C	0..+255 ≙ -0,0..+40,0°C	527
	SAB channel 2 value manipulating variable		--	0	100	%	0..+100 ≙ -0..100%	528
	SAB channel 2 temperature		--	0	40	°C	0..+255 ≙ -0,0..+40,0°C	529
	SAB channel value manipulating variable		--	0	100	%	0..+100 ≙ -0..100%	530
	SAB channel 3 temperature		--	0	40	°C	0..+255 ≙ -0,0..+40,0°C	531
	SAB channel 4 value manipulating variable		--	0	100	%	0..+100 ≙ -0..100%	532
	SAB channel 4 temperature		--	0	40	°C	0..+255 ≙ -0,0..+40,0°C	533
	SAB channel value manipulating variable		--	0	100	%	0..+100 ≙ -0..100%	534
	SAB channel 5 temperature		--	0	40	°C	0..+255 ≙ -0,0..+40,0°C	535
	SAB channel 6 value manipulating variable		--	0	100	%	0..+100 ≙ -0..100%	536
	SAB channel 6 temperature		--	0	40	°C	0..+255 ≙ -0,0..+40,0°C	537

Error management	Error list EnOcean		--	--	--	--	Bit 0-7 – channel Bit 8-14 – type identification Bit 15 – error pending=1/gone=0	538
	Error counter EnOcean		--	0	65535	--		539
Rocker switch	Feedback Rocker Switch		-	-	-	-	Bit 4 – Left OFF (Left top), 4 Rocker PTM100 and PTM200 Bit 5 – Left ON (Left bottom), 4 Rocker PTM100 and PTM200 Bit 6 – Right OFF (Right top),4 Rocker PTM200 resp. OFF (top button),2 Rocker PTM200 Bit 7 – Right ON (Right bottom), 4 Rocker PTM200 resp. ON (bottom button), 2 Rocker PTM200	1022

10 Appendix

10.1 Supported Control Commands

The following MODBUS control commands are supported by JOY:

Description	Function Code	
Read Holding Register	03 (hex)	3 (dez)
Read Input Register	04 (hex)	4 (dez)
Write multiple registers	10 (hex)	16 (dez)

Table 1 Supported Modbus Commands

10.2 Data Transmission

Master/Slave Protocol

One Master and one or more slaves are connected to the serial bus. Communication between Master and Salve is solely regulated by the Master. The Slaves are only allowed to transmit if they were addressed by the Master before. Slaves are only transmitting back to the Master, never to another slave.

Data Frame

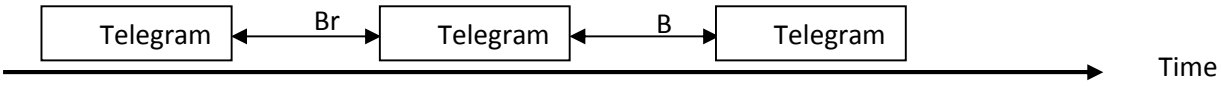
Data packets are transmitted according to strictly defined defaults:

Address	Control	Data	Checksum

In general a MODBUS telegram is started with the address of the slave, following a control command (e.g. read out registers) and the data. By means of the checksum at the telegram-end the bus participants can recognize transmission errors.

Transmission Mode RTU

In transmission mode RTU telegrams are separated from each other by means of transmission breaks.



The time of the transmission breaks for the separation of telegrams is depending on the adjusted baud rate and amounts to 3,5 * Word-Transmission Time (11 Bit). With 9600 baud at least 4ms and with 19200 baud at least 2ms between both telegrams must pass by.

Telegram Structure

Address 1 Byte	Control Command	Data 0 - 100 Byte	Checksum	
			Low	

Calculation of CRC-Checksum

The CRC–checksum (Cyclical Redundancy Check) is calculated by the sender from all bytes transmitted and attached to the message. The receiver calculates the CRC checksum again and compares the same with the checksum received. If values do not match, a transmission error is assumed and the received data packet is rejected. The low-order byte of the 16 bit checksum is sent in the telegram at the next to last position and the high-order byte at last position.

Calculation of checksum (programming example in C):

```
crc = 0xFFFF;                                   // CRC-Check, Init
for(i = 0; i < telegram_length-2; i++)
        crc = crc_calc(crc, telegram_data[i]);

crc_low  = crc & 0x00FF;                        // Low-Byte
crc_high = (crc & 0xFF00) >> 8;                 // High-Byte

// Calculate CRC
unsigned int crc_calc(unsigned int crc_temp, unsigned int data)
{
        unsigned int    Index_CC=0;
        unsigned int    LSB=0;
        crc_temp = ( ( crc_temp ^ data) | 0xFF00) & (crc_temp | 0x00FF) ;
        for(Index_CC = 0; Index_CC<8; Index_CC++)
        {
            LSB = (crc_temp & 0x0001);
            crc_temp        >>= 1;
            if(LSB)
            crc_temp = crc_temp ^ 0xA001;       // calculation polynominal for CRC16
        }
        return(crc_temp);
}
```