KES Plus

KNX Energy Meter

ZIO-KESP

Application Program Version: [1.2]
User Manual Version: [1.2]_a

www.zennio.com

CONTENTS

DOCUMENT UPDATES

Version	Changes	Page(s)
[1.2]_a	**Changes in the application program:** • Global consumed and generated power objects are included. • *V* and *A* are added to the voltage and current unit selector. • Sending of voltage and current magnitudes. • Alarms for generated power.	-
	V and *A* are added to the voltage and current unit selector.	21
	Sending voltage and current magnitudes.	27, 31
	Alarms for generated power.	38

1 INTRODUCTION

1.1 KES PLUS

The **KES Plus** (*KNX Energy saver*) from Zennio is an energy saver of electrical energy for single-phase or three-phase systems.

It can measure and notify in KNX system, not only the consumed or produced energy, but also the associated cost according to 6 different tariffs, CO2 emissions, instant active and reactive power, power factor and other information related with the use of electric energy in the installation.

Alarms and notifications can be configured as warnings when power exceeds the limits established, for example, to disconnect low priority systems to reduce consumption.

The most outstanding features of KES Plus are:

- Support for frequencies of 50 and 60 Hz.

- Support for **single-phase** and **three-phase** systems.

- **3 independent input channels** to monitor up to three independent single-phase lines or one three-phase line. Power and energy, cost and CO_2 emissions measurement in **up to 3 registers** (one **total** and two **partial**).

- **Up to 6 tariff** counters for the estimation of the cost of energy consumption.

- **4 Alarms** for power excess and low power.

- Up to **15 notifications** of different situations: overvoltage, low voltage, excess of consumption, energy generation, economic cost, CO_2 emissions.

- Synchronisation with an external **KNX clock**.

- **10** customisable, multi-operation **logic functions**.

- **Heartbeat** or periodic "still-alive" notification.

1.2 INSTALLATION

KES Plus connects to the KNX bus via the connecting terminals.

The current transformers Zennio (**ZN1AC-CST60** and **ZN1AC-CST120**) are connected to KES Plus input channels.

KES Plus can be used in single-phase and three-phase installations with and without accessible neutral wire. Please refer to section 1.2.2 to get detailed information about the different use cases and connection schemes for each type of installation.

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

Figure 1 shows the element scheme of KES Plus.

1. Phase/line (voltage)

2. Neutral (voltage)

3. Programming button

4. Programming LED

5. Phase/line status LED

6. Current transformer connection

7. KNX connector

8. Three-phase status LED

9. Current Transformer
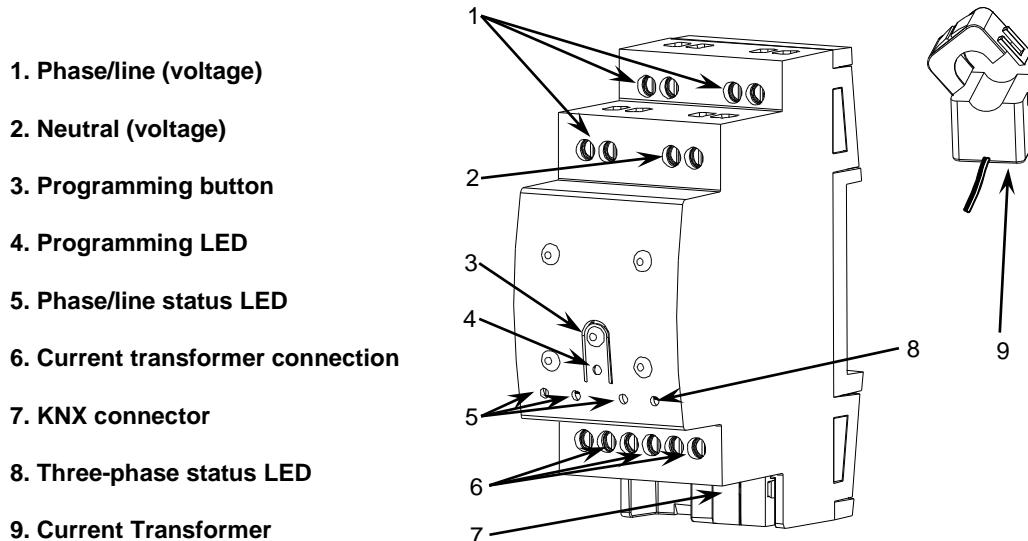
Figure 1. KES Plus**.** Element scheme.

The functionality of the main elements is described below:

- **Phase/line (voltage) (1)**: inputs for the Phase/line connection.

- **Neutral (voltage) (2)**: inputs for the Neutral connection.

- **Programming Button (3)**: a short press on this button sets the device into the programming mode, making the associated LED (4) light in red.

    Note: *If this button is held while plugging the device into the KNX bus, KES will enter the Safe Mode. The LED will then blink in red every 0.5 seconds.*

- **Current Transformer connection (6)**: inputs for the current transformers connection. A different transformer will be required per electrical line being monitored. The two wires of each transformer will be inserted into the two connection points of the particular input channel to be used. For instance, 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" in the Single-Phase application program), another one to the slots CT12 +/- ("Phase 2"), and a third one to the slots CT3 +/- ("Phase 3"). In the case of the Three-Phase version, each transformer will be destined to monitor one of the three phase lines in the electrical system.

To get 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.

1.2.1 CURRENT TRANSFORMER

The set-up process of the **ZN1AC-CST60** and **ZN1AC-CST120** transformers is described below.

- **Open** the top clamp of the transformer.

- Put the **wire of the phase to be measured** inside it respecting the orientation.

    Important: *only one phase line should be inserted into the transformer, not the entire power cable with the neutral and other phases.*

- **Close** back the top clamp of the transformer.

- Connect the **two wires** of the transformer into the two connection slots of the KES Plus terminal block (6).

Please remember that KES Plus only performs measurements of the power consumed by **alternating current** (AC) lines.

Note: *it is **very important** to keep in mind that neither ordinary power supplies (230 V) nor other external supplies should be connected to the KNX bus, nor directly to the input terminal probes of KES Plus.*

1.2.2 KES PLUS USE CASES IN DIFFERENT TYPES OF INSTALLATIONS

The following figures show the connection diagram of KES Plus in different types of installations:

Case 1: Three-phase installation with accessible neutral wire and three-phase load
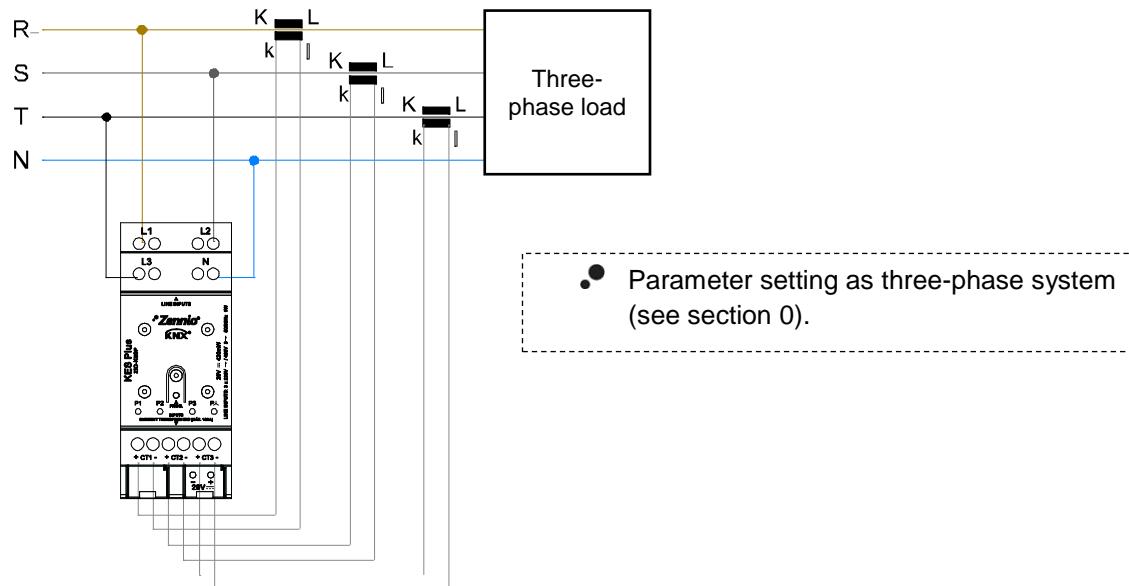

Figure 2 Three-phase with accessible neutral wire and three-phase load.

Case 2: Three-phase installation with accessible neutral wire and single-phase loads
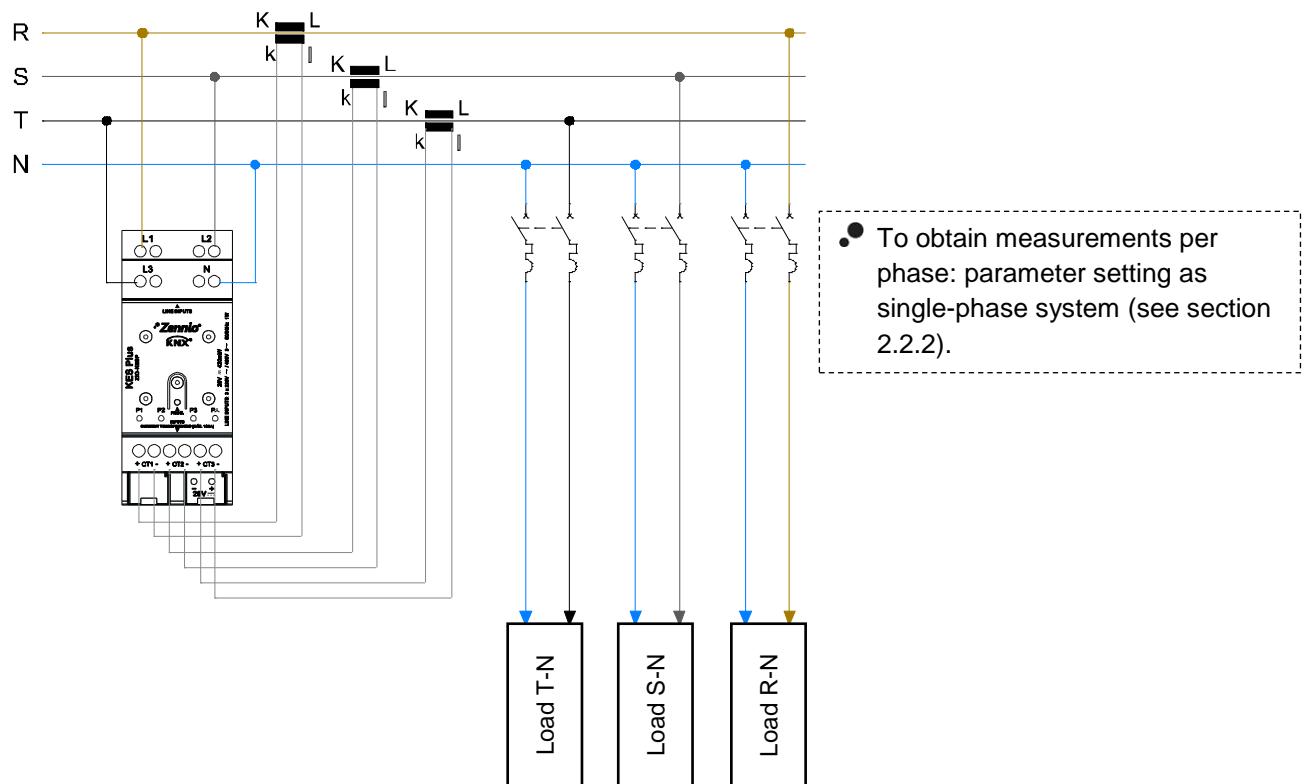
Figure 3 Three-phase with accessible neutral wire and single-phase loads.

Case 3: Single-phase installation with accessible neutral wire or two-phase with $U_{Línea} \leq 230V$
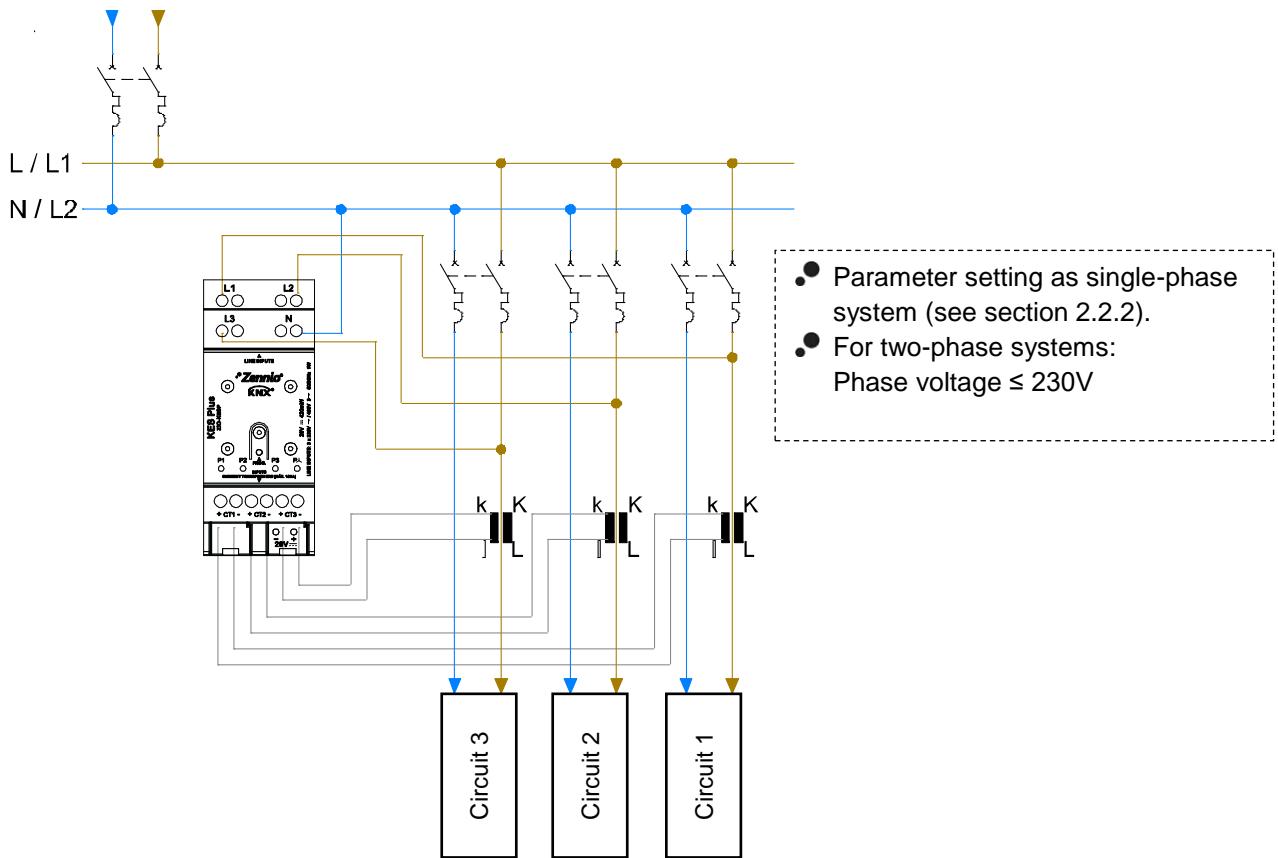
Figure 4 Single-phase system with accessible neutral wire or two-phase system.

Case 4: Three-phase installation without accessible neutral wire and three-phase load
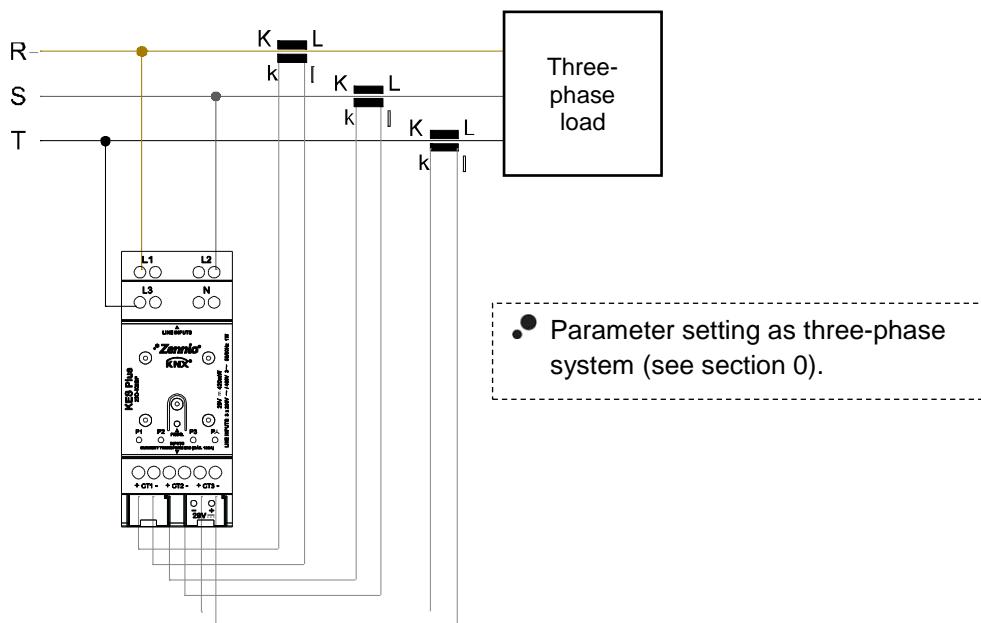
Figure 5 Three-phase system without accessible neutral wire and three-phase load.

## Case 5: Three-phase installation without accessible neutral wire and three single-phase loads
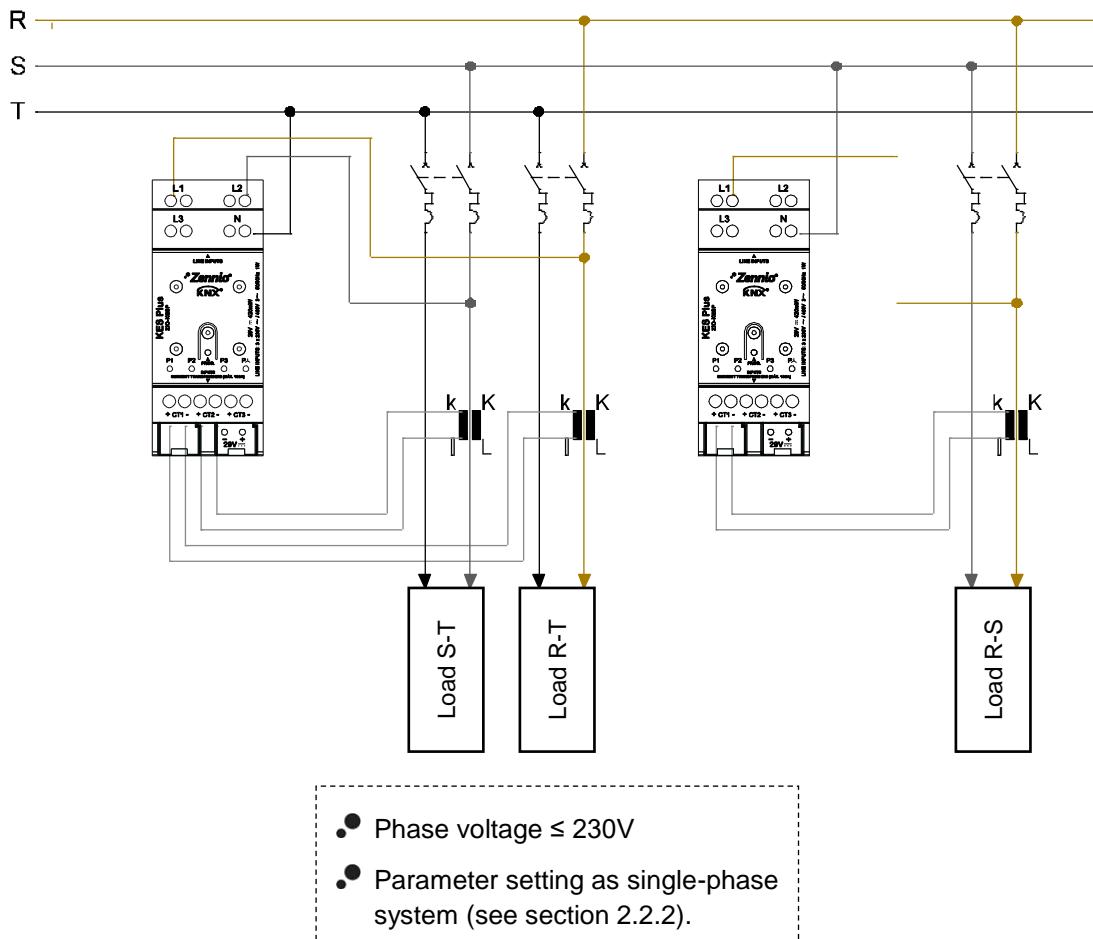

Figure 6 Three-phase system without accessible neutral wire and single-phase loads.

In this case, since two KES Plus are used, the power measurements per phase can be added together using a logic function (section 2.6) to obtain total (three-phase) power measurements, provided they are set in kW.

1.3 MEASURED QUANTITIES

Next, the quantities measured by the KES Plus that can be sent to the bus for monitoring and energy management are described.

T → magnitude available for three-phase systems.

S → magnitude available for single-phase systems.

Magnitudes of each conductor or phase:

- **Phase Voltage** (T/S): rms value expressed in millivolts [mV] or volts [V].

- **Phase Current** (T/S): rms value expressed in milliamps [mA] or amps [A].

- **Active Power** (S): effective power capable of transforming electrical energy into work. Measured in watts [W] or kilowatts [kW], as selected by parameter, with 2W-resolution. The sign of this magnitude indicates whether the power is being consumed or generated:

  - Active Power > 0 → Active power consumed (the receptor is a load, absorbing power from the electricity grid).

  - Active Power < 0 → Active power generated (the receptor is a generator, injecting power to the electricity grid).

- **Power Factor** (S): relation between active and apparent power (dimensionless).

- **Active Energy** (S): time integration of the active power. It is disaggregated in two objects, active energy consumed and active energy generated (always positive values). Measured in watts per hour [W·h] or kilowatts per hour [kW·h], as selected by parameter.

Global magnitudes:

- **Frequency** (T/S): weighted average of the frequencies of each phase connected. Measured in hertz [Hz].

- **Consumed Active Power** (S)**:** Sum of the consumed active power of each phase. Resolution: 8W

- **Generated Active Power** (S)**:** Sum of generated active power of each phase. Resolution: 8W

- **Active Power** (T/S): arithmetic sum of the active power of each phase. Resolution: 8W.

- **Reactive Power** (T/S)**:** power developed in capacitive and inductive circuits. Measured in volt-ampere reactive [VAr] or kilovolt-ampere reactive [kVAr], as selected by parameter. The reactive power would have two possible meanings depending on its sign:

  - Inductive Reactive Power would have a positive sign in consumption and a negative sign in generation, with load mainly of inductive type.

  - Capacitive Reactive Power would have a negative sign in consumption and a positive sign in generation, with load mainly of inductive type.

- **Power Factor** (T/S): relation between active and apparent power.

- **Active Energy** (T/S): time integration of the global active power. It is broken-down in two objects, active energy consumed and active energy generated (always positive values). Measured in watts·hour [W·h] or kilowatts·hour [kW·h], as selected by parameter.

- **Reactive Energy** (T/S): time integration of the global reactive power. It is broken-down in two objects, inductive reactive energy and capacitive active energy (always positive values). Measured in volt-ampere reactive hour [VAr·h] or kilovolt-ampere reactive hour [kVAr·h], as selected by parameter.

- **Voltage and Current Unbalance** (T): measures, as a percentage, the difference between voltages and currents of each one of the phases. The calculation is done in accordance with IEC 61000-2-1, IEC 61000-4-27, ANSI C84.1 standards for phase voltages.

$$D_i = \frac{I_{max} - I_{med}}{I_{med}}\,100\%;\ D_v = \frac{V_{max} - V_{med}}{V_{med}}\,100\%$$

The following table resumes the mentioned magnitudes.

Phase / Global	Magnitude	Units	Single Phase	Three-Phase
Per Phase	Voltage	mV / V	✔	✔
	Current	mA / A	✔	✔
	Active Power	W / kW	✔	
	Active Consumed Energy	W·h / kW·h	✔	
	Active Generated Energy	W·h / kW·h	✔	
	Power Factor	-	✔	
Global	Frequency	Hz	✔	✔
	Consumed Active Power	W / kW	✔	
	Generated Active Power	W / kW	✔	
	Active Power	W / kW	✔	✔
	Reactive Power	VAr / kVAr	✔	✔
	Active Energy Consumed	W·h / kW·h	✔	✔
	Active Energy Generated	W·h / kW·h	✔	✔
	Inductive Reactive Energy	VAr·h / kVAr·h	✔	✔
	Capacitive Reactive Energy	VAr·h / kVAr·h	✔	✔
	Power Factor	-	✔	✔
	Voltage Unbalance	%		✔
	Current Unbalance	%		✔

Table 1. Quantities measured in Single and Three-Phase systems

1.4 CONSUMPTION DATA INITIALIZATION AFTER A DOWNLOAD

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 to 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 and 2.2.3.1).

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

Notes:

- *In **single-phase** configuration, only the energy registers broken down by each phase can be initialized by parameter, not the global registers.*

- ***Reactive energy registers** can only be initialized by writing in the communication object. It is recommended to initialize them after the first start-up as they may have invalid values.*

Table 2 shows the available options to set the initial value in each energy register. The options are:

- By parameter.

- By object: writing the desired value in the corresponding communication object.

- Reset register: partial registers can be reset (set to zero) through the reset communication object.

Phase / Global		Magnitude	Initialization	
			Single Phase	Three-Phase
Per Phase	Total Register	Active Energy Consumed	- By parameter - By object	
		Active Energy Generated	- By parameter - By object	
	Partial Register	Active Energy Consumed	- By parameter - Reset register	
		Active Energy Generated	- By parameter - Reset register	
Global	Total Register	Active Energy Consumed	-	- By parameter - By object
		Active Energy Generated	-	- By parameter - By object
		Capacitive Reactive Energy	- By object	- By object
		Inductive Reactive Energy	- By object	- By object
	Partial Register	Active Energy Consumed	- Reset register	- By parameter - Reset register
		Active Energy Generated	- Reset register	- By parameter - Reset register
		Capacitive Reactive Energy	- Reset register	- Reset register
		Inductive Reactive Energy	- Reset register	- Reset register

Table 2 Consumption data initialization.

1.5 SETTING THE TIME OF DAY

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

During the start-up, KES Plus 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).

Notes:

- *The time count is performed internally by KES Plus. However, it must be notified (through external events) of any time adjustments in order to ensure the synchronisation of the periodic timing of the registers.*

- *It is advisable to resynchronise the internal clock of KES Plus periodically to prevent precision loss after prolonged operation. Therefore, KES Plus sends a time request to the KNX bus every 15 minutes.*

1.6 VISUAL NOTIFICATION

KES Plus includes four LED indicators which provide information of the consumption in each of the phases in single phase systems or the consumption of the three phases in three-phase systems.

The LEDs are bicolour. The colour indicates whether there is consumption or generation of energy in the phase:

- Yellow LED: consumption of energy. $P_{phase} > 0$.

- Green LED: generation of energy. $P_{phase} < 0$.

The LED illumination is intermittent. The lighting frequency is proportional to the power value:

$$t_{on} = \frac{P_{phase}}{P_{max}} * T$$

$$t_{off} = T - t_{on}$$

Where P_{max} is configurable by parameter and T is a fixed period of 1 second.

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.

ETS PARAMETERISATION

The configurable parameters on the General screen are the followings:
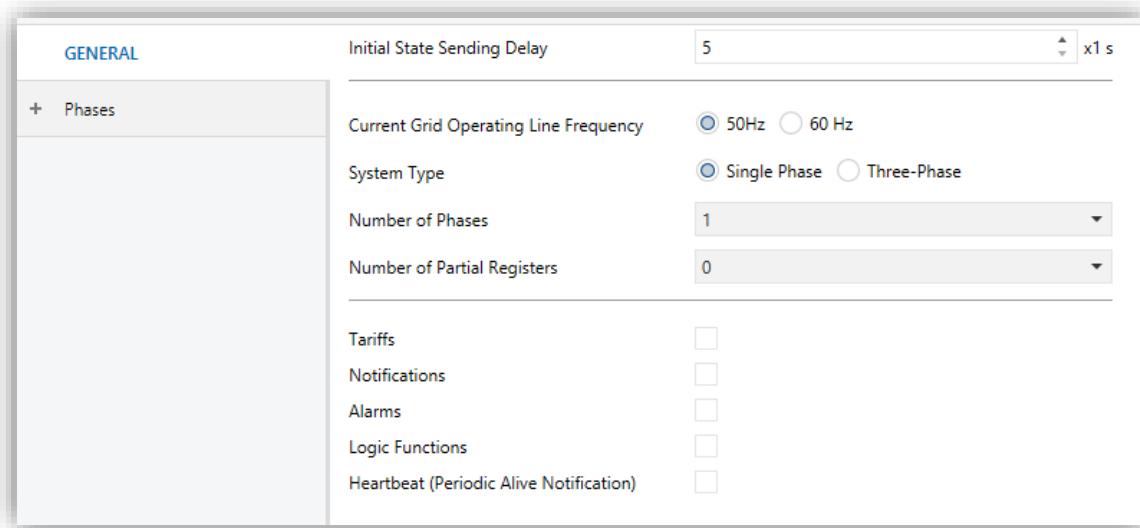
Figure 7: General

- **Initial State Sending Delay** [*5…255*][1]**:** Time (seconds) that elapses between the start-up of the device and the beginning of sending objects through the bus.

- **Current Grid Operating Line Frequency** [*50 / 60*] Hz. There is a status object for this magnitude "**[Global] Frequency**".

- **System Type** [*Single Phase / Three-Phase*]: Type of installation. For "Single Phase", additionally, is possible to configure the number of phases.

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[1] The default values of each parameter will be highlighted in blue in this document, as follows: [*default*/*rest of options*].

➢ **Number of Phases** [*1 / 2 / 3*]**:** Number of phases of the installation.

- **Number of Partial Registers** [*0 / 1 / 2*]**:** Sets the number of partial registers for each consumption register. When selecting more than zero, the following objects appear (apart from the registers itself):

  ➢ "**Reset Partial Register n**": when receives a "1" all the objects of the partial register n are set reset (set to zero).

  ➢ "**Starting Date of Partial Register n**": reset date of partial register n.

- **Tariffs** [*enabled/disabled*]**:** Enables or disables the "Tariff" tab on the left menu. See section 2.3 for more details.

- **Notifications** [*enabled/disabled*]**:** enables or disables the "Notification" tab on the left menu. See section 2.4 for more details.

- **Alarms** [*enabled/disabled*]**:** enables o disables the "Notification" tab on the left menu. See section 2.5 for more details.

- **Logic Functions** [*enabled/disabled*]**:** enables o disables the "Logic Functions" configuration screen on the left menu. See section 2.6 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*).
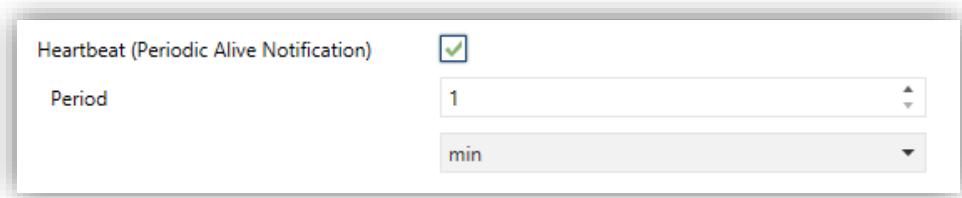
Figure 8. Heartbeat (Periodic Alive Notification)

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 sendings match the period set.*

The communication objects available by default are (T → available for three-phase systems; S → available for single-phase systems.):

- "**Data**" y "**Time of day**" (T/S): Objects for updating date and time of KES Plus. See section 1.5 for details.

- "**[Global / 3-Phase] Request metering**" (T/S): When receiving a "1" through this object global magnitudes of power, energy, cost and emissions, as well as voltage and current of each phase are sent to the bus.

- "**[Global / 3-Phase] Frequency**" (T/S)

- "**[Phn] Request metering**" (S): When receiving a "1" through this object magnitudes of power, energy, cost, emissions, voltage and current of phase n are sent to the bus.

- "**[Phn] Voltage**" (T/S)

- "**[Phn] Current**" (T/S)

- "**[Phn] Active Power**" (S)

- "**[Phn] Power Factor**" (S)

- "**[Global / 3-Phase] Active Power**" (T/S)

- "**[Global] Consumed Active Power**" (S)

- "**[Global] Generated Active Power**" (S)

- "**[Global / 3-Phase] Reactive Power**" (T/S)

- "**[Global / 3-Phase] Power Factor**" (T/S)

- "**[Global / 3-Phase] [TR] Consumed Active Energy**" y "**[Global] [RT] Generated Active Energy**" (T/S)

- "**[Global / 3-Phase] [TR] Inductive Reactive Energy**" y "**[Global] [RT] Capacitive Reactive Energy**" (T/S)

- "**[Global / 3-Phase] [TR] CO2 Emissions**" (T/S)

- "**[3-Phase] Voltage Unbalance**" y "**[3-Phase] Current Unbalance** "(T).

Notes:

- *The label **[Phn]** refers to magnitudes or measures of phase n (where n = 1, 2, 3).*

- *The label **[Global]** refers to magnitudes or measures of the phases altogether in single phase systems.*

- *The label **[3-Phase]** refers to magnitudes or measures of the phases altogether in 3-phase systems.*

For further information about the magnitudes measured by these objects, please see section 1.3.

2.2 PHASES

The parameter configuration depends on the system type (single phase or three-phase). The options available will slightly differ for each case, although are entirely analogous.

2.2.1 GENERAL CONFIGURATION

On this screen, the basic configuration common to all KES Plus phases can be selected.

ETS PARAMETERISATION

The general Configuration parameters are shown below:
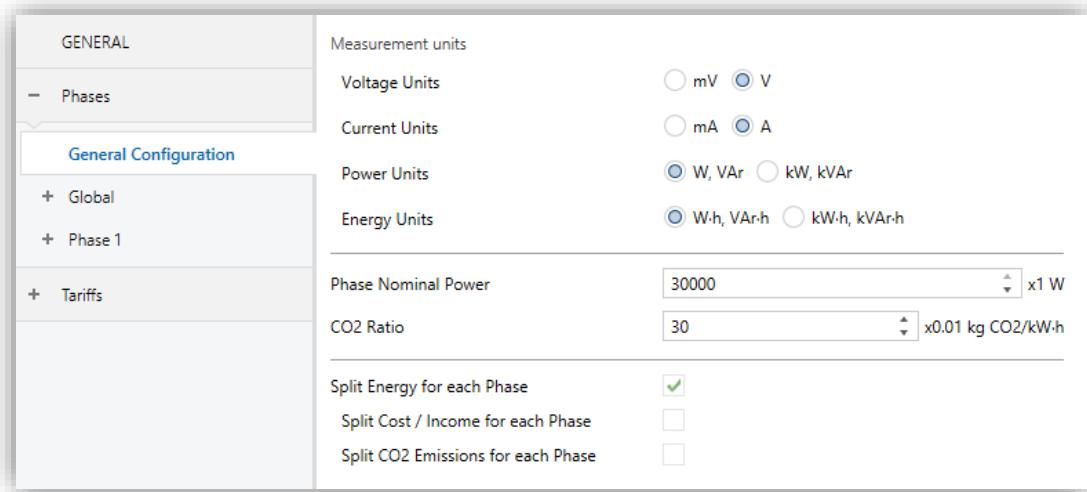
Figure 9 Phases: General configuration

. **Measurement Units:**

- ➢ **Voltage Units** [_mV / V_]: sets the measurement units of the voltage objects.

- ➢ **Current Units** [_mA / A_]: sets the measurement units of the current objects.

- ➢ **Power Units** [_W, VAr / kW, kVAr_]: sets the measurement units of the power objects.

- ➢ **Energy Units** [_W·h, VAr·h / kW·h, kVAr·h_]: sets the measurement units of the energy objects.

- **Phase/3-Phase Nominal Power** [*[100…30000][W][1…30][kW]* / *[100…90000][W][1…90][kW]*]: sets the phase nominal power which will be used to calculate the light-on time of the LEDs (see section 1.6 for details). The available range will vary depending on the power unit selected.

- **CO2 Ratio** [*1…30…255*]: sets the hundredths of a kilogramme of CO_2 released to the atmosphere per consumption unit (0.01 kgCO_2/kWh).

When selecting a single-phase system there are some more parameters available:

- **Split Energy for each Phase** [*enabled/disabled*]: shows or hides active energy objects for each enabled phase.

  - **Split Cost / Income for each Phase** [*enabled/disabled*]: shows or hides the objects relating to cost / profit for each phase. This option will be available whenever "Tariffs" are enabled (see section 2.1).

  - **Split CO₂ Emissions for each Phase** [*enabled/disabled*]: shows or hides the objects relating to CO_2 emissions for each phase.

2.2.2 SINGLE PHASE SYSTEM

When selecting a single-phase system, there are two more tabs apart from the "General Configuration": "Global" and "Phase n".

2.2.2.1 GLOBAL

On this screen can be configured the options related to global objects, that is, those that refer to measures of all phases together.

ETS PARAMETERISATION

The parameters shown in the Global tab are the following:
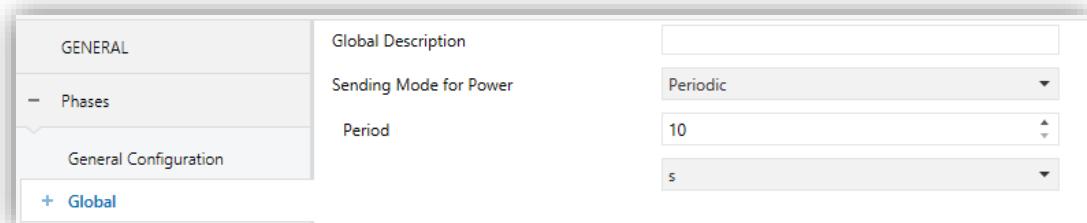
Figure 10 Phases: Global

- **Global Description**: text box without functionality, simply allows adding a description.

- **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.
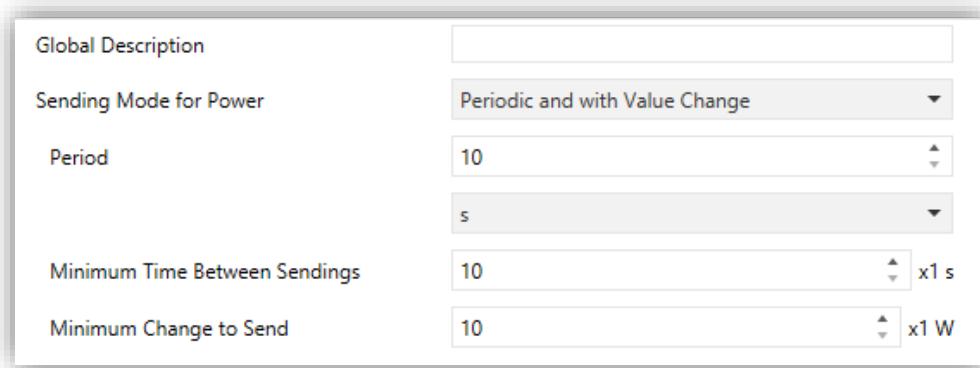
Figure 11 Phases: Global - Sending modes

➢ **Period** [*10…255*][*s*] [*1…255*][*min/h*]: sets the period between cyclical sendings.

➢ **Minimum Time Between Sendings** [*10…255*]: sets a minimum period of time (seconds) between consecutive sendings.

➢ **Minimum Change to Send** [[*10…90000*][*W*] / [*1…90*][*kW*]]: sets the minimum value change required to send the next value.

2.2.2.1.1 Total register

The total registers of global magnitudes store the accumulated values of consumption of energy, costs and CO_2 emissions of all the phases since the start-up of the device.

ETS PARAMETERISATION

The parameters shown in the Total Register tab are the following:
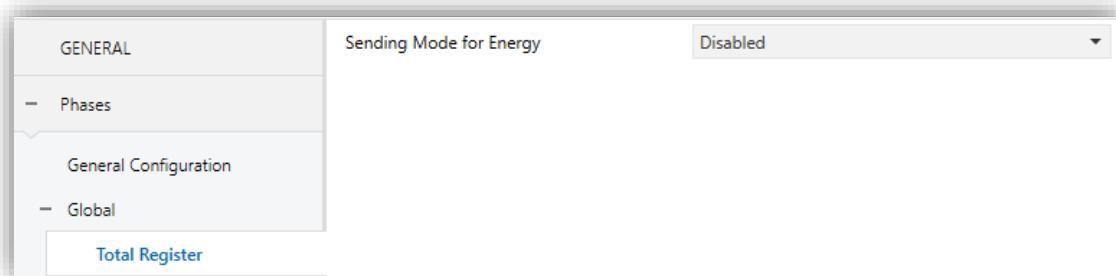
Figure 12 Phases: Global - Total Register

- **Sending Mode for Energy** [_Disabled / Periodic / With Value Change / Periodic and with Value Change_]: sets the sending mode of consumption, cost and CO_2 emissions objects. Depending on this selection, some more parameters will be available:
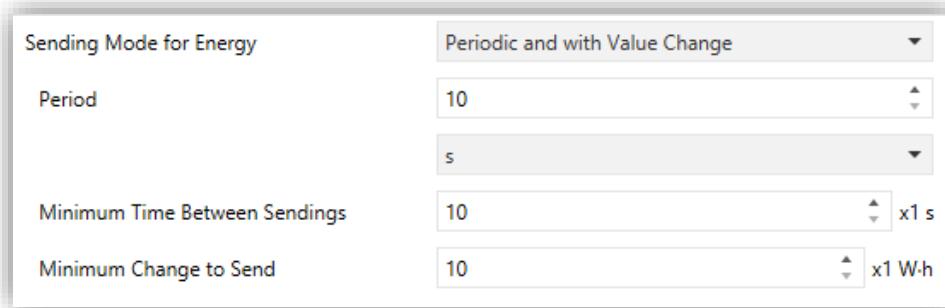
Figure 13 Phases: Global - Total Register – Sending Modes

> **Period** [_10…255_][_s_] [_1…255_][_min/h_]: sets the period between cyclical sendings.

> **Minimum Time Between Sendings** [_10…255_]: sets a minimum period of time between consecutive sendings.

> **Minimum Change to Send** [[_10…65535_][_W·h_] / [_1…65535_][_kW·h_]]: sets the minimum value change required to send the next value.

The communication objects of total registers have the label "**[Global] [TR]**".

2.2.2.1.2 Partial registers

Up to two partial registers for global values can be enabled, which store data during a period of time (for example, a day, a month …). As the total register, there are partial registers for consumption, CO_2 emissions and costs.

Two binary objects "**Reset Partial Register 1**" and "**Reset Partial Register 2**" are available to reset a partial register anytime (set to zero). Moreover, a **periodic reset** can be configured by parameter.

Every time a partial register is reset, the values of the **immediately previous period** are saved in other communication objects and are sent to the bus. Note that this sending will take place even if the resending restrictions configured are not met.

Note: _Partial registers are disabled by default. Please refer to section 2.1 for enabling them._

ETS PARAMETERISATION

The parameters to configure any of the partial registers are:
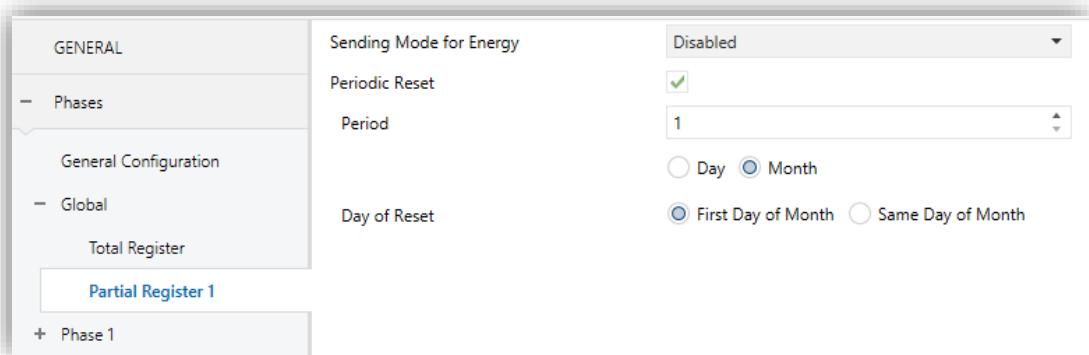
Figure 14 Phases: Global - Partial Register

- **Sending Mode for Energy** [*Disabled / Periodic / With Value Change / Periodic and with Value Change*]: analogous to the same parameter of the total register (see section 2.2.2.1.1).

- **Periodic Reset** [*enabled/disabled*]: enables or disables the automatic reset of the partial register when a certain period expires:

  ➢ **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.

  Please note the following:

  ➢ In the absence of bus power at the end of the cycle, the register will be reset after power recovery.

  ➢ In case of time adjustments, resets may be affected by a delay.

  ➢ 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.

The communication objects of partial registers of global magnitudes have the label "**[Global] [PR1]**" or "**[Global] [PR2]**".

2.2.2.2 PHASE n

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:
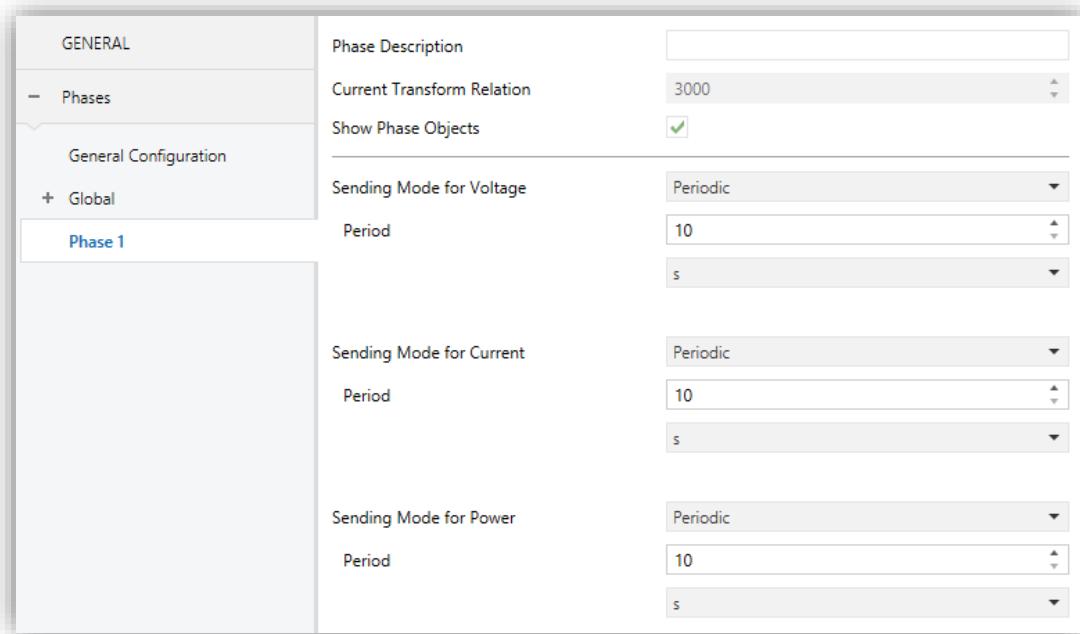
Figure 15 Phases: Phase y

- **Phase 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.

- **Show Phase Objects** [*enabled/disabled*]: show or hide the following objects of the phase n.

  - ➤ "**[Phn] Request metering**".

  - ➤ "**[Phn] Voltage**".

  - ➤ "**[Phn] Current**".

  - ➤ "**[Phn] Active Power**".

  - ➤ "**[Phn] Power Factor**".

- **Sending Mode for Voltage** [*Disabled / Periodic / With Value Change / Periodic and with Value Change*]**:** sets when voltage object of the corresponding phase should be sent. Depending on this selection, some more parameters will be available.
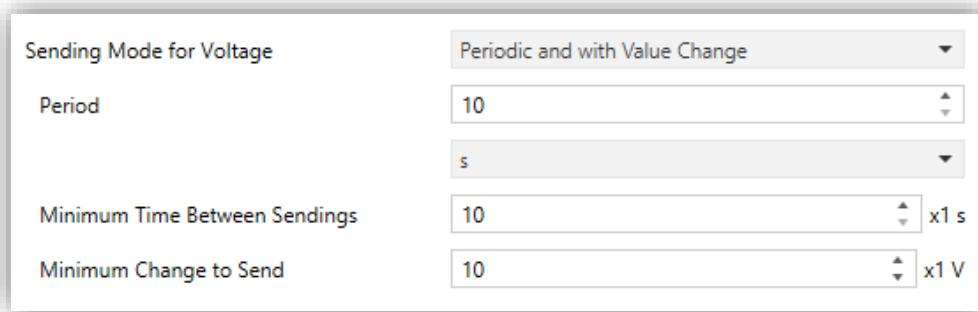
Figure 16 Phases: Global - Sending modes

> **Period** [*10…255*][*s*] [*1…255*][*min/h*]: sets the period between cyclical sendings.

> **Minimum Time Between Sendings** [*10…255*]: sets a minimum period of time (seconds) between consecutive sendings.

> **Minimum Change to Send** [*[10…10000…250000][mV]* / *[1…250][V]*]: sets the minimum value change required to send the next value.

- **Sending Mode for Current** [*Disabled / Periodic / With Value Change / Periodic and with Value Change*]**:** sets when current object of the corresponding phase should be sent. Depending on this selection, some more parameters will be available.
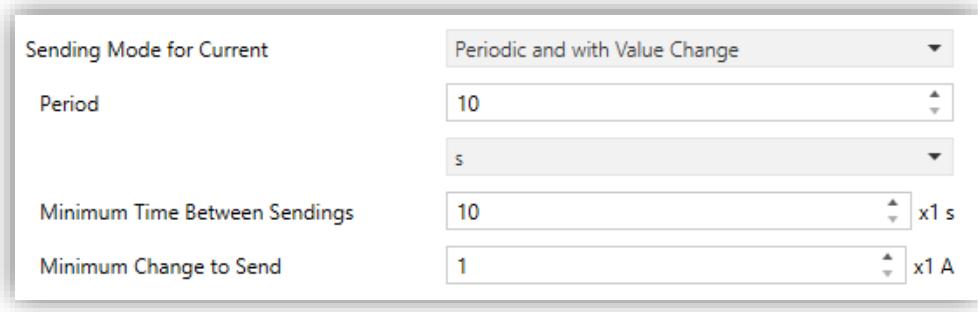
Figure 17 Phases: Global - Sending modes

> **Period** [*10…255*][*s*] [*1…255*][*min/h*]: sets the period between cyclical sendings.

> ➢ **Minimum Time Between Sendings** [_10…255_]: sets a minimum period of time (seconds) between consecutive sendings.

> ➢ **Minimum Change to Send** [_[100…1000…130000][mA]_ / _[1…130][A]_]: sets the minimum value change required to send the next value.

- **Sending Mode for Power** [_Disabled / Periodic / With Value Change / Periodic and with Value Change_]: analogous to the same parameter of the "Global" tab (see section 2.2.2.1).

2.2.2.2.1 Total register

The total registers of magnitudes per phase store the accumulated values of consumption of energy, costs and CO2 emissions of one phase since the start-up of the device.

Note: _Total registers per phase are disabled by default. To enable them it is necessary to check the **Split energy for each phase** checkbox in the "General Configuration" tab (see section 2.2.1)._

ETS PARAMETERISATION

The parameters to configure total registers are:
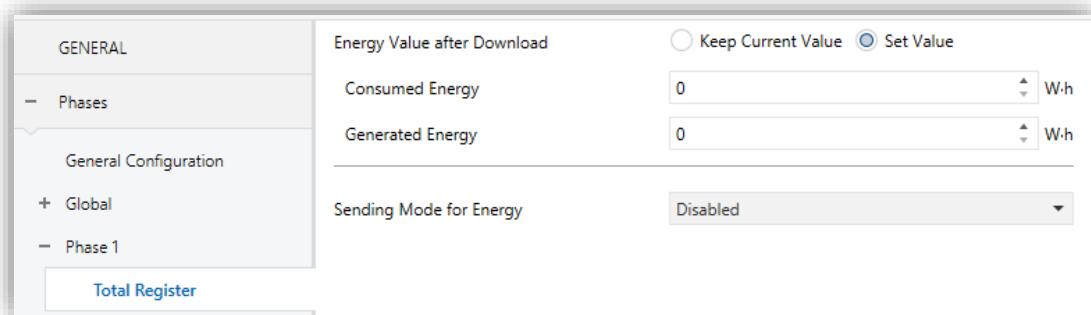
Figure 18 Phases: Phase y - Total Register

- **Energy Value after Download** [_Keep Current Value / Set Value_]: sets the initial value of the total register of **active energy** after an ETS download. When selecting "Set value", and additional textbox appear to enter the desired value for both **Consumed energy** and **Generated 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 global registers (see section 2.2.2.1.1).

2.2.2.2.2 Partial register

They are equivalent to partial records of global magnitudes (see section 2.2.2.1.2), but in this case, they store single-phase data.

ETS PARAMETERISATION

The parameters to configure any of the partial registers are:
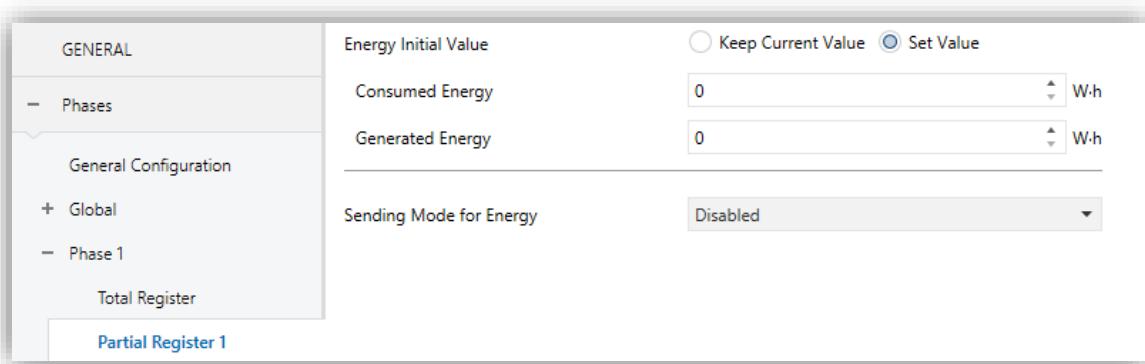
Figure 19 Phases: Phase y - Partial Register

- **Energy Value after Download** [*Keep Current Value / Set Value*]:]: sets the initial value of the total register of **active energy** after an ETS download. When selecting "Set value", and additional textbox appear to enter the desired value for both **Consumed energy** and **Generated 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 global registers (see section 2.2.2.1.1).

2.2.3 THREE-PHASE SYSTEM

When selecting a single-phase system, there is one more tab apart from the "General Configuration": "3-Phase".

2.2.3.1   3-PHASE

On this screen can be configured the options related to 3-phase system objects. These are measures of all phases together.

 ETS PARAMETERISATION

The 3-Phase parameters are shown below:

Figure 20 Phases: 3-Phase

- **3-Phase Description**: text box without functionality, simply allows adding a description.

- **Current Transform Relation for Phase *n*** [*3000*]: informative parameter indicating the transformer ratio (loops number) that the current transformer must have.

- **Sending Mode for Voltage** [*Disabled / Periodic / With Value Change / Periodic and with Value Change*]: analogous to the same parameter in the tab "Phase *n*" (see section 2.2.2.2).

- **Sending Mode for Current** [*Disabled / Periodic / With Value Change / Periodic and with Value Change*]: parameter analogous to the same described in the tab "Phase *n*" (see section 2.2.2.2).

- **Sending Mode for Power** [*Disabled / Periodic / With Value Change / Periodic and with Value Change*]: parameter analogous to the same described in the tab "Global" (see section 2.2.2.1).

- **Show Phase Objects (Voltage and Current)** [*enabled/disabled*]: show or hide the following objects of the phase n.

  ➢ **[Phn] Voltage.**

  ➢ **[Phn] Current.**

2.2.3.1.1 Total register

Analogous to the total registers of the phases of a single-phase system (see section 2.2.2.2.1).

2.2.3.1.2 Partial register

Analogous to the partial registers of the phases of a single-phase system (see section 2.2.2.2.2) with one more parameter:

- **Periodic Reset** [*enabled/disabled*]: enables or disables the automatic reset of the partial register when a certain period expires:

  ➢ **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.

  Please note the following:

  ➢ In the absence of bus power at the end of the cycle, the register will be reset after power recovery.

> ➢ In case of time adjustments, resets may be affected by a delay.

> ➢ In case of selecting "<u>Same Day of Month</u>", the specific day of the month will change whenever the register is manually reset through the object.

2.3 TARIFFS

For every register, it is possible to calculate the monetary cost of the accumulated consumption/generation, together with the consumption corresponding to each tariff, in case of a time-slot based tariff system.

Thus, it will be possible to configure up to **six tariffs**, being also possible to modify them through object. To allow tariff switchovers, the device will also provide a one-byte object "**[Trf] Set Tariff**", so it can be notified about the tariff (1 to 6) to be adopted at the end of each time slot. In addition, another object ("**[Trf] Tariff (Status)**") will be available to inform about the current tariff.

Please note that the **activate tariff by default** is tariff number 1. Therefore, any initial consumption set in parameters will compute in such tariff.

Besides, for single phase system, it is also possible:

  · **Split Tariff Energy for each Phase.**

  · **Split Tariff Cost / Profit for each Phase.**

ETS PARAMETERISATION

The Tariff tab will become visible once the Tariff function has been enabled in the General screen (see section 2.1).
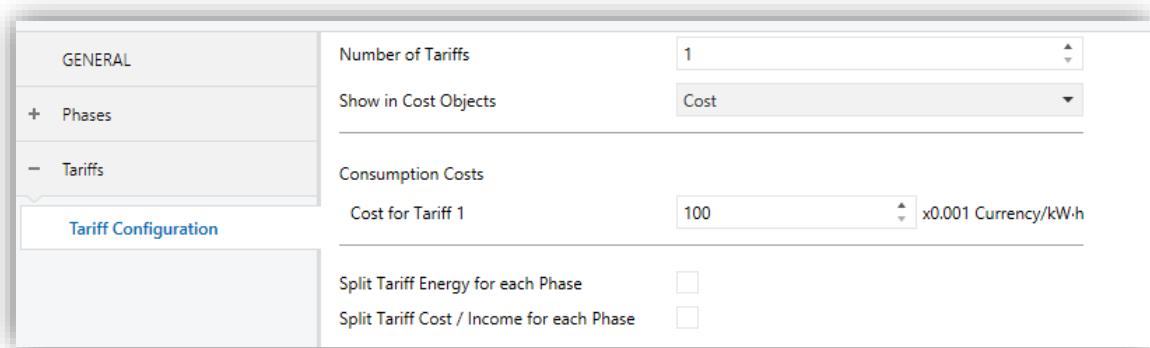
Figure 21 Tariffs

  · **Number of Tariffs** [*1…6*]: sets the number of available tariff slots.

For each tariff enabled consumption and cost (or income) communication objects are added for each tariff. For example, for tariff 1:

> "**[Trf1] [TR] Tariff Consumed Active Energy**"

> "**[Trf1] [TR] Tariff Generated Active Energy**"

> "**[Trf1] [TR] Tariff Inductive Reactive Energy**"

> "**[Trf1] [TR] Tariff Capacitive Reactive Energy**"

> "**[Trf1] [TR] Tariff Cost / Income**"

And the same objects for each partial register enabled.

- **Show in Cost Objects** [*Cost / Income / Net Balance = Cost - Income*]: sets which the cost object to show.

    > **Consumption Costs / Generation Bonus** [*0…65535*]: sets the fee (in hundredths of the currency unit per unit consumption/generation (kWh)) for tariff *y*.

    Depending on the selected option, the following objects will be available:

    > "**[Trfy] Set Tariff Consumption Cost**": allows overwriting the fee initially set consumption cost

    > "**[Trfy] Set Tariff Generation Bonus**": allows overwriting the fee initially set generation bonus.

Single-Phase systems also have the following options:

- **Split Tariff Energy for each Phase** [*enabled/disabled*]: additional objects are enabled to indicate the energy consumed for each phase in each tariff.

- **Split Tariff Cost / Income for each Phase** [*enabled/disabled*]: additional objects are enabled to indicate cost for each phase in each tariff.

2.4 NOTIFICATIONS

Notifications in KES Plus 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 **consumption**, **generation**, **cost** and **CO₂ emissions**, for global magnitudes and 3-phase systems.

In addition, for single phase systems, it is possible to configure **overvoltage** or **low voltage** notifications in one phase.

ETS PARAMETERISATION

The Notifications tab will become visible once the Notification function has been enabled in the General screen (see section 2.1).
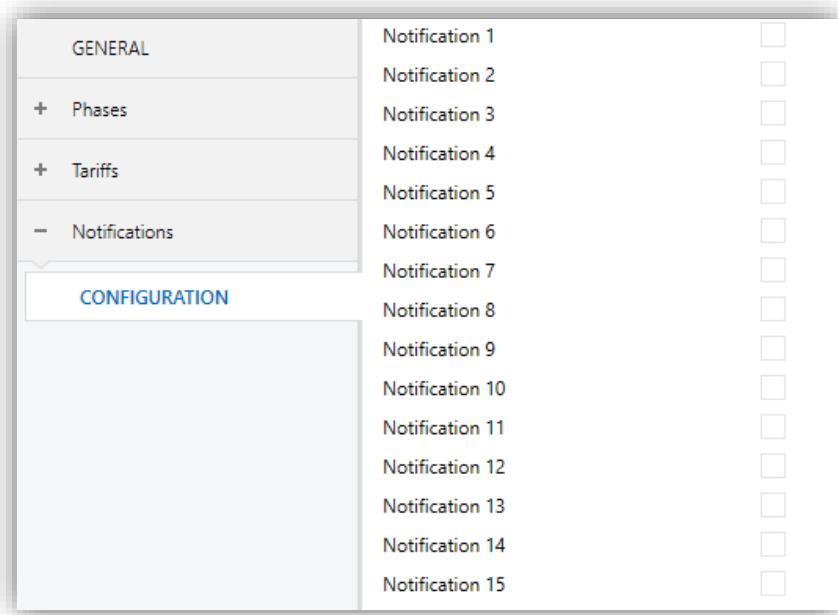
Figure 22 Notifications

Individual Notification tabs and the binary objects "**Notification y: _____**" will become visible once some of 15 notifications has been enabled.

2.4.1 NOTIFICATION n
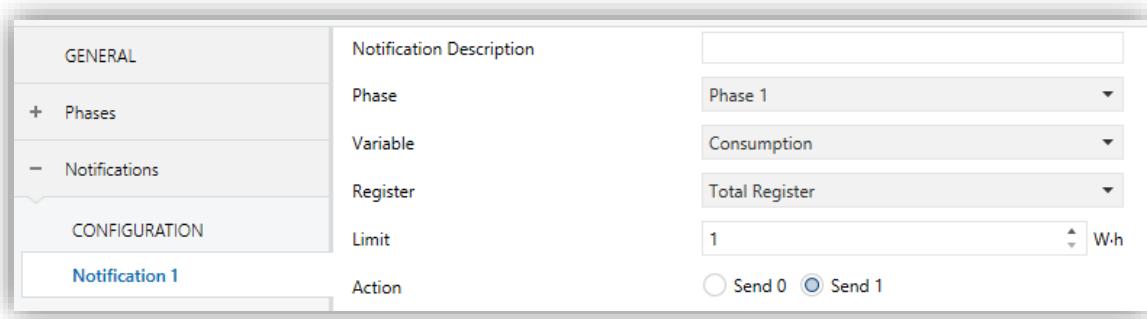
Figure 23 Notifications - Notification y

- **Notification Description**: text box without functionality, simply allows adding a description.

- **Phase** [*Phase 1 / Phase 2 / Phase 3 / Global*] [*3-Phase*]**:** sets the phase to monitor. The available options depend on the type of installation selected and the number of phases enabled in the General screen (see section 2.1).

- **Variable** [*Consumption / Generation / Economic Cost / CO2 Emission / Overvoltage / Low voltage*]**:** sets the variable to be monitored

  Nota:

  - ➢ The variables "*Overvoltage*" and "*Low voltage*" are only available for phases.

  - ➢ The variable "*Economic Cost*" is only available if Tariffs have been enabled.

- **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*.

- **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*]**:** sets the value to be sent when the notification is triggered.

2.5 ALARMS

In addition to notifications, KES Plus implements four alarms to monitor the power according to an upper limit (**excess power**) and a lower limit (**low power**), which can be enabled and parameterised independently.

In the event of being calculated power greater or lower than such limits, the device will send a binary value, respectively through who separated objects.

The excess power alarm will be deactivated when the power is less than the upper limit minus the hysteresis. In the same way, the lower power alarm will be deactivated when the power reaches a value greater than the lower limit plus the hysteresis.

ETS PARAMETERISATION

The Alarms tab will become visible once the Alarm function has been enabled in the General screen (see section 2.1).
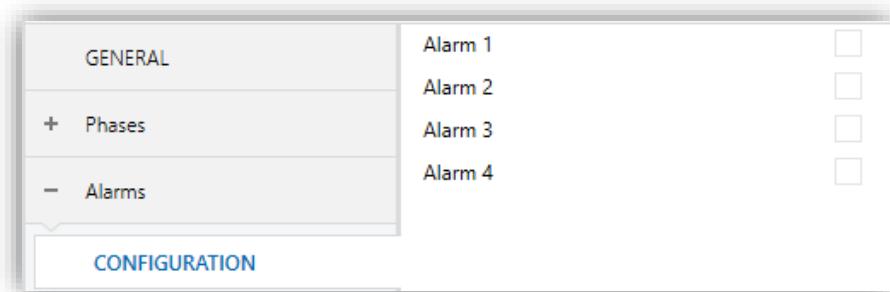
Figure 24 Alarms

Individual Alarm tabs will become visible once some of the alarms have been enabled.

2.5.1 ALARM n
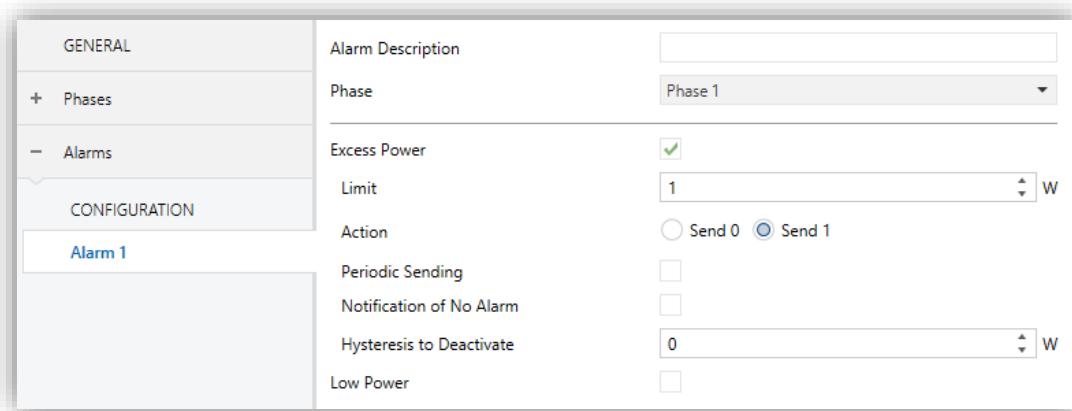
Figure 25 Alarms: Alarm n

- **Alarm Description**: text box without functionality, simply allows adding a description.

- **Phase** [*Phase 1 / Phase 2 / Phase 3 / Global*] [*3-Phase*]: sets the phase to monitor. The available variables depend on the type of installation selected and the number of phases enabled in the General screen (see section 2.1).

- **Excess Power** [*enabled/disabled*]: enables or disables the excess power alarm. When enabled, the following parameters appear:

  - **Limit** [*[-30000…1…30000][W] / [-30…30][kW]*]: alarm trigger value. A positive value sets the alarm for power consumption. A negative value, for generation.

  - **Action** [*Send 0 / Send 1*]: sets the value to be sent through the **"Alarm n: excess power"** objects on the activation of the alarm.

  - **Periodic Sending** [*enabled/disabled*]: activates or deactivates the periodic resending of the object while the alarm remains active.

    - **Period** [*10…255*][*s*] [*1…255*][*min/h*]: resending time.

  - **Notification of No Alarm** [*enabled/disabled*]: indicates if the alarm object should be sent (with inverse value of the configured action) once the power is under the upper limit.

  - **Hysteresis to Deactivate** [*[-30000…0…30000][W] / [-30…30][kW]*]**:** defines a deadband for power. The deactivation of the alarm will take

place when the power reaches a value outside the deadband. The sign must be consistent with the sign of the limit.

- **Low Power** [_enabled/disabled_]: enables or disables the low power alarm. Once enabled, the same parameters as in **excess power** alarm and the communication object **"Alarm _n_: low power"** appear.

2.6 LOGIC FUNCTIONS

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.

KES Plus 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, parameterizable 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 KES Plus product section at the Zennio homepage: www.zennio.com) for detailed information about the functionality and the configuration of the related parameters.

ANNEX I: COMUNICATION 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	3 Bytes	I	C T - W U	DPT_Date	01/01/1990 - 31/12/2089	Date	Set Date
2	3 Bytes	I	C T - W U	DPT_TimeOfDay	00:00:00 - 23:59:59	Time of Day	Set Time of Day
3	1 Bit	I	C - - W -	DPT_Reset	0/1	Reset Partial Register 1	0 = No Action; 1 = Reset
4	1 Bit	I	C - - W -	DPT_Reset	0/1	Reset Partial Register 2	0 = No Action; 1 = Reset
5	3 Bytes	O	C T R - -	DPT_Date	01/01/1990 - 31/12/2089	Starting Date of Partial Register 1	Date when the register was started
6	3 Bytes	O	C T R - -	DPT_Date	01/01/1990 - 31/12/2089	Starting Date of Partial Register 2	Date when the register was started
7, 32, 57	1 Bit	I	C - - W -	DPT_Ack	0/1	[Phx] Request metering	0 = No Action; 1 = Request metering values
8, 33, 58	2 Bytes	O	C T R - -	DPT_Value_Volt	0 - 670760.96	[Phx] Voltage	RMS Voltage (mV)
8, 33, 58	4 Bytes	O	C T R - -	DPT_Value_Electric_Potential		[Phx] Voltage	RMS Voltage (V)
9, 34, 59	4 Bytes	O	C T R - -	DPT_Value_Electric_Current		[Phx] Current	RMS Current (A)
9, 34, 59	2 Bytes	O	C T R - -	DPT_Value_Curr	0 - 670760.96	[Phx] Current	RMS Current (mA)
10, 35, 60	4 Bytes	O	C T R - -	DPT_Value_Power	-2147483648 - 2147483647	[Phx] Active Power	Consumption > 0; Generation < 0 (W)
10, 35, 60	2 Bytes	O	C T R - -	DPT_Power	-670760 - 670760	[Phx] Active Power	Consumption > 0; Generation < 0 (kW)
11, 36, 61	4 Bytes	O	C T R - -	DPT_Value_Power_Factor	-1000 - 1000	[Phx] Power Factor	[-1000, 1000]
12, 37, 62	4 Bytes	I/O	C T R W -	DPT_ActiveEnergy	0 - 2147483647	[Phx] [TR] Consumed Active Energy	W·h
12, 37, 62	4 Bytes	I/O	C T R W -	DPT_ActiveEnergy_kWh	0 - 2147483647	[Phx] [TR] Consumed Active Energy	kW·h
13, 38, 63	4 Bytes	I/O	C T R W -	DPT_ActiveEnergy	0 - 2147483647	[Phx] [TR] Generated Active Energy	W·h
13, 38, 63	4 Bytes	I/O	C T R W -	DPT_ActiveEnergy_kWh	0 - 2147483647	[Phx] [TR] Generated Active Energy	kW·h
14, 16, 39, 41, 64, 66	4 Bytes	O	C T R - -	DPT_ActiveEnergy	0 - 2147483647	[Phx] [PRx] Consumed Active Energy	W·h
14, 16, 39, 41, 64, 66	4 Bytes	O	C T R - -	DPT_ActiveEnergy_kWh	0 - 2147483647	[Phx] [PRx] Consumed Active Energy	kW·h
15, 17, 40, 42, 65, 67	4 Bytes	O	C T R - -	DPT_ActiveEnergy	0 - 2147483647	[Phx] [PRx] Generated Active Energy	W·h
15, 17, 40, 42, 65, 67	4 Bytes	O	C T R - -	DPT_ActiveEnergy_kWh	0 - 2147483647	[Phx] [PRx] Generated Active Energy	kW·h
18, 43, 68	2 Bytes	O	C T R - -	DPT_Value_Currency	0 - 670760.96	[Phx] [TR] Cost	Currency
18, 43, 68	2 Bytes	O	C T R - -	DPT_Value_Currency	-671088.64 - 0	[Phx] [TR] Income	Currency
18, 43, 68	2 Bytes	O	C T R - -	DPT_Value_Currency	-671088.64- 670760.96	[Phx] [TR] Cost / Income	Cost > 0; Income < 0 (Currency)
19, 20, 44, 45, 69, 70	2 Bytes	O	C T R - -	DPT_Value_Currency	0 - 670760.96	[Phx] [PRx] Cost	Currency

	2 Bytes	O	C T R - -	DPT_Value_Currency	-671088.64 - 0	[Phx] [PRx] Income	Currency
	2 Bytes	O	C T R - -	DPT_Value_Currency	-671088.64- 670760.96	[Phx] [PRx] Cost / Income	Cost > 0; Income < 0 (Currency)
21, 46, 71	2 Bytes	O	C T R - -	DPT_CO2_Emission	0 - 670760.96	[Phx] [TR] CO2 Emissions	kg CO2
22, 23, 47, 48, 72, 73	2 Bytes	O	C T R - -	DPT_CO2_Emission	0 - 670760.96	[Phx] [PRx] CO2 Emissions	kg CO2
24, 26, 49, 51, 74, 76	4 Bytes	O	C T R - -	DPT_ActiveEnergy	0 - 2147483647	[Phx] [PRx] Consumed Active Energy (Previous Period)	W·h
	4 Bytes	O	C T R - -	DPT_ActiveEnergy_kWh	0 - 2147483647	[Phx] [PRx] Consumed Active Energy (Previous Period)	kW·h
25, 27, 50, 52, 75, 77	4 Bytes	O	C T R - -	DPT_ActiveEnergy	0 - 2147483647	[Phx] [PRx] Generated Active Energy (Previous Period)	W·h
	4 Bytes	O	C T R - -	DPT_ActiveEnergy_kWh	0 - 2147483647	[Phx] [PRx] Generated Active Energy (Previous Period)	kW·h
28, 29, 53, 54, 78, 79	2 Bytes	O	C T R - -	DPT_Value_Currency	0 - 670760.96	[Phx] [PRx] Cost (Previous Period)	Currency
	2 Bytes	O	C T R - -	DPT_Value_Currency	-671088.64 - 0	[Phx] [PRx] Income (Previous Period)	Currency
	2 Bytes	O	C T R - -	DPT_Value_Currency	-671088.64 - 670760.96	[Phx] [PRx] Cost / Income (Previous Period)	Cost > 0; Income < 0 (Currency)
30, 31, 55, 56, 80, 81	2 Bytes	O	C T R - -	DPT_CO2_Emission	0 - 670760.96	[Phx] [PRx] CO2 Emissions (Previous Period)	kg CO2
82	1 Bit	I	C - - W -	DPT_Ack	0/1	[Global] Request metering	0 = No Action; 1 = Request metering values
	1 Bit	I	C - - W -	DPT_Ack	0/1	[x-Phase] Request metering	0 = No Action; 1 = Request metering values
83	4 Bytes	O	C T R - -	DPT_Value_Frequency		[Global] Frequency	Hz
	4 Bytes	O	C T R - -	DPT_Value_Frequency		[x-Phase] Frequency	Hz
84	2 Bytes	O	C T R - -	DPT_Power	0 - 670760	[Global] Consumed Active Power	kW
	4 Bytes	O	C T R - -	DPT_Value_Power	0 - 2147483647	[Global] Consumed Active Power	W
85	2 Bytes	O	C T R - -	DPT_Power	0 - 670760	[Global] Generated Active Power	kW
	4 Bytes	O	C T R - -	DPT_Value_Power	0 - 2147483647	[Global] Generated Active Power	W
86	4 Bytes	O	C T R - -	DPT_Value_Power	-2147483648 - 2147483647	[Global] Active Power	Consumption > 0; Generation < 0 (W)
	2 Bytes	O	C T R - -	DPT_Power	-670760 - 670760	[Global] Active Power	Consumption > 0; Generation < 0 (kW)
	4 Bytes	O	C T R - -	DPT_Value_Power	-2147483648 - 2147483647	[x-Phase] Active Power	Consumption > 0; Generation < 0 (W)
	2 Bytes	O	C T R - -	DPT_Power	-670760 - 670760	[x-Phase] Active Power	Consumption > 0; Generation < 0 (kW)
87	4 Bytes	O	C T R - -	DPT_Value_Power	-2147483648 - 2147483647	[Global] Reactive Power	VAr
	2 Bytes	O	C T R - -	DPT_Power	-670760 - 670760	[Global] Reactive Power	kVAr
	4 Bytes	O	C T R - -	DPT_Value_Power	-2147483648 - 2147483647	[x-Phase] Reactive Power	VAr
	2 Bytes	O	C T R - -	DPT_Power	-670760 - 670760	[x-Phase] Reactive Power	kVAr
88	4 Bytes	O	C T R - -	DPT_Value_Power_Factor	-1000 - 1000	[Global] Power Factor	[-1000, 1000]
	4 Bytes	O	C T R - -	DPT_Value_Power_Factor	-1000 - 1000	[x-Phase] Power Factor	[-1000, 1000]
89	4 Bytes	O	C T R - -	DPT_ActiveEnergy	0 - 2147483647	[Global] [TR] Consumed Active Energy	W·h

	4 Bytes	O	**C T R – –**	DPT_ActiveEnergy_kWh	0 - 2147483647	[Global] [TR] Consumed Active Energy	kW·h
	4 Bytes	I/O	**C T R W –**	DPT_ActiveEnergy	0 - 2147483647	[x-Phase] [TR] Consumed Active Energy	W·h
	4 Bytes	I/O	**C T R W –**	DPT_ActiveEnergy_kWh	0 - 2147483647	[x-Phase] [TR] Consumed Active Energy	kW·h
90	4 Bytes	O	**C T R – –**	DPT_ActiveEnergy	0 - 2147483647	[Global] [TR] Generated Active Energy	W·h
	4 Bytes	O	**C T R – –**	DPT_ActiveEnergy_kWh	0 - 2147483647	[Global] [TR] Generated Active Energy	kW·h
	4 Bytes	I/O	**C T R W –**	DPT_ActiveEnergy	0 - 2147483647	[x-Phase] [TR] Generated Active Energy	W·h
	4 Bytes	I/O	**C T R W –**	DPT_ActiveEnergy_kWh	0 - 2147483647	[x-Phase] [TR] Generated Active Energy	kW·h
91	4 Bytes	I/O	**C T R W –**	DPT_ReactiveEnergy	-2147483648 - 2147483647	[Global] [TR] Inductive Reactive Energy	VAr·h
	4 Bytes	I/O	**C T R W –**	DPT_ReactiveEnergy_kVARh	-2147483648 - 2147483647	[Global] [TR] Inductive Reactive Energy	kVAr·h
	4 Bytes	I/O	**C T R W –**	DPT_ReactiveEnergy	-2147483648 - 2147483647	[x-Phase] [TR] Inductive Reactive Energy	VAr·h
	4 Bytes	I/O	**C T R W –**	DPT_ReactiveEnergy_kVARh	-2147483648 - 2147483647	[x-Phase] [TR] Inductive Reactive Energy	kVAr·h
92	4 Bytes	I/O	**C T R W –**	DPT_ReactiveEnergy	-2147483648 - 2147483647	[Global] [TR] Capacitive Reactive Energy	VAr·h
	4 Bytes	I/O	**C T R W –**	DPT_ReactiveEnergy_kVARh	-2147483648 - 2147483647	[Global] [TR] Capacitive Reactive Energy	kVAr·h
	4 Bytes	I/O	**C T R W –**	DPT_ReactiveEnergy	-2147483648 - 2147483647	[x-Phase] [TR] Capacitive Reactive Energy	VAr·h
	4 Bytes	I/O	**C T R W –**	DPT_ReactiveEnergy_kVARh	-2147483648 - 2147483647	[x-Phase] [TR] Capacitive Reactive Energy	kVAr·h
93, 97	4 Bytes	O	**C T R – –**	DPT_ActiveEnergy	0 - 2147483647	[Global] [PRx] Consumed Active Energy	W·h
	4 Bytes	O	**C T R – –**	DPT_ActiveEnergy_kWh	0 - 2147483647	[Global] [PRx] Consumed Active Energy	kW·h
	4 Bytes	O	**C T R – –**	DPT_ActiveEnergy	0 - 2147483647	[x-Phase] [PRx] Consumed Active Energy	W·h
	4 Bytes	O	**C T R – –**	DPT_ActiveEnergy_kWh	0 - 2147483647	[x-Phase] [PRx] Consumed Active Energy	kW·h
94, 98	4 Bytes	O	**C T R – –**	DPT_ActiveEnergy	0 - 2147483647	[Global] [PRx] Generated Active Energy	W·h
	4 Bytes	O	**C T R – –**	DPT_ActiveEnergy_kWh	0 - 2147483647	[Global] [PRx] Generated Active Energy	kW·h
	4 Bytes	O	**C T R – –**	DPT_ActiveEnergy	0 - 2147483647	[x-Phase] [PRx] Generated Active Energy	W·h
	4 Bytes	O	**C T R – –**	DPT_ActiveEnergy_kWh	0 - 2147483647	[x-Phase] [PRx] Generated Active Energy	kW·h
95, 99	4 Bytes	O	**C T R – –**	DPT_ReactiveEnergy	-2147483648 - 2147483647	[Global] [PRx] Inductive Reactive Energy	VAr·h

	4 Bytes	O	**C T R - -**	DPT_ReactiveEnergy_kVARh	-2147483648 - 2147483647	[Global] [PRx] Inductive Reactive Energy	kVAr·h
	4 Bytes	O	**C T R - -**	DPT_ReactiveEnergy	-2147483648 - 2147483647	[x-Phase] [PRx] Inductive Reactive Energy	VAr·h
	4 Bytes	O	**C T R - -**	DPT_ReactiveEnergy_kVARh	-2147483648 - 2147483647	[x-Phase] [PRx] Inductive Reactive Energy	kVAr·h
96, 100	4 Bytes	O	**C T R - -**	DPT_ReactiveEnergy	-2147483648 - 2147483647	[Global] [PRx] Capacitive Reactive Energy	VAr·h
	4 Bytes	O	**C T R - -**	DPT_ReactiveEnergy_kVARh	-2147483648 - 2147483647	[Global] [PRx] Capacitive Reactive Energy	kVAr·h
	4 Bytes	O	**C T R - -**	DPT_ReactiveEnergy	-2147483648 - 2147483647	[x-Phase] [PRx] Capacitive Reactive Energy	VAr·h
	4 Bytes	O	**C T R - -**	DPT_ReactiveEnergy_kVARh	-2147483648 - 2147483647	[x-Phase] [PRx] Capacitive Reactive Energy	kVAr·h
101	2 Bytes	O	**C T R - -**	DPT_Value_Currency	0 - 670760.96	[Global] [TR] Cost	Currency
	2 Bytes	O	**C T R - -**	DPT_Value_Currency	0 - 670760.96	[x-Phase] [TR] Cost	Currency
	2 Bytes	O	**C T R - -**	DPT_Value_Currency	-671088.64 - 0	[Global] [TR] Income	Currency
	2 Bytes	O	**C T R - -**	DPT_Value_Currency	-671088.64 - 0	[x-Phase] [TR] Income	Currency
	2 Bytes	O	**C T R - -**	DPT_Value_Currency	-671088.64 - 670760.96	[Global] [TR] Cost / Income	Cost > 0; Income < 0 (Currency)
	2 Bytes	O	**C T R - -**	DPT_Value_Currency	-671088.64 - 670760.96	[x-Phase] [TR] Cost / Income	Cost > 0; Income < 0 (Currency)
102, 103	2 Bytes	O	**C T R - -**	DPT_Value_Currency	0 - 670760.96	[Global] [PRx] Cost	Currency
	2 Bytes	O	**C T R - -**	DPT_Value_Currency	0 - 670760.96	[x-Phase] [PRx] Cost	Currency
	2 Bytes	O	**C T R - -**	DPT_Value_Currency	-671088.64 - 0	[Global] [PRx] Income	Currency
	2 Bytes	O	**C T R - -**	DPT_Value_Currency	-671088.64 - 0	[x-Phase] [PRx] Income	Currency
	2 Bytes	O	**C T R - -**	DPT_Value_Currency	-671088.64 - 670760.96	[Global] [PRx] Cost / Income	Cost > 0; Income < 0 (Currency)
	2 Bytes	O	**C T R - -**	DPT_Value_Currency	-671088.64 - 670760.96	[x-Phase] [PRx] Cost / Income	Cost > 0; Income < 0 (Currency)
104	2 Bytes	O	**C T R - -**	DPT_CO2_Emission	0 - 670760.96	[Global] [TR] CO2 Emissions	kg CO2
	2 Bytes	O	**C T R - -**	DPT_CO2_Emission	0 - 670760.96	[x-Phase] [TR] CO2 Emissions	kg CO2
105, 106	2 Bytes	O	**C T R - -**	DPT_CO2_Emission	0 - 670760.96	[Global] [PRx] CO2 Emissions	kg CO2
	2 Bytes	O	**C T R - -**	DPT_CO2_Emission	0 - 670760.96	[x-Phase] [PRx] CO2 Emissions	kg CO2
107	2 Bytes	O	**C T R - -**	DPT_Coefficient	0 - 100	[x-Phase] Voltage Unbalance	%
108	2 Bytes	O	**C T R - -**	DPT_Coefficient	0 - 100	[x-Phase] Current Unbalance	%
109, 113	4 Bytes	O	**C T R - -**	DPT_ActiveEnergy	0 - 2147483647	[Global] [PRx] Consumed Active Energy (Previous Period)	W·h
	4 Bytes	O	**C T R - -**	DPT_ActiveEnergy_kWh	0 - 2147483647	[Global] [PRx] Consumed Active Energy (Previous Period)	kW·h
	4 Bytes	O	**C T R - -**	DPT_ActiveEnergy	0 - 2147483647	[x-Phase] [PRx] Consumed Active Energy (Previous Period)	W·h
	4 Bytes	O	**C T R - -**	DPT_ActiveEnergy_kWh	0 - 2147483647	[x-Phase] [PRx] Consumed Active Energy (Previous Period)	kW·h
110, 114	4 Bytes	O	**C T R - -**	DPT_ActiveEnergy	0 - 2147483647	[Global] [PRx] Generated Active Energy (Previous Period)	W·h
	4 Bytes	O	**C T R - -**	DPT_ActiveEnergy_kWh	0 - 2147483647	[Global] [PRx] Generated Active	kW·h

	4 Bytes	O	C T R - -	DPT_ActiveEnergy	0 - 2147483647	Energy (Previous Period)	
	4 Bytes	O	C T R - -	DPT_ActiveEnergy	0 - 2147483647	[x-Phase] [PRx] Generated Active Energy (Previous Period)	W·h
	4 Bytes	O	C T R - -	DPT_ActiveEnergy_kWh	0 - 2147483647	[x-Phase] [PRx] Generated Active Energy (Previous Period)	kW·h
111, 115	4 Bytes	O	C T R - -	DPT_ReactiveEnergy	-2147483648 - 2147483647	[Global] [PRx] Inductive Reactive Energy (Previous Period)	VAr·h
	4 Bytes	O	C T R - -	DPT_ReactiveEnergy_kVARh	-2147483648 - 2147483647	[Global] [PRx] Inductive Reactive Energy (Previous Period)	kVAr·h
	4 Bytes	O	C T R - -	DPT_ReactiveEnergy	-2147483648 - 2147483647	[x-Phase] [PRx] Inductive Reactive Energy (Previous Period)	VAr·h
	4 Bytes	O	C T R - -	DPT_ReactiveEnergy_kVARh	-2147483648 - 2147483647	[x-Phase] [PRx] Inductive Reactive Energy (Previous Period)	kVAr·h
112, 116	4 Bytes	O	C T R - -	DPT_ReactiveEnergy	-2147483648 - 2147483647	[Global] [PRx] Capacitive Reactive Energy (Previous Period)	VAr·h
	4 Bytes	O	C T R - -	DPT_ReactiveEnergy_kVARh	-2147483648 - 2147483647	[Global] [PRx] Capacitive Reactive Energy (Previous Period)	kVAr·h
	4 Bytes	O	C T R - -	DPT_ReactiveEnergy	-2147483648 - 2147483647	[x-Phase] [PRx] Capacitive Reactive Energy (Previous Period)	VAr·h
	4 Bytes	O	C T R - -	DPT_ReactiveEnergy_kVARh	-2147483648 - 2147483647	[x-Phase] [PRx] Capacitive Reactive Energy (Previous Period)	kVAr·h
117, 118	2 Bytes	O	C T R - -	DPT_Value_Currency	0 - 670760.96	[Global] [PRx] Cost (Previous Period)	Currency
	2 Bytes	O	C T R - -	DPT_Value_Currency	0 - 670760.96	[x-Phase] [PRx] Cost (Previous Period)	Currency
	2 Bytes	O	C T R - -	DPT_Value_Currency	671088.64 - 0	[Global] [PRx] Income (Previous Period)	Currency
	2 Bytes	O	C T R - -	DPT_Value_Currency	671088.64 - 0	[x-Phase] [PRx] Income (Previous Period)	Currency
	2 Bytes	O	C T R - -	DPT_Value_Currency	-671088.64 - 670760.96	[Global] [PRx] Cost / Income (Previous Period)	Cost > 0; Income < 0 (Currency)
	2 Bytes	O	C T R - -	DPT_Value_Currency	-671088.64 - 670760.96	[x-Phase] [PRx] Cost / Income (Previous Period)	Cost > 0; Income < 0 (Currency)
119, 120	2 Bytes	O	C T R - -	DPT_CO2_Emission	0 - 670760.96	[Global] [PRx] CO2 Emissions (Previous Period)	kg CO2
	2 Bytes	O	C T R - -	DPT_CO2_Emission	0 - 670760.96	[x-Phase] [PRx] CO2 Emissions (Previous Period)	kg CO2
121	1 Byte	I	C - - W -	DPT_Tariff	0 - 255	[Trf] Set Tariff	Change to Tariff N
122	1 Byte	O	C T R - -	DPT_Tariff	0 - 255	[Trf] Tariff (Status)	Enumerated Value
123, 167, 211, 255, 299, 343	2 Bytes	I/O	C - R W -	DPT_Value_Currency	0 - 65535	[Trfx] Set Tariff Consumption Cost	[0, 65535] x0.001 Currency/kW·h
124, 168, 212, 256, 300, 344	2 Bytes	I/O	C - R W -	DPT_Value_Currency	0 - 65535	[Trfx] Set Tariff Generation Bonus	[0, 65535] x0.001 Currency/kW·h
125, 169, 213, 257, 301, 345	4 Bytes	O	C T R - -	DPT_ActiveEnergy	0 - 2147483647	[Trfx] [TR] Tariff Consumed Active Energy	W·h
	4 Bytes	O	C T R - -	DPT_ActiveEnergy_kWh	0 - 2147483647	[Trfx] [TR] Tariff Consumed Active Energy	kW·h

126, 170, 214, 258, 302, 346	4 Bytes	O	**C T R - -**	DPT_ActiveEnergy	0 - 2147483647	[Trfx] [TR] Tariff Generated Active Energy	W·h
	4 Bytes	O	**C T R - -**	DPT_ActiveEnergy_kWh	0 - 2147483647	[Trfx] [TR] Tariff Generated Active Energy	kW·h
127, 171, 215, 259, 303, 347	4 Bytes	O	**C T R - -**	DPT_ReactiveEnergy	-2147483648 - 2147483647	[Trfx] [TR] Tariff Inductive Reactive Energy	VAr·h
	4 Bytes	O	**C T R - -**	DPT_ReactiveEnergy_kVARh	-2147483648 - 2147483647	[Trfx] [TR] Tariff Inductive Reactive Energy	kVAr·h
128, 172, 216, 260, 304, 348	4 Bytes	O	**C T R - -**	DPT_ReactiveEnergy	-2147483648 - 2147483647	[Trfx] [TR] Tariff Capacitive Reactive Energy	VAr·h
	4 Bytes	O	**C T R - -**	DPT_ReactiveEnergy_kVARh	-2147483648 - 2147483647	[Trfx] [TR] Tariff Capacitive Reactive Energy	kVAr·h
129, 133, 173, 177, 217, 221, 261, 265, 305, 309, 349, 353	4 Bytes	O	**C T R - -**	DPT_ActiveEnergy	0 - 2147483647	[Trfx] [PRx] Tariff Consumed Active Energy	W·h
	4 Bytes	O	**C T R - -**	DPT_ActiveEnergy_kWh	0 - 2147483647	[Trfx] [PRx] Tariff Consumed Active Energy	kW·h
130, 134, 174, 178, 218, 222, 262, 266, 306, 310, 350, 354	4 Bytes	O	**C T R - -**	DPT_ActiveEnergy	0 - 2147483647	[Trfx] [PRx] Tariff Generated Active Energy	W·h
	4 Bytes	O	**C T R - -**	DPT_ActiveEnergy_kWh	0 - 2147483647	[Trfx] [PRx] Tariff Generated Active Energy	kW·h
131, 135, 175, 179, 219, 223, 263, 267, 307, 311, 351, 355	4 Bytes	O	**C T R - -**	DPT_ReactiveEnergy	-2147483648 - 2147483647	[Trfx] [PRx] Tariff Inductive Reactive Energy	VAr·h
	4 Bytes	O	**C T R - -**	DPT_ReactiveEnergy_kVARh	-2147483648 - 2147483647	[Trfx] [PRx] Tariff Inductive Reactive Energy	kVAr·h
132, 136, 176, 180, 220, 224, 264, 268, 308, 312, 352, 356	4 Bytes	O	**C T R - -**	DPT_ReactiveEnergy	-2147483648 - 2147483647	[Trfx] [PRx] Tariff Capacitive Reactive Energy	VAr·h
	4 Bytes	O	**C T R - -**	DPT_ReactiveEnergy_kVARh	-2147483648 - 2147483647	[Trfx] [PRx] Tariff Capacitive Reactive Energy	kVAr·h
137, 143, 149, 181, 187, 193, 225, 231, 237, 269, 275, 281, 313, 319, 325, 357, 363, 369	4 Bytes	O	**C T R - -**	DPT_ActiveEnergy	0 - 2147483647	[Trfx] [Phx] [TR] Tariff Consumed Active Energy per Phase	W·h
	4 Bytes	O	**C T R - -**	DPT_ActiveEnergy_kWh	0 - 2147483647	[Trfx] [Phx] [TR] Tariff Consumed Active Energy per Phase	kW·h
138, 144, 150, 182, 188, 194, 226, 232, 238, 270, 276, 282, 314, 320, 326, 358, 364, 370	4 Bytes	O	**C T R - -**	DPT_ActiveEnergy	0 - 2147483647	[Trfx] [Phx] [TR] Tariff Generated Active Energy per Phase	W·h
	4 Bytes	O	**C T R - -**	DPT_ActiveEnergy_kWh	0 - 2147483647	[Trfx] [Phx] [TR] Tariff Generated Active Energy per Phase	kW·h
139, 141, 145, 147, 151, 153, 183, 185, 189, 191, 195, 197, 227, 229, 233, 235, 239, 241, 271, 273, 277, 279, 283, 285, 315, 317, 321, 323, 327, 329, 359, 361, 365, 367, 371, 373	4 Bytes	O	**C T R - -**	DPT_ActiveEnergy	0 - 2147483647	[Trfx] [Phx] [PRx] Tariff Consumed Active Energy per Phase	W·h
	4 Bytes	O	**C T R - -**	DPT_ActiveEnergy_kWh	0 - 2147483647	[Trfx] [Phx] [PRx] Tariff Consumed Active Energy per Phase	kW·h

140, 142, 146, 148, 152, 154, 184, 186, 190, 192, 196, 198, 228, 230, 234, 236, 240, 242, 272, 274, 278, 280, 284, 286, 316, 318, 322, 324, 328, 330, 360, 362, 366, 368, 372, 374	4 Bytes	O	C T R - -	DPT_ActiveEnergy	0 - 2147483647	[Trfx] [Phx] [PRx] Tariff Generated Active Energy per Phase	W·h
	4 Bytes	O	C T R - -	DPT_ActiveEnergy_kWh	0 - 2147483647	[Trfx] [Phx] [PRx] Tariff Generated Active Energy per Phase	kW·h
155, 199, 243, 287, 331, 375	2 Bytes	O	C T R - -	DPT_Value_Currency	0 - 670760.96	[Trfx] [TR] Tariff Cost	Currency
	2 Bytes	O	C T R - -	DPT_Value_Currency	-671088.64 - 0	[Trfx] [TR] Tariff Income	Currency
	2 Bytes	O	C T R - -	DPT_Value_Currency	-671088.64 - 670760.96	[Trfx] [TR] Tariff Cost / Income	Cost > 0; Income < 0 (Currency)
156, 157, 200, 201, 244, 245, 288, 289, 332, 333, 376, 377	2 Bytes	O	C T R - -	DPT_Value_Currency	0 - 670760.96	[Trfx] [PRx] Tariff Cost	Currency
	2 Bytes	O	C T R - -	DPT_Value_Currency	-671088.64 - 0	[Trfx] [PRx] Tariff Income	Currency
	2 Bytes	O	C T R - -	DPT_Value_Currency	-671088.64 - 670760.96	[Trfx] [PRx] Tariff Cost / Income	Cost > 0; Income < 0 (Currency)
158, 161, 164, 202, 205, 208, 246, 249, 252, 290, 293, 296, 334, 337, 340, 378, 381, 384	2 Bytes	O	C T R - -	DPT_Value_Currency	0 - 670760.96	[Trfx] [Phx] [TR] Tariff Cost per Phase	Currency
	2 Bytes	O	C T R - -	DPT_Value_Currency	-671088.64 - 0	[Trfx] [Phx] [TR] Tariff Income per Phase	Currency
	2 Bytes	O	C T R - -	DPT_Value_Currency	-671088.64 - 670760.96	[Trfx] [Phx] [TR] Tariff Cost / Income per Phase	Cost > 0; Income < 0 (Currency)
159, 160, 162, 163, 165, 166, 203, 204, 206, 207, 209, 210, 247, 248, 250, 251, 253, 254, 291, 292, 294, 295, 297, 298, 335, 336, 338, 339, 341, 342, 379, 380, 382, 383, 385, 386	2 Bytes	O	C T R - -	DPT_Value_Currency	0 - 670760.96	[Trfx] [Phx] [PRx] Tariff Cost per Phase	Currency
	2 Bytes	O	C T R - -	DPT_Value_Currency	-671088.64 - 0	[Trfx] [Phx] [PRx] Tariff Income per Phase	Currency
	2 Bytes	O	C T R - -	DPT_Value_Currency	-671088.64 - 670760.96	[Trfx] [Phx] [PRx] Tariff Cost / Income per Phase	Cost > 0; Income < 0 (Currency)
387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401	1 Bit	O	C T R - -	DPT_Switch	0/1	Notification x: Consumption	Sending of 0
	1 Bit	O	C T R - -	DPT_Switch	0/1	Notification x: Consumption	Sending of 1
	1 Bit	O	C T R - -	DPT_Switch	0/1	Notification x: Generation	Sending of 0
	1 Bit	O	C T R - -	DPT_Switch	0/1	Notification x: Generation	Sending of 1
	1 Bit	O	C T R - -	DPT_Switch	0/1	Notification x: Economic Cost	Sending of 0
	1 Bit	O	C T R - -	DPT_Switch	0/1	Notification x: Economic Cost	Sending of 1
	1 Bit	O	C T R - -	DPT_Switch	0/1	Notification x: CO_2 Emission	Sending of 0
	1 Bit	O	C T R - -	DPT_Switch	0/1	Notification x: CO_2 Emission	Sending of 1
	1 Bit	O	C T R - -	DPT_Switch	0/1	Notification x: Overvoltage	Sending of 0
	1 Bit	O	C T R - -	DPT_Switch	0/1	Notification x: Overvoltage	Sending of 1
	1 Bit	O	C T R - -	DPT_Switch	0/1	Notification x: Low Voltage	Sending of 0
	1 Bit	O	C T R - -	DPT_Switch	0/1	Notification x: Low Voltage	Sending of 1
402, 403, 404, 405, 406, 407, 408, 409	1 Bit	O	C T R - -	DPT_Alarm	0/1	Alarm x: Excess Power	0 = No Alarm; 1 = Alarm
	1 Bit	O	C T R - -	DPT_Alarm	0/1	Alarm x: Excess Power	0 = Alarm; 1 = No Alarm
410, 411, 412, 413,	1 Bit	I	C - - W -	DPT_Bool	0/1	[LF] (1-Bit) Data Entry x	Binary Data Entry (0/1)

414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441							
442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457	1 Byte	I	**C - - W -**	DPT_Value_1_Ucount	0 - 255	[LF] (1-Byte) Data Entry x	1-Byte Data Entry (0-255)
458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473	2 Bytes	I	**C - - W -**	DPT_Value_2_Ucount	0 - 65535	[LF] (2-Byte) Data Entry x	2-Byte Data Entry
				DPT_Value_2_Count	-32768 - 32767		
				DPT_Value_Temp	-273,00 - 670760,00		
474, 475, 476, 477, 478, 479, 480, 481	4 Bytes	I	**C - - W -**	DPT_Value_4_Count	-2147483648 - 2147483647	[LF] (4-Byte) Data Entry x	4-Byte Data Entry
482, 483, 484, 485, 486, 487, 488, 489, 490, 491	1 Bit	O	**C T R - -**	DPT_Bool	0/1	[LF] Function x - Result	(1-Bit) Boolean
	1 Byte	O	**C T R - -**	DPT_Value_1_Ucount	0 - 255	[LF] Function x - Result	(1-Byte) Unsigned
	2 Bytes	O	**C T R - -**	DPT_Value_2_Ucount	0 - 65535	[LF] Function x - Result	(2-Byte) Unsigned
	4 Bytes	O	**C T R - -**	DPT_Value_4_Count	-2147483648 - 2147483647	[LF] Function x - Result	(4-Byte) Signed
	1 Byte	O	**C T R - -**	DPT_Scaling	0% - 100%	[LF] Function x - Result	(1-Byte) Percentage
	2 Bytes	O	**C T R - -**	DPT_Value_2_Count	-32768 - 32767	[LF] Function x - Result	(2-Byte) Signed
	2 Bytes	O	**C T R - -**	DPT_Value_Temp	-273.00 - 670760.00	[LF] Function x - Result	(2-Byte) Float
492	1 Bit		**C T - - -**	DPT_Trigger	0/1	[Heartbeat] Object to Send '1'	Sending of '1' Periodically

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