User Manual

Energy Management System

ECO-8 III

Version: 1.1

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Automation Components

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1 Introduction

This user manual describes the devices of the *ECO8 III* product family which is part of the energy management system. It includes the devices named *ECO_SYS* and the system expansion module *ECO_GATE*. The important information to install and operate these devices can be found within this document. It contains the connecting diagrams and some operational details also.

This section describes the common aspects of the document and explains the basics of how to operate the devices.

1.1 Target Group

This user manual is intended to be used by the following groups of persons:

- Service technicians — Responsible for installation and maintenance
- Engineers — Responsible for optimizing the operational power consumption
- Prospective customer — Responsible for application planning of the *ECO8 III* products

1.2 Preconditions

A basic understanding of menu oriented user interfaces supports the operation of the *ECO8 III* devices. The local regulations for installation and cabling have to be considered. These regulations are not part of this user manual. Also the related standards and work instructions for electricians are not part of this user manual. A reference is explicitly given, if a special requirement has to be considered.

The local regulations, related standards and work instructions are not part of this user manual.	

1.3 The User Manual

The document has the following structure:

- *Introduction* — Describes the basics regarding the user manual and the common operation of the *ECO8 III* devices.
- *Installation and Operation* — Explains the required steps to implement and start-up operation of the *ECO8 III* devices.
- *Configuration / Parameter* — Describes the parameters of the *ECO8 III* devices.
- *FAQ / How to...* — Gives hints for optimizing the operation of the *ECO8 III* devices. Additional frequently asked questions (FAQ) are listed.
- *Technical Data* — The technical data of the *ECO_SYS* and the *ECO_GATE* are described.
- *Tables* — Contains all used tables. Starting with the abbreviations up to the table of tables.

1.3.1 Typographical Conventions

The used presentations of this user manual are described within this chapter.

An *italic* font is used for labels. For example labels of keys, proper names, and labels of connectors.

Examples:

- *ESC* Label of a key
- *24V* Label of a connector
- *Power* Label of a LED

This user manual uses [frames] to indicate the keys of the devices.

Example:

To cancel press [ESC] . Press the *ESC* key of the device.

If two or more keys have to be pressed simultaneously a plus sign (+) is used to combine the single keys.

Example:

[-] + [+] Press simultaneously the + and – key of the device.

A special font is used to show the content of the display (LCD). Also parameters and menus shown on the display are presented by the same font.

Example:

`period time`

Illustration of a display:

Figure 1: Example of a Display

To indicate a range of values or expressions three dots are used.

Example:

110 ... 240 V, AC 110 Volt up to 240 Volt, alternating current

1.3.2 Used Symbols

This chapter describes the used symbols of the user manual. Symbols are used to highlight some explanations. These symbols are designed according to the ISO 3864-1984 (E) and must to be strictly adhered to.

Prohibition	
Danger	
Instruction	
Additional information	

1.4 Control Elements

1.4.1 ECO_SYS

This chapter gives an overview of the essential control elements of the *ECO_SYS*. Figure 2 shows the front view of the *ECO_SYS* and is used to describe the connectors.

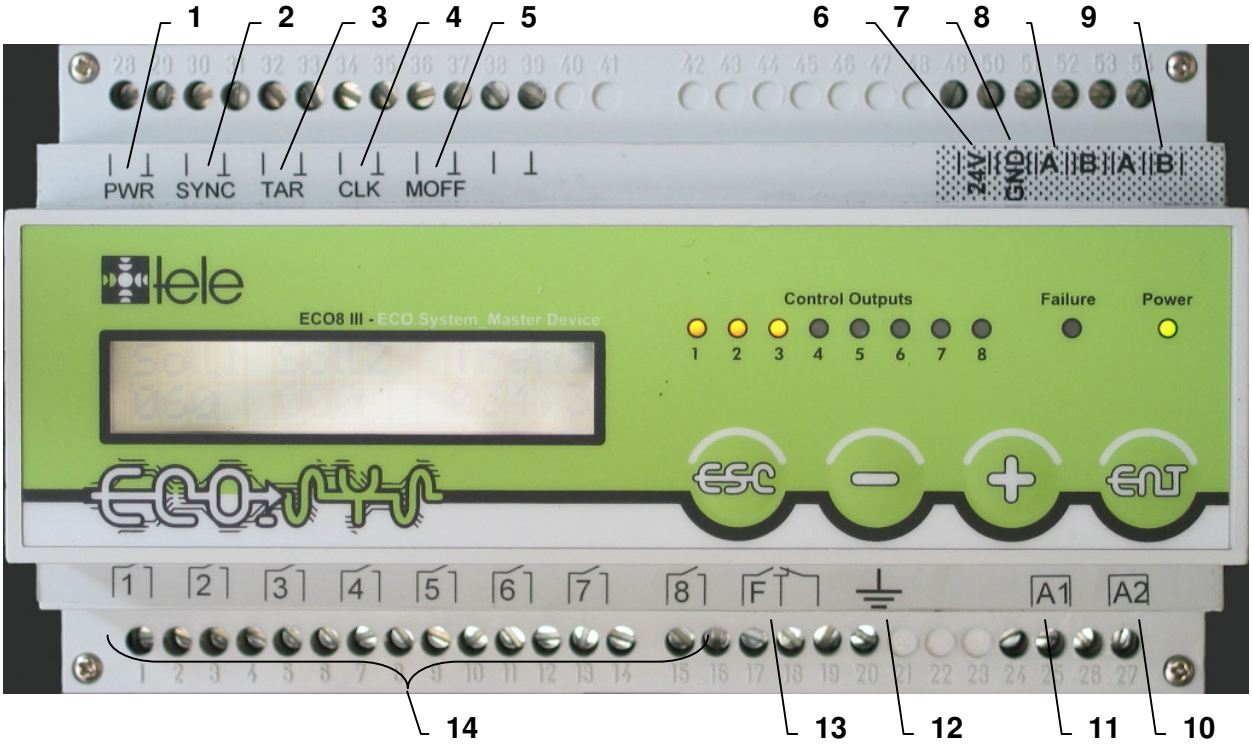


Figure 2: ECO_SYS Front View

No.	*Label*	Connector No.	Description
1	*PWR*	*28, 29*	Input: power pulse of an energy meter
2	*SYNC*	*30, 31*	Input: synchronisation pulse of the grid operator
3	*TAR*	*32, 33*	Input: changing tariff from the grid operator
4	*CLK*	*34, 35*	Input (optional): synchronisation of the real time clock
5	*MOFF*	36, 37	Input (optional): disconnects all load
6	*24V*	*49*	24 V direct current supply for external components (for example an additional display)
7	*GND*	*50*	Ground (direct current supply and the *RS485* interface)
8	*A*	*51, 53*	Connectors of the *RS485* interface (*A* = *RS485+*)
9	*B*	*52, 54*	Connectors of the *RS485* interface (*B* = *RS485-*)
10	*A2*	*26, 27*	Power supply
11	*A1*	*24, 25*	Power supply
12	⏚	*20*	Earthing
13	*F*	*17, 18, 19*	Connectors of the zero potential change-over contact (root = *18*)
14	*1 ... 8*	*1 ... 16*	Connectors of the 8 circuits of the *ECO_SYS*

Closing the *MOFF* input turns off all connected devices immediately. This input has priority compared to all other control parameters.	

Figure 3 shows the control elements of the *ECO_SYS*.

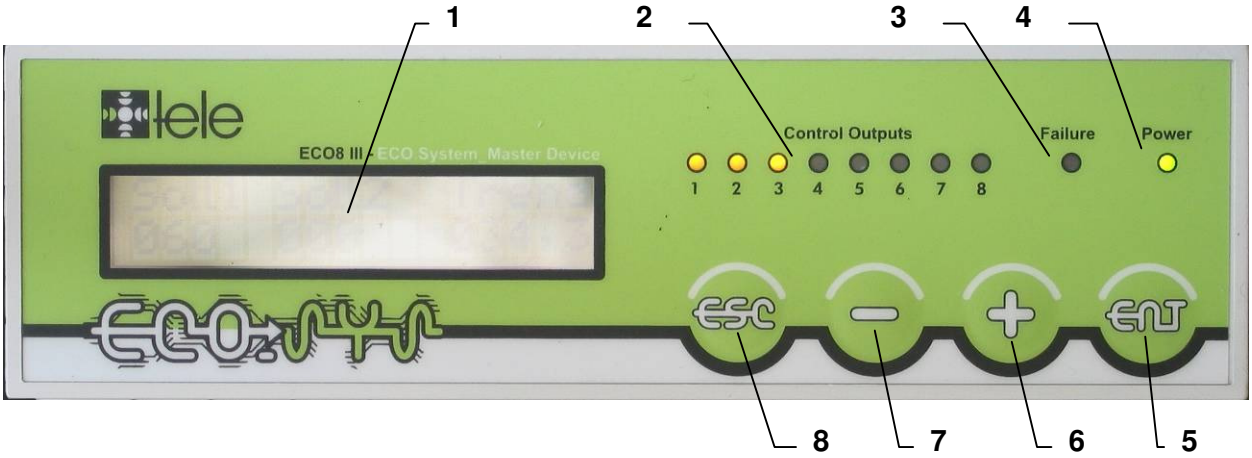


Figure 3: ECO_SYS Control Elements

No.	Label	Description
1		Display (LCD) of the *ECO_SYS*, two lines, 16 characters each
2	*Control Outputs*	Yellow LEDs to indicate the status of the 8 circuits (*1* ... *8*)
3	*Failure*	Red LED to indicate any failure status
4	*Power*	Green LED to indicate the operational status (On / Off)
5	*ENT*	ENT , Enter key of the *ECO_SYS*
6	*+*	+ , + key of the *ECO_SYS*
7	*-*	- , - key of the *ECO_SYS*
8	*ESC*	ESC , Escape key of the *ECO_SYS*

1.4.2 ECO_GATE

This chapter gives an overview of the essential control elements of the *ECO_GATE*. Figure 4 shows the front view of the *ECO_GATE* and is used to describe the connectors.

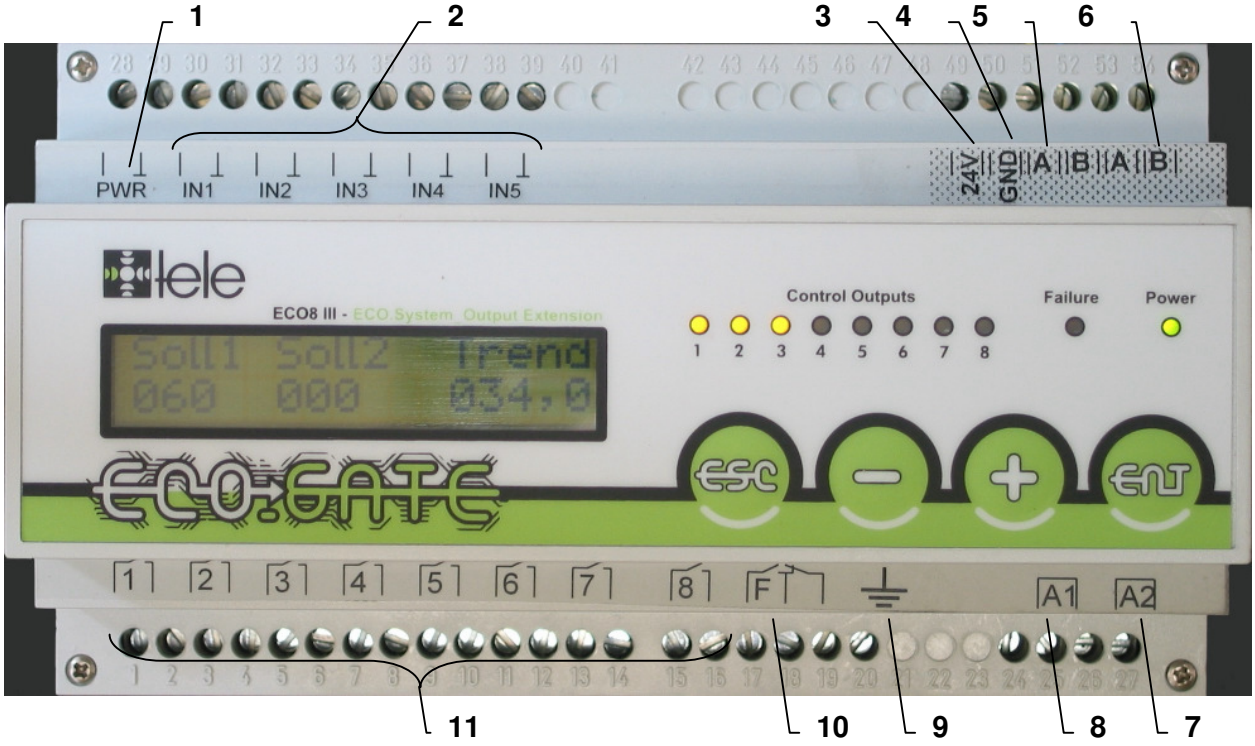


Figure 4: ECO_GATE Front View

No.	*Label*	Connector No.	Description
1	*PWR*	*28, 29*	Input: power pulse of an energy meter
2	*IN1 ... IN5*	*30 ... 39*	5 inputs: affect according to the settings of the related circuits (output *1 ... 5*)
3	*24V*	*49*	24 V direct current supply for external components (for example an additional display)
4	*GND*	*50*	Ground (direct current supply and the *RS485* interface)
5	*A*	*51, 53*	Connectors of the *RS485* interface (*A* = *RS485+*)
6	*B*	*52, 54*	Connectors of the *RS485* interface (*B* = *RS485-*)
7	*A2*	*26, 27*	Power supply
8	*A1*	*24, 25*	Power supply
9	⏚	*20*	Earthing
10	*F*	*17, 18, 19*	Connectors of the zero potential change-over contact (root = *18*)
11	*1 ... 8*	*1 ... 16*	Connectors of the 8 circuits of the *ECO_GATE*

Use the pulse input for a sub energy meter only.
The main energy meter has to be connected to the *ECO_SYS*.

Figure 5 shows the control elements of the *ECO_GATE*.

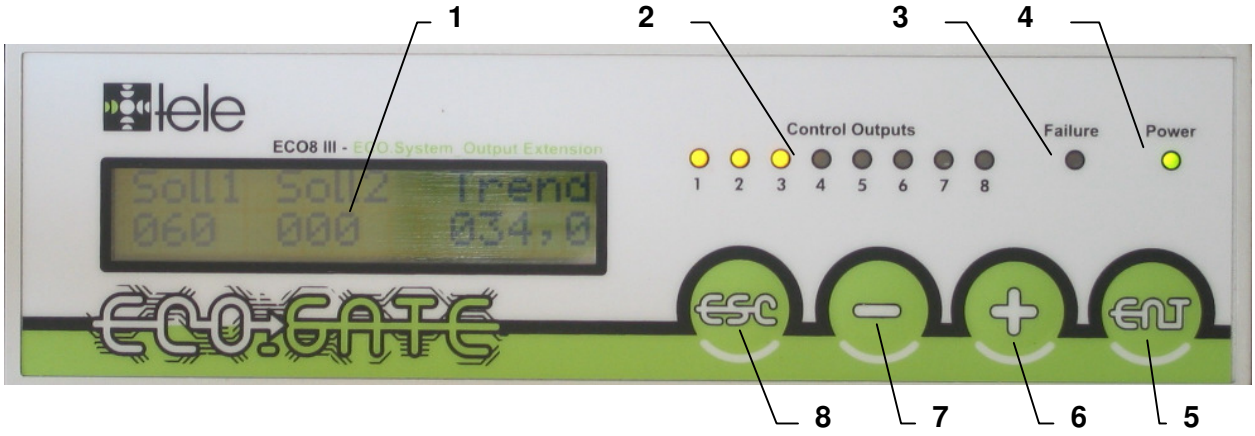


Figure 5: ECO_GATE Control Elements

No.	Label	Description
1		Display (LCD) of the *ECO_SYS*, two lines, 16 characters each
2	*Control Outputs*	Yellow LEDs to indicate the status of the 8 circuits (*1* ... *8*)
3	*Failure*	Red LED to indicate any failure status
4	*Power*	Green LED to indicate the operational status (On / Off)
5	*ENT*	ENT , Enter key of the *ECO_GATE*
6	*+*	+ , + key of the *ECO_GATE*
7	*-*	- , - key of the *ECO_GATE*
8	*ESC*	ESC , Escape key of the *ECO_GATE*

1.5 Basic Operating

The operation of the devices is done by menus. The *ECO8 III* devices are equipped with four keys. Depending on the operational status these keys have various effects and will initiate one of the following functions:

- ESC Escape key
  - Goes back to the previous level
  - Cancels the input of a parameter
- \- Minus key
  - Scrolls to the previous display
  - Scrolls to the previous menu
  - Decreases the value of a parameter
- \+ Plus key
  - Scrolls to the next display
  - Scrolls to the next menu
  - Increases the value of a parameter
- ENT Enter key
  - Opens the selected menu
  - Confirms the entered parameter

The following key combinations are available:

- [+] + [-] Pressed at least for 3 seconds, activates the parameter settings
- [ENT] + [ESC] Goes to the end of the parameters of the *controller* menu

The current input position is indicated by a blinking cursor. Therefore the cursor switches from the assigned character of that position to a black rectangle and vice versa.

1.6 Functional Principal

The *ECO8 III* product family allows optimizing the energy consumption. It gives a better utilization of the power supply of the grid operator. Because the power consumption has a variation over a period of time, the devices of the *ECO8 III* product family are using this circumstance to shift power consumption peaks into a period with less power consumption. Based on the energy management system those peaks can be significantly reduced and lower tariffs can be applied. The best results are achieved by implementing the *ECO8 III* devices together with devices which store energy or react slow to switching activities. These properties are valid for heating and cooling devices (heater, air condition) or devices which are operating with pressure (pneumatic systems). Some potential devices are listed in chapter 4.1.

To turn on and off the various devices step by step results in an efficient operational energy management system. The following chapters describe the control concepts which are supported by the *ECO8 III* devices.

1.6.1 Integrating Load Limiter (ILL)

The Integrating Load Limiter (ILL) Method is based on a turn-on and turn-off limiter. The run of the energy consumption curve should range between these two limits. The *ECO8 III* devices control the consumption by turning on and off the various consumer load (Figure 6).

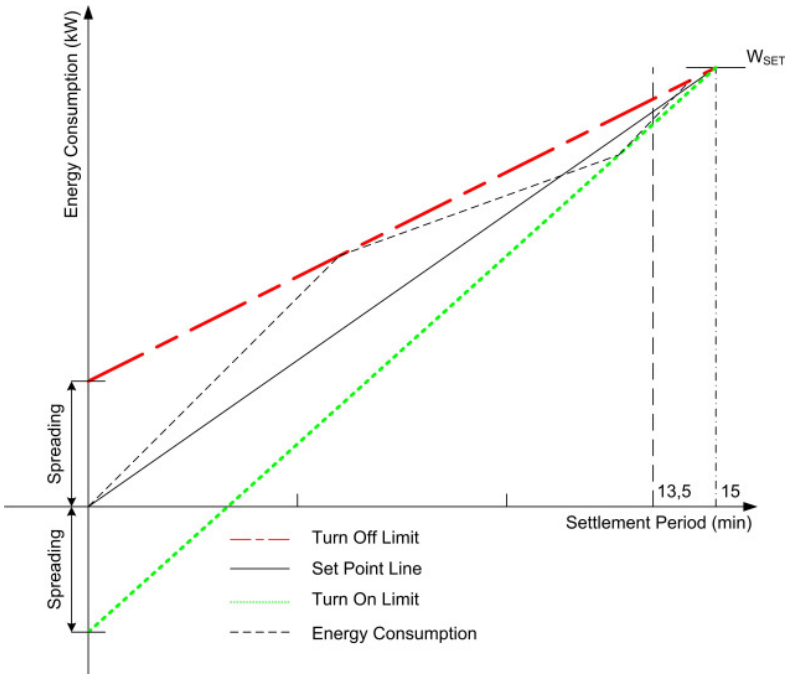


Figure 6: Integrating Load Limiter (ILL) Method

The control mechanism can be adapted by setting of parameter. Therefore the spreading has to be defined (as percentage of the power set point P_{SET}).

If 90% of the settlement period has been reached load is switched on only if the power demand is lower than the nominal power of the energy interface (depending on the contract between the

customer and the grid operator, respectively the energy supplier). This helps to consume the energy more continuously and avoids peak load situations.

1.6.2 Energy Estimator

The Energy Estimator Method is based on the actual electrical power consumption, which will be compared to values of another period (interval). The actual electrical power is calculated in-between two pulses. Figure 7 shows the determination as graphic.

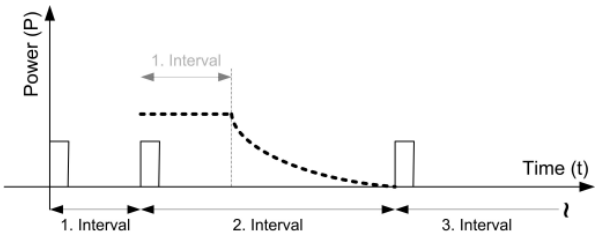


Figure 7: Current Power Inquiry

At the beginning of the second interval the power is presented proportional to the first interval. If the second interval lasts longer than the first one, the power will be reduced until the next impulse is reached. The beginning of the third interval shows the power in relation to the second interval, etc.

Due to the elapsed time and the cumulated energy W_C a disposable power P_{DIS} can be calculated. Additional the disposable power can be consumed without exceeding the predefined energy limit of the settlement period. See for details Figure 8.

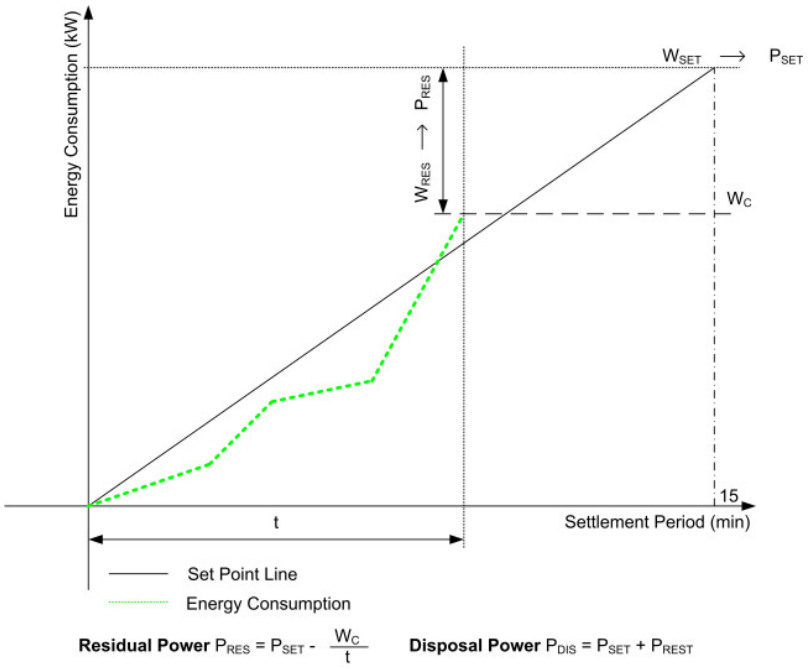


Figure 8: Energy Estimator Method

The disposable power is always the basis for the decision to turn on or turn off load groups. If residual power gets negative (more consumption as scheduled), the disposable power can get lower than the nominal power. The active power is calculated as shown in Figure 7. If the active power exceeds the disposable power, load must be turned off.

1.6.3 Active Power Limiting

The active power limiting method is based on limiting the active power below a nominal power, within time tolerances. So it avoids reactions of overload protection equipment. Mathematically this method is similar to the energy estimator method with a residual power of 0 kW.

Consider a minimal release delay of 5 seconds.	

2 Installation and Operation

This section describes all required steps for the installation and the operation of the *ECO8 III* devices. Additional essential information for the operation of the devices is given.

2.1 Connecting Diagrams

For interacting during operation the devices have to be connected together with the bus terminals A, B und GND (see 1.4.1 resp. 1.4.2). Figure 9 shows the scheme for wiring the bus connection:

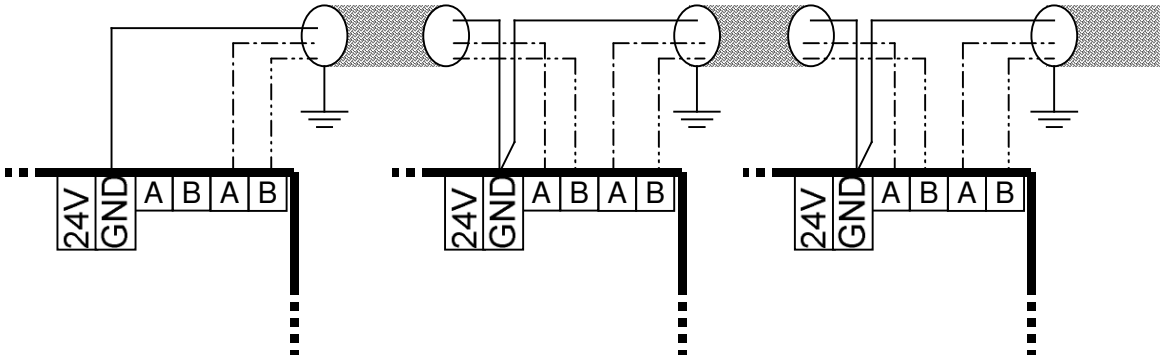


Figure 9 Bus connection with shielded cable

The regulations of the local operator grid have to be fulfilled.	

The following graphics show various kinds of connecting the *ECO_SYS* with an energy meter. Sometimes additional components could be necessary. These components are not part of the delivery. Based on the connector numbers an efficient identification of the connectors is supported.

Important Notice:

Depending on the manufacturer of the energy meter the connector numbers of the graphics may be different. The related numbers of the effectively implemented energy meter have to be used.	

Figure 10 shows the connecting diagram for an energy meter without zero potential contacts. The relay labelled *d1* and *d2* is used for decoupling. The coil of the relay has to be designed for 230 V and 50 Hz.

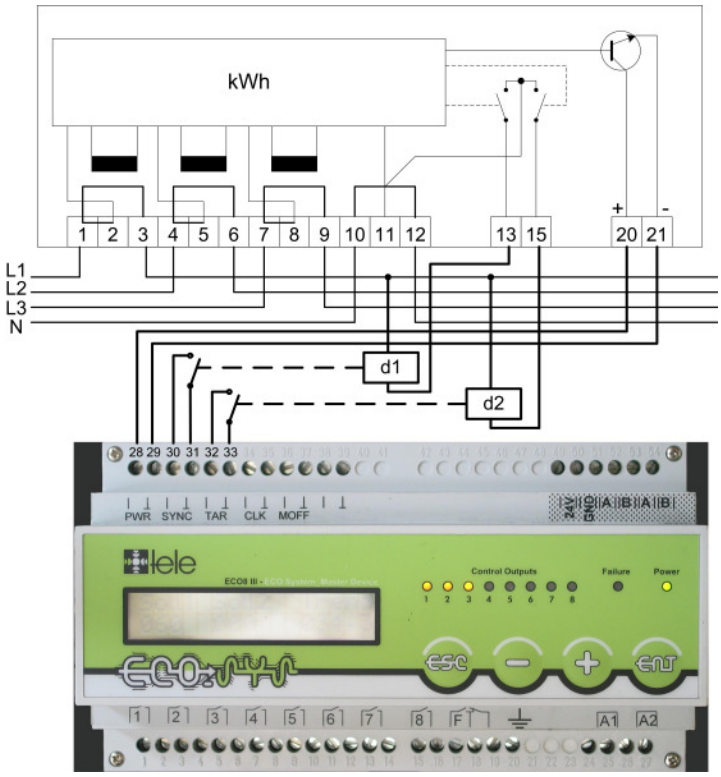


Figure 10: Connecting Diagram without Zero Potential Contacts

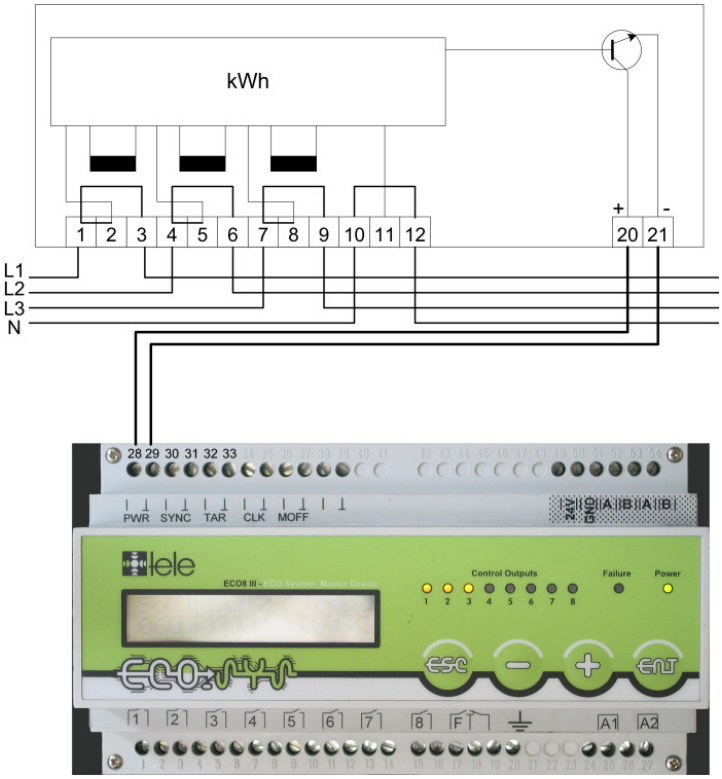


Figure 11: Connecting Diagram with Tariff Pulse

Figure 12 shows the connecting diagram for an energy meter with zero potential contacts.

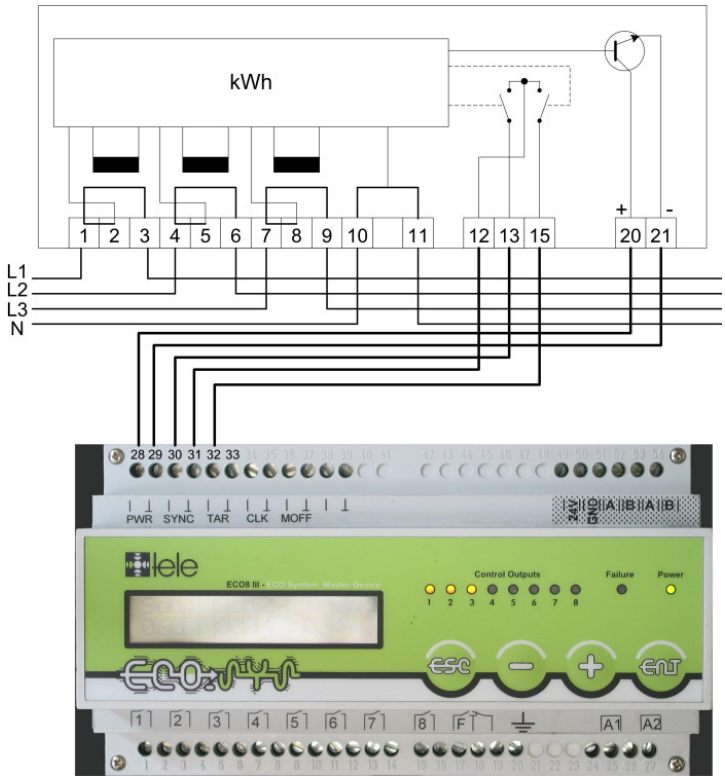


Figure 12: Connecting Diagram with Zero Potential Contacts

Figure 13 shows the connecting diagram for an energy meter with zero potential contacts but without the input of a tariff pulse.

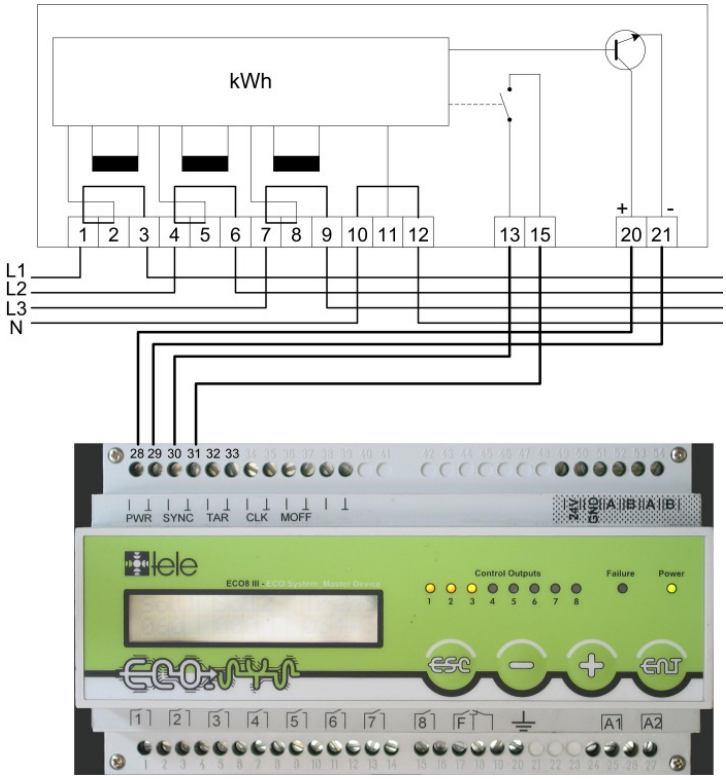


Figure 13: Connecting Diagram with Zero Potential Contacts, without Tariff Pulse

Figure 14 shows the connecting diagram of an energy meter by a S0 interface for a power pulse and a pulse for synchronisation.

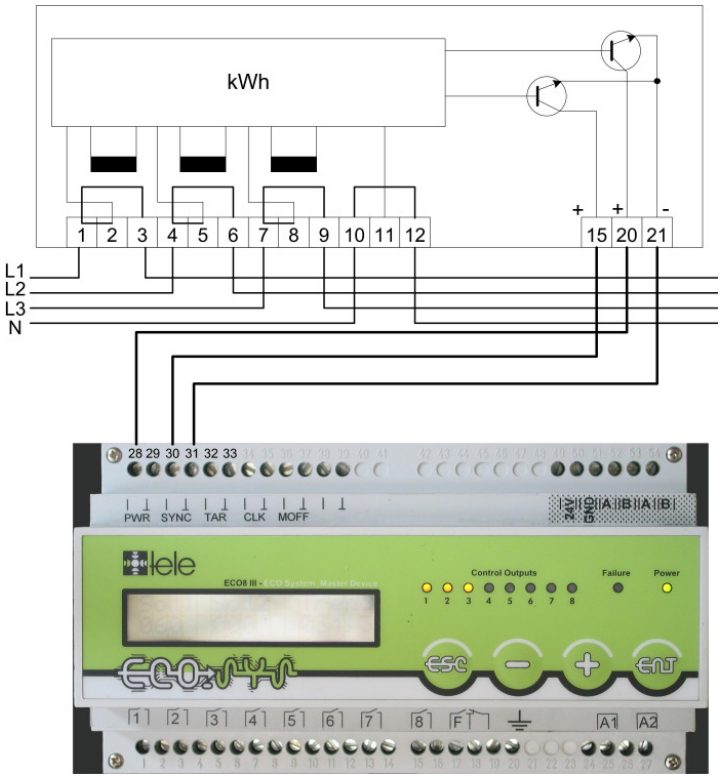


Figure 14: Connecting Diagram with a S0 Interface

Figure 15 shows a complete wiring of an *ECO_SYS.* The relays labelled *d1* ... *d8* are used to switch the load groups. The load group labelled *Load Group 1* ... *Load Group 5* shows a three-phase wiring and *Load Group 6* ... *Load Group 8* shows a two-phase wiring.

The change-over contact of the *ECO_SYS* or the *ECO_GATE* can be used for a failure signalization for remote maintenance.

The relays have to be dimensioned according to the load of the load groups.	

The fuses have to be dimensioned according to the load groups.	

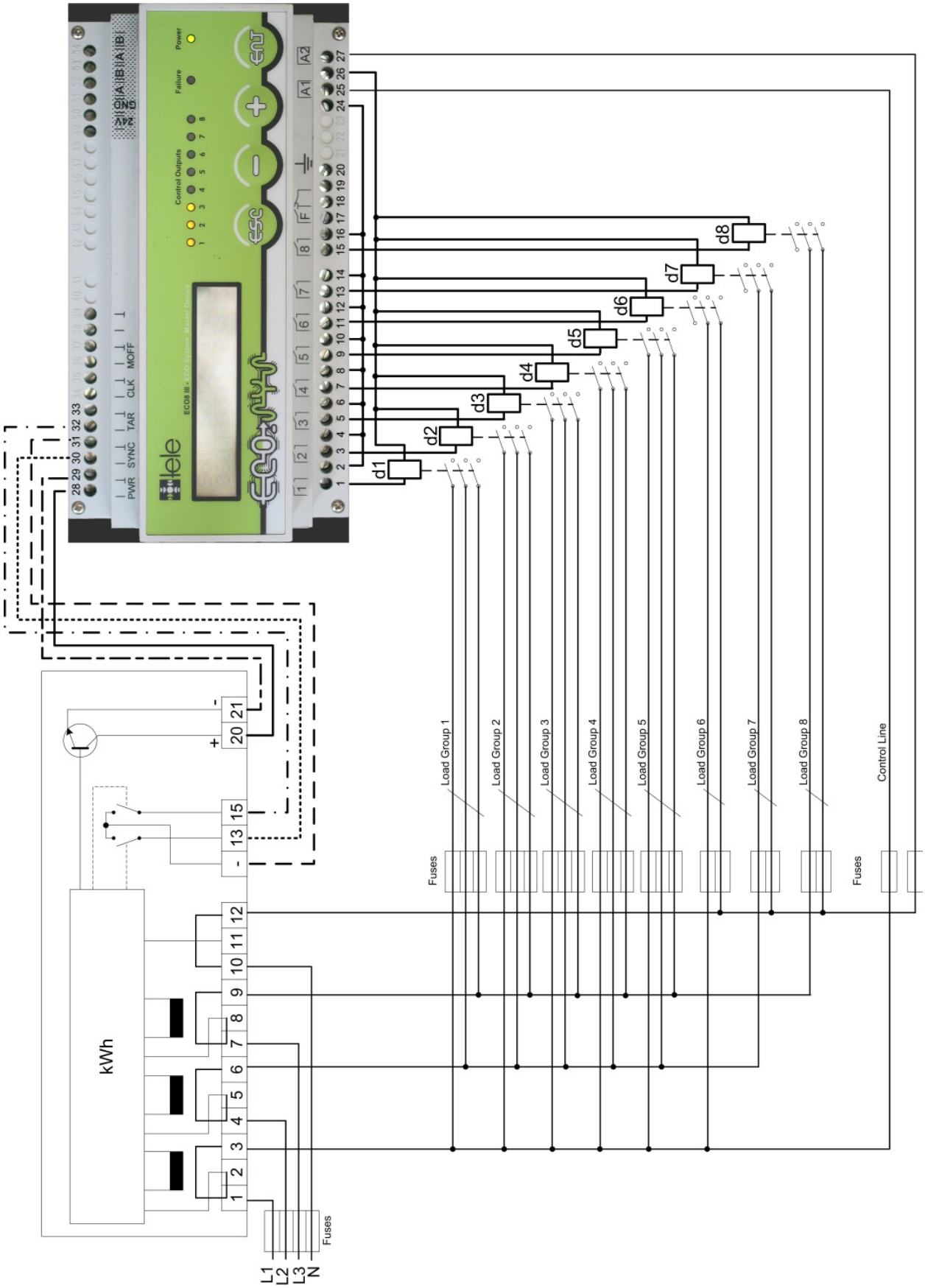


Figure 15: Wiring Scheme

2.2 Initial Settings

These settings have to be defined for the operation of the *ECO_SYS*. The bus settings have to be defined for the *ECO_GATE* too.	

For the initial set-up the following parameters are required:

- Pulse Rating: according to the energy meter, see table 2
- Transformer Ratio: according to the ratio of the used current transformer, see table 2

After the definition of the pulse rating and the transformer ratio check the display of the actual power *Pact* (see chapter 2.4). The value should be compared with the display of the energy meter or the value of the last electricity bill.	

- Bus Settings
  Only to be defined if the maximum priority is greater than 8. Each device which is connected via the bus gets an individual *Bus-ID.* This address has to be defined for the initial set-up. The addresses have to start by *1.* The selected addresses can be chosen starting with *1* not including more than one blank in sequence.
- Nominal Power (Set Points)
  To set-up the nominal power (set points) three different cases of operation have to be distinguished:
  - Reduction of the peak load to reduce the costs of the net:
    The nominal power is set to a higher value, for example 999 kW. It should be a value so that the energy management system will not influence the load. Watch the energy consumption over a period of one week. Therefore the daily registration of the peak value of the *ECO_SYS* is necessary or analyse the data of the logging function with a PC. Afterwards start to decrease the nominal power setting in steps of around 10%.
- Reduction of the peak load to meet the connected wattage
  - The nominal power is set according to the connected wattage of the equipment. The operational requirements regarding the energy consumption have to be considered. To determine that the current connected wattage is sufficient it is recommended to watch the energy consumption.
- Customizing of the energy consumption according to an energy road map
  - The nominal power is customized according to the delivery of the grid operator. For each settlement period the nominal power has to be set according to the set points of the energy road map.

2.3 Status Information

The display of the *ECOIII 8* devices is used to show status and measurement information. To scroll through the various displays use [+] and [-] . The descriptions are done according to the sequence of the displays. At the beginning the status displays are shown, followed by the measurement displays. The first status display shows some device information. The measurement readings are described by chapter 2.4. Additional to the display each device is equipped with LEDs. These LEDs give indication of the current switching state of the load groups, the current failure state and the power supply state.

2.3.1 LED Display

The LEDs give a fast overview of the operational state of the devices. Figure 16 gives an example of a LED display based on an *ECO_SYS*.

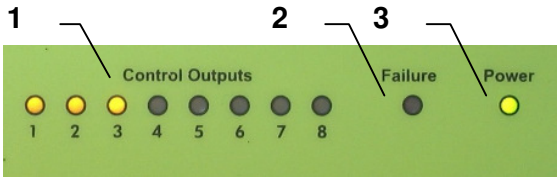


Figure 16: ECO_SYS LED Display

1	*Control Outputs 1 ... 8*	Yellow LEDs to indicate the switching state of the related output (*1 ... 8*) LED on Contact is closed LED off Contact is open
2	*Failure*	Red LED to indicate failure states LED on Signalisation of a failure LED off No failure
3	*Power*	Green LED to indicate the power supply state LED on Power supply is switched on LED off Power supply is switched off

An Interpretation according to the example above leads to the following results:

- The outputs with the number *1*, *2* and *3* are switched (active, the contacts are closed), because the related LEDs are illuminated.
- The outputs with the number *4 ... 8* are not switched (not active, the contacts are open), because the related LEDs are not illuminated.
- No failure because the red *Failure* LED is not illuminated.
- The power supply is switched on because the green *Power* LED is illuminated.

2.3.2 Status Displays

Figure 17 shows an example of the *ECO-SYS*. Figure 18 shows an example of the *ECO_GATE*. The displayed information gives details regarding the product family, type of device and the loaded software version.

By switching on the devices the device information is presented. If there is no input for a period of time, the display changes automatically (at least after a settlement period) to the trend display.

Figure 17: ECO_SYS Display of the Device Information

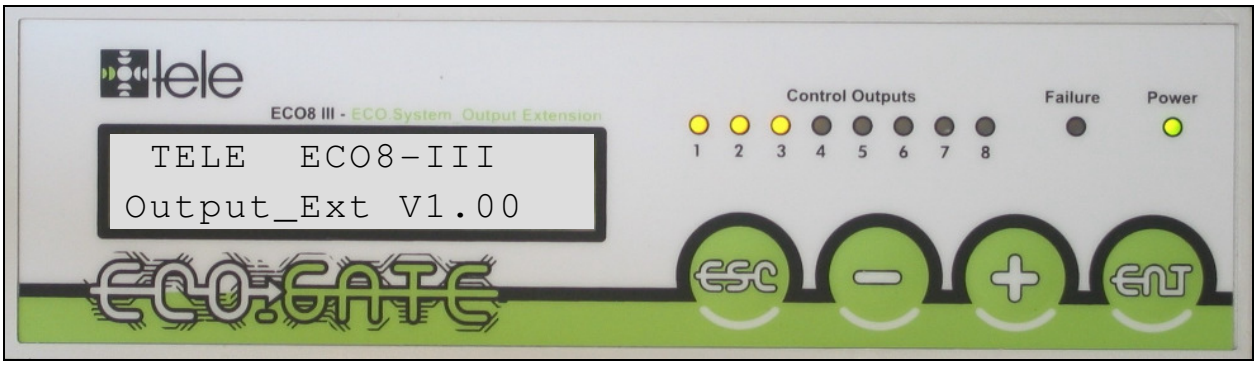


Figure 18: ECO_GATE Display of the Device Information

The next display shows the actual date and time information and is similar for both types of devices. Figure 19 shows an example based on an *ECO_GATE*.

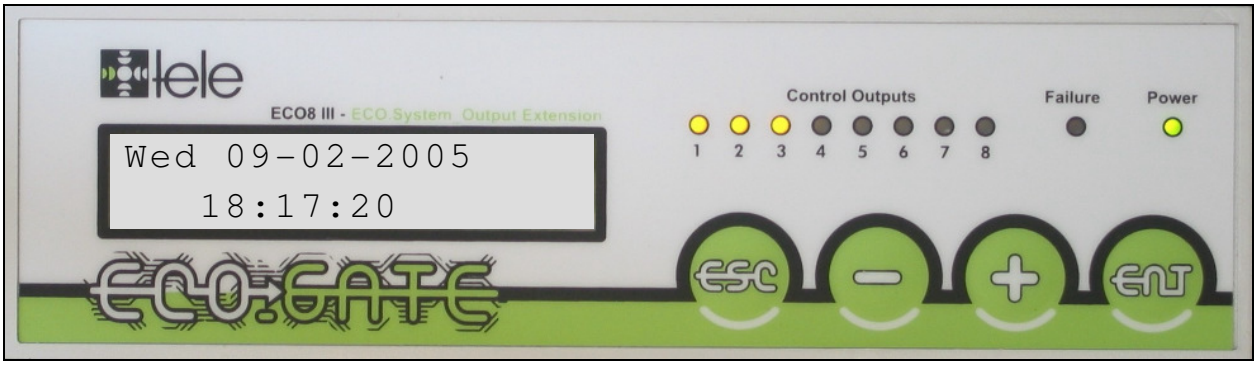


Figure 19: Display of Date and Time

Afterwards the display of warnings is presented. Figure 20 shows an example of a clean operation. Warnings have no influence on the contact for the failure indication. The following list contains all warning messages and their meanings:

- *no* No warnings at the moment.
- *auto sync* The pulse for synchronisation was missed and has been generated internally.

Figure 20: Display of Warnings

After the warnings the internal failure are displayed. Figure 21 shows an example. The following list contains all internal failures and their meanings:

- *no* No internal failures
- *RTC-Battery* The battery of the internal real time clock has to be replaced. Send the to the TELE HAASE service centre.
- *no pulses* During the last settlement period no power pulse has been arrived.

Figure 21: Display of Internal Failure

After the internal failure display the information related to the *RS485* interface (= bus failure) is presented. Figure 22 shows an example. The following list gives an overview of possible failure messages and their meaning:

- *no* — No error of the *RS485* interface exists.
- *illegal function* — An illegal function code has been received by a slave of the *RS485* interface.
- *illegal address* — Access of the master to an invalid address.
- *illegal data* — The length of the data transmission exceeded 64 bytes (Header Information not included)
- *slave failure* — A slave failure has occurred.
- *equal MasterID* — A master of the *RS485* interface has detected his own *Master-ID*.
- *no response* — If the maximal priority is configured greater than 8, more devices are connected via the *RS485* interface. If a Master does not get any answer to his request, a failure of the communication will exist.
- *Comm error* — Communication error of the *RS485* interface.

Figure 22: Display of the Bus Failure (RS485)

2.4 Measurement Displays

After the status displays the measurement displays are presented. To scroll through the measurement displays the same keys are used as for he status displays ([+] and [-]). The description is done in the scrolling sequence. After the measurement displays the sequence starts with the status displays again (see chapter 2.3.2). All displays can be scrolled through within this loop.

The following measurement display (*last period*) is relevant for the *ECO_SYS* only. Therefore it is not presented on the *ECO_GATE*. Figure 23 shows an example of the last period measurement display (for the last settlement period).

Figure 23: ECO_SYS Last Period Display

The next display is also only available for *ECO_SYS* only and shows the daily peak value in kW with the related time of occurrence. Figure 23 shows an example.

Figure 24: ECO_SYS Daily Peak Value

The next display is available for both devices. Figure 25 shows an example of the nominal power display and the trend display. Because the devices can be operated with two separate nominal power settings per settlement period, both values are displayed in kW.

Figure 25: ECO_SYS Nominal Power and Trend Display

The next display is different for each type of device. Figure 26 shows the display for the *ECO_SYS*, which presents the following information:

- *Pact* Actual power in kW
- *remt* Remaining time in minutes:seconds
- *per* Settlement period in minutes

Figure 26: ECO_SYS Measurement Display

Figure 27 shows the display of an *ECO_GATE*, which presents the following information:

- *Pgate* Actual power of the *ECO_GATE* in kW
- *remt* Remaining time in minutes:seconds
- *Psys* Actual power of the related *ECO_SYS* in kW

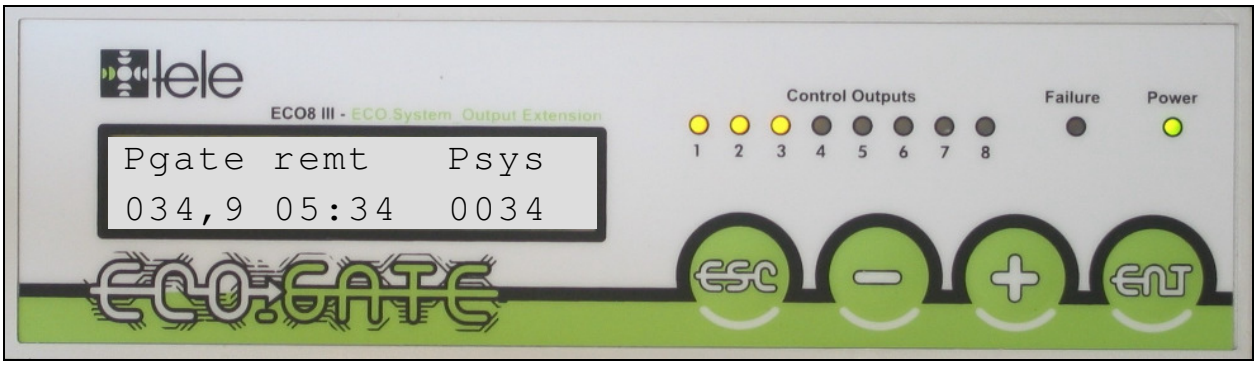


Figure 27: ECO_GATE Measurement Display

The following three displays give an overview of the active switching, controlled by the clock timer. These displays are available for the *ECO_SYS* and the *ECO_GATE*. The examples are based on the *ECO-SYS*. Figure 28 shows the display of all by the clock timer activated outputs. For the example output number *3* is activated (* = channel activated by the clock timer, - = channel not activated).

Figure 28: ECO_SYS by Clock Timer Activated Outputs

The next display (Figure 29) shows the by the clock timer deactivated outputs. For this example the output with the number 7 is deactivated (* = switched, - = not switched).

Figure 29: ECO_SYS by Clock Timer Deactivated Outputs

Figure 30 shows the display for switching based on priorities. The example shows that no changed sequence is given based on priorities (* = changed sequence, - = not changed sequence).

Figure 30: ECO_SYS Priority Switching

After the display of the clock timer the current tariff settings are displayed. This display is relevant for the *ECO_SYS* only. Figure 31 shows an example of a current high tariff with static switching by an external pulse (input *TAR*).

Figure 31: ECO_SYS Tariff Settings

The following displays present the current priority settings. The first two displays show an example of the related channels (Figure 32 outputs *1* ... *4*, Figure 33 outputs *5* ... *8*). Figure 34 shows an example of the display for the current deactivation priority.

Figure 32: ECO_SYS Current Priority Display for Channel 1 ... 4

Figure 33: ECO_SYS Current Priority Display for Channel 5 ... 8

Figure 34: ECO_SYS Current Deactivation Priority

2.5 Data Logger

ECO_SYS is equipped with an internal data logger, recording the most important energy data of a system. The data from the last and the current month are stored in a non-volatile memory and can be accessed by PC. The following information is available for each day:

- Total Average Power (i.e. the consumed energy)
- Average Power according to *set point2* (equivalent to the consumed energy without exceeding *set point 2*)
- Peak values of the settlement periods of the day
- Time and date stamp for the peak values of the day
- *Set point1* when peak has occurred
- *Set point2* when peak has occurred

A reset to the default settings will not delete the information of the data logger.	

The information of the data logger can be accessed by a PC and can be analysed with the help of the evaluation program.	

3 Configuration / Parameter

All settings for the operation of the *ECO8 III* devices can be entered directly. Additional the settings can be entered with a connected PC (*RS485* interface) also.

To enter parameters open the menu *Configuration* by pressing [+] + [-] at least for three seconds. The following overview shows all available menus and the related settings (parameters). Figure 35 gives a graphical overview.

- *Date/Time* — Date and time settings for the internal real time clock
- *controller* — Parameters of the controller (e. g. measuring method, settlement period, spreading etc.)
- *channels* — Settings for each channel (turn-on time (minimal), turn-off time (minimal/maximal) and priority)
- *timers* — Settings of the timers (e. g. start time/date, end time/date and activity)
- *tariff* — Settings regarding the evaluation of the tariff input
- *device setup* — Device parameters (e. g. language, automatically daylight saving etc.)
- *bus setup* — Configuration of the *RS485* interface (e. g. master-ID, bus-ID etc.)
- *clear data block* — Clears all timer settings or resets the parameters to the factory defaults (see chapter 4.2)

Resetting the parameters to the factory defaults will erase all previously changes.	

- *bus stop* — This menu is available for the *ECO_SYS* only. It turns on and off the data transmission of the *RS485* interface.
- *I/O control* — This menu is available for the *ECO_GATE* only. It defines the mode of operation of the 5 available inputs.

The following chapters describe all common parameters of the *ECO8 III* devices in relation to the individual menus. The overview figures show the menus and parameters of the *ECO_GATE* (see Figure 35) and of the *ECO_SYS* (see Figure 36).

Specific parameters for one device only are marked (bold letters for the overview graphics). The following device indications are used:

- *ECO_SYS* — Parameter is relevant for the *ECO_SYS* only
- *ECO_GATE* — Parameter is relevant for the *ECO_GATE* only
- *both* — Parameter is relevant for both devices

To scroll through the supported values of a parameter keep pressing the key.	

To enter a parameter with more digits pressing ENT confirms the current digit and the cursor goes to the next position.	

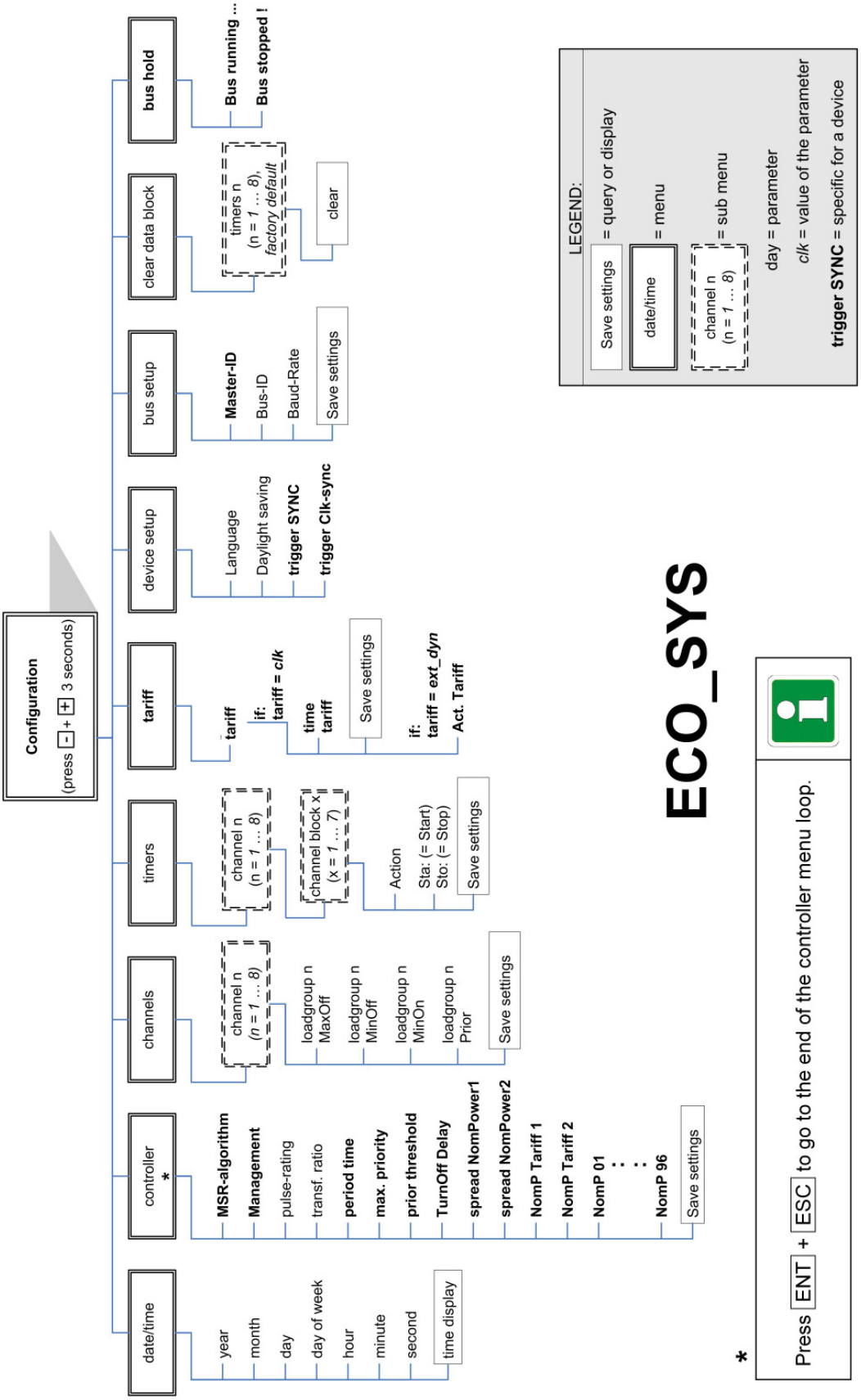


Figure 35: ECO_SYS, Menu- and Parameter Overview

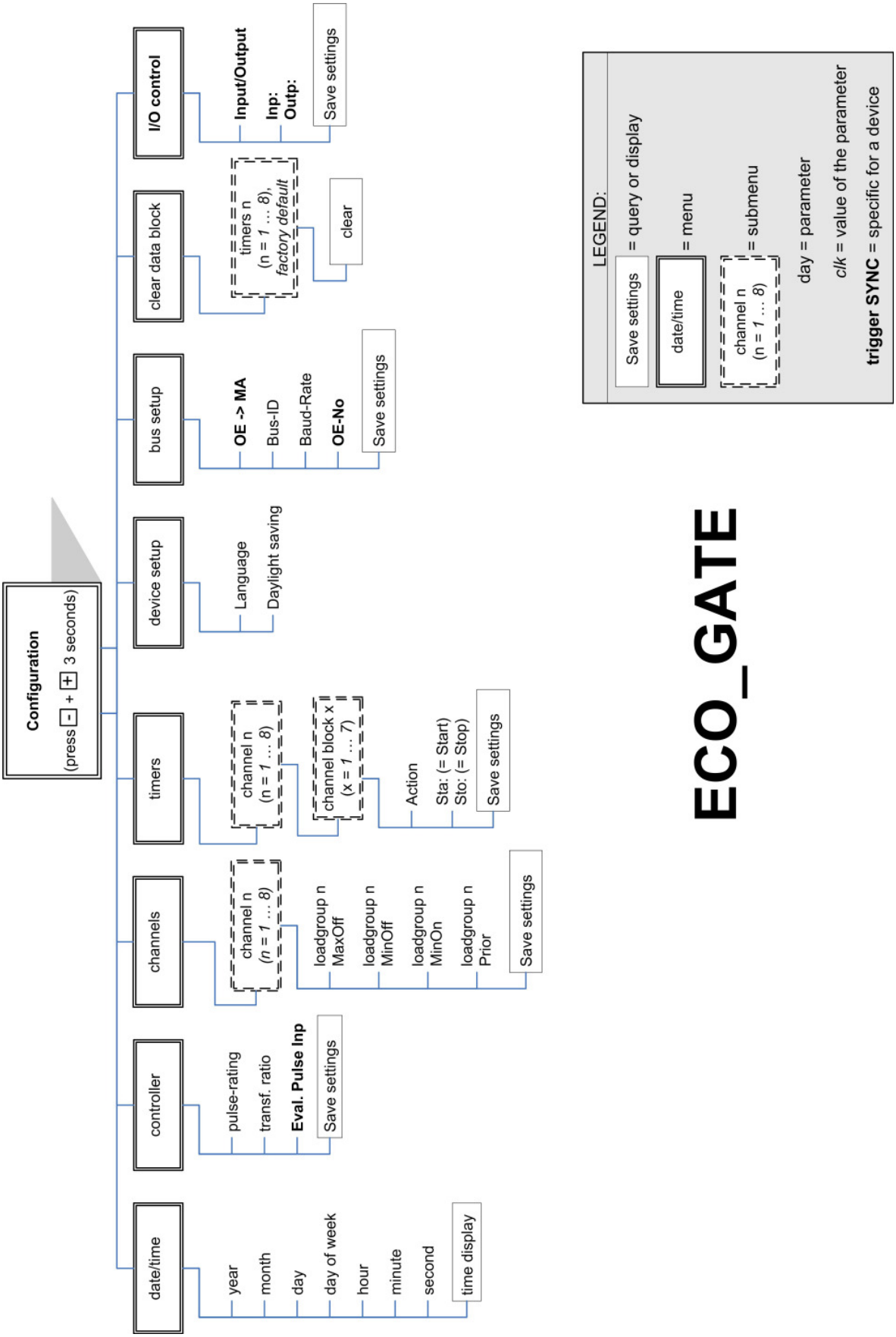


Figure 36: ECO_GATE, Menu- and Parameter Overview

3.1 Date/Time Menu

The *date/time* menu gives access to the parameter of the internal real clock time settings. Table 1 gives a list of all parameters including the available values. The list is valid for both device types.

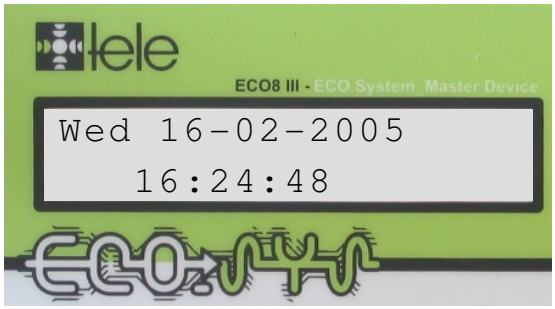
Parameter	Value	Description
year	2000 ... 2099	Defines the four digits of the year
month	01 ... 12	Defines the month: 01 =January ... 12 = December
day	01 ... 31	Defines the day of the month. Only numbers which comply with the month are available.
day of week	Mon ... Son	Defines the three digit label for the day: ● Mon Monday ● Tue Tuesday ● Wed Wednesday ● Thu Thursday ● Fri Friday ● Sat Saturday ● Sun Sunday
hour	00 ... 23	Definition of the hour for the internal clock
minute	00 ... 59	Definition of the minute for the internal clock
second	00 ... 59	Definition of the second for the internal clock
Concluding time display		To check the current settings the time display is presented after the entry of all parameters: 

Table 1: Date/Time Parameters

The clock starts by confirming the parameter *second* by pressing ENT .

Changing the clock settings during operation may influence the load group switching (depending on the timer settings).

3.2 Controller Menu

To define the function of the control mechanism the parameters of the *controller* menu are used. It includes the setting of the used control method, the nominal power up to the settlement period (see chapter 1.6 and 3.2.1). Each parameter is described in Table 2. If the description needs more details a reference to a separate chapter is given.

Parameter	Value	*Device*	Description
MSR-algorithm	ILL	*ECO_SYS*	Integrated load limiter method (description see chapter 1.6.1)
	Energy estimator	*ECO_SYS*	Energy estimator method (description see chapter 1.6.2)
	Act. Power Limit.	*ECO_SYS*	Active power limiting Method (description see chapter 1.6.3)
Management	dual max. mode	*ECO_SYS*	The energy management considers two set points.
	tariff managem.	*ECO_SYS*	The energy management considers the tariff input (*TAR*).
	cycle management	*ECO_SYS*	The energy management is based on the settlement period.
pulse-rating	00,00 ... 99,99	both	Defines the generated power by one pulse (Wh/pulse).
transf.ratio	000 ... 999	both	Defines the ratio of the current transformer e. g. 600 A/5 A = *120*
period time	005 min	*ECO_SYS*	Defines a period of 5 minutes.
	010 min	*ECO_SYS*	Defines a period of 10 minutes.
	015 min	*ECO_SYS*	Defines a period of 15 minutes.
	020 min	*ECO_SYS*	Defines a period of 20 minutes.
	030 min	*ECO_SYS*	Defines a period of 30 minutes.
	040 min	*ECO_SYS*	Defines a period of 40 minutes.
	045 min	*ECO_SYS*	Defines a period of 45 minutes.
	060 min	*ECO_SYS*	Defines a period of 60 minutes (one hour).
	080 min	*ECO_SYS*	Defines a period of 80 minutes (1 hour and 20 minutes).
	090 min	*ECO_SYS*	Defines a period of 90 minutes (1 hour and 30 minutes).
	360 min	*ECO_SYS*	Defines a period of 5 minutes (6 hours).
max. priority	01 ... 64	*ECO_SYS*	Defines the maximal priority. *1* is the highest priority. The energy management starts to turn off load with the lowest priority first.
prior threshold	02 ...max. priority	*ECO_SYS*	Defines the threshold of the priority if operation is done with two set points. See chapter 3.2.1.
TurnOff Delay	05 ... 30 s	*ECO_SYS*	Defines the minimal turn-off delay.
spread NomPower1	02 ... 15 %	*ECO_SYS*	Defines the spreading for the set

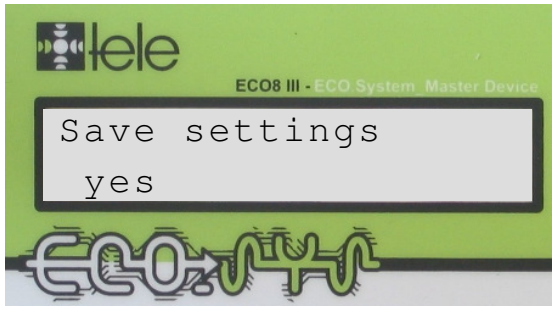
			point 1 (percentage). See chapter 1.6.1.
spread NomPower2	02 ... 15 %	*ECO_SYS*	Defines the spreading for the set point 2 (percentage). See chapter 1.6.1.
NomP Tariff 1	000,1 ... 999,9 kW	*ECO_SYS*	Defines the set point for tariff 1. See chapter 3.2.1.
NomP Tariff 2	000,1 ... 999,9 kW	*ECO_SYS*	Defines the set point for tariff 2. See chapter 3.2.1.
NomP 01 ... 96	000,1 ... 999,9 kW	*ECO_SYS*	Defines the set points for each settlement period.
Eval. Pulse Inp	only display	*ECO_GATE*	The evaluation of the pulse input is done for the display only.
	to control	*ECO_GATE*	The evaluation of the pulse input is done for the controller.
Save settings?	no ... yes	Confirmation of the parameters:  *no* will discard all changes!	

Table 2: Controller Parameters

Press ENT + ESC to go to the end of the controller menu loop.

3.2.1 Set point Settings

The consumption of electrical energy can be optimized according to two criteria:

- To use the energy grid in the most efficient way
- To balance the generation and consumption of electricity (energy road map)

To support this optimization in the best manner the energy management system can operate with one or two set points per settlement period. Therefore the load can be split into two groups according to the above criteria.

Set point1 is used to fulfil the grid criteria. This value is defined according to the related tariff (*HT*, *NT*).

Set point2 is used to fulfil the energy consumption within the particular period. This value has to be defined individually for each settlement period. The goal is to need as less balance energy from the supplier as possible. Splitting the set points may be used to manage an energy contract with an alternative supplier or simply to get a level of warning.

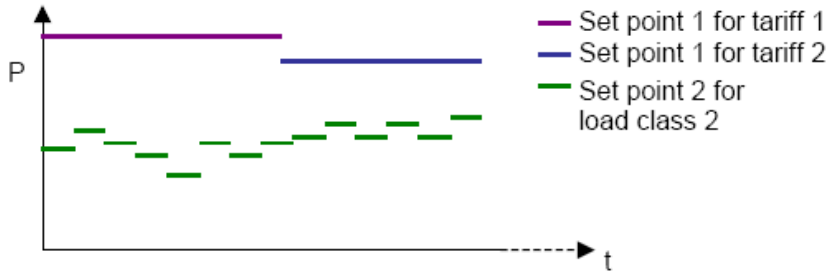


Figure 37: Set Point Requirements

Using both set points two classes of load groups have to be defined. All load channels below a certain priority level (e.g. those with lower priority) are designated as *load class 2*. The load channels of *load class 2* are taken into account to regulate for *set point 2*.

If it is not possible to regulate for *set point 2*, the load channels of *load class 1* are additionally taken into account for regulating power demand. In this case, the system regulates to keep the average power below *set point 1*.

Set point requirements (*Set Point2*) are supported for a minimal settlement period of 15 minutes only.	

A changed set point gets active with the start of the next settlement period.	

3.3 Channels Menu

The devices are equipped with 8 switching circuits. For each channel the parameters listed in Table 3 can be defined. To work with the specific parameters of a channel the related channel number (*1* ... *8*) has to be selected first.

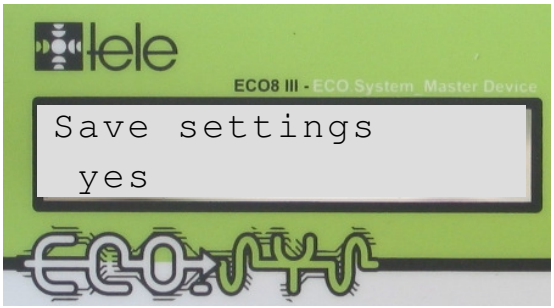
Parameter	Value	Description
`MaxOff`	`00m01s` ... `19m59s`	Defines the maximal turn-off time of the channel. This is the longest period the load can be switched off.
`MinOff`	`00m01s` ... `19m59s`	Defines the minimal turn-off time of the channel. This is the shortest period a load can be switched off.
`MinOn`	`00m00s` ... `19m59s`	Defines the minimal turn-on period. This is the period the load will stay switched on before it is turned off again.
`Prior`	`01` ... `max. priority`	Defines the priority of the channel. *1* is the highest priority.
Save settings ?	`no` ... `yes`	Confirmation of the parameters:  *no* will discard all changes!

Table 3: Channel Parameters

3.4 Timers Menu

The internal clock timer allows for time based switching. There are up to 8 independent channels available each of which is able to control 7 channel blocks. A channel block defines all settings for a time controlled switching. This adds up to 56 adjustable time blocks per device. Table 4 lists the corresponding parameters.

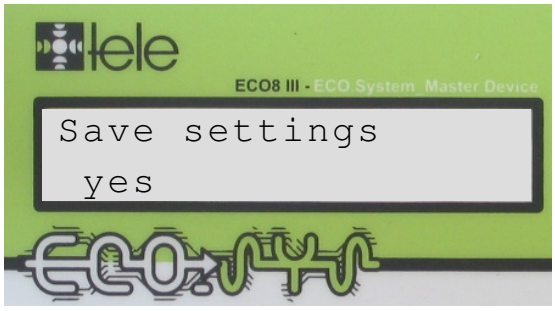
Parameter	Value	Description
channel	1 ... 8	Defines which channel is configured.
block	1 ... 7	Defines which block is configured.
action	deact.	Deactivates the block.
	P01 ... max.priority	Defines the alternative priority (*1* ... *max. Prior*) of the block. *1* is the highest priority.
	ein	Time controlled switching is on.
	aus	Time controlled switching is off.
Sta:	01.01. 00:00 ... 31.12. 23:59	Defines the start for switching by date.
	Mon 00:00 ... Son 23:59	Defines the start for switching by day per week.
Sto:	01.01. 00:00 ... 31.12. 23:59	Defines the end for switching by date.
	Mon 00:00 ... Son 23:59	Defines the end for switching by day per week.
Save settings ?	no ... yes	Confirmation of the parameters:  *no* will discard all changes!

Table 4: Timer Parameters

The timer supports switching based on a certain period (switching by date) and switching based on a weekly period (switching by day per week). The start and end parameters define which switching method is used. By entering time and date the switching by date is activated. Entering time and weekday will activate the switching by weekday per week.

No overlapping is allowed for blocks with definitions for switching by day per week.	
Overlapping blocks for switching by date and switching by day per week result in a prioritisation of the switching by date definitions.	

3.5 Tariff Menu

The tariff settings are done by the following parameters described in Table 5.

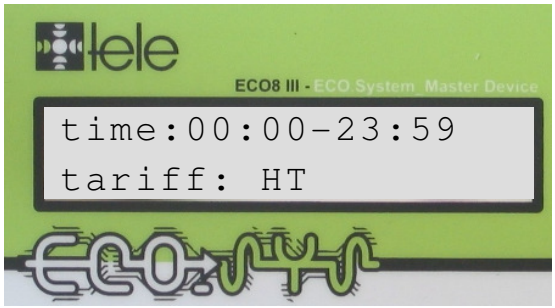
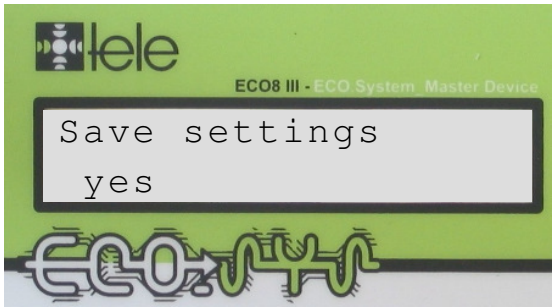
Parameter	Value	Description
tariff	ex_st	Defines an external and static switching of the tariff (*TAR*).
	ext_dyn	Defines an external (*TAR*) and dynamic switching of the tariff and requires a definition of the current status of the tariff according to the following settings: • HT high tariff • NT low tariff
	clk	Defines the tariff in relation to the time. The following settings have to be entered:  The tariff has to be defined according to the following settings: • HT High tariff • NT Low tariff
Save settings ?	no ... yes	Confirmation of the parameters:  *no* will discard all changes!

Table 5: Tariff Parameters

3.6 Device Setup Menu

The parameters of the device setup are defined according to the description in Table 6.

Parameter	Value	*Device*	Description
Language	Deutsch	both	The display of the menus is done in German.
	English	both	The display of the menus is done in English.
Daylight saving	on	both	Activates the automatic switching between summer and winter time.
	off	both	Deactivates the automatic switching between summer and winter time.
trigger SYNC	external source	*ECO_SYS*	Defines an external source (*SYNC*) for the synchronisation of the settlement period.
	no ext. source	*ECO_SYS*	Defines the operation without an external synchronisation of the settlement period.
trigger Clk-sync	no ext. source	*ECO_SYS*	Specifies a free running of the internal real time clock.
	sync input	*ECO_SYS*	Defines the pulse (*SYNC*) of the settlement period as a reference per hour.
	external source	*ECO_SYS*	Defines the time synchronisation by an external input (*CLK*, see chapter 1.4.1).

Table 6: Device Setup Parameters

Using an external source for the clock synchronisation requires a presetting of the time with a tolerance of +/- 5 minutes.

The clock can be synchronised by the *CLK* input hourly (see chapter 1.4.1). For example a *DCF77* receiver can be used as reference.

Each hour the *ECO_GATE* synchronises automatically with the clock of the *ECO_SYS*.

3.7 Bus Setup Menu

The settings of the *RS485* interface are managed by the bus setup menu. The main parameters are the identification of the bus system and the transmission rate. Table 7 describes the available parameters.

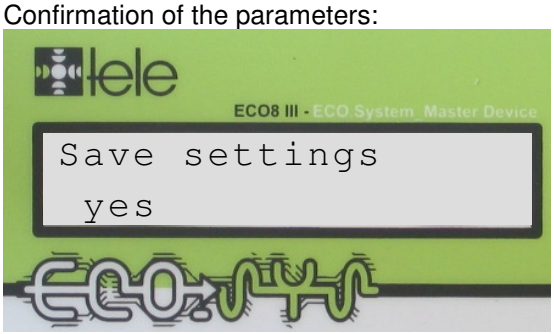
Parameter	Value	Device	Description
Master-ID	1 ... 5	*ECO_SYS*	Defines the identification of the *RS485* master.
Bus-ID	01 ... 32	both	Defines the *RS485* interface identification.
Baud-Rate	9600 or 19200	both	Defines the transmission rate of the *RS485* interface.
OE -> MA	1 ... 5	*ECO_GATE*	Defines the assigned master.
OE-No	1 ... 7	*ECO_GATE*	Defines the identification of the *ECO_GATE*.
Save settings ?	no ... yes	Confirmation of the parameters:  *no* will discard all changes!	

Table 7: Bus Setup Parameters

3.8 Clear Data Block Menu

This menu supports clearing all definitions of the individual timers (*1* ... *8*) and resetting the parameters to the factory default values (the values of the factory default settings are listed in chapter 4.2). Table 8 shows all options.

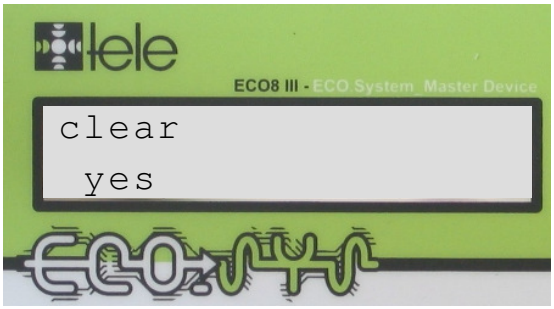
Parameter	Value	Description
clear data block	timers 1 ... 8	Defines which channel definitions are erased.
	factory default	Defines to reset all parameters.
clear ?	no ... yes	Confirm the selected action:  *no* does not execute any function!

Table 8: Clear Data Block Parameters

All individual settings are lost by resetting the parameters to the factory defaults.	

3.9 Bus Hold Menu

This menu is available for the *ECO_SYS* only. It is used to control the *RS485* interface and allows stopping the data communication. Pressing [+] or [-] toggles between data transmission on and off (see Table 9).

To exit the menu press [ENT] .

Only when the data communication is running the menu can be closed.	

Function	Description
Bus running...	The data communication is in operation
Bus stopped !	The data communication is stopped

Table 9: Bus Hold Menu

3.10 I/O Control Menu

This menu is available for the *ECO_GATE* only. It is used to customise the parameters of the five inputs (*IN1* ... *IN5*) of the *ECO_GATE*. These settings effect directly the five related outputs (*1* ... *5*). Details regarding the connectors are described in chapter 1.4.2.

The basis of the setting is the status of the inputs. Therefore two parameters are necessary, one for the open contact and one for the closed contact. The first value of the display reflects the setting of the open contact. The second value of the display reflects the value of the closed contact.

Parameter	Value	Description
`Input/Output`	`1 ... 5`	Selects the input to define the related parameters.
`Out:`	`reg reg`	An opened or closed contact results in control of the related output.
	`reg on`	The related output is controlled only, if the contact is open. A closed contact leads to a remaining turned on output.
	`reg off`	The related output is controlled only, if the contact is open. A closed contact leads to a remaining turned off output.
	`on reg`	The related output is controlled only, if the contact is closed. An open contact leads to a remaining turned on output.
	`off reg`	The related output is controlled only, if the contact is closed. An open contact leads to a remaining turned off output.
	`on off`	The open contact leads to a remaining turned on output. The closed contact leads to a remaining turned off output.
	`off on`	The open contact leads to a remaining turned off output. The closed contact leads to a remaining turned on output.

Table 10: I/O Control Parameters

The inputs provide the operation of requirement lines which can be used to evaluate sensors.

4 FAQ / How to

This section gives some background information and lists the frequently asked questions.

4.1 Which Consumer Load Can Be Used?

The following list gives an overview which consumer loads can be used for an efficient energy management system. This list is only an example and not a complete list. It should be used as a proposal for additional possibilities. Also a step by step deactivation should be considered during the design phase. The following devices can be used with the *ECO8 III* family:

ventilations, defrosting heaters, ovens, bain-marie, trace heating, washers, electrolytic bath heaters, ironing machines, boilers, defrosters, floor heating, chip pans, dish washers, grills, infragrills, hydraulic aggregates, tiled stoves, air conditions, compressors, cooling systems, refrigerators, chargers, soldering systems, massage pumps, milk heaters, oil burners, electrical heaters, melting furnaces, sauna heaters, heaters of swimming pools, drying chambers, dryers, vacuum systems, heat pumps, etc.

4.2 Default Settings

Table 11 shows the parameters and their assigned values for the factory default settings.

All individual settings are lost by resetting the parameters to the factory defaults.	

Date, time, and the data of the data logger are not influenced by resetting the devices to the factory defaults.	

Name of the parameter	Assigned value	Devices	Comment
Master-ID	*1*	*ECO_SYS*	
OE -> MA	*1*	*ECO_GATE*	
Bus-ID	*01*	both	
Baud-Rate	*9600*	both	
OE-No	*1*	*ECO_GATE*	
spread NomPower1	*04 %*	*ECO_SYS*	
spread NomPower2	*02 %*	*ECO_SYS*	
period time	*15 min*	*ECO_SYS*	
pulse-rating	*01,00 Wh/pulse*	both	
transf. ratio	*001*	both	*ECO_GATE = 0*
tariff source	*ex_st*	*ECO_SYS*	external and static
current tariff period	*HT*	*ECO_SYS*	*HT* = high tariff
tariff begin time	*03:01*	*ECO_SYS*	
tariff end time	*03:02*	*ECO_SYS*	
max. priority	*08*	*ECO_SYS*	
prior threshold	*06*	*ECO_SYS*	
TurnOff Delay	*05 s*	*ECO_SYS*	
Input/Output *2 ... 5*	*reg reg*	*ECO_GATE*	
Eval. pulse input	*only display*	*ECO_GATE*	evaluation of pulse input
Prior	*01*	both	channel parameter *1 ... 8*
MinOn	*00m03s*	both	for all channels

Name of the parameter	Assigned value	Devices	Comment
MinOff	*00m03s*	both	for all channels
MaxOff	*19m59s*	both	for all channels
Nomp Tariff 1	*010,0 kW*	*ECO_SYS*	
Nomp Tariff 2	*010,0 kW*	*ECO_SYS*	
Set points (NomP *01 ... 96*)	*010,0 kW*	*ECO_SYS*	
timers (Action)	*deact.*	both	for all channels
timers start time (Sta)	*00:00*	both	for all channels
timers stop time (Sto)	*00:00*	both	for all channels
timers start date	*01.01.*	both	for all channels
timers stop date	*01.01.*	both	for all channels
MSR-algorithm	*ILL*	*ECO_SYS*	integrated load limiter method
Management	*tariff managem.*	*ECO_SYS*	
Language	*Deutsch*	both	
Daylight saving	*on*	both	*ECO_GATE = off*
trigger SYNC	*external source*	*ECO_SYS*	
trigger Clk-sync	*no ext. source*	*ECO_SYS*	

Table 11: Factory Defaults

5 Technical Data

This section describes the technical data of the *ECO_SYS* and the *ECO_GATE*. Both devices meet the following specifications.

Mechanical Specification

- Housing with self-extinguishing plastics, protection class IP40
- Mounting on profile rail TS35 according to EN 50022
- Mounting position: catch down
- Direct contact protected connectors, protection class IP20
- Recommended / maximal length of skinning: 6 mm / 9 mm
- Cross sections for connectors
  - Flexible without cable bushings 2 x 0,5 to 1,5 mom, 1 x 2,5 mom
  - Inflexible with cable bushings 1 x 1 to 2,5 mm²

Environmental Conditions

- Ambient temperature 0℃ to +50℃ (in operation)
- Store/transport temperature -25℃ to +70℃
- Relative humidity 15 % to 85 % (confirms to IEC 721-3-3 class 3K3)
- Pollution degree 2, mounted 3 (according to IEC 60664-1)

Power Supply

- Voltage 110 V ... 240 V, AC +10 % / -15 %
  - (Connectors *A1* and *A2*) 110 V ... 300 V, DC +10 % / -15 %
- Earthing To be EMC compatible
- Own consumption max. 3,6 W (55 mA @110 V, AC, 30 mA @240 V, AC)
- Current consumption max. 100 mA @110 V, max. 50 mA @240 V
- Duty ratio 100 %
- Nominal voltage of isolation 300 V
- Peak voltage 4 kV
- Minimal electrical strength to other circuits
  - 3000 V, AC/1 min (enhanced isolation according to EN 60950)

Inputs

The minimal electrical strength to other switching circuits is 500 V.	
The digital inputs are connected internally via the connector labelled ⊥ (ground).	

Inputs of the *ECO_SYS*

- *PWR*
  - Function Power pulse output of an energy meter
  - Connection Zero potential
  - Type S0 (according to DIN43864)
  - Sensing current 12,5 mA, DC
  - Sensing voltage 15 V, DC
  - Allowable fluctuation +10%
  - Frequency max. 50Hz
- *SYNC*
  - Function Pulse for synchronisation from the grid operator
  - Connection Zero potential
  - Type S0 (according to DIN43864)
  - Sensing current 12,5 mA, DC
  - Sensing voltage 15 V, DC
  - Allowable fluctuation +10%
  - Frequency Pulse 6 s (nominal) each 5 ... 99 min
- *TAR*
  - Function Changing tariff input from the grid operator
  - Connection Zero potential
  - Type S0 (according to DIN43864)
  - Sensing current 12,5 mA, DC
  - Sensing voltage 15 V, DC
  - Allowable fluctuation +10%

- *CLK (optional)*
  - Function Synchronisation of the clock
  - Connection Zero potential
  - Type Current loop
  - Sensing current 6,25 mA, DC
  - Sensing voltage 15 V, DC
  - Allowable fluctuation +10%
- *MOFF (optional)*
  - Function Turn off all loads immediately
  - Connection Zero potential
  - Type Current loop
  - Sensing current 6,25 mA, DC
  - Sensing voltage 15 V, DC
  - Allowable fluctuation +10%

Inputs of the *ECO_GATE*

- *PWR*
  - Function Power pulse output of an energy meter
  - Connection Zero potential
  - Type S0 (according to DIN43864)
  - Sensing current 12,5 mA, DC
  - Sensing voltage 15 V, DC
  - Allowable fluctuation +10%
  - Frequency max. 50Hz
- *Inputs IN1 ... IN5*
  - Function Effects the outputs 1 to 5 according to the parameters
  - Connection Zero potential
  - Type Current loop
  - Sensing current 6,25 mA, DC
  - Sensing voltage 15 V, DC
  - Allowable fluctuation +10%

Outputs

- 8 zero potential make contacts *(1 ... 8)*
  - Details regarding the settings see chapter 3.3
  - Breaking capacity 230 V, AC maximum of 3A
- 1 zero potential change-over contact (F)
  - Function Notice of malfunction summary
  - Breaking capacity 230 V, AC maximum of 3A
- Breaking capacity max. 690 VA (230 V, AC / 3 A)
- Mechanical durability 20 x 106 switching cycles
- Electrical durability 2 x 105 switching cycles with an ohm resistive load
- Operating cycles (according to IEC 60947-5-1)
  - max. 60/min with 100 VA, ohm resistive load
  - max. 6/min with 1000 VA, ohm resistive load
- Nominal voltage of isolation 250 V
- Minimal electrical strength to other circuits
  - 1500 V, AC / 1 min (basic isolation according to EN 60950)

RS485 Interface

The serial two-wire interface (*RS485*, *A* = *RS485+*, *B* = *RS485-*) of the *ECO_SYS* is used to extend the energy management system. External components like the *ECO_GATE* can be connected. Additional the connection of a PC is supported (requires a converter from *RS485* to *RS232*, which is not part of the delivery). The interface fulfils the following specifications:

- Specification *RS485*
  - Reference potential Connector *GND* (see chapter 1.4)
- Partner settings 1 ... 32
- Master settings 1 ... 5
- Power supply output 24 V DC, load capacity 100 mA

6 Tables

The additional tables of the user manual are listed within this section.

6.1 Abbreviations

The following abbreviations are used within this document:

A	Ampere
AC	alternate current
act	current
CH	channel
Clk	clock, input to synchronise the time
DC	direct current
DCF77	Reference for clock synchronisation: *D* for Germany, *C* as identification of the transmitter and *F* for the location near Frankfurt; *77* regarding to the used frequency of 77,5 kHz
deact	deactivated, deactivation
dev	device
eval	evaluation
ex-dyn	external and dynamic
ex-st	external and static
ext.	external or extension
FAQ	frequently asked questions
Fri	Friday
GND	ground
h	hour
HT	high tariff
Hz	Hertz
ID	identification
ILL Method	integrating load limiter method (see chapter 1.6.1)
IN	input
ISO	International Organization for Standardization
m	minute
MA	master
max	maximal
min	minimal or minute

MOFF	Master Off, input to turn of all consumer loads at once
Mon	Monday
No	number
NT	low tariff
OE	output extension
Pact	actual power
per	period
Prior	priority
P	power
remt	remaining time
RS485	interface for the data communication
RTC	real time clock
s	seconds
Sat	Saturday
Sun	Sunday
Sta	start
Sto	stop
SYNC	synchronisation
t	time
TAR	tariff input
Thu	Thursday
transf	transformer
Tue	Tuesday
Wed	Wednesday

6.2 Illustrations

6.3 Tables