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Product Description

Energy Management System

ECO-8III

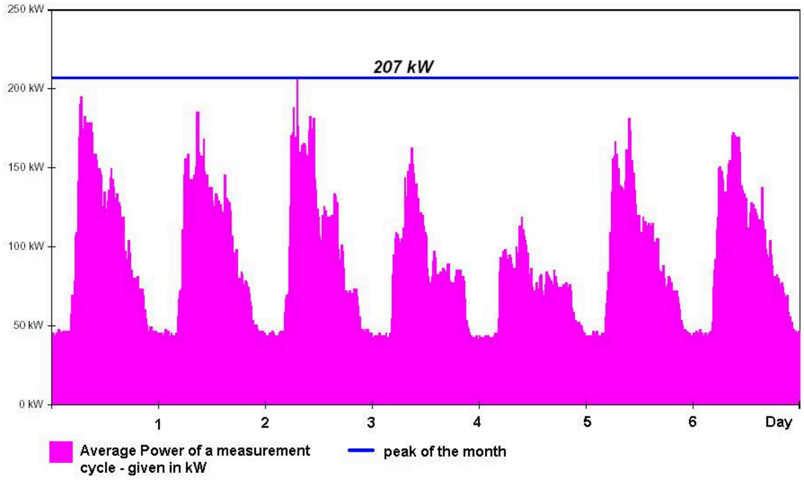
Peak Load – Power Demand Optimising System for facilities up to 1MW

Automation Components

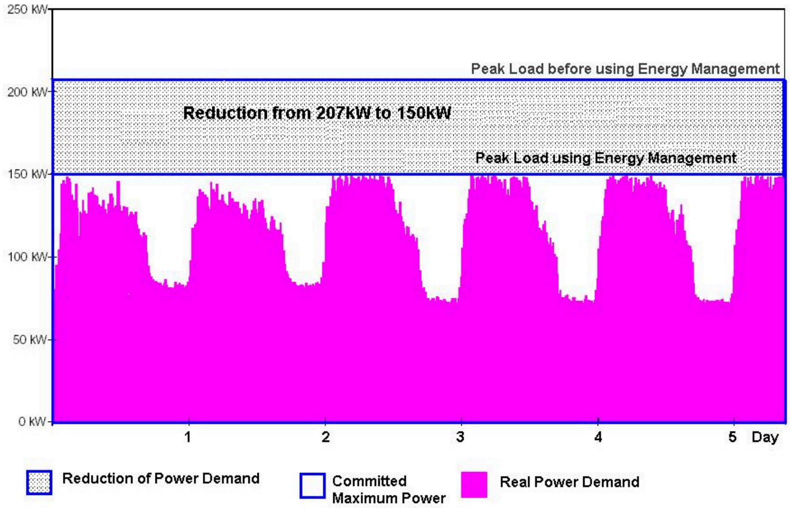
Content

1 Principal of functionality

The Power demand of an electrical plant always varies with time. There are periods of high and periods of low power demand. As a matter of fact, day demand lines as shown below reoccur periodically:



Because the electrical grids must be dimensioned to the highest demand that can occur, the costs of the grid are calculated by the highest peak demand at the customer. Usually smaller plants are classified in a flat tariff without metering the power demand. Plants with a higher delivery rate are equipped with an energy meter including a peak load detection. The peak load is determined by the load which is simultaneously switched on. Thanks to an energy management system, peak loads can be reduced substantially.



This can be done by postponing energy demand of certain electrical loads into time periods with lower power demand. Loads which have the ability to store energy, e.g. in the form of thermal energy (heating, coldness, frostiness), pressure, height (Level) etc. are very suitable for this purpose. But also loads which do not have this ability can be taken into account of energy management, delaying the demand into periods of lower power consumption.

1.1 Integrating Load Limiter [1]

The algorithm works with a turn on and a turn off limit (see Figure 1-1). The behaviour of energy consumption should vary between these two limits. If the turn off limit is exceeded, load will be switched off, until the curve falls down below this limit. When the turn on limit is reached, load will be switched on again. The angle between the turn on and turn off limit is adjustable. Therefore a span can be defined, designated as parameter “d” in Figure 1-1.

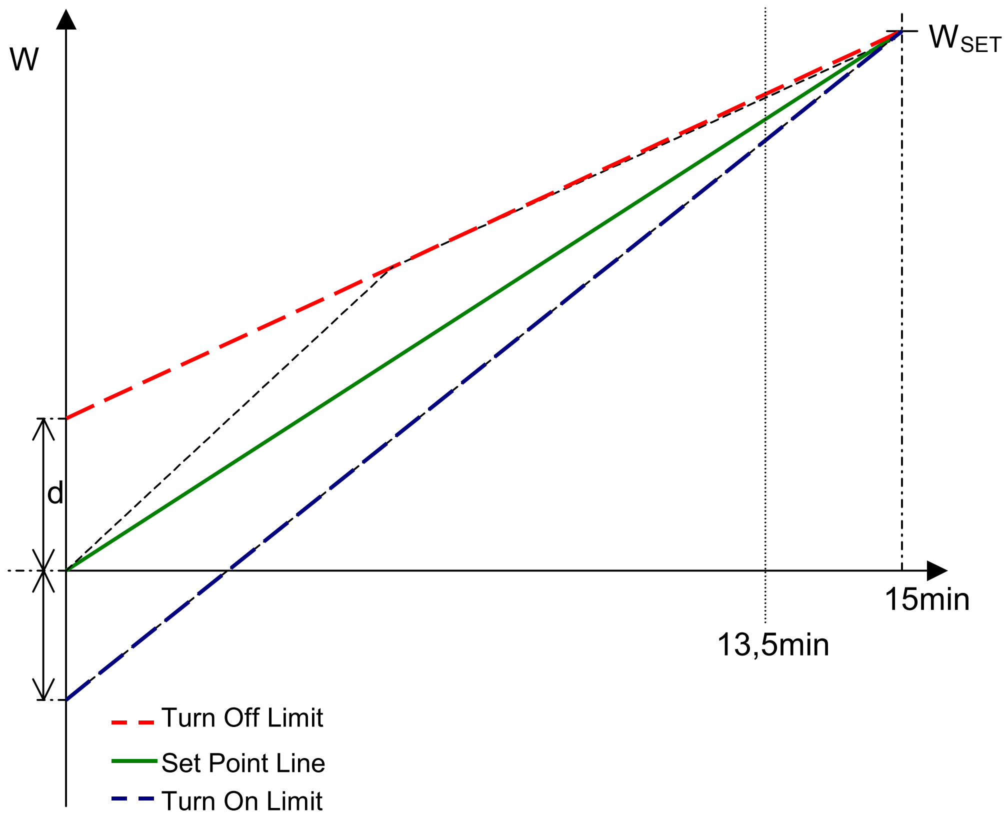


Figure 1-1 regulating algorithm of the integrating load limiter

If 90% of the time in a measurement period has been reached load is only switched on if the power demand is below 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] Integrating Load Limiter: optimisation method building integral of power for trend analysis

1.2 Energy Estimator Method

For the Energy Estimator Method the actual active power needs to be known. It can be calculated from the time period between two power pulses from the energy meter.

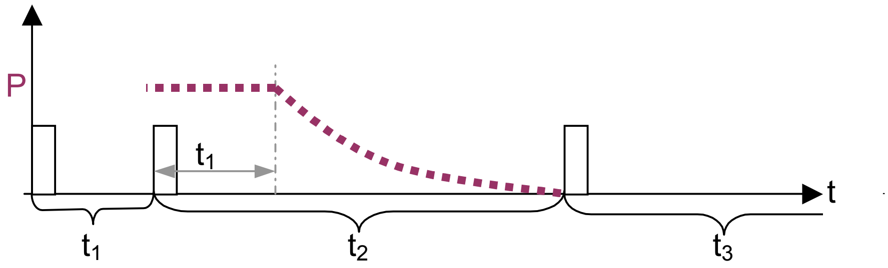


Figure 1-2 Calculating the active power

In the period t_2 the active power will be displayed proportional to the length of the period t_1. If period t_2 exceeds the duration of t_1, the displayed power will be calculated again due to the longer time period (active power is a reciprocally function of time). With the next impulse a period t_3 is started, where the power is displayed proportional to the length of t_2 , and so on…

Due to the elapsed time and the cumulated energy W_C a **disposable power** P_{DIS} can be calculated, with which the energy can be consumed, without exceeding the energy limit of a measurement period.

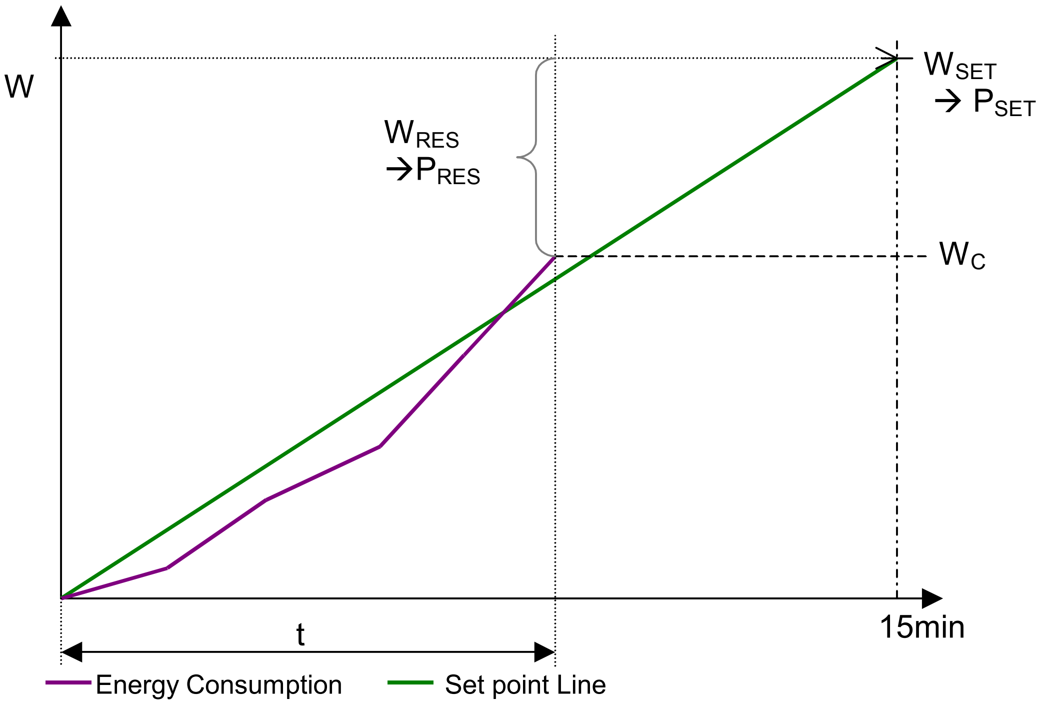


Figure 1-3 regulating algorithm according to the energy estimator method

$$P_{RES} = P_{SET} - \frac{W_C}{t} \qquad P_{DIS} = P_{SET} + P_{RES}$$

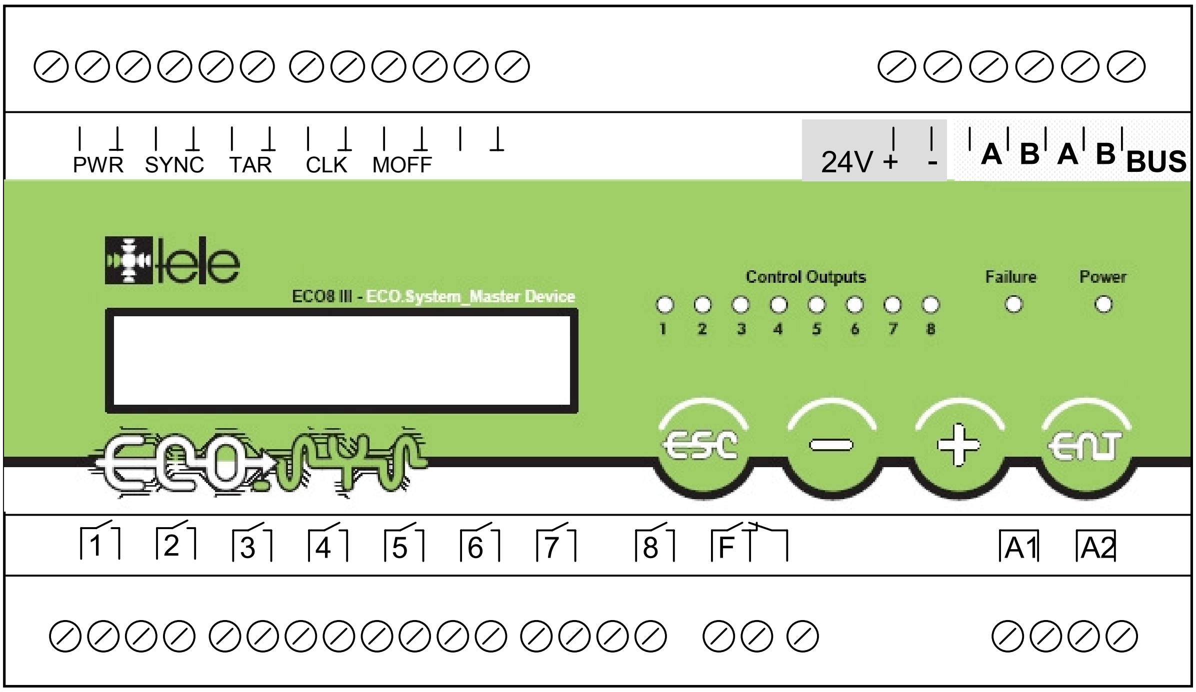
The disposable power is always the basis for the decision to turn on or turn off load groups. If residual power gets negative (more consumption than scheduled), the disposable power can get lower than the nominal power. The active power is calculated as shown in Figure 1-2 . If active power exceeds the disposable power, load must be turned off.

1.3 Active power limiting

This method will limit the active power below the nominal power, within time tolerances, to avoid reaction of overload protection equipment. Mathematically this method complies to the energy estimator method with a residual power of 0 kW.

2 System Components

2.1 EcoSys



EcoSys is the energy controller in the system. *EcoSys* can be combined with up to seven Output Extensions.

2.1.1 Functionality

EcoSys calculates the energy consumption within a defined time period, which is specified by the local grid operator. For this reason it synchronizes itself either with the synchronic impulse of the grid operator or the internal real time clock. Information about the present situation of energy consumption can be acquired with the power pulses coming from the pulse output of an energy meter.
By adequate setting of the parameters impulse value and transformer ratio, *EcoSys* can be configured to every combination of energy meter and instrumentation transformer. *EcoSys* uses the controllable load to regulate the power demand below the adjusted set point. Therefore it can administer the demand of up to 64 load channels (in combination with up to seven Output Extensions *EcoGate*). For processing the optimisation there are three different algorithms available (see Chapter 1.1 to 1.3)

2.1.2 Inputs

➜ **Power Pulse Input PWR**

Function:	Input for the power pulse output of an energy meter
Connection:	potential free
Type:	S0 (according to DIN43864)
Sensing current:	12,5mA DC
Sensing voltage:	15V DC
Allowable fluctuation:	+10%
Input frequency:	max. 50Hz

➜ **Control Input SYNC**

Function:	Synchronic impulse from the grid operator
Connection:	potential free
Type:	S0 (according to DIN43864)
Sensing current:	12,5mA DC
Sensing voltage:	15V DC
Allowable fluctuation:	+10%

➜ **Control Input TAR**

Function:	changing tariff from grid operator
Connection:	potential free
Type:	S0 (according to DIN43864)
Sensing current:	12,5mA DC
Sensing voltage:	15V DC
Allowable fluctuation:	+10%

➜ **Control Input CLK (optional)**

Function:	Synchronising the clock
Connection:	potential free
Type:	current loop
Sensing current:	6,25mA DC
Sensing voltage:	15V DC
Allowable fluctuation:	+10%

➜ **Control Input MOFF (optional)**

Function:	turn off all load channels immediately
Connection:	potential free
Type:	current loop
Sensing current:	6,25mA DC
Sensing voltage:	15V DC
Allowable fluctuation:	+10%

2.1.3 Outputs

- **8 potential free make contacts**

Function:	Controlling of power demand
Minimum ON Time:	0min 0s - 19min 59s
Maximum OFF Time:	0min 1s - 19min 59s
Minimum OFF Time:	0min 1s - 19min 59s
Switching capacity:	230VAC/3A

- **1 potential free changeover**

Function:	Failure Signal
Switching capacity:	230VAC/3A

2.1.4 Power Supply

- Variant A: Single Supply Range 230V, 110V
- Variant B: Wide Supply Range 110 -240VAC 50/60Hz, 110-300VDC
- Variant C: Wide Supply Range 18-36VDC or 9-36VDC

2.1.5 Bus Interface

The bus interface permits *EcoSys* to extend with external components. Such Components are e.g. the Output Extensions *EcoGate* , a coupling module to a PC or a terminal module for visualisation.

Interface Type:	RS485,
Attendee settings:	1 to 32
Master settings:	1 to 5
Power Supply Output:	24V 80mA / 100mA for Wide Supply Range

2.1.6 Controller Settings

To get correct measurement values some general settings must be done. To arrange optimising of power consumption with proper operation of the plant, there are some additional separate parameter settings for each load channel provided. They are called blocking time because the channel is blocked for the regulation.

Priority

The priority determines the order of load channels switched off if the power demand is too high.
In this context 1 is the highest priority, i.e. it is most important. Therefore it will be turned off as the last channel. The energy control system starts to turn off load channels always at the lowest priority. Each load channel can be parameterised with a priority between 1 and 64.

Transformer Ratio

Transformer Ration of the current transformer, e.g. 600A/5A= 120

Impulse Value

Quantity of Energy represented by one pulse, e.g. 1Wh/pulse (=1000 Pulses/kWh)

Measurement cycle

Time period for calculating average power, specified by the grid operator.
Adjustable length of period:
5; 10; 15; 20; 30; 40; 45; 60; 80; 90;

A Separate set point for each cycle can be adjusted only for measurement cycles equal or greater than 15min.

Blocking Time for each channel:

Minimum ON Time

If the maximum off time in case of power regulation has been exceeded, the load channel must be turned on for this fixed time interval before it can be turned off again.

Maximum OFF Time

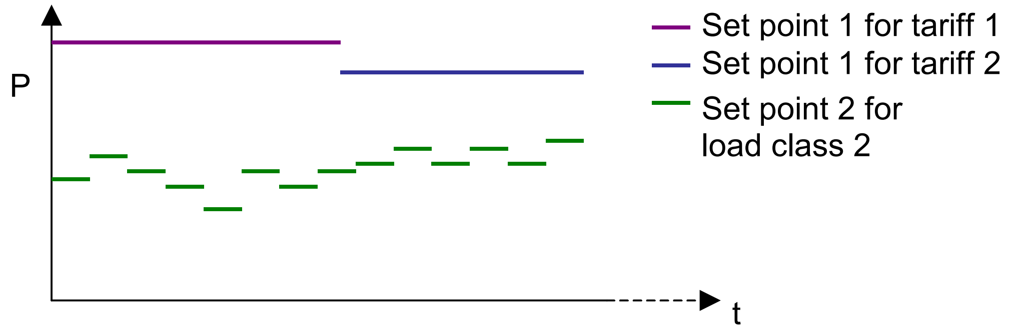
Maximum length of a time interval a load channel may be turned off by the regulating system.

Minimum OFF Time

Fixed time period a load channel has to be turned off, if it was once turned off by the regulating algorithm.

2.1.7 Set point settings

The system can be optionally operated with one or two set points for each measurement cycle. One of the set points which can be assumed as fixed, may be influenced by the tariff input. The other set point (2) varies with the time. For each measurement cycle a separate set point may be adjusted.
Splitting the set points may be used to manage an energy contract with an alternative supplier or simply to get a level of warning.



Using both set points two classes of load groups needs 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.

If a set point is changed by the user, the new value will be used when the next period starts. The actual set point can also be changed dynamically using the bus interface.

2.1.8 Synchronizing the measurement cycle

Synchronising the measurement cycle with the grid operator can be done in two different ways:

- ➜ Externally with an impulse from a ripple control receiver giving an impulse on the SYNC Input
- ➜ Internally using the Real Time Clock

When using the SYNC-Input, synchronic pulses are only accepted in a certain time area. If once a synchronic pulse is missing longer than 3s, an internal synchronic pulse is generated with a warning.

If synchronization using the real time clock is chosen, the synchronic pulse is always generated internally when a new measurement cycle is starting.

After Power Up the device begins with registration of the current measurement cycle. Afterwards it is starting normal operation.

2.1.9 Real Time Clock

The system devices of ECO-8III has a built in real time clock as a standard equipment. The real time clock can be re-triggered with the control input CLK to avoid a long term drift.

2.1.9.1 Re-trigger using the SYNC-Impulse

The synchronic impulse of the grid operator is used for re-triggering every full hour. This option may only be used if the synchronic impulse is available and reliable enough to be considered as accurate. Clock time pre-adjustment must be done with a maximum inaccuracy of ±5 minutes.

2.1.9.2 Re-trigger using the CLK-Input

The clock can be re-triggered every full hour using the control input CLK. The signal may be generated by a radio controlled clock. This is especially useful, if the synchronic impulse from the grid operator is not available.

2.1.9.3 Using no re-trigger option

Clock is running with quartz crystal precision. No synchronising to the official clock time occurs.

2.1.9.4 Daylight saving time

Automatic switching into the daylight saving time is available.

2.1.10 Data Logger

EcoSys is equipped with an internal data logger, recording the most important energy data of a system. Therein the data from the last and the current month are stored in a non-volatile memory. As a consequence, there is one months time to read out the data from the internal logger and store it on a backup system. The data space gives the following information for each day:

- Total Average Power (i.e. the consumed energy)
- Average Power, not exceeding set point2
- Maximum cycle average power of the day
- Time and date stamp from the maximum of the day
- Set point1 when maximum occurred
- Set point2 when maximum occurred

2.1.11 Master OFF

EcoSys is equipped with a digital input, including the Master OFF function. This means, if the input is activated (i.e. the input terminals are shorted), all load channels in the system will be turned off immediately. This action has precedence against all other configuration settings.

2.1.12 Timer

For each load channel, up to seven time blocks with a certain behaviour of the output may be defined. As a matter of fact, it is possible to create up to 56 time blocks for a device. The action in the time block can be configured as follows:

- Channel fixed switched ON
- Channel fixed switched OFF
- Changing priority of the load channel

Further more, it is possible to create time blocks by date or by day of week. Time blocks created by day of week will be repeated every week. The time block is defined by a starting time at a certain day of week and a stopping time, also with an appropriate day of week. There must not be any conflict between the time blocks created by day of week.

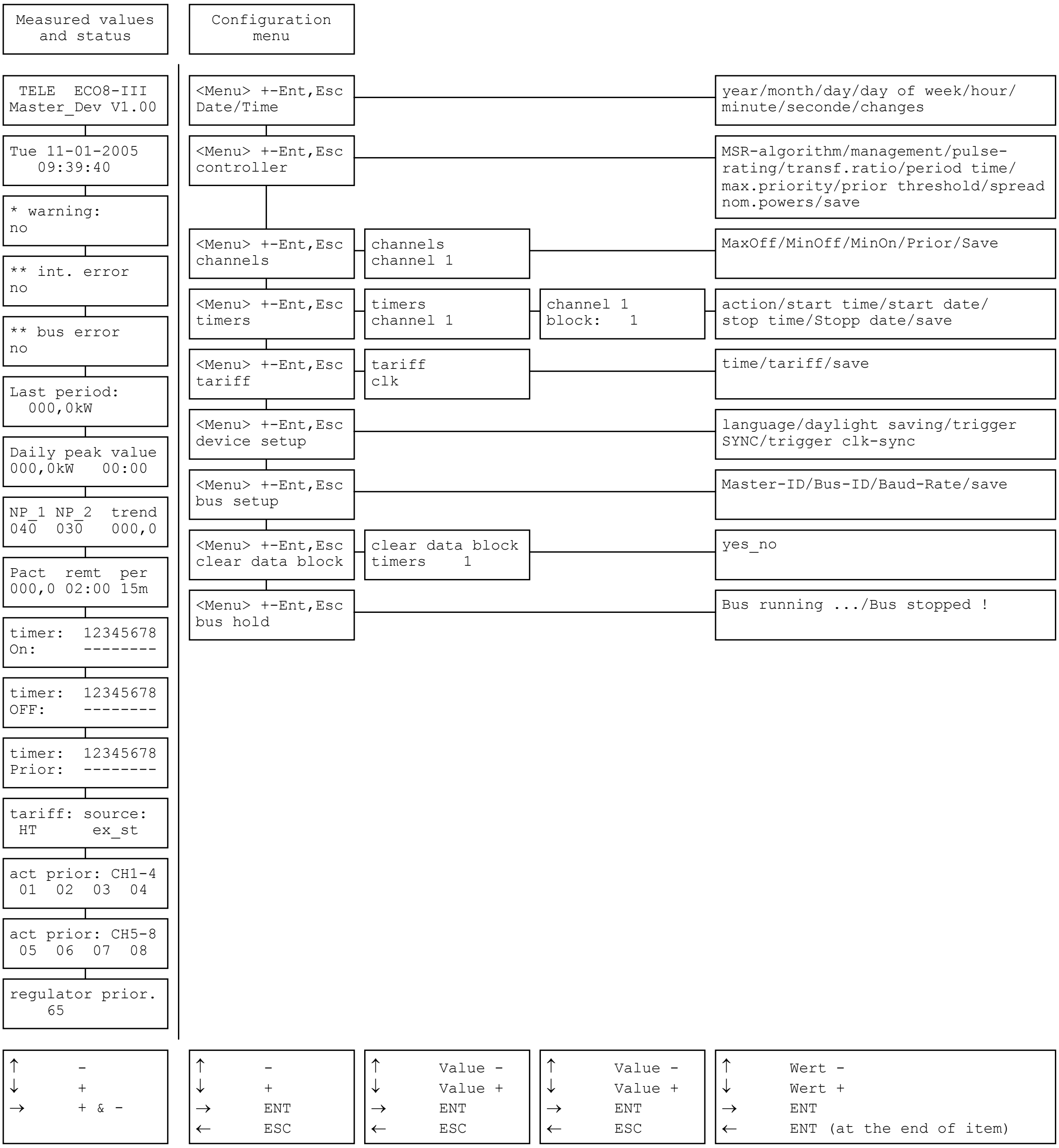
Creating time blocks by date, the desired action is only done in a time period between the starting date/time and the stopping date/time. A conflict between a time block created by date/time and a time block created by day of week is permissible. In this case, time blocks created by date/time has precedence against any time block created by day of week.

The following table shows an example for building blocks at any load channel (1 to 8):

Time Block	Channel x (1-8)	Action
1	Mo 10:30 - Mo11:00	Priority 1
2	Tue 10:45 – Tue 11:15	ON
3	We 17:00 – Thu 08:00	OFF
4	Thu 12:00 – Thu 13:00	ON
5	Fr 10:00 - Fr 10:45	ON
6	30.03.07:00-02.04.13:00	OFF
7	----	DEACT

2.1.13 Parameter settings

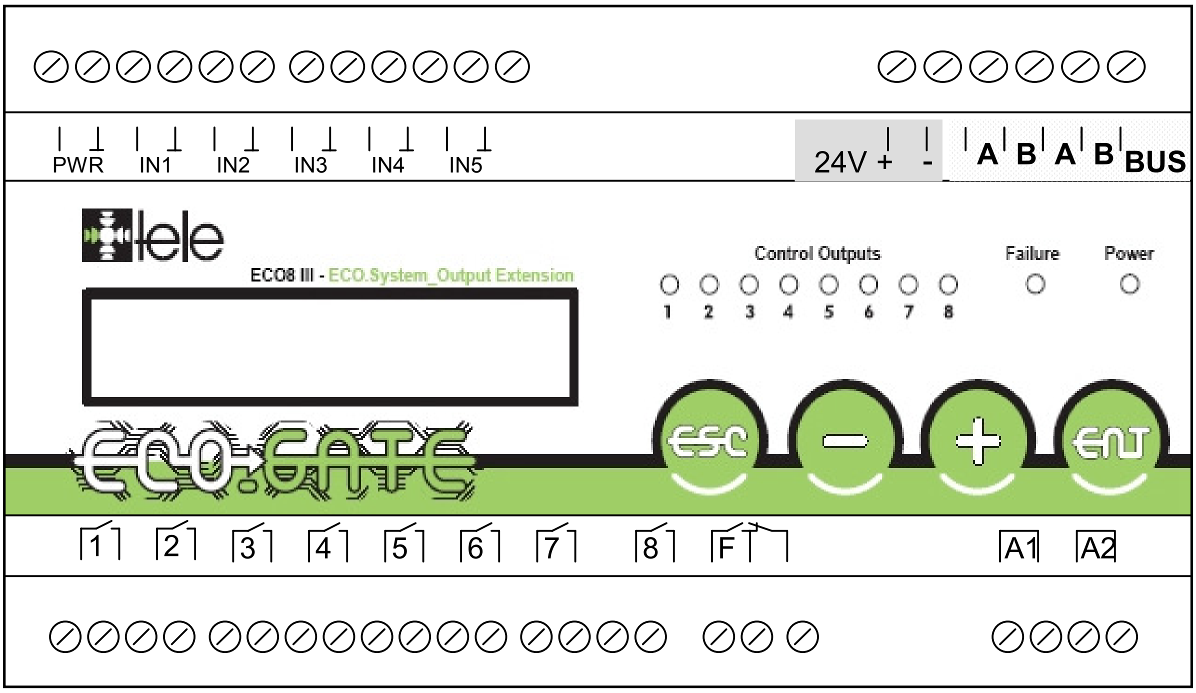
The parameter settings may be done direct on the device or by configuration software with a PC. Parameter settings direct on the device is possible with a structured menu:



Key combinations:
+ and - ... Enter to menu at parameter settings (press both keys for 3 seconds)
ENT and ESC ... Jump to the end of the menu item (only for menu item “controller”)

EcoSys can always be reset back to factory settings in the menu item “clear data block”. The data from the internal data logger will be kept unchanged in the non volatile memory.

2.2 EcoGate



2.2.1 Functionality

EcoGate receives its data for operation from the bus. From this data, the channels to be switched on or off are apparent in priority levels. Load channels with a lower priority than the current priority level will be used for power demand regulation. Those with higher priority will not be affected. With this data, in combination with the configuration settings, it is apparent to the device which channel has to be switched on or off.

Further more operational data like active power, set points and trend of energy consumption is shown on the display.

2.2.2 Inputs

➜ **Power Pulse Input PWR**

Function: Input for the power pulse output of an energy meter
Connection: potential free
Type: S0 (according to DIN43864)
Sensing current: 12,5mA DC
Sensing voltage: 15V DC
Allowable fluctuation: +10%
Input frequency: max. 50Hz

The power pulse input may be used in two different ways. This can be configured in the menu item “controller”. It can be used to interpret power pulses from a sub-metering station, only displaying the active power from this sub energy meter. In this case, power data from the pulse input will not be transmitted to the Master Device *EcoSys*.

The input can also be configured to integrate an additional energy interface to the electric plant. In this case, the captured amount of energy is transmitted to the Master Device. It will there be summarized to the total amount of energy. Using this modus only the ILL method for optimising should be applied.

➜ **Control Input IN1 to IN5**
Function: acts to the output 1 to 5 acc. configuration
Connection: potential free
Type: current loop
Sensing current: 6,25mA DC
Sensing voltage: 15V DC
Allowable fluctuation: +10%

The effect from the inputs 1 to 5 to the load channels can be configured in the menu item "I/O-control". Combinations for each load channel are available as shown in the table below:

Configuration	Input open	Input shorted
Effect for load channel	Controlled	Controlled
	Controlled	ON
	Controlled	OFF
	ON	Controlled
	OFF	Controlled
	ON	OFF
	OFF	ON

2.2.3 Outputs

➜ **8 potential free make contacts**
Function: Controlling of power demand
Minimum ON Time: 0min 0s - 19min 59s
Maximum OFF Time: 0min 1s - 19min 59s
Minimum OFF Time: 0min 1s - 19min 59s

Switching capacity: 230VAC/3A

➜ **1 potential free changeover**
Function: Failure Signal
Switching capacity: 230VAC/3A

2.2.4 Power Supply

➜ Variant A: Single Supply Range 230V, 110V

➜ Variant B: Wide Supply Range 110 -240VAC 50/60Hz, 110-300VDC

➜ Variant C: Wide Supply Range 18-36VDC or 9-36VDC

2.2.5 Bus Interface

Interface Type:	RS485, see chapter bus system
Attendee settings:	1 to 32
Master settings:	1 to 5
Power Supply Output:	24V 80mA / 100mA for Wide Supply Range

2.2.6 Controlling parameters

Each *EcoGate* has specific controlling parameters. These parameters are administered autonomously. They only contain information about the time slots the channels may be switched on or off. They are called blocking time because the channel is blocked for the regulation. These parameters are similar to those of *EcoSys*:

Priority

Minimum OFF Time

Maximum OFF Time

Minimum OFF Time

The master device in the system has no influence to the blocking time of the output extensions.

2.2.7 Real Time Clock

EcoGate is equipped with a real time clock. The device synchronizes itself to the clock time of the Master Device every full hour.

2.2.8 Timer

The timer function is for *EcoGate* as well available as for *EcoSys*. It is also possible to create seven blocks of time periods for each channel. The parameters of the timer are administered autonomous by the Output Extension. Action is taken independently from the regulation algorithm.

2.2.9 Output Forcing

To force the output channels directly, five input channels are provided. As a matter of fact, the status of the appropriate output relay can be influenced by an external sensor (see Control Inputs IN1 to IN5)

3 Bus System Interface

The bus interface is established to connect external components to the energy controller *EcoSys*. It is part of the modular concept for a profound energy management system. The interface is designed as a serial two wire bus system using elements of Modbus® protocol.

The hardware structure needs one trunk cable, along which devices are connected directly at the bus terminals. The physical layer is implemented as a two wire bus system, according to the Modbus® standard (see [2]). For certainty of the transmission of signals, the devices should be connected together using the ground terminal.

3.1.1 Protocol Description

The messages are constructed according to the Modbus® Application Protocol Specification V1.1, issue 6. December 2002 [1].

3.1.2 Access method

The access to the participants is going on into two steps. Addressing a slave (server), the master, which acts as a client, first checks out which data has to be updated. On the second step data is exchanged between client and server.
Each Slave has several 16-Bit Modbus-registers for controlling data transfer with the master. The control register starts in the address space at address F000h.

Control Reg.	Address	Topic of the register	Feasible values
1	F000h	Starting address read	0000h-EFFFh
2	F001h	Starting address write	0000h-EFFFh
3	F002h	Number of registers. read/write	0000h-2020h
4	F003h	Master register	0000h-0005h
5	F004h	Token register	0000h-0005h
6	F005h	Date Year	07D0h-0833h
7	F006h	Date Month : Day	0101h-1F0Ch
8	F007h	Time Hour : Minute	0000h-173Bh
9	F008h	Time Second: Day of week	0001h-3B07h
10	F009h	Baud Rate	
11	F00Ah	Bus Stop	
12	FFFFh	Dummy Register	---

Table 3-1 Meaning of Control Register

Addresses F000h and F001h contain the starting address for the read- and write operation at the second access step. The High Order Byte (HOB) of Address F002h contains the number of bytes to write, the Low Order Byte (LOB) contains the number of bytes[2] to read from the slave (server).

The master uses for access the function code “read holding register 03h” and the combined read/write execution code 17h only. (see. [1], page 12). The combined read/write command executes the write action at first. The data structure uses only the holding register from the Modbus® data model.

If a Slave wants to transmit data to the master, the starting address of the data block he wants to send to must be written to the register F000h. The length of the data block has to be written to the

[2] The length of transmission blocks is limited to 32 words (64 Bytes)

LOB on address F002h. In a transaction access the master is reading the data block beginning with the starting address, processing the data in its own memory.

If a slave wants to update a data block, the starting address of the data block it needs to get from the master has to be written to the address F001h. The length of the data block must be written to the HOB of address F002h. When the next access takes place, the master will write the updated data in the specified segment. An access between the master and each slave occurs cyclic.

If a slave does not want to transfer data (no need to receive, to send, or both), a dummy register can be addressed writing FFFFh to the control registers F000h and/or F001h.

Note: If the dummy register is addressed, the number of bytes has be set to 1.

The content of each address in the Modbus address space has a unique meaning for all participants in the bus system. Data transfer takes place using two steps:

First Step

The master wants to read the registers F000h to F003h from the addressed slave. Therefore it sends the function code 03h with the starting address F000h and a specified length of 4 registers to the slave. The slave responds with the content of the addresses F000h to F003h (8 Bytes), sending it to the master in a Modbus application data unit.

Now the master prepares a data unit for the second step of the access. Therefore it has to provide all the data necessary for the writing action.

If a participant needs no data exchange, the dummy address FFFFh has to be used. The value inside this data address is of no relevance.

Second Step

The master transfers with the combined write/read operation code 17h the requested data which has to be written to the slave as well as the starting address and the length of the data block he wants to get from the slave. The slave processes the received data and replies with transmission of the requested data for the read operation. With this action a write/read access is completed.
Figure 3-1 shows the principle sequence of a data transfer between master and slave. Therein the single PDU[3]'s are sketched simplified:

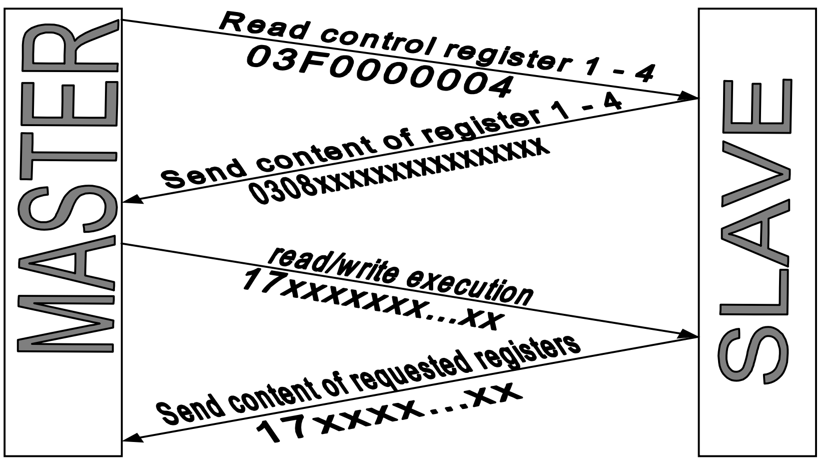


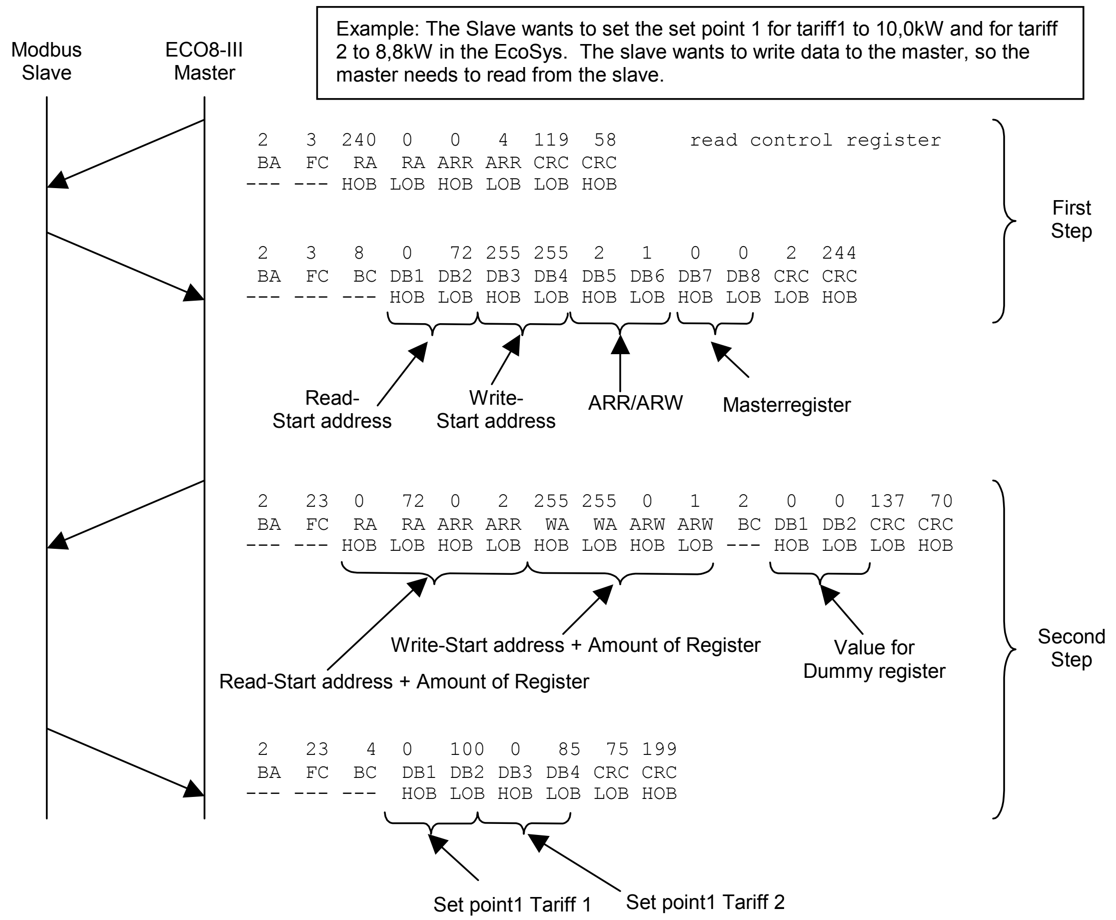
Figure 3-1 cyclic access to a bus participant

[3] PDU Protocol Data Unit

3.1.3 Examples for Two Step Access

Example 1:

A Modbus Slave with the bus address 2 needs to change the set point 1 for both tariffs. The values are stored one after another (4 Bytes) in the internal EEPROM starting at Modbus address 72dez. Because the slave only wants to transfer data to the master, the master will write only to the dummy register of the slave.




```
 BA ... Bus Address
 FC ... Function Code
 RA ... Reading address
ARR ... Amount Register Reading
 WA ... Writing Address
ARW ... Amount Register Writing
 BC ... Byte Count
DBx ... Data byte X
```

All Values are shown in decimal format

Figure 3-2 Example for Access “Write to the master”

Example 2:

A Modbus Slave with bus address 2 needs to read set point 1 for both tariffs. The values are stored one after another (4 Bytes) in the internally EEPROM starting at Modbus address 72dez. Because the slave does not want to transfer any data to the master, the master reads only from the dummy register.

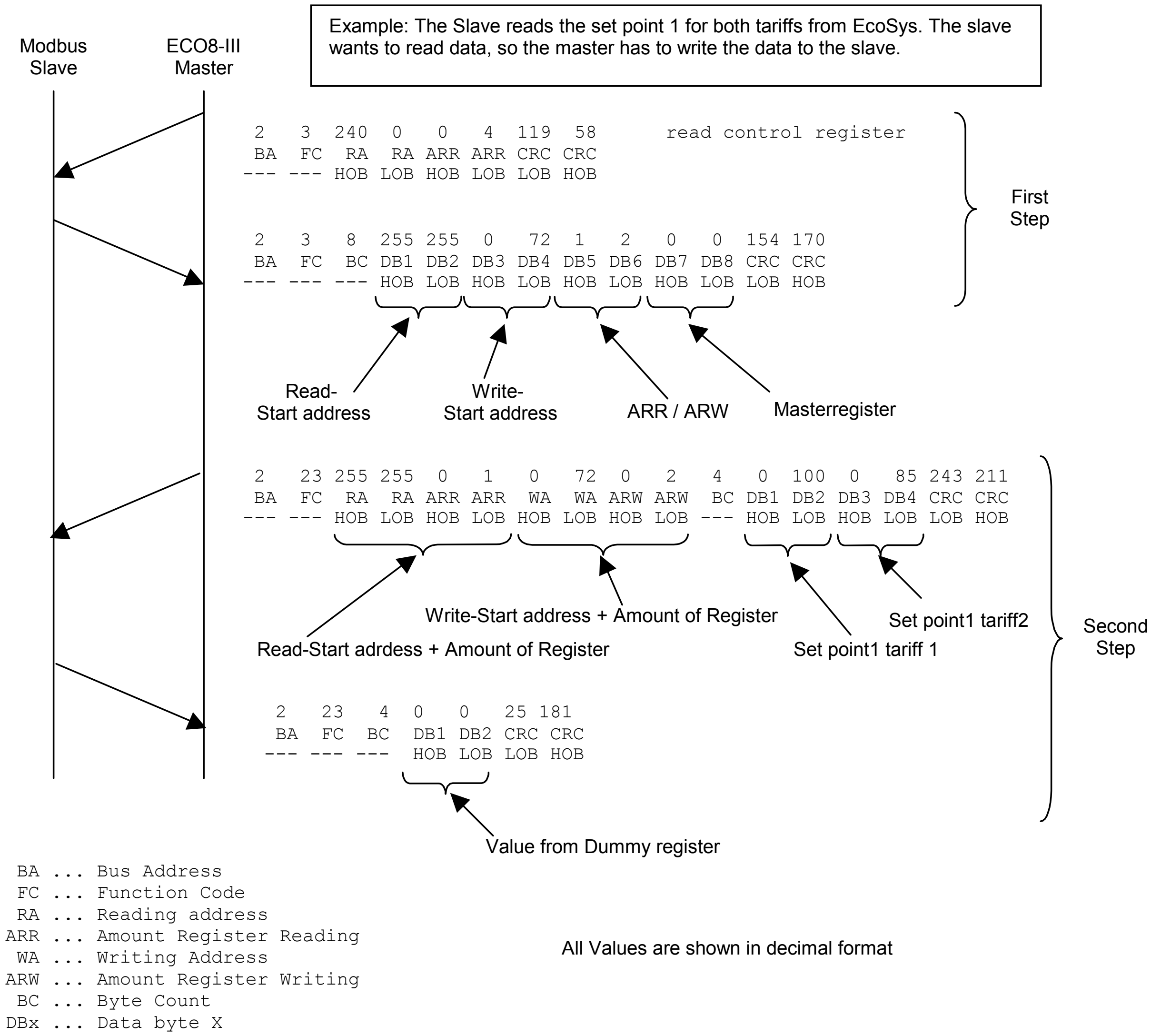


Figure 3-3 Example for Access "Read from the master"

3.1.4 Multi Master Control

The access protocol permits operation of several masters on the same bus line. At step 1 of an access the master register is transferred to the current master. As a consequence, the master can recognize which participants on the bus are able to become a master. If the master register contains the value Zero, the participant can only act as a slave. If the content of the master register is unequal to Zero, the value is considered as a master number. Each participant of the bus system needs a unique bus address, also those who can become a master.

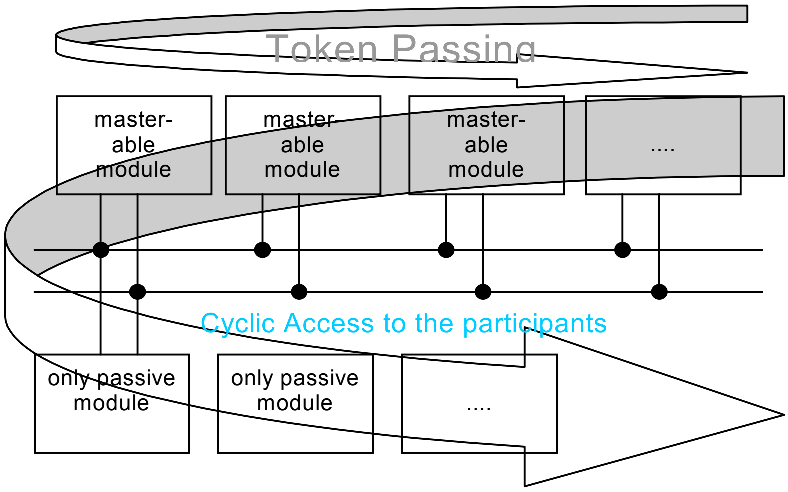


Figure 3-4 Structure of processing the Bus Protocol

Addressing is going on in a ring-structure, starting with the next higher address than the own one. Thereby the requests of the participants are processed. The Master sequentially increments the bus address, processing requests of the participants until no answer is coming (i.e. a module with this address is not present). Then the master continues with the bus address 1, addressing the participants until the own bus address is reached. During processing the data transfer to each participant the current master recognizes which modules are able to become a master.

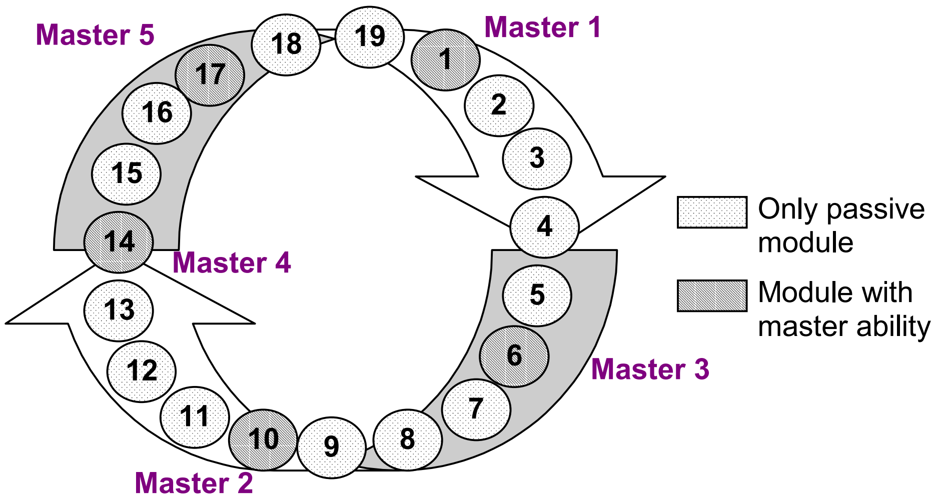


Figure 3-5 Sequence to address modules

Now the token will be given to the next master (if present). The current master will give the token to a master-able device situated next to him in the address ring.

Example (see Figure 3-5):
Master 3 with Bus-ID 6 gets the token with the broadcast. Therefore it starts processing requests at address 7. It proceeds up to address 19, tries to address 20 and 21, getting no answer from the last two addresses. So it continues with address 1 until it has finished processing Bus-ID 5. During processing the bus members it has recognized that the module with master number 2 and Bus-ID 10 is the master next to it. As a consequence it sends a broadcast to all participants to set the token register to the value 2. So the token is given to the master with the number 2. When master 2 is ready with processing the participants it will send the token to the master with the number 4, and so on….

Each Master accepts a request indicated by the control register F000h to F002h only in a certain address space. So it is ensured, that a master only exchanges data with a slave module specified to the appropriate area. Special Slave modules may arrange a data transfer from one to another master area.

Assignation	Address area
Master 1	0000-2FFF
Master 2	3000-5FFF
Master 3	6000-8FFF
Master 4	9000-BFFF
Master 5	C000-EFFF
Control register	F000-FFFF

Table 3-2 Specification of Modbus Holding Register

Inside the devices, the first 4096 Modbus register of the own master area are stored in a non-volatile memory. As shown in Table 3-2 simultaneously operation of up to 5 masters is possible. The control registers are intended for access control and can be generally addressed. A detailed listing of Modbus address is given in the file Adressen_en_v00_240304.xls.

To avoid on Power-Up that two masters with the same Master-ID 1 begins to send messages [4], all masters with Master-ID 1 send a priority-broadcast after a randomised waiting time. If a master with Master-ID 1 is addressed before the random waiting time is over, it means that another device acts with Master–ID 1. The addressed master changes into passive operation and generates an error signal. The Master 1 which began to send first continues processing the bus participant. It will at once recognize that another Master 1 is in the system and send then a Master-OFF broadcast to all participants of its sub-system. Now only the second master 1 will be addressed, until the Master-ID of one of the both devices will be changed to another value by the user.

This approach guarantees that the failure might be corrected without Power-Down.

[4] in case of a configuration error

3.1.5 Synchronic command transmission

To transmit certain execution synchronic data, special broadcast commands are established. They are unidirectional, i.e. data can only be sent from the master to the slaves. Data like the current priority, the token or the current time are transmitted to the slaves in this way.

There are following broadcasts existing:

Master OFF/Priority	Only of Sub-system	For regulation of power
Token	Complete system	For token passing control
RTC Sync for Current Time	Complete system	It is recommended to execute this broadcast only by one single master
Baud Rate	Complete system	Set the baud rate (9600/19200 bps)
Bus Stop	Complete system	While connecting additional devices to the bus

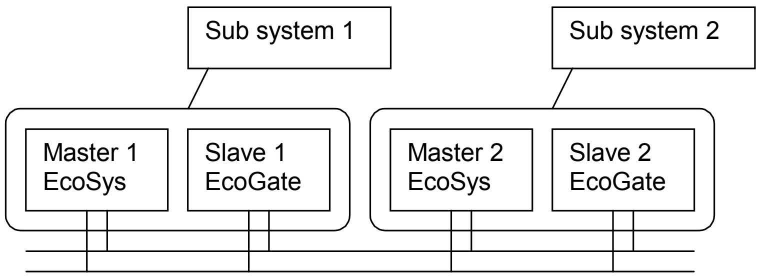


Figure 3-6 Bus Structure with two Sub-systems

Broadcast Command	Modbus Address	Byte Count	Valid for
Master OFF/Priority	0x2018+$Offset_{MA}$	2	Subsystem
Token	0xF004	2	Complete system
RTC Sync	0xF005 - 0xF008	8	Complete system
Baud Rate	0xF009	2	Complete system
Bus Stop	0xF00A	2	Complete system

Table 3-3 Address and number of bytes of broadcast commands

3.1.6 Implemented Modbus Commands

The bus interface can be accessed with the three Modbus function codes

- 03h Read Holding Register
- 10h Write Multiple Registers
- 17h Read/Write Multiple Registers

only.

A broadcast command can be built in the following way:

0h	Bus address
10h	Function code (Write Multiple Registers)
XX	Starting address HOB
YY	Starting address LOB
0	Quantity of Registers HOB
n	Quantity of Registers LOB
n*2	Byte Count
ZZ	Data bytes
CRC_LOB	
CRC_HOB	

3.1.7 Memory Organisation

The memory is divided into three areas:

Memory	Modbus Address	Art	Capacity [Byte]
EEPROM	0000h – 0FFFh	Non volatile	8k
RAM 1	1000h – 1FFFh	Volatile	8k
RAM 2	2000h – 2FFFh	Volatile	8k

Table 3-4 Internal Organisation of Memory

Each block (EEPROM, RAM1, RAM2) might be accessed within its address borders. Writing data with no respect of the memory block borders will cause loss of data.

Example:

Start Address = 0FFEh and ByteCount = 6h => last Address = 1000h → illegal operation
Start Address = 0FFEh and ByteCount = 2h => last Address = 0FFFh → valid operation

3.1.8 Reference

[1] Modbus Application Protocol Specification V1.1

[2] Modbus Specification & Implementation guide V1.0