

# KEM

## KNX Energy Monitor

ZEMKEM

Application program version: [1.1]

User manual edition: [1.1]\_a

[www.zennio.com](http://www.zennio.com)

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## DOCUMENT UPDATES

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Version	Changes	Page(s)
[1.1]_a	<b>Changes in the application program:</b> <ul style="list-style-type: none"><li data-bbox="459 533 1155 667">• Parameter Flow Sensor Type has been removed. Now, parameters 'K' and 'a' must be inserted mandatorily.</li><li data-bbox="459 689 1198 770">• Optimisation of the binary inputs, motion detector, logic functions and temperature probe modules.</li></ul>	25  -

# 1 INTRODUCTION

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## 1.1 KEM

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The **KEM** (KNX Energy Monitor) is an electrical energy (for single-phase systems), water consumption and calorific energy meter. Its use will ease a more efficient consumption of energy resources, resulting in savings for the user.

KEM is able to measure and report in the KNX system the values of energy, water consumption and caloric energy along with other magnitudes related to these three.

**Alarms and notifications** can be configured as warnings when a magnitude exceed the limits established, for example, to disconnect low priority systems to reduce consumption.

The most outstanding features of KEM are:

- Measurement of **power and electrical energy** of up to 3 single-phase circuits. Support for frequencies of 50 and 60 Hz.
- Measurement of **flow and consumed water** of up to 4 channels.
- Measurement of **calorific energy** consumed (for both cooling and heating) from up to 2 climate systems.
- Up to **7 Alarms** for electrical power, electrical current or flow.
- Up to **10 notifications** for water consumption or electrical energy.
- Synchronisation with an external **KNX clock**.
- **10** customisable, multi-operation **logic functions**.
- **5 multifunction inputs** parameterisable as binary input, motion sensor or temperature sensor.
- **Heartbeat** or periodic “still-alive” notification.

## 1.2 INSTALLATION

Figure 1 shows the element scheme of KEM:

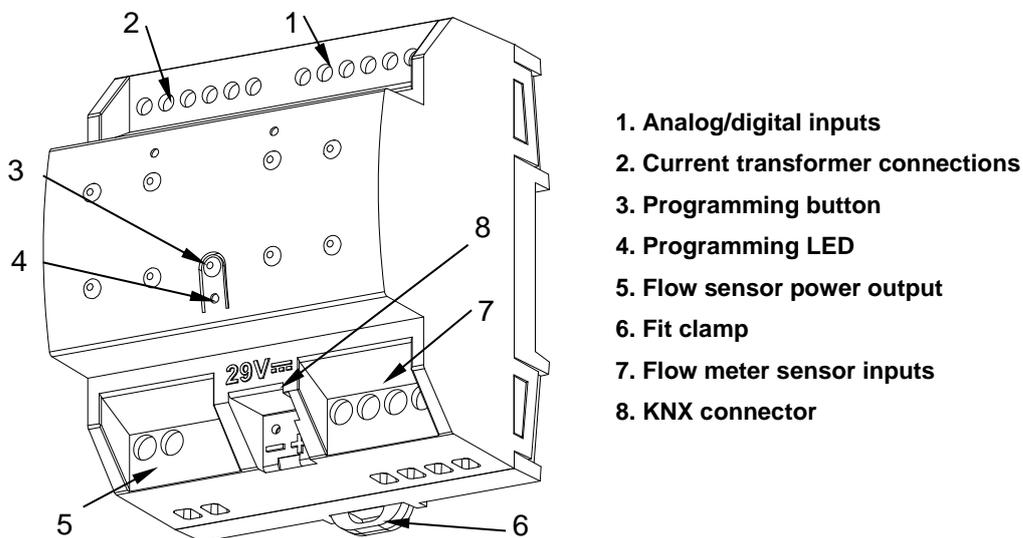


Figure 1. KEM. Element scheme

KEM connects to the KNX bus via the built-in terminals (8). An external DC power supply is not needed.

Once the device is provided with power from the KNX bus, both the individual address and the associated application program can be downloaded.

To carry out **electricity consumption** measurements, it is necessary to connect the Zennio current transformers to the KEM inputs intended for that use (2). A different transformer will be required per electrical line being monitored. Thus, if three electrical lines are going to be monitored, one transformer will need to be connected to the slots CT1 +/- (referred to as “Phase 1”), another one to the slots CT12 +/- (“Phase 2”), and a third one to the slots CT3 +/- (“Phase 3”).

For **water consumption** measurements, the output of each flow meter will be connected to the flow meter inputs of KEM (7). The flow meter will be supplied from the 5V power output of KEM (5). Note that this output will only be live if at least one of the channels for water measurement is enabled in the parameterisation (see section 2.3).

To calculate the **calorific energy** consumed by the system is required, in addition to the flow meter, it is necessary to know the temperature of the fluid at the outlet (supply) and at the inlet (return) of the air-conditioning circuit. For this purpose, the temperature probes incorporated in the flow meters and fittings supplied by Zennio can be used. Each one of these probes can be connected in any of the 5 analogue/digital inputs (1).

A short press on the **Prog./Test button** (3) will make the device enter the programming mode. The **Prog./Test LED** (4) will light in red. On the contrary, if this button is held while plugging the device into the KNX bus, the device will enter the **Safe Mode**. In such case, the programming LED will then blink in red.

For detailed information about the technical features of the device, as well as on the installation and security procedures, please refer to the corresponding **Datasheet**, bundled with the original package of the device and also available at [www.zennio.com](http://www.zennio.com).

## 1.3 MEASURED QUANTITIES

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Next, the quantities measured by the KEM that can be sent to the bus for monitoring are described.

### 1.3.1 ELECTRICITY

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Magnitudes of each conductor or phase:

- **Current:** rms value expressed in milliamps [**mA**].
- **Active power:** effective power capable of transforming electrical energy into work. Measured in watts [**W**] or kilowatts [**kW**], as selected by parameter.
- **Consumed active energy:** time integration of the active power. Measured in watts hour [**W·h**] or kilowatts hour [**kW·h**], as selected by parameter.

Global magnitudes:

- **Current:** arithmetic sum of the currents of each of the phases.
- **Active power:** sum of the active powers of each of the phases. Measured in watts hour [**W·h**] or kilowatts hour [**kW·h**], as selected by parameter.
- **Consumed active energy:** time integration of the global active power. Measured in watts hour [**W·h**] or kilowatts hour [**kW·h**], as selected by parameter.

There are two additional objects that represent magnitudes not measured by KEM. Although they are set by parameter, assigning them the desired value by object is possible:

- **Voltage:** magnitude available for each phase expressed in rms and millivolt units [**mV**].
- **Power Factor:** global magnitude that expresses the relation between active and apparent power (dimensionless).

### 1.3.2 WATER

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Magnitudes of each water channel:

- **Flow:** water flow measured in liters per hour [**L/h**] or cubic meters per hour [**m<sup>3</sup>/h**].
- **Consumed water:** quantity of water consumed calculated from the flow rate and elapsed time. Its units will be litres [**L**] or cubic metres [**m<sup>3</sup>**] as indicated by parameter.

Global water measures:

- **Flow:** sum of the flow of each channel. Measured in litres per hour [**L/h**] or cubic meters per hour [**m<sup>3</sup>/h**], as indicated by parameter.
- **Consumed water:** sum of the water consumed by each of the channels. Measured in litres [**L**] or cubic meters [**m<sup>3</sup>**] as indicated by parameter.

ANNEX I. Flow calculation details how to calculate the flow rate from the frequency measured by the flow meter.

### 1.3.3 HEAT/COOL QUANTITY

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The magnitudes measured by each channel are:

- **Temperature difference:** difference between forward temperature and return temperature.
- **Heat quantity:** calorific energy consumed by the associated water channel when the temperature difference is positive. It is measured in joules [**J**].
- **Cool quantity:** calorific energy consumed by the associated water channel when the temperature difference is negative. It is measured in joules [**J**].
- **Heat/cool quantity:** sum of the calorific energy consumed during both heating and cooling. It is enabled by an ETS parameter and is always measured in joules [**J**].

## 1.4 DATA INICIALIZATION AFTER A DOWNLOAD

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It is important to keep in mind that, when reprogramming the device from ETS (either partial or complete downloads), the consumption variables and therefore any data accumulated so far are cleared on both partial and total registers.

If it is required to maintain the present consumption values, before carrying out the download, the option “maintain the current values” must be activated in ETS in the desired registers, or an initial value must be parameterised (see sections 2.2.2, 2.3.2 and 2.4.2 for more details).

There are also certain objects with the flag *W* enabled, so they can be initialized directly writing the desired value in the communication object.

It is important to note that global objects are always the sum of channels or phases, so it is not possible to set a value after download for these nor have flag *W* enabled.

## 1.5 SETTING THE TIME OF DAY

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For certain functionalities, such as periodic registers or the starting date of each register, it is necessary to set the time of day of KEM through a master clock in the installation.

During the start-up, KEM will request the time of day to the KNX bus through the objects “**Date**” and “**Time of day**”. Up to four read requests will be sent (after a customisable initial delay). If there is no response after these four requests, the device sets the last known date and time.

### Notes:

- *The time count is performed internally by KEM. However, any time adjustments must be notified (through external events) in order to ensure the synchronisation of the periodic timing of the registers.*
- *Periodic synchronise of the internal clock of KEM is advisable to prevent precision loss after prolonged operation. Therefore, KEM sends a time request to the KNX bus every 15 minutes.*
- *Please take into account that the device does not start measuring until it has a valid date and time.*

## 2 CONFIGURATION

### 2.1 GENERAL

After importing the corresponding database in ETS and adding the device into the topology of the desired project, the configuration process begins by entering the Parameters tab of the device.

#### 2.1.1 CONFIGURATION

Main tab where the main functions of the device are enabled.

#### ETS PARAMETERISATION

The configurable parameters on the “General” screen are the followings:

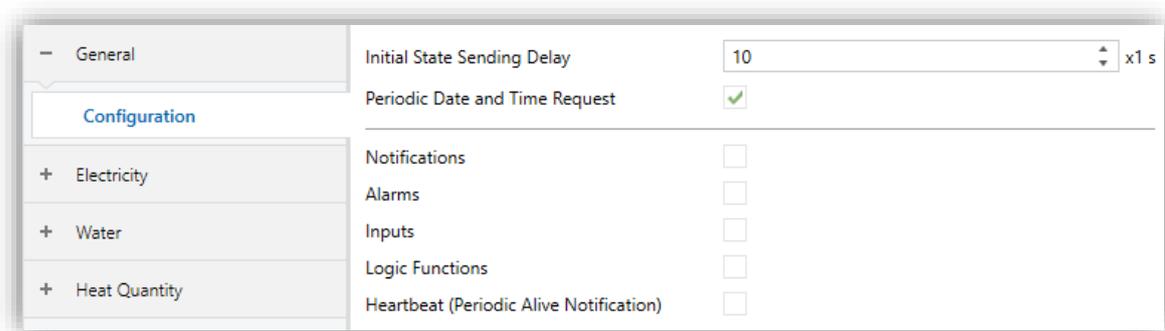


Figure 2. General

- **Initial State Sending Delay** [\[5...255\]](#) [\[x1 s\]](#)<sup>1</sup>: time that elapses between the start-up of the device and the beginning of sending objects through the bus.
- **Periodic Date and Time Request** [\[enabled / disabled\]](#): if this parameter is enabled, will be sent a periodic request for date and time every 15 minutes.

<sup>1</sup> The default values of each parameter will be highlighted in blue in this document, as follows: [\[default/rest of options\]](#).

- **Notifications** [*enabled / disabled*]: enables or disables the “Notifications” tab on the left menu. See section 2.5 for more details.
- **Alarms** [*enabled / disabled*]: enables or disables the “Alarms” tab on the left menu. See section 2.6 for more details.
- **Inputs** [*enabled / disabled*]: enables or disables the “Inputs” tab on the left menu. See section 2.7 for more details.
- **Logic Functions** [*enabled / disabled*]: enables or disables the “Logic Functions” configuration screen on the left menu. See section 2.8 for more details.
- **Heartbeat (Periodic Alive Notification)** [*enabled / disabled*]: incorporates a one-bit object to the project (“**[Heartbeat] Object to Send ‘1’**”) that will be sent periodically with value “1” to notify that the device is still working (still alive).

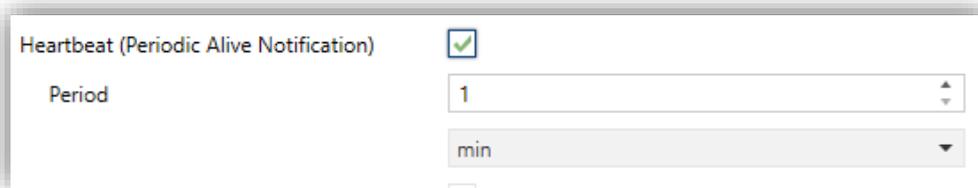


Figure 3. Heartbeat

**Note:** *the first sending after download or bus failure takes place with a delay of up to 255 seconds, to prevent bus overload. The following sending match the period set.*

The communication objects available by default are “**Date**” and “**Time of Day**”. See section 1.5 for more information about the behavior of these objects.

### 2.1.2 PARTIAL REGISTERS: GLOBAL CONFIGURATION

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In this tab you can configure the periodic reset of partial registers.

In order for this tab to be displayed, it is necessary to have at least one partial record enabled for one of the magnitudes (electricity, water or heat quantity). See sections 2.2.1, 2.3.1 and 2.4.1.

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**ETS PARAMETERISATION**


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<ul style="list-style-type: none"> <li>General</li> <li>Configuration</li> <li>Partial Registers: Global Con...</li> <li>Electricity</li> <li>Water</li> </ul>	<p>Periodic Reset of Partial Register 1 <input checked="" type="checkbox"/></p> <p>Period <input type="text" value="1"/></p> <p><input checked="" type="radio"/> Day <input type="radio"/> Month</p>
	<p>Periodic Reset of Partial Register 2 <input checked="" type="checkbox"/></p> <p>Period <input type="text" value="1"/></p> <p><input checked="" type="radio"/> Day <input type="radio"/> Month</p>

Figure 4. Partial Registers: Global Configuration

- **Periodic Reset of Partial Register n** [*enabled / disabled*]: enables or disables the automatic reset of the partial register at the end of a configurable period:
  - **Period** [*1...255*] [*Day / Month*]: when selecting “Month” a new parameter appears:
    - **Day of Reset** [*First Day of Month / Same Day of Month*]: in case the above period has been set in terms of months, sets when the reset should take place, taking into account the day the device starts working. In case of selecting “Same Day of Month”, the specific day of the month will change whenever the register is manually reset through the object “**Reset Partial Registers n**”.

## 2.2 ELECTRICITY

Within this tab, all the parameters related to electricity consumption monitoring are configured.

### 2.2.1 CONFIGURATION

On this screen, the basic configuration common to all KEM phases can be selected. It is possible to enable or disable the different phases in addition to configuring some variables such as frequency and power factor.

#### ETS PARAMETERISATION

The “Configuration” tab parameters are shown below:

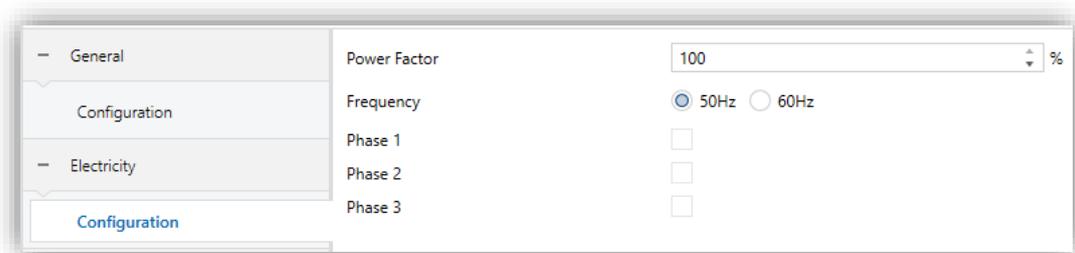


Figure 5. Electricity - Configuration

- **Power Factor** [0...100] [%]: parameter that set the power factor value.
- **Frequency** [50/60] [Hz]: sets the current grid operating line frequency.
- **Phase x** [enabled / disabled]: if any of the phases is enabled, a new tab appears on the left menu. For more information see section 2.2.2.

If at least one of the phases is enabled, the following parameters are also available:

- **Number of Partial Registers** [0/1/2]: sets the number of partial registers for each phase. For more than zero, the following communication objects appear:
  - **“Reset Partial Registers n”**: when receives a ‘1’ all the objects of the partial register n are reset (set to 0).
  - **“Starting Date Partial Registers n”**: reset date of partial register n.

**Note:** Both objects are generic for all quantities (electricity, water and heat quantity).

- “[Elec][Phx][PRn] Consumed Active Energy”. (See section 2.2.2.2).

In addition, a new tab will appear under “General” tab, where is possible to set **periodic resets** of the enabled partial registers. For more information see section 2.1.2.

- **Show Global Objects** [*enabled / disabled*]: this parameter enables the global objects where the accumulated energy consumption data is stored.

Figure 6. Electricity - Configuration - Global objects

- **Power Units** [*W / kW*]: sets the measurement units of the global power objects.
- **Energy Units** [*Wh / kWh*]: sets the measurement units of the global energy objects.
- **Sending Mode for Power** [*Disabled / Periodic / With Value Change / Periodic and with Value Change*]: sets when global power objects should be sent. Depending on this selection, some more parameters will be available:
  - **Period** [*30...255*][s] / [*1...10...255*][min / h]: sets the period between cyclical sendings.
  - **Minimum Time Between Sendings** [*10...255*][s]: sets a minimum period of time (seconds) between consecutive sendings.
  - **Minimum Change to Send** [*1...10...15300*][W] / [*1...15*][kW]: sets the minimum value change required to send the next value.

Sending Mode for Power	Periodic and with Value Change
Period	10
	min
Minimum Time Between Sendings	10 x1 s
Minimum Change to Send	10 x1 W
<p><b>i</b> 'Period' Must Be Greater than 'Minimum Time Between Sendings'.</p>	

Figure 7. Electricity - Global - Sending Mode for Power

- **Sending Mode for Energy** [Disabled / Periodic / With Value Change / Periodic and with Value Change]: parameter analogous to **Sending Mode for Power**, which sets when the global energy objects should be sent.

The range of values for the parameter **Minimum Change to Send** will, in this case, be  $[[10...65535][Wh] / [1...65535][kWh]]$ .

Sending Mode for Energy	Periodic and with Value Change
Period	10
	min
Minimum Time Between Sendings	10 x1 s
Minimum Change to Send	10 x1 Wh
<p><b>i</b> 'Period' Must Be Greater than 'Minimum Time Between Sendings'.</p>	

Figure 8. Electricity - Global - Sending Mode for Energy

Listed below are the objects that appear when the **Show Global Objects** option is enabled:

- “[Elec][Global] Disable” : when receives a ‘0’, measurements and sendings of all phases are stopped.
- “[Elec][Global] Consumed Active Energy” : stores the sum of the energy consumed by the different phases.

- “[Elec][Global] Active Power”:  
indicates the global power as the sum of the power in each phase.
- “[Elec][Global] Current”:  
stores the value of the global system current.
- “[Elec][Global] Power Factor”:  
object to change the global power factor of the system.
- “Global Data Request”:  
this object appear when global object of electricity or water are enabled. For electricity magnitude, when receiving a ‘1’ through this object, the global values of consumed energy, current and active power will be sent.

## 2.2.2 PHASE X

On this screen can be configured the options related to phase objects, that is, those that refer to measures of a specific phase.

### ETS PARAMETERISATION

The parameters shown in each phase tab are the following:

Channel Description	<input type="text"/>
Current Transform Relation	3000
Power Supply Voltage (AC)	<input type="text" value="230"/> x1 V
Power Units	<input checked="" type="radio"/> W <input type="radio"/> kW
Energy Units	<input checked="" type="radio"/> Wh <input type="radio"/> kWh
<hr/>	
Sending Mode for Power	Periodic and with Value Change
Period	<input type="text" value="10"/> min
Minimum Time Between Sendings	<input type="text" value="10"/> x1 s
Minimum Change to Send	<input type="text" value="10"/> x1 W
<div style="border: 1px solid #ccc; padding: 5px; background-color: #e6f2ff;"> <p><b>i</b> 'Period' Must Be Greater than 'Minimum Time Between Sendings'.</p> </div>	

Figure 9. Electricity - Phase x

- **Channel Description:** text box without functionality, simply allows adding a description.
- **Current Transform Relation [3000]:** informative parameter indicating the transformer ratio (loops number) that the current transformer must have.
- **Power Supply Voltage (AC) [0...230...255][x1 V]:** sets the voltage of the phase. The object “[Elec][Phx] Voltage” will be also available to set this value (in mV).
- **Power Units [W/kW]:** sets the measurement units of the phase power objects.
- **Energy Units [Wh / kWh]:** sets the measurement units of the phase energy objects.
- **Sending Mode for Power [Disabled / Periodic / With Value Change / Periodic and with Value Change]:** analogous to the same parameter of the “Configuration” tab (see section 2.2.1) applied to the phase being configured.

Listed below are the objects that appear when each phase is enabled:

- “[Elec][Phx] Voltage”.
- “[Elec][Phx] Disable”: 1-bit object to enable/disable measurements and sendings on each phase.
- “[Elec][Phx] Active Power”: provides the value of the power of the phase.
- “[Elec][Phx] Current”: this object gives the current of the phase.
- “[Elec][Phx][TR] Consumed Active Energy”. See section 2.2.2.1.

#### 2.2.2.1 TOTAL REGISTER

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The total registers of magnitudes per phase store the accumulated values of energy consumption of one phase since the start-up of the device.

#### ETS PARAMETERISATION

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The parameters to configure total registers are:

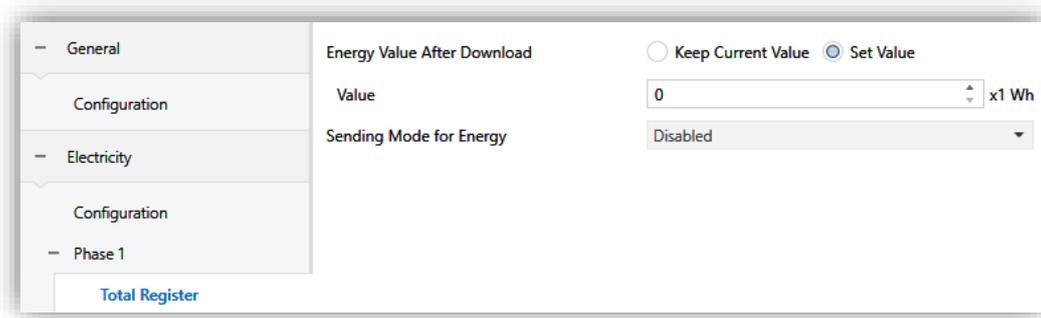


Figure 10. Electricity - Phase x - Total Register

- **Energy Value After Download** [Keep Current Value / Set Value]: sets the initial value of the total register of **energy** after an ETS download. When selecting “Set value”, an additional textbox appears to enter the desired value for **Consumed energy**, in terms of the selected measurement units.
- **Sending Mode for Energy** [Disabled / Periodic / With Value Change / Periodic and with Value Change]: analogous to the same parameter of the “Configuration” tab (see section 2.2.1) applied to the phase being configured.

The communication object “[Elec][Phx][TR] Consumed Active Energy” will always be available when the phase is enabled. This object will store the accumulated value of the consumed energy of the corresponding phase. It can only be initialized by writing on it the desired energy value.

#### 2.2.2.2 PARTIAL REGISTERS

Up to 2 partial registers can be enabled to store the energy values of each phase during a period of time (for example, a day, a month ...).

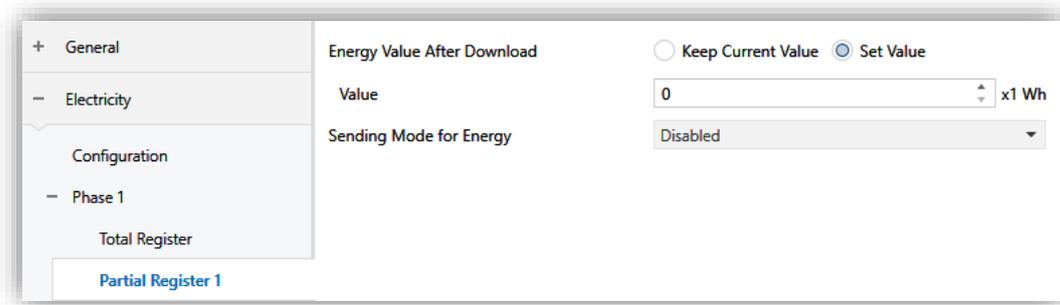
Two binary objects “**Reset Partial Registers 1**” and “**Reset Partial Registers 2**” are available to reset a partial register anytime (set to zero). Moreover, a **periodic reset** can be configured by parameter (see section 2.1.2).

Each time a partial register is restarted, the reset date is stored in “**Starting Date Partial Registers n**” and the values of the partial register are sent to the bus.

**Note:** *Partial registers are disabled by default. Please refer to section 2.2.1 for enabling them.*

## ETS PARAMETERISATION

The parameterization of this tab is analogous to that of "Total Register" (see section 2.2.2.1), applied to the configured partial register.



The screenshot shows a configuration window for a Partial Register. On the left is a sidebar with a tree view containing: General (expanded), Electricity (expanded), Configuration (expanded), Phase 1 (expanded), Total Register, and Partial Register 1 (selected). The main area displays the configuration for the selected register:

- Energy Value After Download:** Radio buttons for "Keep Current Value" (unselected) and "Set Value" (selected).
- Value:** A numeric input field containing "0" with a multiplier of "x1 Wh".
- Sending Mode for Energy:** A dropdown menu currently set to "Disabled".

Figure 11. Electricity - Phase x - Partial Register

The energy values of the partial registers of each of the phases can be read through the objects “[Elec][Phx][PRn] Consumed Active Energy”.

## 2.3 WATER

In addition to the electrical consumptions, KEM is able to monitor water flows and consumptions of up to 4 channels.

### 2.3.1 CONFIGURATION

On this screen, the basic configuration common to all KEM channels can be selected. It is possible to enable or disable the different channels and water global objects.

#### ETS PARAMETERISATION

The “Configuration” tab parameters are shown below:

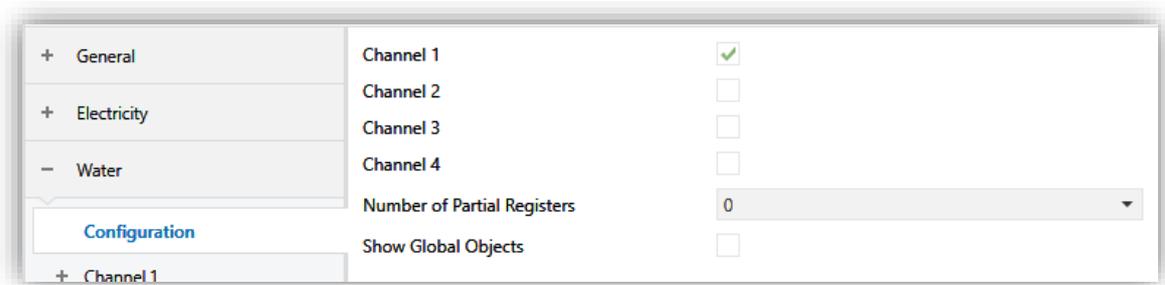


Figure 12. Water – Configuration

- **Channel x** [*Enabled / Disabled*]: if any of the channels is enabled, a new tab appears on the left menu. For more information see section 2.3.2.

If at least one of the channels is enabled, the following parameters are also available:

- **Number of Partial Registers** [*0 / 1 / 2*]: analogous to the same parameter explained in electricity section (see section 2.2.1).

In this case, enabling at least one partial register, the objects “[Water][Chx][PRn] Consumed Water” will be displayed (see section 2.3.2.2).

- **Show Global Objects** [*Enabled / Disabled*]: this parameter enables the global objects where the accumulated water consumption data is stored. The following parameters are displayed:

Figure 13. Water - Configuration - Show Global Objects

- **Flow Units** [L/h / m<sup>3</sup>/h]: sets the measurement units of the global flow object.
- **Volume Units** [L / m<sup>3</sup>]: sets the measurement units of the global consumption object.
- **Sending Mode for Flow** [Disabled / Periodic / With Value Change / Periodic and with Value Change]: sets when global flow object should be sent. Depending on this selection, some more parameters will be available:

Figure 14. Water - Global - Sending Mode for Flow

- **Period** [30...255][s] / [1...10...255][min / h]: sets the period between cyclical sendings.
- **Minimum Time Between Sendings** [10...255][s]: sets a minimum period of time (seconds) between consecutive sendings.

- **Minimum Change to Send**  $[[10...65535][L/h] / [1...65535][m^3/h]]$ : sets the minimum value change required to send the next value.
- **Sending Mode for Volume**  $[Disabled / Periodic / With Value Change / Periodic and with Value Change]$ : parameter analogous to **Sending Mode for Flow**, which sets when the global consumed water objects should be sent.

The range of values for the parameter **Minimum Change to Send** will, in this case, be  $[[1...65535][L] / [1...65535][m^3]]$ .

Sending Mode for Volume	Periodic and with Value Change	
Period	10	
	min	
Minimum Time Between Sendings	10	x1 s
Minimum Change to Send	1	x1 L

**i** 'Period' Must Be Greater than 'Minimum Time Between Sendings'.

Figure 15. Water - Global - Sending Mode for Volume

Listed below are the objects that appear when the **Show Global Objects** option is enabled:

- “[Water][Global] **Disable**”: when receives a ‘0’, measurements and sendings of all water channels are stopped.
- “[Water][Global] **Consumed Water**”: stores the sum of the water consumed by the different channels.
- “[Water][Global] **Flow**”: provides the value of the sum of the flow of the different channels.
- “[Global] **Data Request**”: this object appear when global object of electricity or water are enabled. For water magnitude, receiving a ‘1’ through this object, the global values of the consumed water flow are sent.

## 2.3.2 CHANNEL X

On this screen can be configured the options related to water channel objects.

### ETS PARAMETERISATION

The parameters shown in each channel tab are the following:

Figure 16. Water - Channel x

- **Channel Description:** the name set in this text box will be the ETS channel name.
- **Flow Units [ $L/h/m^3/h$ ]:** sets the measurement units of the channel flow object.
- **Volume Units [ $L/m^3$ ]:** sets the measurement units of the channel consumption object.
- **Include Channel in Global Calculation [*enabled / disabled*]:** if this parameter is enabled, channel values are included in global measurement.

**Note:** this parameter is only available if **global water objects** have been enabled in configuration tab (section 2.3.1).

- **Flow Sensor Parameters [ $F=(K-Q)/60 - a$ ]:** the internal calculation of the flow rate is carried out according to the indicated formula. The following terms of this formula can be parameterized:
  - **K Factor ('K') [ $1...660...65535$ ] [ $x1\ pulses/L$ ]:** constant provided by the flow meter manufacturer. For the flowmeter the K Factor is 660 pulses/L.

- **Error Correction ('a')** [0...7...255] [x1 Hz]: Correction factor given by the flow meter manufacturer.

It is recommended to read [ANNEX I. Flow calculation](#) carefully in order to correctly configure the two previous parameters.

**Important:** Although other models can be parameterised, **the flow meter function is only guaranteed for the water flow sensors provided by Zennio.**

- **Sending Mode for Flow** [[Disabled](#) / [Periodic](#) / [With Value Change](#) / [Periodic and with Value Change](#)]: analogous to the same parameter of the “Configuration” tab (see section 2.3.1) applied to the channel being configured.

Listed below are the **objects** that appear when each **channel** is enabled:

- “[Water][Chx] Flow”: stores the amount of water flowing through the corresponding channel per unit of time
- “[Water][Chx] Disable”: 1-bit objects to enable/disable measurements and sendings of the corresponding canal.
- “[Water][Chx][RT] Consumed Water”. See section 2.3.2.1.

### 2.3.2.1 TOTAL REGISTER

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The total registers store the accumulated water consumption data from a single channel since the device commissioning.

### ETS PARAMETERISATION

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The parameters to configure total registers are:

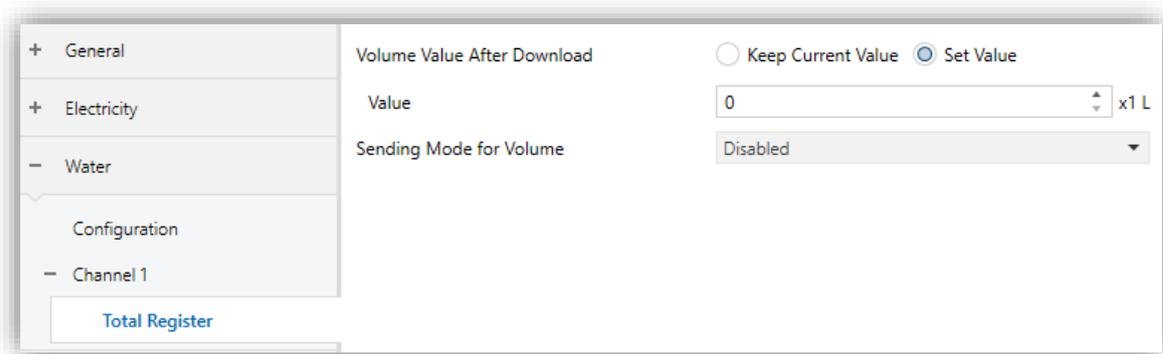


Figure 17. Water - Channel x - Total register

- **Volume Value After Download** [Keep Current Value / Set Value]: sets the initial value of the total register of **water** after an ETS download. When selecting “Set value”, an additional textbox appears to enter the desired value for **Consumed water**, in terms of the selected measurement units.
- **Sending Mode for Volume** [Disabled / Periodic / With Value Change / Periodic and with Value Change]: analogous to the same parameter of the “Configuration” tab (see section 2.3.1) applied to the total register of the water channel being configured.

The communication object “[**Water**][**Chx**][**RT**] **Consumed Water**” will always be visible when the channel is enabled. This object will store the accumulated value of the consumed water of the corresponding channel. It can only be initialized by writing on it the desired energy value.

### 2.3.2.2 PARTIAL REGISTERS

Up to 2 partial registers can be enabled to store the volume values of each channel during a period of time (for example, a day, a month ...).

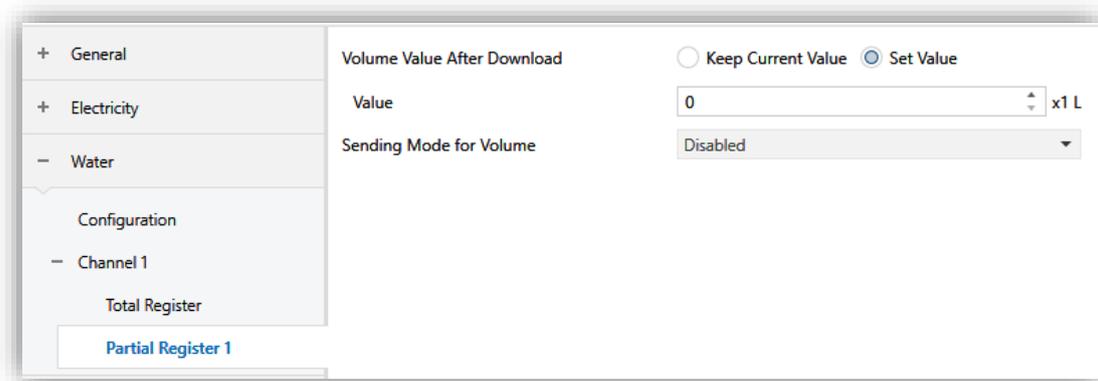
Two binary objects “**Reset Partial Registers 1**” and “**Reset Partial Registers 2**” are available to reset a partial register anytime (set to zero). Moreover, a **periodic reset** can be configured by parameter (see section 2.1.2).

Each time a partial register is restarted, the reset date is stored in “**Starting Date Partial Registers n**” and the values of the partial register are sent to the bus.

**Note:** *Partial registers are disabled by default. Please refer to section 2.3.1 for enabling them.*

## ETS PARAMETERISATION

The parameterization of this tab is analogous to that of "Total Register" (see section 2.3.2.1), applied to the partial register being configured.



The screenshot shows a configuration window for a Partial Register. On the left is a tree view with the following items: General, Electricity, Water (expanded), Configuration, Channel 1 (expanded), Total Register, and Partial Register 1 (selected). The main area contains the following settings:

- Volume Value After Download:** Radio buttons for  Keep Current Value and  Set Value.
- Value:** A numeric input field containing '0' and a unit selector 'x1 L'.
- Sending Mode for Volume:** A dropdown menu currently set to 'Disabled'.

Figure 18. Water - Channel x - Partial Register

The volume values of the partial registers of each of the channels can be read through the objects “[Water][Chx][PRn] Consumed Water”.

## 2.4 HEAT/COOL QUANTITY

KEM can measure the calorific energy consumed by water-operated climate systems. At least one water channel and two temperature probes must be enabled.

The 2 temperature probes are installed at the input and output of the climate circuit. In this way, the calorific energy consumed is calculated from the volume of water consumed and the temperature difference.

### 2.4.1 CONFIGURATION

On this screen, the basic configuration common to all KEM channels of heat quantity can be configured. It is possible to enable or disable the different channels and partial registers.

#### ETS PARAMETERISATION

The “Configuration” tab parameters are shown below:

+ General	Heat Quantity 1	<input checked="" type="checkbox"/>
+ Electricity	Heat Quantity 2	<input type="checkbox"/>
+ Water	Number of Partial Registers	0
- Heat Quantity		
Configuration		

Figure 19. Heat Quantity – Configuration

- **Heat Quantity x** [*Enabled / Disabled*]: if any of the channels is enabled, a new tab appears on the left menu. For more information see section 2.4.2.

**Note:** *at least one water channel and 2 temperature probes must be enabled to enabling any heat quantity channel.*

When one of the channels of heat quantity is enabled, the following parameter appear:

- **Number of Partial Registers** [*0 / 1 / 2*]: analogous to the same parameter explained in electricity section (see section 2.2.1).

In this case, when at least one of the partial registers is enabled, the following 4-byte objects appear: “[Heat Qty][Chx][PRn] Heat Quantity” and “[Heat Qty][Chx][PRn] Cool Quantity” or “[Heat Qty][Chx][PRn] Heat/Cool Quantity”.. See section 2.4.2.2

## 2.4.2 HEAT QUANTITY X

On this screen the options related to heat quantity channel objects can be configured.

### ETS PARAMETERISATION

The parameters shown in each channel tab are the following:

Figure 20. Heat Quantity - "Heat Quantity x" tab

- **Channel Description:** the name set in this text box will be the ETS channel name.
- **Water Sensor Channel** [[Channel 1](#) / ... / [Channel 4](#)]: sets which water channel is used for flow measurement in the calculation of the calorific energy.
- **Forward Temperature Probe** [[Input 1](#) / ... / [Input 5](#)]: determines the input to which the temperature probe of the climate circuit forward zone is connected.
- **Return Temperature Probe** [[Input 1](#) / ... / [Input 5](#)]: determines the input to which the temperature probe of the climate circuit return zone is connected.
- **One Object for Heat and Cool Quantity?** [[No](#) / [Yes](#)]: allows to configure whether the objects of heat and cool quantity are independent or all the calorific energy is stored in the same object (“[Heat Qty][Chx][TR] Heat/Cool Quantity”).

If a single object is used for cool/heat quantity, the energy in both modes is added together regardless of the sign of the temperature difference.

Listed below are the objects that appear by default when each of the heat quantity channels are enabled:

- “[Heat Qty][Chx] Temperature Difference”: object that stores the value of the temperature difference between forward and return probes. If the difference is positive, the heat quantity increases, otherwise cool quantity increases.
- “[Heat Qty][Chx] Disable”: disables heat/cool quantity measurements and sendings of the corresponding channel.
- “[Heat Qty][Chx][TR] Heat Quantity”. See section 2.4.2.1
- “[Heat Qty][Chx][TR] Cool Quantity”. See section 2.4.2.1.

#### 2.4.2.1 TOTAL REGISTER

The total registers store the accumulated calorific energy consumption data from a single channel since the device was put into operation.

### ETS PARAMETERISATION

The parameters to configure total registers are:

Figure 21. Heat Quantity - Total Register

- **Heat Quantity Value After Download** [Keep Current Value / Set Value]: sets the initial value of the total register of **heat quantity** after an ETS download. When selecting “Set value”, an additional textbox appears to enter the desired value for **heat quantity** in **Joules**.

- **Cool Quantity Value After Download** [[Keep Current Value](#) / [Set Value](#)]: sets the initial value of the total register of **cool quantity** after an ETS download. When selecting “[Set value](#)”, an additional textbox appears to enter the desired value for **cool quantity** in **Joules**.

**Note:** *If only one object has been chosen for heat and cool quantity (see section 2.4.2), there will be only one analogous parameter: **Heat/ Cool Quantity Value After Download**.*

- **Sending Mode for Heat/Cool Quantity** [[Disabled](#) / [Periodic](#) / [With Value Change](#) / [Periodic and with Value Change](#)]: sets when heat/cool quantity objects should be sent. Depending on this selection, some more parameters will be available:

Sending Mode for Heat/Cool Quantity	Periodic and with Value Change
Period	10
	min
Minimum Time Between Sendings	10 x1 s
Minimum Change to Send	1 x100 J

**i** 'Period' Must Be Greater than 'Minimum Time Between Sendings'.

Figure 22. Heat Quantity - Total Register - Sending Mode

- **Period** [[30...255](#)][s] / [[1...10...255](#)][[min](#) / h]: sets the period between cyclical sendings.
- **Minimum Time Between Sendings** [[10...255](#)] [[x1 s](#)]: sets a minimum period of time (seconds) between consecutive sendings.
- **Minimum Change to Send** [[1...65535](#)] [[x100 J](#)]: sets the minimum value change required to send the next value.

The communication object “[**Heat Qty**][**Chx**][**TR**] **Heat Quantity**” and “[**Heat Qty**][**Chx**][**TR**] **Cool Quantity**” or “[**Heat Qty**][**Chx**][**TR**] **Heat/Cool Quantity**” will always be visible when the channel is enabled. These objects will store the calorific energy consumed by the system when heating and/or cooling. It can only be initialized by writing on it the desired value.

### 2.4.2.2 PARTIAL REGISTERS

Up to 2 partial registers can be enabled to store the calorific energy values of each channel during a period of time (for example, a day, a month ...).

Two binary objects “**Reset Partial Registers 1**” and “**Reset Partial Registers 2**” are available to reset a partial register anytime (set to zero). Moreover, a **periodic reset** can be configured by parameter (see section 2.1.2).

Each time a partial register is restarted, the reset date is stored in “**Starting Date Partial Registers n**” and the values of the partial register are sent to the bus.

**Note:** *Partial registers are disabled by default. Please refer to section 2.4.1 for enabling them.*

### ETS PARAMETERISATION

The parameterization of this tab is analogous to that of "Total Register" (see section 2.4.2.1), applied to the partial register being configured.

+ General	Heat Quantity Value After Download	<input type="radio"/> Keep Current Value <input checked="" type="radio"/> Set Value
+ Electricity	Value	0 x1 J
+ Water	Cool Quantity Value After Download	<input type="radio"/> Keep Current Value <input checked="" type="radio"/> Set Value
- Heat Quantity	Value	0 x1 J
Configuration	Sending Mode for Heat/Cool Quantity	Disabled
- Heat Quantity 1		
Total Register		
Partial Register 1		

Figure 23. Heat Quantity - Partial Registers

The volume values of the partial registers of each of the channels can be read through the objects “[Heat Qty][Chx][PRn] Heat Quantity” and “[Heat Qty][Chx][PRn] Cool Quantity” or “[Heat Qty][Chx][PRn] Heat/Cool Quantity”.

## 2.5 NOTIFICATIONS

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Notifications in KEM consist in sending a binary object to the KNX bus when the selected variables, stored in either total or partial registers, reach a pre-set value.

The variables on which it is possible to configure notifications are **water consumption** and **electricity consumption** for global and individual magnitudes.

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### ETS PARAMETERISATION

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The Notifications tab will become visible once the Notification function has been enabled in the General screen (see section 2.1).

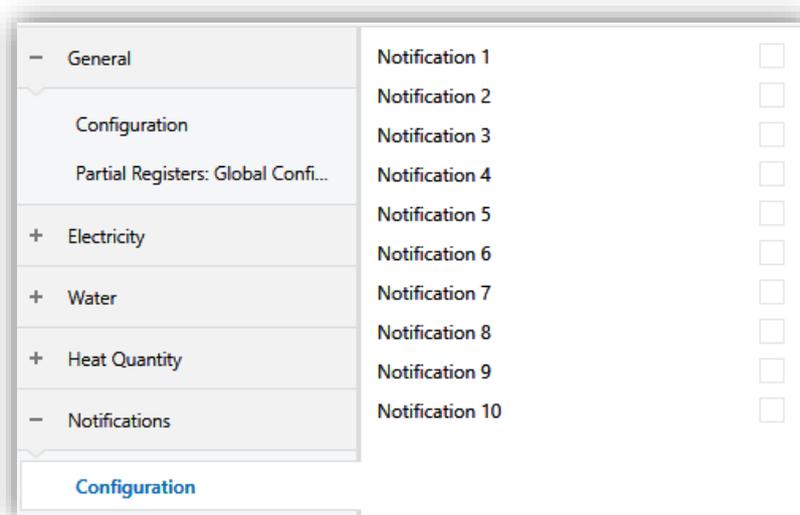


Figure 24. Notifications - Configuration

Individual Notification tabs and the binary objects “**Notification n: \_\_\_\_\_**” will become visible once any of the 10 notifications has been enabled.

### 2.5.1 NOTIFICATION N

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When enabling a notification, this tab appears, where the magnitude of the notification and the limit from which it is sent can be configured.

## ETS PARAMETERISATION

The configuration parameters for notifications are the following:

Notification Description	<input type="text"/>
Variable	<input checked="" type="radio"/> Water Consumption <input type="radio"/> Electric Consumption
Channel	Channel 1
Register	<input checked="" type="radio"/> Total Register <input type="radio"/> Partial Register 1
Limit	1 x1 L
Action	<input type="radio"/> Send 0 <input checked="" type="radio"/> Send 1

Figure 25. Notifications - Notification n

- **Notification Description:** the name set in this text box will be the ETS tab name.
- **Variable** [[Water Consumption](#) / [Electric Consumption](#)]: sets the magnitude to be monitored.

Next parameters depend on the variable selected and the number of partial registers enabled:

- **Channel** [[Global](#) / [Channel or Phase 1](#) / ... / [Channel or Phase 4](#)]: sets the channel or phase to be monitored.
- **Register** [[Total Register](#) / [Partial Register 1](#) / [Partial Register 2](#)]: sets the register containing the variable monitored. Only currently enabled registers will be displayed.

**Note:** *partial registers are only available if have been enabled previously in the selected variable.*

- **Limit** [[1...2147483647](#)]: sets the trigger value for the notification. The measurement units will match the ones than have been configured for the selected variable.
- **Action** [[Send 0](#) / [Send 1](#)]: set the value to be sent through the binary object “**Notification n:** \_\_\_\_\_” when the notification is triggered.

## 2.6 ALARMS

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In addition to notifications, KEM implements 7 alarms to monitor **electric power**, **electric current** and **water flow**, which can be enabled and parameterised independently.

It will be possible to set an upper and a lower limit for any of the variables. When these limits are exceeded, the device will send a binary value through the different objects.

The deactivation of the alarm after **exceeding the limit** shall be effective when the value of the variable is less than the upper limit minus the hysteresis. In the same way, the deactivation of the alarm after falling **below the lower limit** will become effective when the variable exceeds the lower limit plus the hysteresis.

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### ETS PARAMETERISATION

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The Alarms tab will become visible once the Alarm function has been enabled in the “General” screen (see section 2.1).

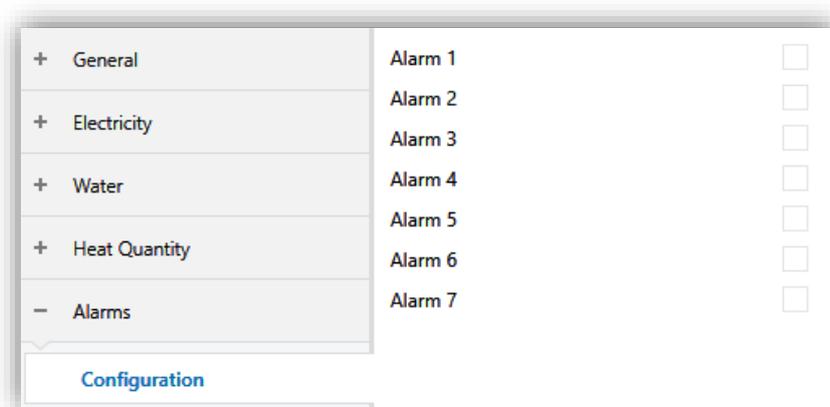


Figure 26. Alarms – Configuration

“Alarm n” tab will become visible once some of the alarms have been enabled.

### 2.6.1 ALARM N

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In this tab both the variable to be used for the alarm and the upper and lower limits for activating the alarm can be configured.

## ETS PARAMETERISATION

Alarm Description	<input type="text"/>
Variable	Electric Power
Channel	Phase 1
Upper Limit	<input checked="" type="checkbox"/>
Limit	1 x1 W
Action	<input type="radio"/> Send 0 <input checked="" type="radio"/> Send 1
Periodic Sending	<input type="checkbox"/>
Notification of No Alarm	<input checked="" type="radio"/> No <input type="radio"/> Yes
Hysteresis Under the Limit	0 x1 W
Lower Limit	<input checked="" type="checkbox"/>
Limit	1 x1 W
Action	<input type="radio"/> Send 0 <input checked="" type="radio"/> Send 1
Periodic Sending	<input type="checkbox"/>
Notification of No Alarm	<input checked="" type="radio"/> No <input type="radio"/> Yes
Hysteresis Above the Limit	0 x1 W

Figure 27. Alarms - Alarm n

- **Alarm Description:** the name set in this text box will be the ETS alarm name.
- **Variable** [[Electric Power](#) / [Electric Current](#) / [Flow](#)]: determines the magnitude that triggers the alarm.
- **Channel** [[Global](#) / [Channel or Phase 1](#) / ... / [Channel or Phase 4](#)]: sets the channel or phase to be monitored.
- **Upper Limit** [[Enabled](#) / [Disabled](#)]: allows the alarm to be triggered if a limit value is exceeded. Enabling this parameter will display the object “**Alarm n: Excess \_\_\_\_\_**” and the following parameters will be displayed:
  - **Limit:** alarm trigger value. The units will match those configured for the chosen channel/phase.
 

This limit can also be set via the object “**Alarm n: Set Upper Limit**”.
  - **Action** [[Send 0](#) / [Send 1](#)]: set the value to be sent through the object “**Alarm n: Excess \_\_\_\_\_**” when the alarm is triggered.

- **Periodic sending** [*Enabled/Disabled*]: activates or deactivates the periodic resending of the object while the alarm remains active.
  - **Period** [*10...30...255*][s] / [*1...255*][min/h]: resending time.
- **Notification of No Alarm** [*No/Yes*]: indicates if the alarm object should be sent (with inverse value of the configured action) once the alarm is deactivated.
- **Hysteresis Under the Limit**: defines a dead band for alarm deactivation. When the alarm is active, it will not be deactivated until a value below the limit minus hysteresis is reached. The units will coincide with those configured for the chosen channel/phase.
- **Lower Limit** [*Enabled/Disabled*]: allows the alarm to be triggered if a limit value is lowered. Enabling this parameter will display the object “**Alarm n: Low \_\_\_\_\_**” and the following parameters will be displayed:
  - **Limit**: sets the value below which the alarm will be triggered. The units will match those configured for the chosen channel/phase.  
  
This limit can also be set via the object “**Alarm n: Set Lower Limit**”.
  - **Action** [*Send 0/Send 1*]: set the value to be sent through the object “**Alarm n: Low \_\_\_\_\_**” when the alarm is triggered.
  - **Periodic sending** [*Enabled/Disabled*]: activates or deactivates the periodic resending of the object while the alarm remains active.
    - **Period** [*10...30...255*][s] / [*1...255*][min/h]: resending time.
  - **Notification of No Alarm** [*No/Yes*]: indicates if the alarm object should be sent (with inverse value of the configured action) once the alarm is deactivated.
  - **Hysteresis Above the Limit**: defines a dead band for alarm deactivation. When active, the alarm will not be deactivated until a value over the limit plus hysteresis is reached. The units will coincide with those configured for the chosen channel/phase.

## 2.7 INPUTS

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KEM incorporates **five analogue/digital inputs**, each configurable as a:

- **Binary Input**, for the connection of a pushbutton or a switch/sensor.
- **Temperature Probe**, to connect a temperature from Zennio.
- **Motion Detector**, to connect a motion detector from Zennio.

### 2.7.1 BINARY INPUT

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Please refer to the specific user manual “**Binary Inputs**”, available in the KEM product section, at the Zennio website ([www.zennio.com](http://www.zennio.com)).

### 2.7.2 TEMPERATURE PROBE

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KEM allows to select four probe types:

- **Zennio Temperature Probe.**
- **Custom NTC Temperature Probe.**
- **Zennio Water Probe.**
- **Custom NTC Water Probe**

These last two probes will be used for the calculation of the calorific energy of the climate system and have the same functionality as the temperature probes mentioned in the manual.

Please refer to the specific user manual “**Temperature Probe**”, available in the KEM product section, at the Zennio website ([www.zennio.com](http://www.zennio.com)).

### 2.7.3 MOTION DETECTOR

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It is possible to connect motion detectors from Zennio to the input ports of KEM. This brings the device with the possibility of monitoring motion and presence in the room. Depending on the detection, different response actions can be parameterised.

Please refer to the specific user manual “**Motion Detector**”, (available in the KEM product section, at the Zennio website, [www.zennio.com](http://www.zennio.com)) for detailed information about the functionality and the configuration of the related parameters.

## 2.8 LOGIC FUNCTIONS

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This module makes it possible to perform numeric and binary operations to incoming values received from KNX bus, and to send the results through other communication objects specifically enabled for this purpose.

KEM can implement **up to 10 different and independent functions**, each of them entirely customisable and consisting in **up to 4 consecutive operations each one**.

The execution of each function can depend on a configurable **condition**, which will be evaluated every time the function **is triggered** through specific, parameterisable communication objects. The result after executing the operations of the function can also be evaluated according to certain **conditions** and afterwards sent (or not) to the KNX bus, which can be done every time the function is executed, periodically or only when the results differs from the last one.

Please refer to the “**Logic Functions**” user manual (available within the KEM product section at the Zennio homepage: [www.zennio.com](http://www.zennio.com)) for detailed information about the functionality and the configuration of the related parameters.

## ANNEX I. FLOW CALCULATION

The KEM has four inputs for connecting Hall effect flow sensor. The operation of this type of sensor is based on a flow of water that enters the sensor and rotates a turbine, which is connected to a magnet that activates a Hall effect sensor that emits an electrical pulse.

The KEM measures the number of pulses read over a period of time (frequency), so it is necessary to apply the following formula to calculate the flow rate:

$$F = \frac{K \cdot Q}{60} - a = K' \cdot Q - a$$

Being:

$F$	=	Frequency in Hz o $s^{-1}$
$K$	=	$K$ Factor in pulses/L
$K'$	=	Constant $K$ in (pulses · min)/(L · s)
$Q$	=	Flow in L/min
$a$	=	Error correction in Hz

Depending on the flow meter, the value of  $K$  and  $a$  may be different, so it is necessary to include these constants in ETS (see section 2.3.2). These values are given in the flow meter datasheet.

### Important:

- It is very important to know how to correctly differentiate whether the constant provided by the flow meter manufacturer is the  $K$  constant or the  $K$  Factor. The  **$K$  factor** is usually indicated with units of pulses/L. If this information is not included, the formula above is usually included with the **constant  $K$**  and the **error correction**.
- If the manufacturer provides the  **$K$  constant**, it is necessary to multiply this value by 60 to enter it in the  **$K$  Factor** parameter.

## ANNEX II. COMMUNICATION OBJECTS

- “**Functional range**” shows the values that, with independence of any other values permitted by the bus according to the object size, may be of any use or have a particular meaning because of the specifications or restrictions from both the KNX standard or the application program itself.

Number	Size	I/O	Flags	Data type (DPT)	Functional Range	Name	Function
1	1 Bit		<b>CT---</b>	DPT_Trigger	0/1	[Heartbeat] Object to Send '1'	Sending of '1' Periodically
2	3 Bytes	I	<b>CT-WU</b>	DPT_Date	01/01/1990 - 31/12/2089	Date	Set Date
3	3 Bytes	I	<b>CT-WU</b>	DPT_TimeOfDay	00:00:00 - 23:59:59	Time of Day	Set Time of Day
4	1 Bit	I	<b>C--W-</b>	DPT_Ack	0/1	Global Data Request	0 = No Action; 1 = Request
5	1 Bit	I	<b>C--W-</b>	DPT_Reset	0/1	Reset Partial Registers 1	0 = No Action; 1 = Reset
6	1 Bit	I	<b>C--W-</b>	DPT_Reset	0/1	Reset Partial Registers 2	0 = No Action; 1 = Reset
7	3 Bytes	O	<b>CTR--</b>	DPT_Date	01/01/1990 - 31/12/2089	Starting Date Partial Registers 1	Date When the Register Was Started
8	3 Bytes	O	<b>CTR--</b>	DPT_Date	01/01/1990 - 31/12/2089	Starting Date Partial Registers 2	Date When the Register Was Started
9	1 Bit	I	<b>C--W-</b>	DPT_Enable	0/1	[Elec][Global] Disable	0 = Disable; 1 = Enable
10	4 Bytes	O	<b>CTR--</b>	DPT_ActiveEnergy	0 - 2147483647	[Elec][Global] Consumed Active Energy	Active Energy Consumption (Wh)
	4 Bytes	O	<b>CTR--</b>	DPT_ActiveEnergy_kWh	0 - 2147483647	[Elec][Global] Consumed Active Energy	Active Energy Consumption (kWh)
11	4 Bytes	O	<b>CTR--</b>	DPT_Value_Power	0 - 15300	[Elec][Global] Active Power	Active Power (W)
	2 Bytes	O	<b>CTR--</b>	DPT_Power	0 - 15	[Elec][Global] Active Power	Active Power (kW)
12	2 Bytes	O	<b>CTR--</b>	DPT_Value_Curr	0 - 60000	[Elec][Global] Current	Electrical Current (mA)
13	4 Bytes	I	<b>C--W-</b>	DPT_Value_Power_Factor	0 - 100	[Elec][Global] Power Factor	Set Power Factor
14, 21, 28	2 Bytes	I	<b>C--W-</b>	DPT_Value_Volt	0 - 255	[Elec][Phx] Voltage	Set Voltage
15, 22, 29	1 Bit	I	<b>C--W-</b>	DPT_Enable	0/1	[Elec][Phx] Disable	0 = Disable; 1 = Enable
16, 23, 30	4 Bytes	O	<b>CTR--</b>	DPT_Value_Power	0 - 5100	[Elec][Phx] Active Power	Active Power (W)
	2 Bytes	O	<b>CTR--</b>	DPT_Power	0 - 5	[Elec][Phx] Active Power	Active Power (kW)
17, 24, 31	2 Bytes	O	<b>CTR--</b>	DPT_Value_Curr	0 - 20000	[Elec][Phx] Current	Electrical Current (mA)
18, 25, 32	4 Bytes	I/O	<b>CTR W-</b>	DPT_ActiveEnergy	0 - 2147483647	[Elec][Phx][TR] Consumed Active Energy	Active Energy Consumption (Wh)

	4 Bytes	I/O	<b>CTR W -</b>	DPT_ActiveEnergy_kWh	0 - 2147483647	[Elec][Phx][TR] Consumed Active Energy	Active Energy Consumption (kWh)
19, 20, 26, 27, 33, 34	4 Bytes	O	<b>CTR - -</b>	DPT_ActiveEnergy	0 - 2147483647	[Elec][Phx][PRx] Consumed Active Energy	Active Energy Consumption (Wh)
	4 Bytes	O	<b>CTR - -</b>	DPT_ActiveEnergy_kWh	0 - 2147483647	[Elec][Phx][PRx] Consumed Active Energy	Active Energy Consumption (kWh)
35	1 Bit	I	<b>C - - W -</b>	DPT_Enable	0/1	[Water][Global] Disable	0 = Disable; 1 = Enable
36	4 Bytes	O	<b>CTR - -</b>	DPT_Value_Volume	0 - 18446744073709	[Water][Global] Consumed Water	Water Volume Consumption (m3)
	4 Bytes	O	<b>CTR - -</b>	1.xxx	0 - 2147483647	[Water][Global] Consumed Water	Water Volume Consumption (L)
37	4 Bytes	O	<b>CTR - -</b>	1.xxx	0 - 2147483647	[Water][Global] Flow	Water Flow (0.0001m3/h)
	2 Bytes	O	<b>CTR - -</b>	DPT_Value_Volume_Flow	0 - 65535	[Water][Global] Flow	Water Flow (L/h)
38, 43, 48, 53	4 Bytes	O	<b>CTR - -</b>	1.xxx	0 - 2147483647	[Water][Chx] Flow	Water Flow (0.0001m3/h)
	2 Bytes	O	<b>CTR - -</b>	DPT_Value_Volume_Flow	0 - 65535	[Water][Chx] Flow	Water Flow (L/h)
39, 44, 49, 54	1 Bit	I	<b>C - - W -</b>	DPT_Enable	0/1	[Water][Chx] Disable	0 = Disable; 1 = Enable
40, 45, 50, 55	4 Bytes	I/O	<b>CTR W -</b>	DPT_Value_Volume	0 - 18446744073709	[Water][Chx][TR] Consumed Water	Water Volume Consumption (m3)
	4 Bytes	I/O	<b>CTR W -</b>	1.xxx	0 - 2147483647	[Water][Chx][TR] Consumed Water	Water Volume Consumption (L)
41, 42, 46, 47, 51, 52, 56, 57	4 Bytes	O	<b>CTR - -</b>	DPT_Value_Volume	0 - 18446744073709	[Water][Chx][PRx] Consumed Water	Water Volume Consumption (m3)
	4 Bytes	O	<b>CTR - -</b>	1.xxx	0 - 2147483647	[Water][Chx][PRx] Consumed Water	Water Volume Consumption (L)
58, 66	2 Bytes	O	<b>CTR - -</b>	DPT_Value_Tempd	-670760.00° - 670760.00°	[Heat Qty][Chx] Temperature Difference	Forward Temperature - Return Temperature
59, 67	1 Bit	I	<b>C - - W -</b>	DPT_Enable	0/1	[Heat Qty][Chx] Disable	0 = Disable; 1 = Enable
60, 68	4 Bytes	I/O	<b>CTR W -</b>	DPT_Value_Heat_Quantity	0 - 18446744073709500	[Heat Qty][Chx][TR] Heat Quantity	Energy Used to Heat (J)
	4 Bytes	I/O	<b>CTR W -</b>	DPT_Value_Heat_Quantity	0 - 18446744073709500	[Heat Qty][Chx][TR] Heat/Cool Quantity	Energy Used to Heat + Energy Used to Cool (J)
61, 69	4 Bytes	I/O	<b>CTR W -</b>	DPT_Value_Heat_Quantity	0 - 18446744073709500	[Heat Qty][Chx][TR] Cool Quantity	Energy Used to Cool (J)
62, 64, 70, 72	4 Bytes	O	<b>CTR - -</b>	DPT_Value_Heat_Quantity	0 - 18446744073709500	[Heat Qty][Chx][PRx] Heat Quantity	Energy Used to Heat (J)
	4 Bytes	O	<b>CTR - -</b>	DPT_Value_Heat_Quantity	0 - 18446744073709500	[Heat Qty][Chx][PRx] Heat/Cool Quantity	Energy Used to Heat + Energy Used to Cool (J)
63, 65, 71, 73	4 Bytes	O	<b>CTR - -</b>	DPT_Value_Heat_Quantity	0 - 18446744073709500	[Heat Qty][Chx][PRx] Cool Quantity	Energy Used to Cool (J)
74, 78, 82, 86, 90, 94, 98	2 Bytes	I	<b>C - - W -</b>	DPT_Value_2_Ucount	0 - 60000	Alarm x: Set Upper Limit	Set Upper Limit Value (mA)
	2 Bytes	I	<b>C - - W -</b>	DPT_Value_2_Ucount	0 - 65535	Alarm x: Set Upper Limit	Set Upper Limit Value (L/h)
	2 Bytes	I	<b>C - - W -</b>	DPT_Value_2_Ucount	0 - 15300	Alarm x: Set Upper Limit	Set Upper Limit Value (W)

	2 Bytes	I	C--W-	DPT_Value_2_Ucount	0 - 1530	Alarm x: Set Upper Limit	Set Upper Limit Value (0.01kW)
	2 Bytes	I	C--W-	DPT_Value_2_Ucount	0 - 65535	Alarm x: Set Upper Limit	Set Upper Limit Value (0.01m3/h)
75, 79, 83, 87, 91, 95, 99	2 Bytes	I	C--W-	DPT_Value_2_Ucount	0 - 65535	Alarm x: Set Lower Limit	Set Lower Limit Value (L/h)
	2 Bytes	I	C--W-	DPT_Value_2_Ucount	0 - 1530	Alarm x: Set Lower Limit	Set Lower Limit Value (0.01kW)
	2 Bytes	I	C--W-	DPT_Value_2_Ucount	0 - 15300	Alarm x: Set Lower Limit	Set Lower Limit Value (W)
	2 Bytes	I	C--W-	DPT_Value_2_Ucount	0 - 60000	Alarm x: Set Lower Limit	Set Lower Limit Value (mA)
	2 Bytes	I	C--W-	DPT_Value_2_Ucount	0 - 65535	Alarm x: Set Lower Limit	Set Lower Limit Value (0.01m3/h)
76, 80, 84, 88, 92, 96, 100	1 Bit	O	CTR--	DPT_Alarm	0/1	Alarm x: Excess Power	0 = No Alarm; 1 = Alarm
	1 Bit	O	CTR--	DPT_Alarm	0/1	Alarm x: Excess Power	1 = No Alarm; 0 = Alarm
	1 Bit	O	CTR--	DPT_Alarm	0/1	Alarm x: Excess Current	1 = No Alarm; 0 = Alarm
	1 Bit	O	CTR--	DPT_Alarm	0/1	Alarm x: Excess Current	0 = No Alarm; 1 = Alarm
	1 Bit	O	CTR--	DPT_Alarm	0/1	Alarm x: Excess Flow	1 = No Alarm; 0 = Alarm
	1 Bit	O	CTR--	DPT_Alarm	0/1	Alarm x: Excess Flow	0 = No Alarm; 1 = Alarm
77, 81, 85, 89, 93, 97, 101	1 Bit	O	CTR--	DPT_Alarm	0/1	Alarm x: Low Power	0 = No Alarm; 1 = Alarm
	1 Bit	O	CTR--	DPT_Alarm	0/1	Alarm x: Low Power	1 = No Alarm; 0 = Alarm
	1 Bit	O	CTR--	DPT_Alarm	0/1	Alarm x: Low Current	1 = No Alarm; 0 = Alarm
	1 Bit	O	CTR--	DPT_Alarm	0/1	Alarm x: Low Current	0 = No Alarm; 1 = Alarm
	1 Bit	O	CTR--	DPT_Alarm	0/1	Alarm x: Low Flow	1 = No Alarm; 0 = Alarm
	1 Bit	O	CTR--	DPT_Alarm	0/1	Alarm x: Low Flow	0 = No Alarm; 1 = Alarm
102, 103, 104, 105, 106, 107, 108, 109, 110, 111	1 Bit	O	CTR--	DPT_Switch	0/1	Notification x: Electric Consumption	Sending of 1
	1 Bit	O	CTR--	DPT_Switch	0/1	Notification x: Electric Consumption	Sending of 0
	1 Bit	O	CTR--	DPT_Switch	0/1	Notification x: Water Consumption	Sending of 1
	1 Bit	O	CTR--	DPT_Switch	0/1	Notification x: Water Consumption	Sending of 0
112, 116, 120, 124, 128	2 Bytes	O	CTR--	DPT_Value_Temp	-273.00 - 670760.00	[Ix] Current Temperature	Temperature Sensor Value
113, 117, 121, 125, 129	1 Bit	O	CTR--	DPT_Alarm	0/1	[Ix] Overcooling	0 = No Alarm; 1 = Alarm
114, 118, 122, 126, 130	1 Bit	O	CTR--	DPT_Alarm	0/1	[Ix] Overheating	0 = No Alarm; 1 = Alarm
115, 119, 123, 127, 131	1 Bit	O	CTR--	DPT_Alarm	0/1	[Ix] Probe Error	0 = No Alarm; 1 = Alarm
132, 138, 144, 150, 156	1 Bit	I	C--W-	DPT_Enable	0/1	[Ix] Input Lock	0 = Unlock; 1 = Lock
133, 139, 145, 151, 157	1 Bit		CT---	DPT_Switch	0/1	[Ix] [Short Press] 0	Sending of 0
	1 Bit		CT---	DPT_Switch	0/1	[Ix] [Short Press] 1	Sending of 1
	1 Bit	I	CT-W-	DPT_Switch	0/1	[Ix] [Short Press] 0/1 Switching	Switching 0/1
	1 Bit		CT---	DPT_UpDown	0/1	[Ix] [Short Press] Move Up Shutter	Sending of 0 (Up)
	1 Bit		CT---	DPT_UpDown	0/1	[Ix] [Short Press] Move Down Shutter	Sending of 1 (Down)
	1 Bit		CT---	DPT_UpDown	0/1	[Ix] [Short Press] Move Up/Down Shutter	Switching 0/1 (Up/Down)
	1 Bit		CT---	DPT_Step	0/1	[Ix] [Short Press] Stop/Step Up Shutter	Sending of 0 (Stop/Step Up)

	1 Bit		<b>CT---</b>	DPT_Step	0/1	[Ix] [Short Press] Stop/Step Down Shutter	Sending of 1 (Stop/Step Down)
	1 Bit		<b>CT---</b>	DPT_Step	0/1	[Ix] [Short Press] Stop/Step Shutter (Switched)	Switching of 0/1 (Stop/Step Up/Down)
	4 Bit		<b>CT---</b>	DPT_Control_Dimming	0x0 (Stop) 0x1 (Dec. by 100%) ... 0x7 (Dec. by 1%) 0x8 (Stop) 0xD (Inc. by 100%) ... 0xF (Inc. by 1%)	[Ix] [Short Press] Brighter	Increase Brightness
	4 Bit		<b>CT---</b>	DPT_Control_Dimming	0x0 (Stop) 0x1 (Dec. by 100%) ... 0x7 (Dec. by 1%) 0x8 (Stop) 0xD (Inc. by 100%) ... 0xF (Inc. by 1%)	[Ix] [Short Press] Darker	Decrease Brightness
	4 Bit		<b>CT---</b>	DPT_Control_Dimming	0x0 (Stop) 0x1 (Dec. by 100%) ... 0x7 (Dec. by 1%) 0x8 (Stop) 0xD (Inc. by 100%) ... 0xF (Inc. by 1%)	[Ix] [Short Press] Brighter/Darker	Switch Bright/Dark
	1 Bit		<b>CT---</b>	DPT_Switch	0/1	[Ix] [Short Press] Light On	Sending of 1 (On)
	1 Bit		<b>CT---</b>	DPT_Switch	0/1	[Ix] [Short Press] Light Off	Sending of 0 (Off)
	1 Bit	I	<b>CT-W-</b>	DPT_Switch	0/1	[Ix] [Short Press] Light On/Off	Switching 0/1
	1 Byte		<b>CT---</b>	DPT_SceneControl	0-63; 128-191	[Ix] [Short Press] Run Scene	Sending of 0 - 63
	1 Byte		<b>CT---</b>	DPT_SceneControl	0-63; 128-191	[Ix] [Short Press] Save Scene	Sending of 128 - 191
	1 Bit	I/O	<b>CTRW-</b>	DPT_Switch	0/1	[Ix] [Switch/Sensor] Edge	Sending of 0 or 1
	1 Byte		<b>CT---</b>	DPT_Value_1_Ucount	0 - 255	[Ix] [Short Press] Constant Value (Integer)	0 - 255
	1 Byte		<b>CT---</b>	DPT_Scaling	0% - 100%	[Ix] [Short Press] Constant Value (Percentage)	0% - 100%
	2 Bytes		<b>CT---</b>	DPT_Value_2_Ucount	0 - 65535	[Ix] [Short Press] Constant Value (Integer)	0 - 65535
	2 Bytes		<b>CT---</b>	9.xxx	-671088.64 - 670760.96	[Ix] [Short Press] Constant Value (Float)	Float Value
133, 134, 139, 140, 145, 146, 151, 152, 157, 158	2 Bytes	O	<b>CTR--</b>	DPT_Value_2_Ucount	0 - 65535	[Ix] [Pulse Counter] Counter	Number of Pulses
134, 140, 146, 152, 158	1 Byte	I	<b>C--W-</b>	DPT_Scaling	0% - 100%	[Ix] [Short Press] Shutter Status (Input)	0% = Top; 100% = Bottom
	1 Byte	I	<b>C--W-</b>	DPT_Scaling	0% - 100%	[Ix] [Short Press] Dimming Status (Input)	0% - 100%

135, 141, 147, 153, 159	1 Bit		CT----	DPT_Switch	0/1	[Ix] [Long Press] 0	Sending of 0
	1 Bit		CT----	DPT_Switch	0/1	[Ix] [Long Press] 1	Sending of 1
	1 Bit	I	CT-W-	DPT_Switch	0/1	[Ix] [Long Press] 0/1 Switching	Switching 0/1
	1 Bit		CT----	DPT_UpDown	0/1	[Ix] [Long Press] Move Up Shutter	Sending of 0 (Up)
	1 Bit		CT----	DPT_UpDown	0/1	[Ix] [Long Press] Move Down Shutter	Sending of 1 (Down)
	1 Bit		CT----	DPT_UpDown	0/1	[Ix] [Long Press] Move Up/Down Shutter	Switching 0/1 (Up/Down)
	1 Bit		CT----	DPT_Step	0/1	[Ix] [Long Press] Stop/Step Up Shutter	Sending of 0 (Stop/Step Up)
	1 Bit		CT----	DPT_Step	0/1	[Ix] [Long Press] Stop/Step Down Shutter	Sending of 1 (Stop/Step Down)
	1 Bit		CT----	DPT_Step	0/1	[Ix] [Long Press] Stop/Step Shutter (Switched)	Switching of 0/1 (Stop/Step Up/Down)
	4 Bit		CT----	DPT_Control_Dimming	0x0 (Stop) 0x1 (Dec. by 100%) ... 0x7 (Dec. by 1%) 0x8 (Stop) 0xD (Inc. by 100%) ... 0xF (Inc. by 1%)	[Ix] [Long Press] Brighter	Long Pr. -> Brighter; Release -> Stop
	4 Bit		CT----	DPT_Control_Dimming	0x0 (Stop) 0x1 (Dec. by 100%) ... 0x7 (Dec. by 1%) 0x8 (Stop) 0xD (Inc. by 100%) ... 0xF (Inc. by 1%)	[Ix] [Long Press] Darker	Long Pr. -> Darker; Release -> Stop
	4 Bit		CT----	DPT_Control_Dimming	0x0 (Stop) 0x1 (Dec. by 100%) ... 0x7 (Dec. by 1%) 0x8 (Stop) 0xD (Inc. by 100%) ... 0xF (Inc. by 1%)	[Ix] [Long Press] Brighter/Darker	Long Pr. -> Brighter/Darker; Release -> Stop
	1 Bit		CT----	DPT_Switch	0/1	[Ix] [Long Press] Light On	Sending of 1 (On)
	1 Bit		CT----	DPT_Switch	0/1	[Ix] [Long Press] Light Off	Sending of 0 (Off)
	1 Bit	I	CT-W-	DPT_Switch	0/1	[Ix] [Long Press] Light On/Off	Switching 0/1
1 Byte		CT----	DPT_SceneControl	0-63; 128-191	[Ix] [Long Press] Run Scene	Sending of 0 - 63	
1 Byte		CT----	DPT_SceneControl	0-63; 128-191	[Ix] [Long Press] Save Scene	Sending of 128 - 191	
1 Bit	O	CTR--	DPT_Alarm	0/1	[Ix] [Switch/Sensor] Alarm: Breakdown or Sabotage	1 = Alarm; 0 = No Alarm	

	2 Bytes		CT---	9.xxx	-671088.64 - 670760.96	[Ix] [Long Press] Constant Value (Float)	Float Value
	2 Bytes		CT---	DPT_Value_2_Ucount	0 - 65535	[Ix] [Long Press] Constant Value (Integer)	0 - 65535
	1 Byte		CT---	DPT_Scaling	0% - 100%	[Ix] [Long Press] Constant Value (Percentage)	0% - 100%
	1 Byte		CT---	DPT_Value_1_Ucount	0 - 255	[Ix] [Long Press] Constant Value (Integer)	0 - 255
136, 142, 148, 154, 160	1 Bit		CT---	DPT_Trigger	0/1	[Ix] [Long Press/Release] Stop Shutter	Release -> Stop Shutter
137, 143, 149, 155, 161	1 Byte	I	C--W-	DPT_Scaling	0% - 100%	[Ix] [Long Press] Dimming Status (Input)	0% - 100%
	1 Byte	I	C--W-	DPT_Scaling	0% - 100%	[Ix] [Long Press] Shutter Status (Input)	0% = Top; 100% = Bottom
162	1 Byte	I	C--W-	DPT_SceneNumber		[Motion Detector] Scene Input	Scene Value
163	1 Byte		CT---	DPT_SceneControl	0-63; 128-191	[Motion Detector] Scene Output	Scene Value
164, 193, 222, 251, 280	1 Byte	O	CTR--	DPT_Scaling	0% - 100%	[Ix] Luminosity	0-100%
165, 194, 223, 252, 281	1 Bit	O	CTR--	DPT_Alarm	0/1	[Ix] Open Circuit Error	0 = No Error; 1 = Open Circuit Error
166, 195, 224, 253, 282	1 Bit	O	CTR--	DPT_Alarm	0/1	[Ix] Short Circuit Error	0 = No Error; 1 = Short Circuit Error
167, 196, 225, 254, 283	1 Byte	O	CTR--	DPT_Scaling	0% - 100%	[Ix] Presence State (Scaling)	0-100%
168, 197, 226, 255, 284	1 Byte	O	CTR--	DPT_HVACMode	1=Comfort 2=Standby 3=Economy 4=Building Protection	[Ix] Presence State (HVAC)	Auto, Comfort, Standby, Economy, Building Protection
169, 198, 227, 256, 285	1 Bit	O	CTR--	DPT_Occupancy	0/1	[Ix] Presence State (Binary)	Binary Value
	1 Bit	O	CTR--	DPT_Start	0/1	[Ix] Presence: Slave Output	1 = Motion Detected
170, 199, 228, 257, 286	1 Bit	I	C--W-	DPT_Window_Door	0/1	[Ix] Presence Trigger	Binary Value to Trigger the Presence Detection
171, 200, 229, 258, 287	1 Bit	I	C--W-	DPT_Start	0/1	[Ix] Presence: Slave Input	0 = Nothing; 1 = Detection from slave device
172, 201, 230, 259, 288	2 Bytes	I	C--W-	DPT_TimePeriodSec	0 - 65535	[Ix] Presence: Waiting Time	0-65535 s.
173, 202, 231, 260, 289	2 Bytes	I	C--W-	DPT_TimePeriodSec	0 - 65535	[Ix] Presence: Listening Time	1-65535 s.
174, 203, 232, 261, 290	1 Bit	I	C--W-	DPT_Enable	0/1	[Ix] Presence: Enable	According to parameters
175, 204, 233, 262, 291	1 Bit	I	C--W-	DPT_DayNight	0/1	[Ix] Presence: Day/Night	According to parameters
176, 205, 234, 263, 292	1 Bit	O	CTR--	DPT_Occupancy	0/1	[Ix] Presence: Occupancy State	0 = Not Occupied; 1 = Occupied
177, 206, 235, 264, 293	1 Bit	I	C--W-	DPT_Start	0/1	[Ix] External Motion Detection	0 = Nothing; 1 = Motion detected by an external sensor
178, 183, 188, 207, 212, 217, 236, 241, 246, 265, 270, 275, 294, 299, 304	1 Byte	O	CTR--	DPT_Scaling	0% - 100%	[Ix] [Cx] Detection State (Scaling)	0-100%
179, 184, 189, 208, 213, 218, 237, 242, 247, 266, 271, 276, 295, 300, 305	1 Byte	O	CTR--	DPT_HVACMode	1=Comfort 2=Standby 3=Economy	[Ix] [Cx] Detection State (HVAC)	Auto, Comfort, Standby, Economy, Building Protection

					4=Building Protection		
180, 185, 190, 209, 214, 219, 238, 243, 248, 267, 272, 277, 296, 301, 306	1 Bit	O	<b>CTR--</b>	DPT_Switch	0/1	[Ix] [Cx] Detection State (Binary)	Binary Value
181, 186, 191, 210, 215, 220, 239, 244, 249, 268, 273, 278, 297, 302, 307	1 Bit	I	<b>C--W-</b>	DPT_Enable	0/1	[Ix] [Cx] Enable Channel	According to parameters
182, 187, 192, 211, 216, 221, 240, 245, 250, 269, 274, 279, 298, 303, 308	1 Bit	I	<b>C--W-</b>	DPT_Switch	0/1	[Ix] [Cx] Force State	0 = No Detection; 1 = Detection
309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340	1 Bit	I	<b>C--W-</b>	DPT_Bool	0/1	[LF] (1-Bit) Data Entry x	Binary Data Entry (0/1)
341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356	1 Byte	I	<b>C--W-</b>	DPT_Value_1_Ucount	0 - 255	[LF] (1-Byte) Data Entry x	1-Byte Data Entry (0-255)
357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372	2 Bytes	I	<b>C--W-</b>	DPT_Pulses	0 - 65535	[LF] (2-Byte) Data Entry x	2-Byte Data Entry
				DPT_Pulses difference	-32768 -32767		
				9.xxx	-671088.64 - 670760.96		
373, 374, 375, 376, 377, 378, 379, 380	4 Bytes	I	<b>C--W-</b>	DPT_Value_4_Count	-2147483648 - 2147483647	[LF] (4-Byte) Data Entry x	4-Byte Data Entry
381, 382, 383, 384, 385, 386, 387, 388, 389, 390	1 Bit	O	<b>CTR--</b>	DPT_Bool	0/1	[LF] Function x - Result	(1-Bit) Boolean
	1 Byte	O	<b>CTR--</b>	DPT_Value_1_Ucount	0 - 255	[LF] Function x - Result	(1-Byte) Unsigned
	2 Bytes	O	<b>CTR--</b>	DPT_Value_2_Ucount	0 - 65535	[LF] Function x - Result	(2-Byte) Unsigned
	4 Bytes	O	<b>CTR--</b>	DPT_Value_4_Count	-2147483648 - 2147483647	[LF] Function x - Result	(4-Byte) Signed
	1 Byte	O	<b>CTR--</b>	DPT_Scaling	0% - 100%	[LF] Function x - Result	(1-Byte) Percentage
	2 Bytes	O	<b>CTR--</b>	DPT_Value_2_Count	-32768 - 32767	[LF] Function x - Result	(2-Byte) Signed
	2 Bytes	O	<b>CTR--</b>	9.xxx	-671088.64 - 670760.96	[LF] Function x - Result	(2-Byte) Float

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