

**It's all about saving your money**

**Power Factor Correction and  
Energy Management**

**FRAKO Kondensatoren- und Anlagenbau GmbH  
Teningen, Germany**

**Asian Customer Information Seminar  
Sept. 1999**



# FRAKO Energy Management System (EMS)

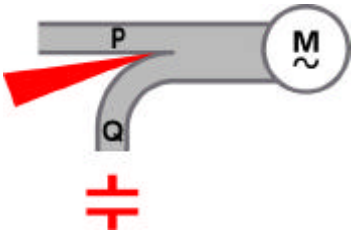


- **Jochen M. Braun**
- **FRAKO Kondensatoren- und Anlagenbau GmbH**
- **Head of Business Unit Energy Management**

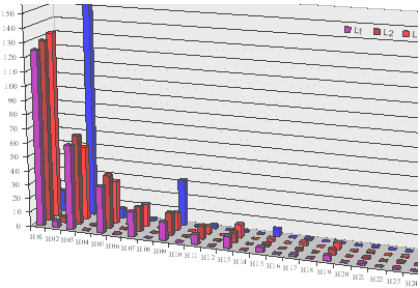
# FRAKO Program Segments



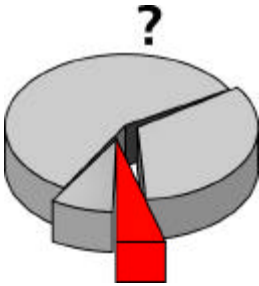
Power Factor Correction



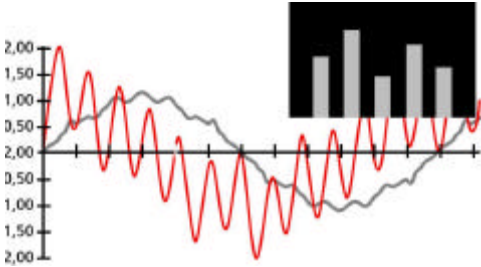
Analysis



Cost Allocation

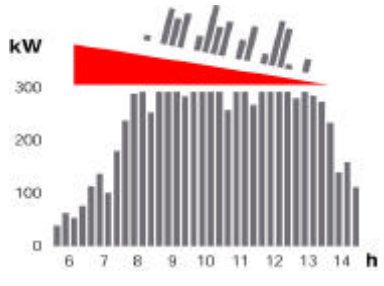


Mains Monitoring



Energy Management

Maximum Demand Control



# FRAKO Energie Management System (EMS)



- **1. Basics of Energy Management (EM)**
- **2. Mains Monitoring**
- **3. Maximum Demand Control (Load Shedding)**
- **4. Power Factor Correction with FRAKO EMS**
- **5. Additional Components and Software**
- **6. FRAKO Energy Management Sets**
  - **Mains Monitoring Set**
  - **Maximum Demand Set**
  - **Maximum Demand Set +**
- **7. Integrated FRAKO Energy Management**
  - Various installations utilizing the FRAKO Starkstrombus™**
  - Mains Monitoring / Load Shedding /**
  - Metering electrical energy and other energies and media**
- **8. Questions & Answers**



# 1. Basics of Energy Management

# Basics of Energy Management



- **Different meanings of term “Energy Management” depending on group of people where it is used:**
- **Persons involved in maximum demand control use it to name their products**
- **Persons involved in building management systems use it mainly for intelligent heating, cooling and ventilation systems**
- **Persons involved in FRAKO products use it mainly for the control and reduction of electrical energy cost**
- **There is a common understanding between these three versions.**

# Basics of Energy Management



- **What exactly is energy management?**  
"Energy Management" has become a frequently used term in recent years.
- **Since we could not find a unique definition, we propose the following:**
  - **The function of EM is fulfilled when**
    - 1. data relevant for energy consumption, cost or power quality are measured and collected which**
    - 2. are then used as input for monitoring, signaling, and/or controlling apparatus for reduction of energy consumption or cost and assuring power quality.**

# Basics of Energy Management



- **Purpose of FRAKO Energy Management Systems:**

**Help our customers save money.**



# Basics of Energy Management



- **How FRAKO Energy Management System helps customers save money:**
  - **Reducing electricity bill**
  - **Increasing electrical power quality**
  - **Reducing costs for resources besides electricity**

# Basics of Energy Management



- **Increasing quality of electrical power**

**The mains quality becomes an increasingly important issue for power engineering.**

**Power quality problems can lead to very costly failures and destruction of electrical equipment and switchgear.**

**FRAKO Energy Management System continuously monitors mains conditions and reports immediately when some parameter are out of bounds - much less costly than waiting for a blown fuse or production loss.**

# Basics of Energy Management



- **Reducing electricity bills**

**Electricity bills for industrial & commercial customers consist of three parts:**

- **active work** (kWh)
- **reactive work** (kVArh)
- **maximum demand** (kW)

- **Each of these parts can be reduced with FRAKO Energy Management System**

# Basics of Energy Management



- **Electricity bill - active work (kWh)**

**All customers need to pay for active work.**

**The energy consumed is measured by a meter and a price per kWh is charged.**

**A useful means of reducing electrical energy consumption is comprehensive monitoring:**

**For this purpose, one of the domains of FRAKO Energy Management System is monitoring of active work.**

# Basics of Energy Management



- **Electricity bill - maximum demand (kW) (1)**

**Dimensions of cables and transformers depend on maximum demand. The value charged is determined by averaging the power drawn over fixed periods of mostly 30 minutes.**

**Costs vary from 17.3 to 25.7 RM p.month depending on the local situation.**

# Basics of Energy Management



- **Electricity bill - maximum demand (kW) (2)**

**These costs can be considerably reduced, when trend calculation during each period is carried out.**

**In case of high forecast of mean power exceeding the maximum demand, loads can be shed in order to**

**reduce power drawn in running measuring period, which has been perceived as critical.**

**FRAKO Energy Management Systems include instruments for such a purpose.**

# Basics of Energy Management



- **Electricity bill - reactive work (kVArh)**

**Current carried by mains bus not only carries flow of active work but also that of reactive work.**

**Here zero net energy is being consumed. Reactive energy is energy oscillating between consumer and utility.**

- **This component calls for larger cables and bigger transformers, leading to increased costs.**

**For this reason reactive work is also being charged by the utility.**

**FRAKO Capacitors Banks can easily reduce these charges to zero and can be operated within the FRAKO EMS.**

# Basics of Energy Management



- **Reducing costs of resources other than electricity**

**FRAKO Energy Management System can also monitor consumption of gas, water, pressurized air, fuel, etc...**



# Basics of Energy Management



- **Modularity**

**FRAKO Energy Management System includes a stand-alone instrument for each of the four domains:**

- **Mains monitoring** **EMA 1101**
- **Maximum demand control** **EML 1101**
- **Energy metering** **EMF 1101, EMKI 1101/1103**
- **Power factor correction** **EMR 1100**

**Each instrument is equipped with RS 485 interface for connecting to FRAKO Power Bus and can be integrated into FRAKO Energy Management System.**

# Basics of Energy Management



- **FRAKO Starkstrombus™ (Power Bus)**
  - Two wires, twisted and shielded pair
  - Transfer rate: 76.8 kbit/sec
  - Max distance covered: approx. 5 km
  - Master - slave system:
    - Max 8 masters
    - Max 116 slaves
- **Stand-alone units mentioned are slaves:  
EMF 1101, EMR 1100, EML 1101 and EMA 1101**

# Basics of Energy Management



- **Masters and Slaves**

- **Masters:**

**Bus Central Units  
Communication Processor**

**EMZ 1000, ... 1102  
EMP 1100**

- **Slaves:**

- EMF 1101
    - EMR 1100
    - EML 1101
    - EMA 1101



Stand-alone units

# Basics of Energy Management



- **What do masters EMZ and EMP do?**
  - **Request actual data from slaves for further processing**
  - **Serve as interface between**  
  
**FRAKO Power Bus (RS 485) and**  
**PC,**  
**PLC or BMS (RS 232)**

# Basics of Energy Management

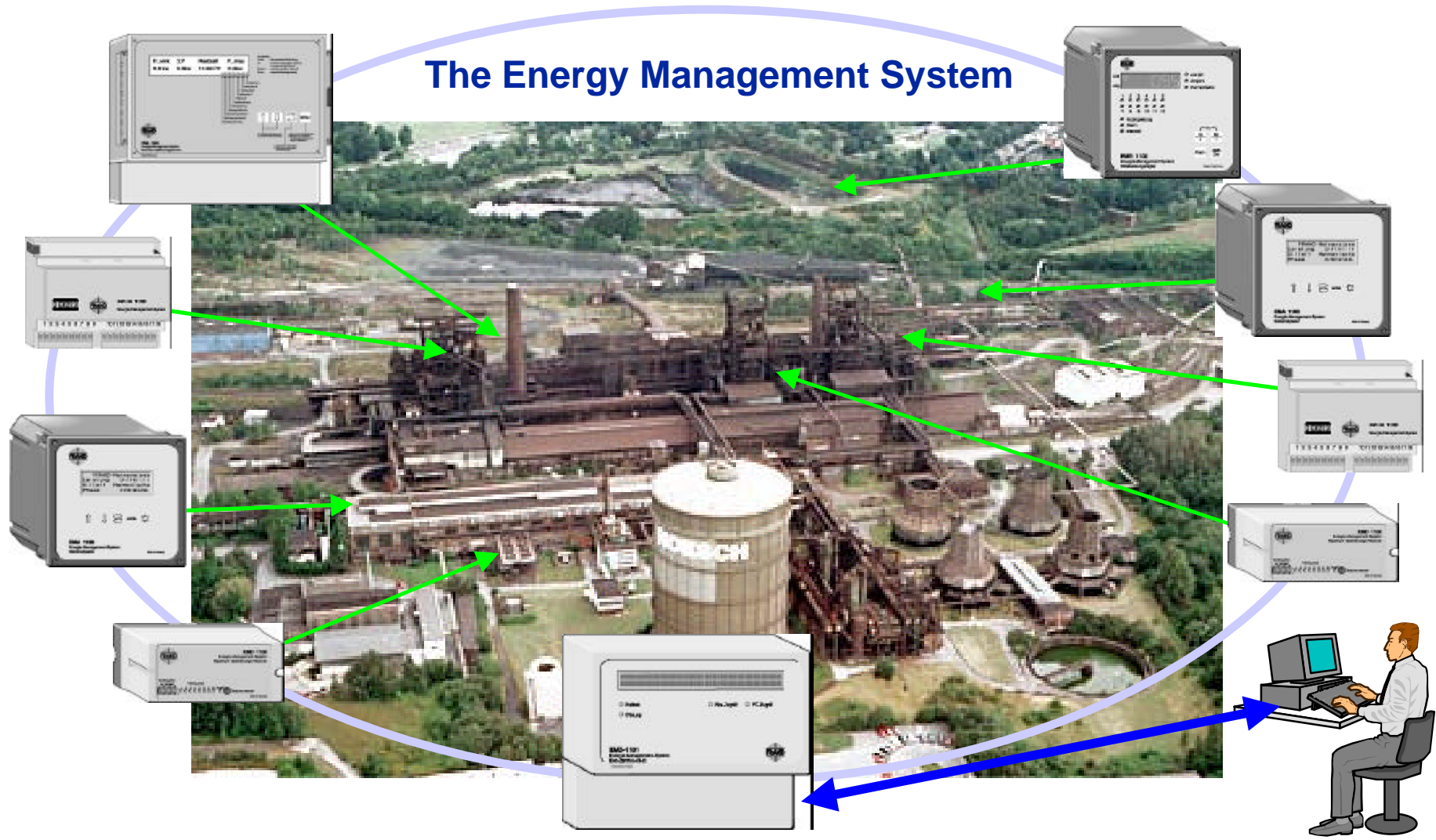


- **Supplementary functions provided by**

**FRAKO Energy Management System :**

- **State and alarm reports from other systems can be handled**
- **Analog signals (0 or 4 to 20 mA) can be included in display of EM-data on screen**

# Integrated FRAKO Energy Management System



Energy Management

# FRAKO Energie Management System (EMS)

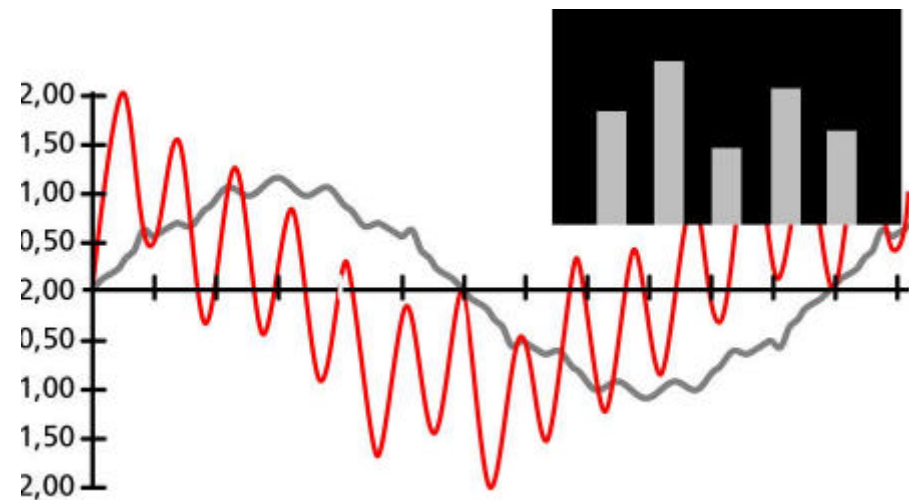


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## 2. Mains Monitoring

Providing qualified information  
for various purposes





# Mains Monitoring Instrument EMA 1101



- Objectives:
  - Prevent unexpected power failures
  - Prevent equipment failure due to high percentage of harmonics
  - Prevent failure and destruction of equipment due to voltage or current overloading
  - Get early information on bad power quality

# Mains Monitoring Instrument EMA 1101



- **Functions:**

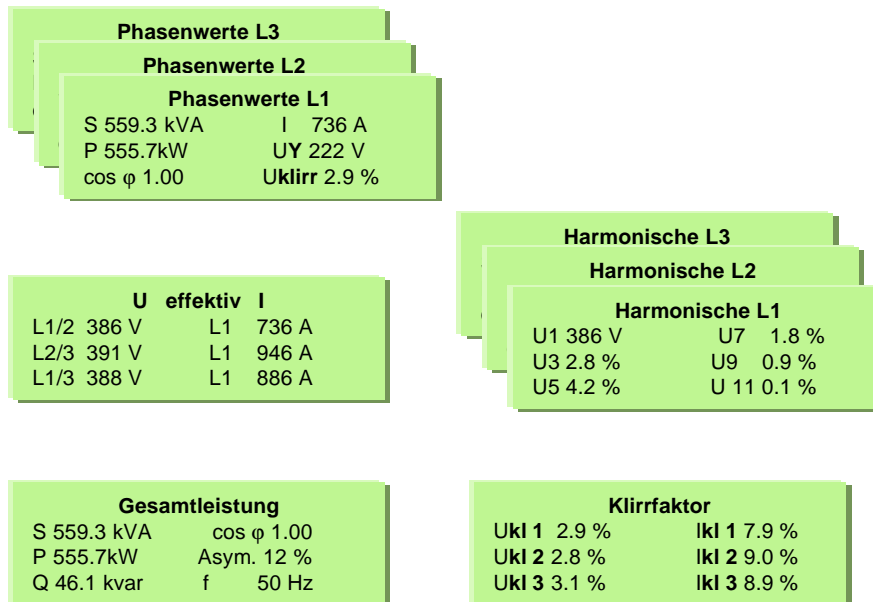
- 3-phase measurement V, I, phi
- 3-phases calculation of P, Q, S
- Monitoring of harmonics, Udf, Idf
- Active and reactive work meters
- Measurement of two temperatures
- LCD 4 x 20 characters
- Contact for tariff switching
- Alarm contact

# Mains Monitoring Instrument EMA 1101



## Mains Monitoring Instrument EMA 1101

All relevant measuring data are registered.



Analyses mains conditions;  
monitors and prevents breakdowns.

# Mains Monitoring Instrument EMA 1101



- **Two examples for application:**

**Central Institute for Calibration in Germany:**

**15 EMZ 1102 with up to 18 EMA 1101 and 5 energy meters**

**Huge recreation area in northern Germany:**

**1 EMZ 1102, 1 EML 1101 + 10 EMD 1101, 5 EMA 1101 and 50 energy meters**

# FRAKO Energie Management System (EMS)

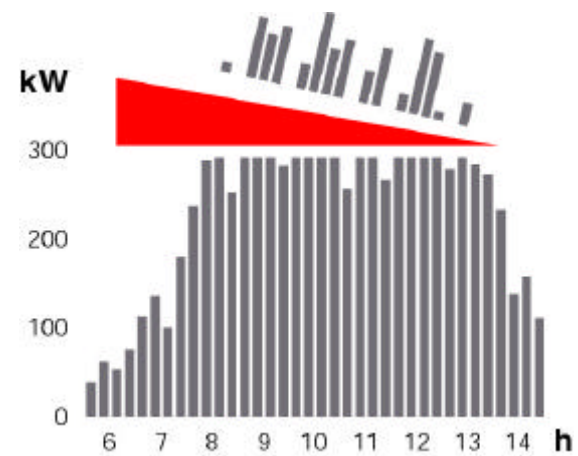


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### 3. Maximum Demand Control

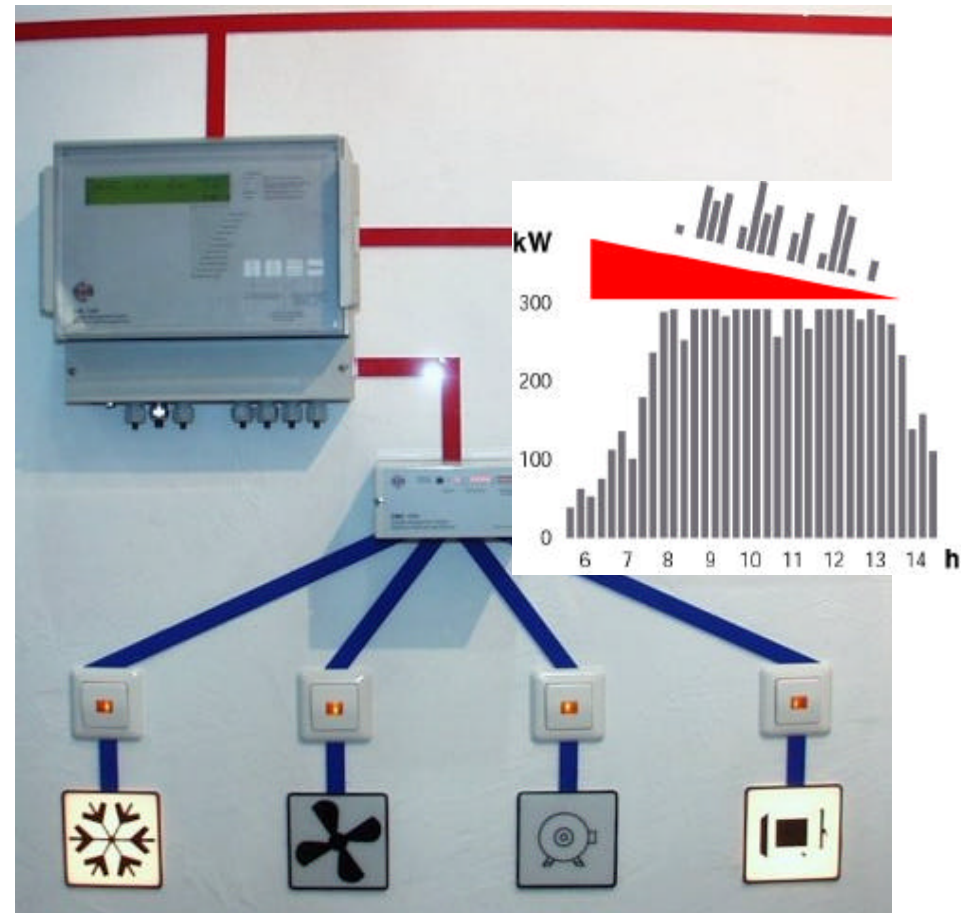
#### Load Shedding



# Maximum Demand Control



- **Cost reduction preventing power surges by shedding loads within defined measuring periods**



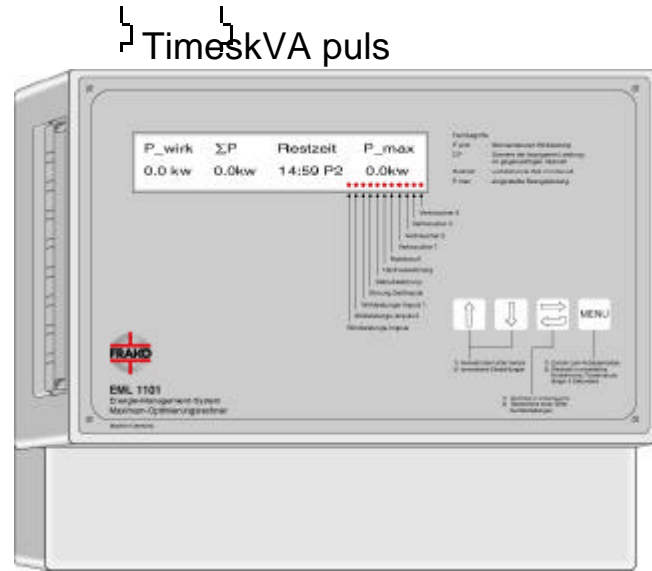
# Mode of determining charges for maximum demand



- **A kW-meter measures the highest average value of kW, that occurs each month.**
- **Each month is subdivided into approximately 1500 measuring periods of 30 minutes.**
- **The average value of kW is taken over each measuring period of 30 min.**
- **The highest average value of kW that has occurred during a month is then charged.**
- **Costs vary from 17.3 to 25.7 RM p. month depending on the local situation.**



# Chances to influence the peaks

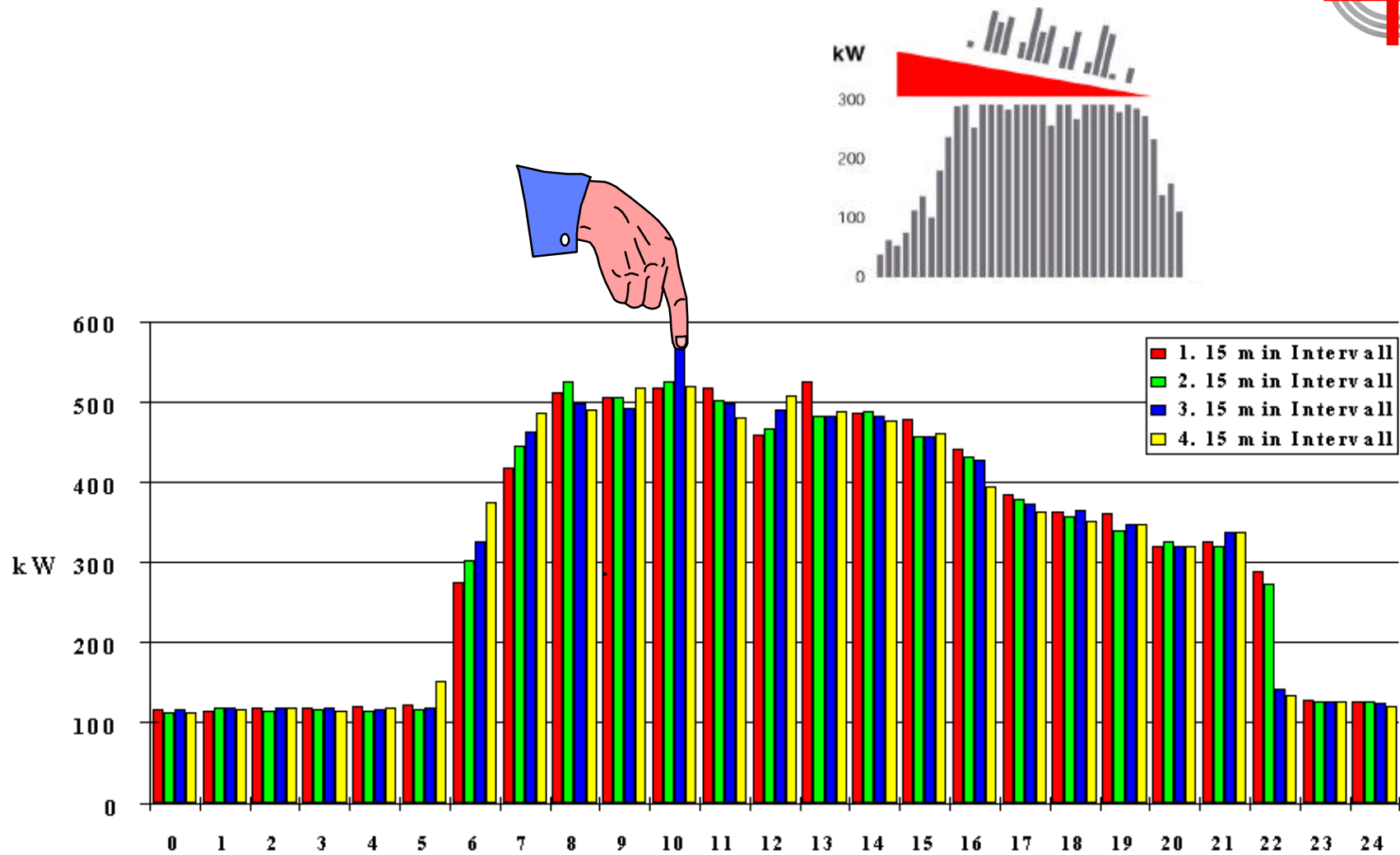


- The fact that average values of kW are charged, gives the customer enough time to keep track of the accumulated kWh that have been used up in the current measuring period.
- On this basis the customer can decide whether loads should be shed in order not to exceed a desired value of maximum demand.

This is the basic function which EML 1101 provides:

- Minimum input: time pulse and kW pulse
- Output: relays, that switch off loads

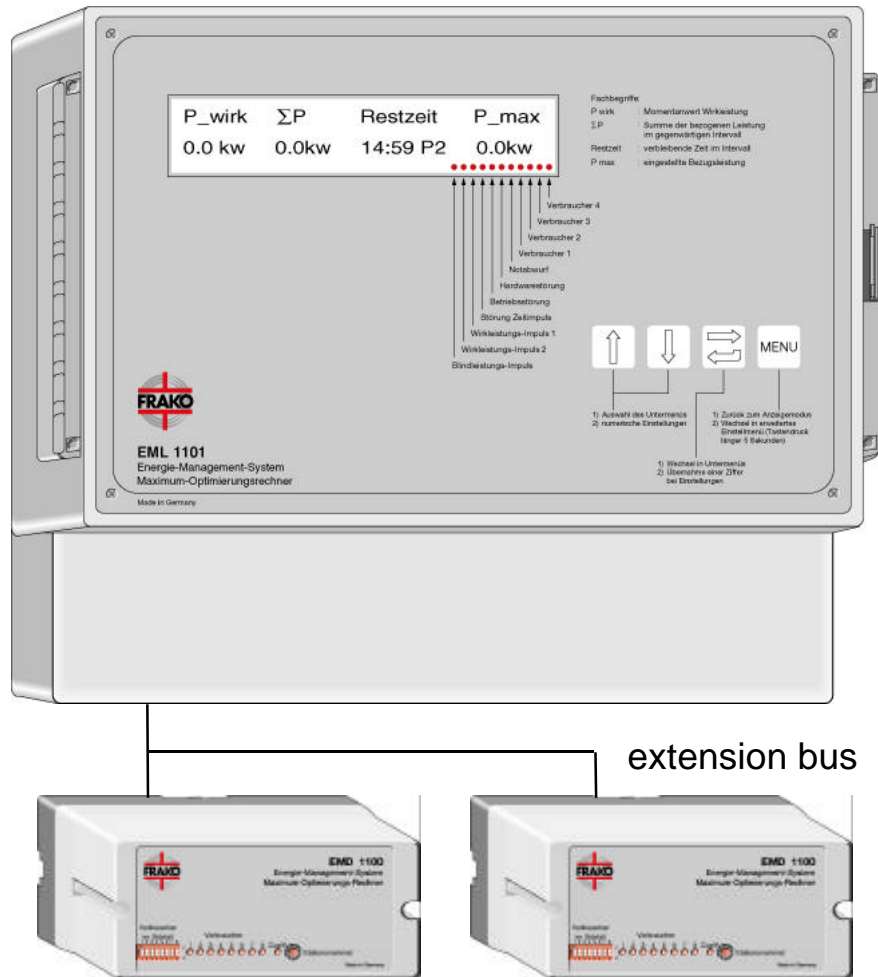
# „Cutting off“ peaks



# Maximum Demand Controller EML 1101



Time kW pulse



## • Functions:

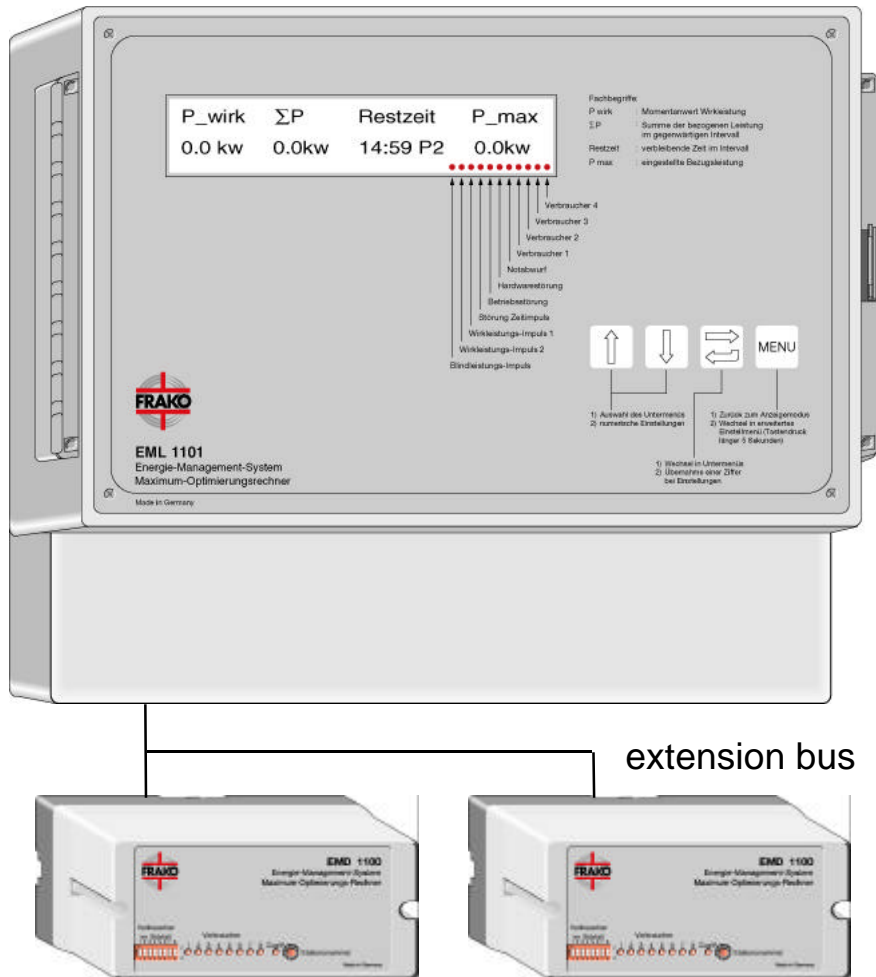
- Operation software
- PC/printer interface
- 4 switch-off channels
- 4 application profiles
- Emergency dump
- Sub-bus for extension modules
- Connection for kW pulse and time pulse
- Help menu guidance
- Bus connection (optional)

Maximum of 84 control channels

# Maximum Demand Controller EML 1101



Time kW pulse



- **Functions:**
  - **Maximum savings via trend calculation**
  - **Direct configuration or via laptop**
  - **Min. input: time and active work pulse**
  - **Modular setup**
  - **4 + 1 relays (250 VAC, 4 A)**
  - **2 contacts for 4 profiles**
  - **2 Alarm contacts**

Maximum of 84 control channels

# Display of Maximum Demand relevant Data



Verbrauchereinstellungen												
<input type="checkbox"/> Alle Verbraucher darstellen <input type="checkbox"/> Notabwurf invertieren                 Profil 1												
Verbr. Nr.	Station Nr.	Kanal in Station	Verbrauchername	Prio-rität	Gruppe	Leistung in kW	Min Ab Min.	Max Ab Min.	Min Ein Min.	Verz. Sek.	Zu-stand	Aus-gang
1	EML 1	1	Impraegnier-Ofen 1	12	0	30,0	2	20	1	0	REG	Ö
2	EML 2	2	Kanal 2 EML	1	0	40,0	1	-----	-----	0	REG	Ö
3	EML 3	3	Zinkspritzanlage	2	0	40,0	1	-----	-----	0	REG	Ö
4	EML 4	4	Fernschalter	1	0	0,0	10	-----	-----	0	REG	Ö
5	1	1	Impraegnier-Ofen 5	12	0	22,5	2	20	1	0	REG	Ö
6	1	2	Impraegnier-Ofen 6	12	0	30,0	2	20	1	0	REG	Ö
7	1	3	Impraegnier-Ofen 7	12	0	30,0	2	20	1	0	REG	Ö
8	1	4	Impraegnier-Ofen 8	12	0	30,0	2	20	1	0	REG	Ö
9	1	5	Impraegnier-Ofen 9	12	0	30,0	2	20	1	0	REG	Ö
10	1	6	Impraegnier-Ofen 10	12	0	30,0	2	20	1	0	REG	Ö
11	1	7	Impraegnier-Ofen 11	12	0	22,5	2	20	1	0	REG	Ö
12	1	8	Deckelheizung	14	0	12,6	5	20	2	0	REG	Ö
13	2	1	Feinvakuum-Pumpen	2	0	15,4	2	-----	-----	0	REG	Ö
14	2	2	Dachventilatoren	19	0	8,0	4	20	2	0	REG	Ö
18	2	6	Klima Wickelei	18	0	6,0	10	15	10	0	REG	Ö

D:\FRAKO\OPT-DEMO\DEFAULT.EML

Beenden Monitor EML-Konfiguration Drucken Verbindung Einstellungen Hilfe

EML: Typ: EML1101  
 SerienNr: 000000  
 ROM-Version: 1.45

Alarmer: OK Notmod. aktiv  
 OK Pkum. > Pmax.  
 OK Pwirk > Pspitz.  
 OK Cos(phi) < Soll.

Schaltkanäle:  
 EIN Notabwurfrelais  
 EIN Impraegnier-Ofen 1  
 EIN Kanal 2 EML  
 EIN Zinkspritzanlage  
 AUS Fernschalter  
 EIN Impraegnier-Ofen 5  
 EIN Impraegnier-Ofen 6  
 EIN Impraegnier-Ofen 7  
 EIN Impraegnier-Ofen 8  
 EIN Impraegnier-Ofen 9  
 EIN Impraegnier-Ofen 10  
 EIN Impraegnier-Ofen 11  
 EIN Deckelheizung  
 EIN Feinvakuum-Pumpen  
 EIN Dachventilatoren  
 EIN Klima Wickelei

Zeit: Restzeit 08:19 Sync Zeit  
 Zeit EML 21.01.99 22:36:41

Störungen: OK EMD inaktiv  
 OK Kein Zeitimp.  
 OK Kein Wirkimp.

Meßwerte:  
 P wirk 357,0 kW  
 P kum. 10,6 kW  
 P kum. alt 500,0 kW  
 Cos(phi) 1,00

Grenzwerte:  
 P spitz 800,0 kW  
 P max. 284,0 kW  
 Cos(phi) min. 0,70

Prognose:  
 Trendleistung 488,8 kW

Arbeitszähler:  
 Aktiv Wirtl 0,3kWh  
 Korrekturleist. 70,4 kW

# Maximum Demand Controller EML 1101



- **Individual settings for each channel:**

- **Rated Power/Peak Consumption**
- **Priority**
- **Min. OFF**
- **Max. OFF**
- **Min. ON**
- **Time/Power priority**
- **Output (NC/NO)**

... limits switch-off times for each consumer to a sustainable degree.

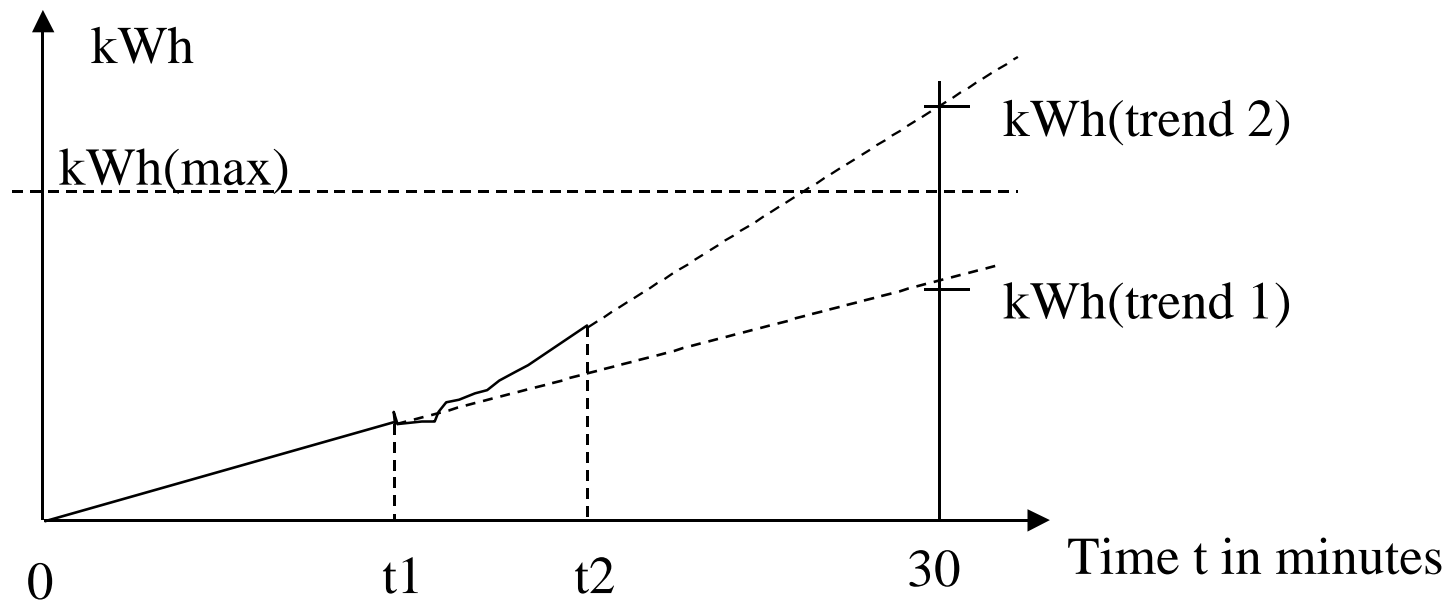
- **Basic settings:**

**Target maximum demand, pulse rates, CT-ratio, VT-ratio, number of profiles, number of add-on stations, number of kW-meters connected, etc...**

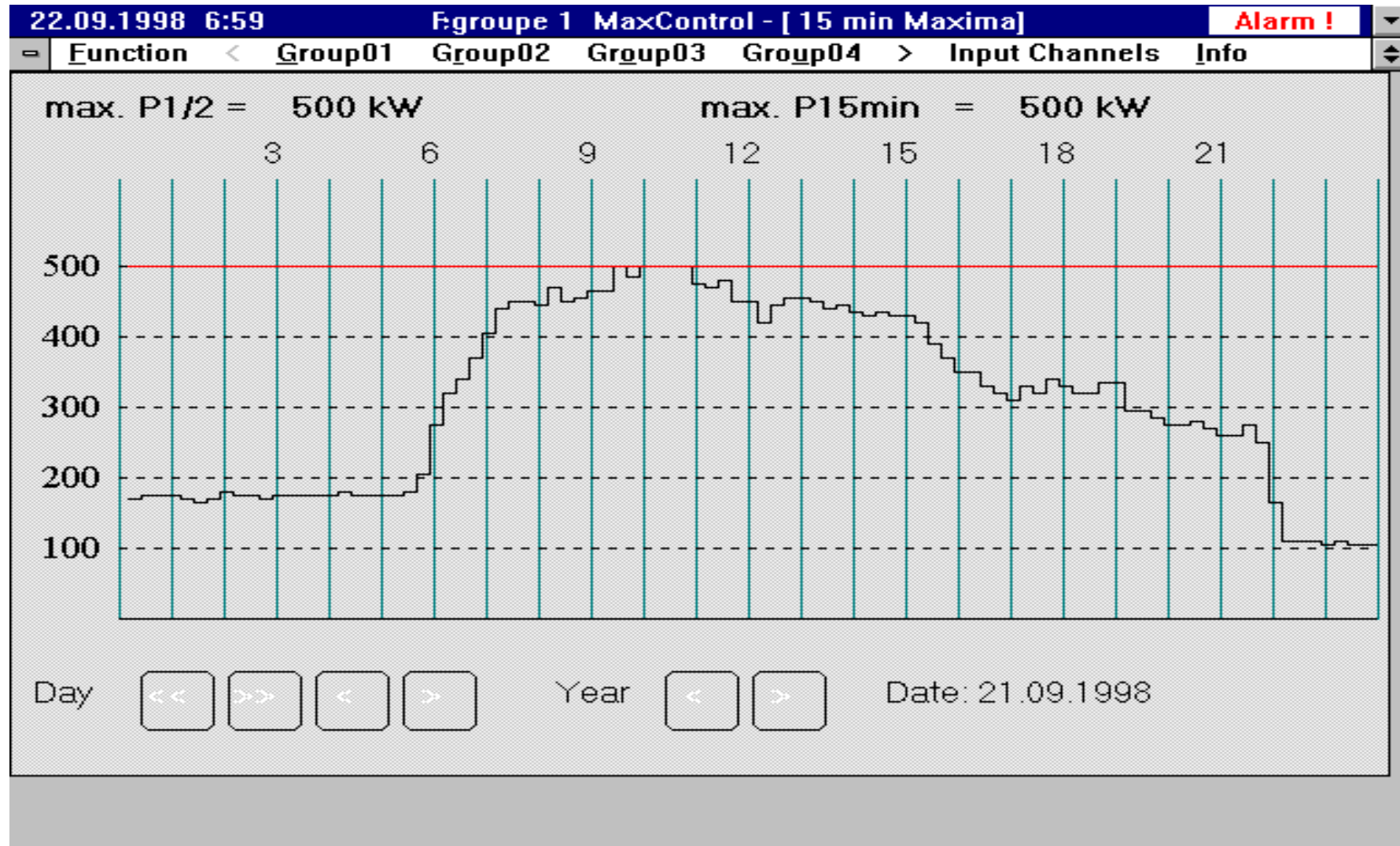
# Basic facts about algorithm implemented in EML 1101:



- kW averaged over 30 minutes = kWh registered during 30 minutes multiplied by 2.
- The maximum value of average kW is related to maximum value of kWh(max) accumulated during 30 minutes.



# Example for a limited profile



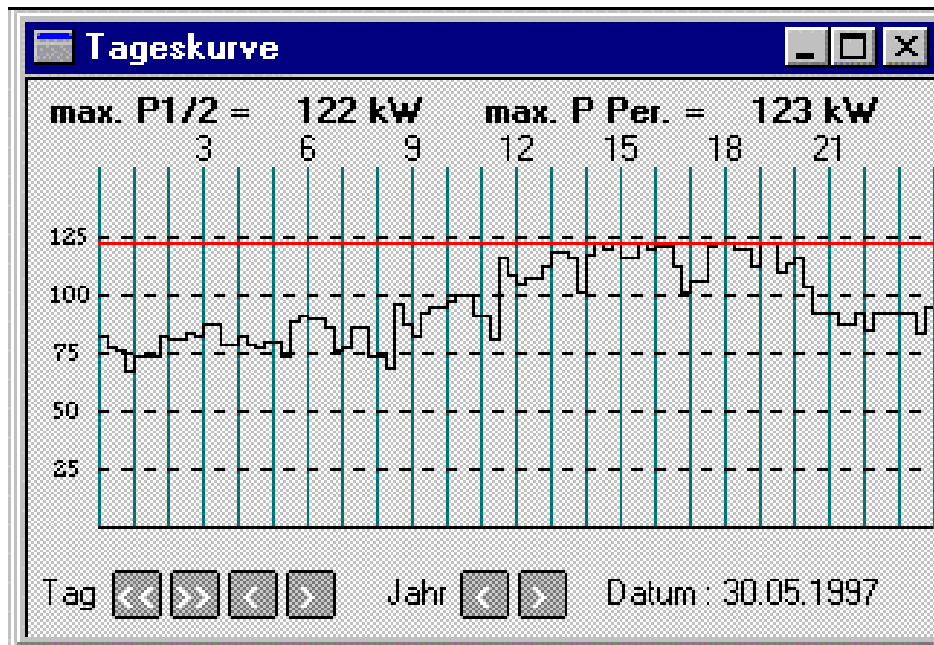
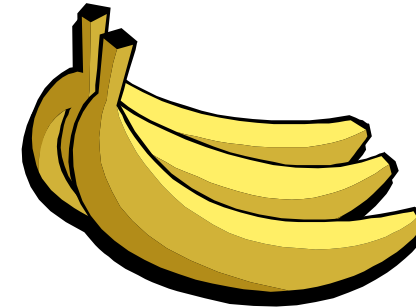


# Example of Food Storage Building



Before Optimizing  
After Optimizing

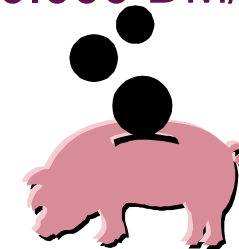
**180 kW**  
120 kW



Daily Demand

Reduction:

ca 20.000 DM/Year



Amortisation:

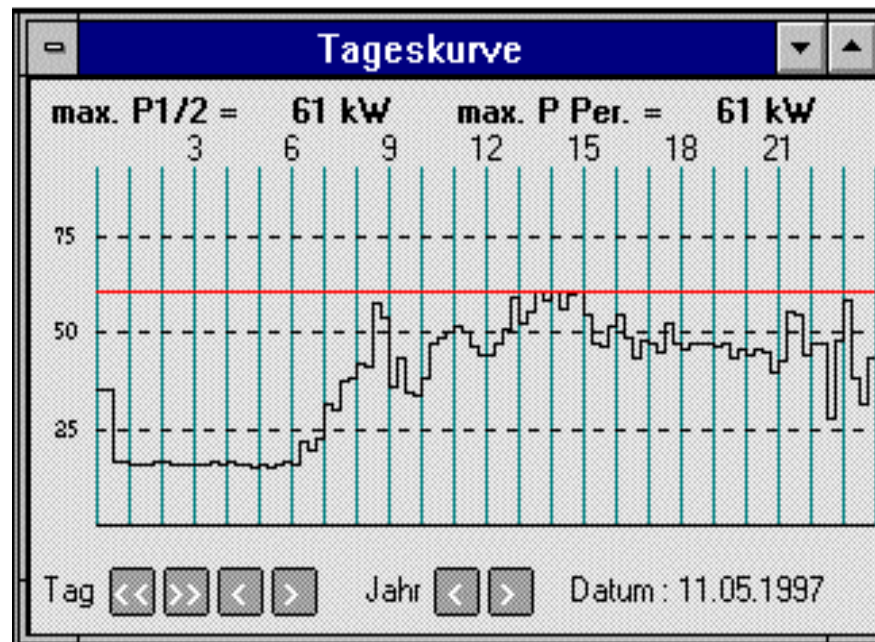
ca. 1 Year

# Example of Hotel Ludinmühle, Freiburg



- **Consumers:**

Daily Power Profile



- Kitchen range
- Double-boiler
- Deep fat fryer
- Frying plate
- Swimming pool pumps
- Sauna furnace
- Steam bath

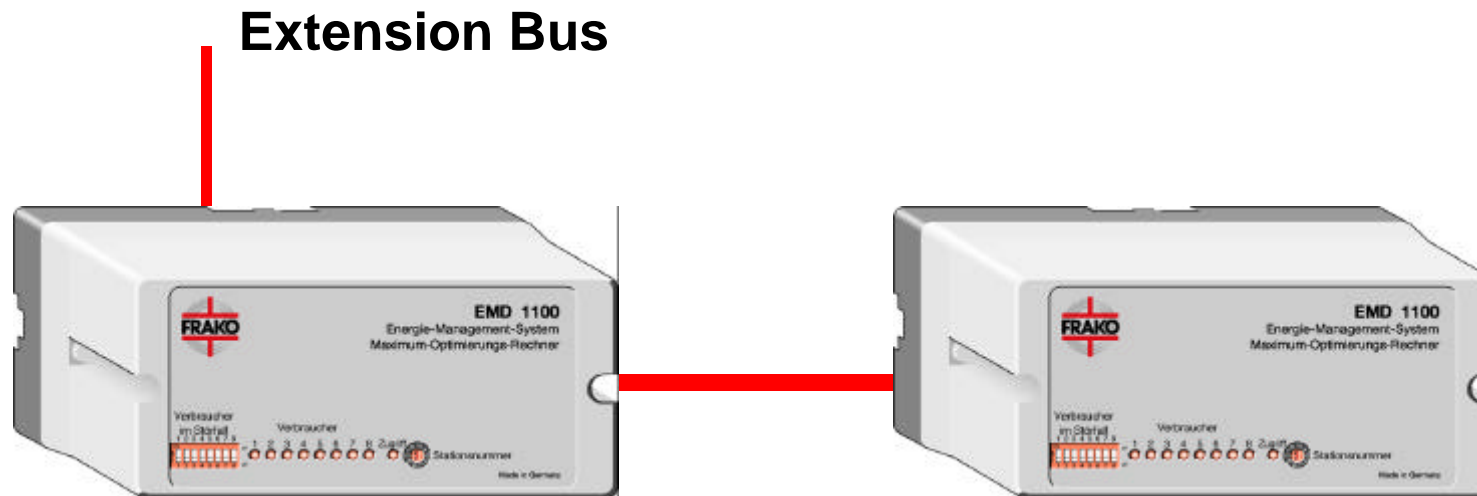
Day / Year / Date:

# Switch-off Options in various Areas



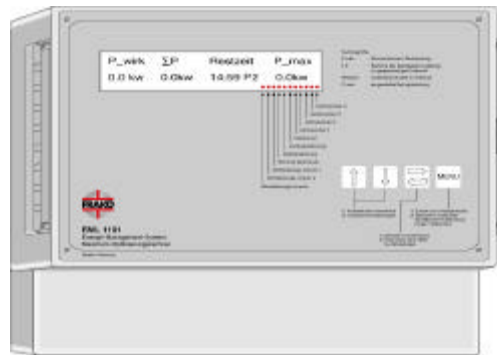
<b>Hotel, Catering</b>	<b>Brewing</b>	<b>Butchering</b>	<b>Industry</b>
<b>Washing machine</b>	<b>Cooling</b>	<b>Cooling</b>	<b>Ventilation systems</b>
<b>Dryer</b>	<b>Ventilation</b>	<b>Passing machine</b>	<b>Light e.g. 1/3</b>
<b>Ironing machine</b>	<b>Water preparation</b>	<b>Cutter</b>	<b>Compressed air</b>
<b>Gutter heating</b>	<b>Cylinder pump</b>	<b>Baking cabinets</b>	<b>Canteen</b>
<b>Refrigeration</b>	<b>CIP cleaning</b>	<b>Smoking chamber</b>	<b>Drying cabinets</b>
<b>Double-boiler</b>		<b>High-pressure cleaner</b>	<b>Warming cabinets</b>
<b>Plate warmer</b>		<b>Heating</b>	<b>Air conditioning systems</b>
<b>Baking ovens</b>		<b>Washing machine</b>	
<b>Frying pan</b>		<b>Dryer</b>	
<b>Deep fat fryer</b>			
<b>Tilting-type frying pan</b>			
<b>Kitchen range</b>			
<b>Grill</b>			
<b>Ventilation</b>			

## Add-on stations EMD 1101



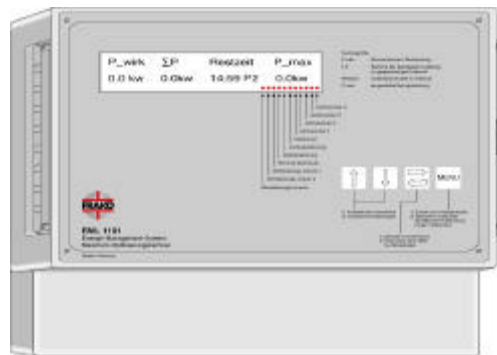
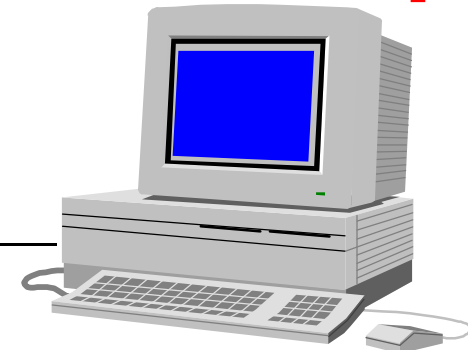
- 8 relays (250 VAC, 4 A)
- 8 LEDs
- 8 dip switches
- RS 485 interface for connecting to extension bus

# Maximum Demand Controller EML 1101 for remote access

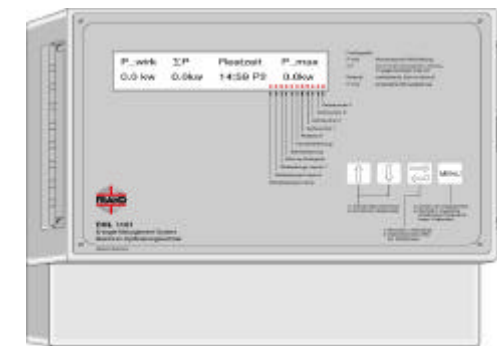


Modem

Modem



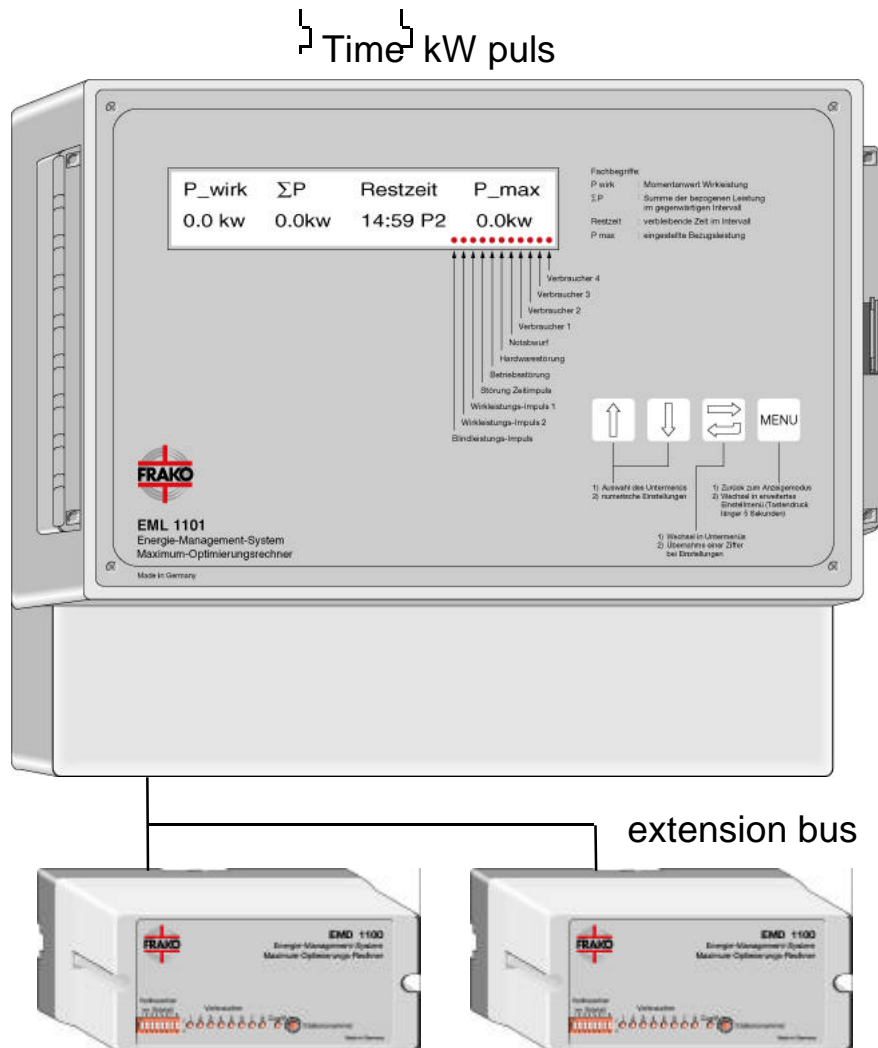
Modem



Modem

- Configuration Software OPT-SW
- Extremely easy configuration of EML 1101 via PC
- Connection via modems possible
- Monitoring of all relevant data

# Maximum Demand Controller EML 1101



- First steps in planning of installation of an EML 1101:
- Inspect electricity bill
- Create load list with load settings
- Possibly measure daily power curve
- Estimate time of payback of investment

Maximum of 84 control channels

# FRAKO Energie Management System (EMS)

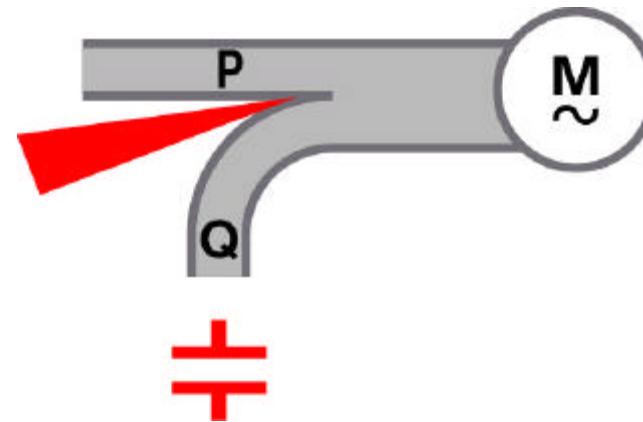


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## 4. Power Factor Correction with FRAKO EMS

### Utilizing FRAKO Capacitors and Power Factor Relays

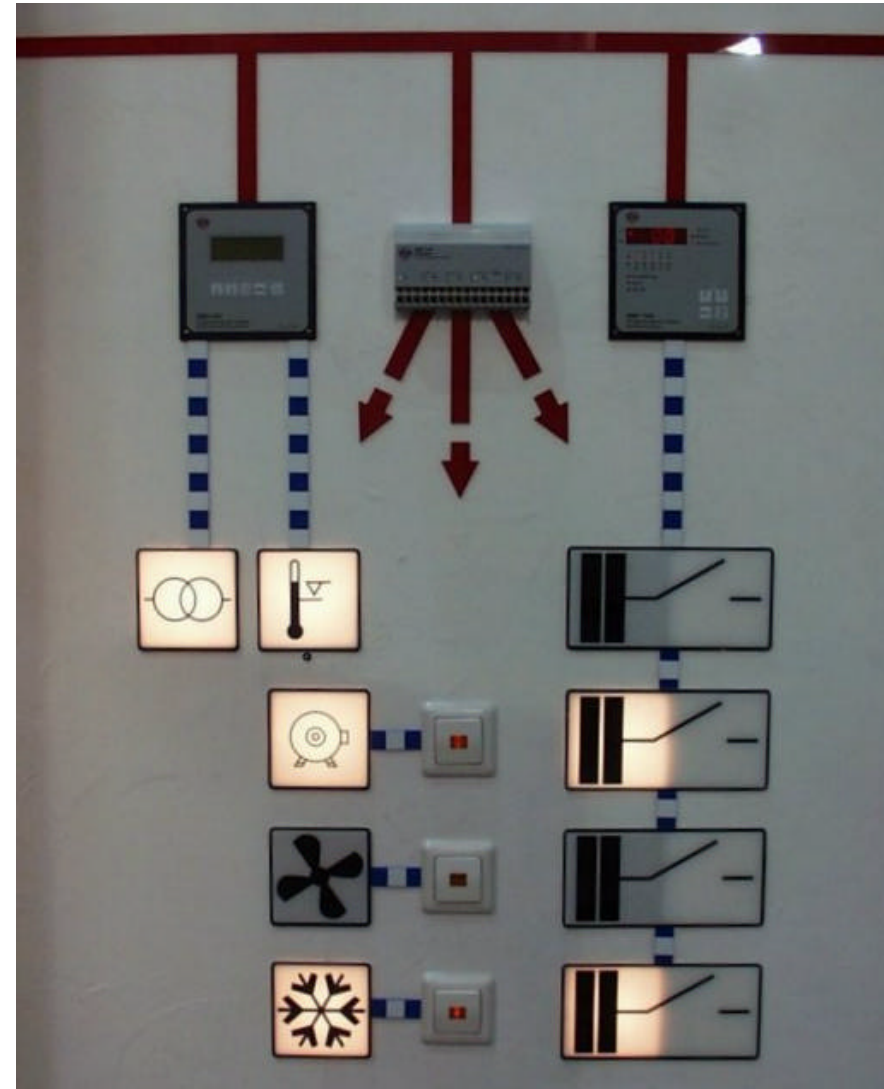
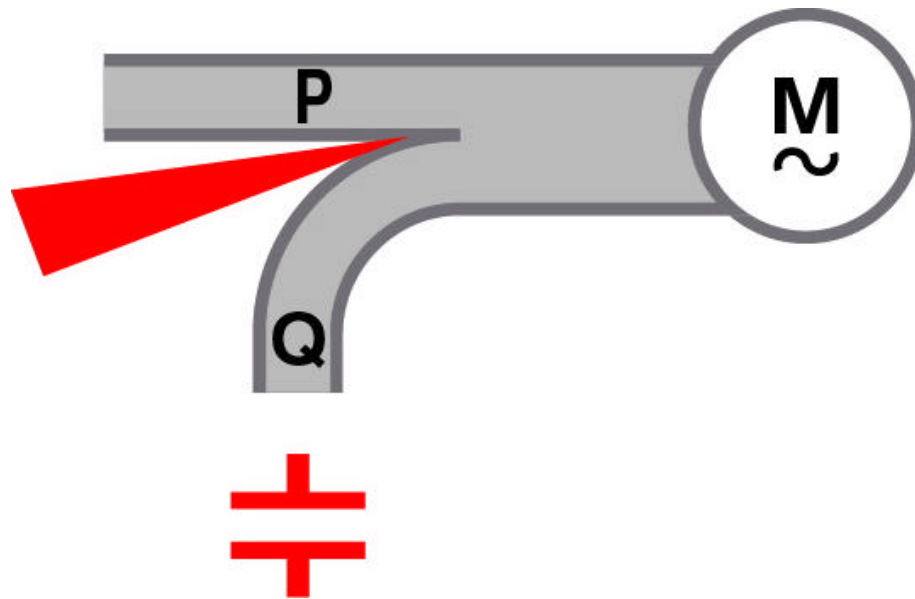




# Power Factor Correction and Mains Monitoring



- Complete reduction of reactive power costs
- Monitoring of mains parameters

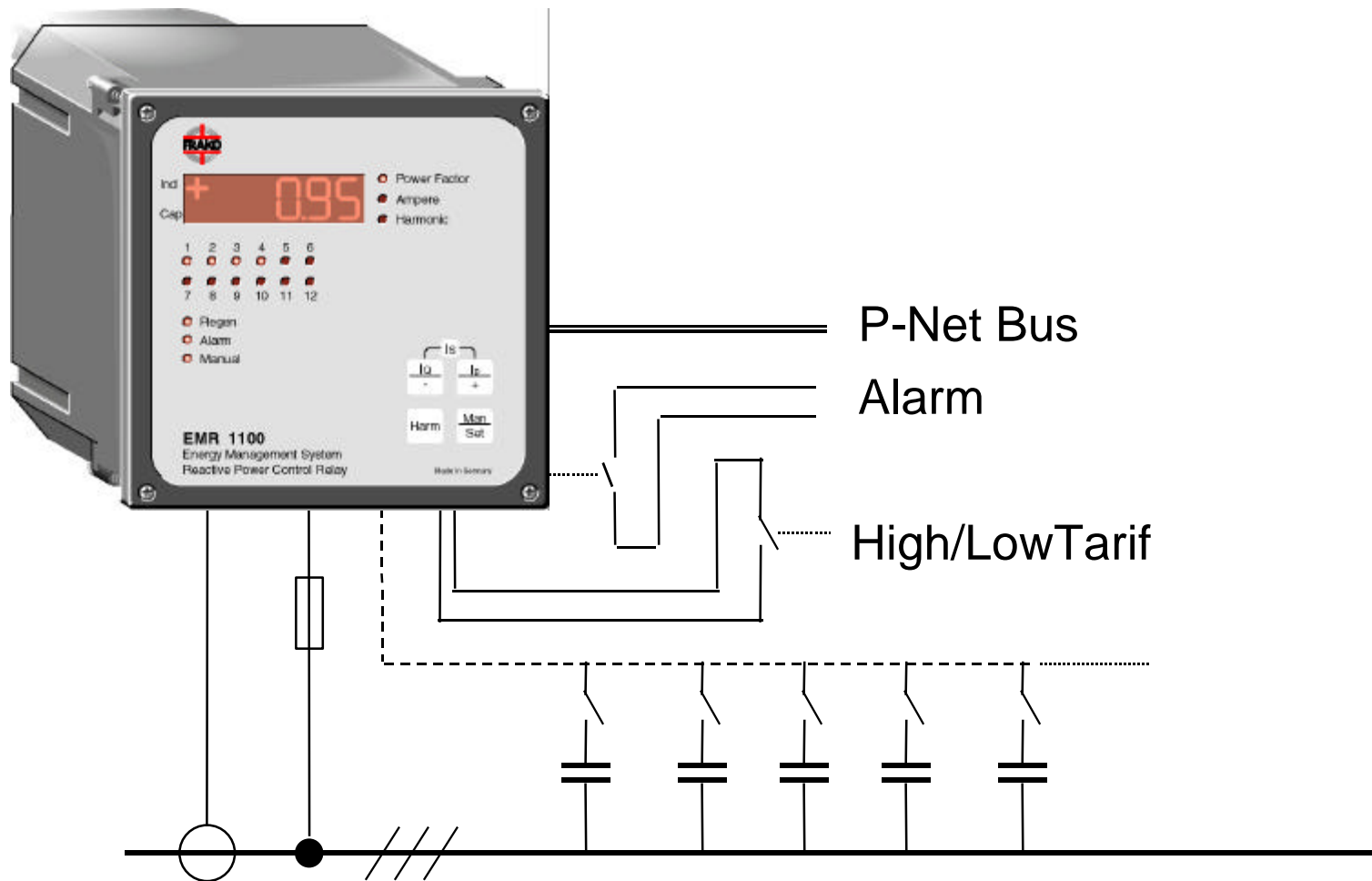


# Reactive Power Relay EMR 1100



- Automatic identification of phases orientation
- Monitoring of harmonics
- Irms-monitoring
- Four-quadrant control
- Switching cycle counters
- Individual control of discharge time for each stage

# Reactive Power Relay EMR 1100



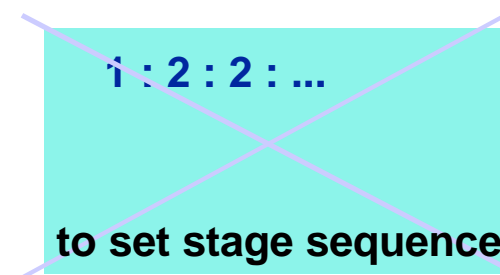
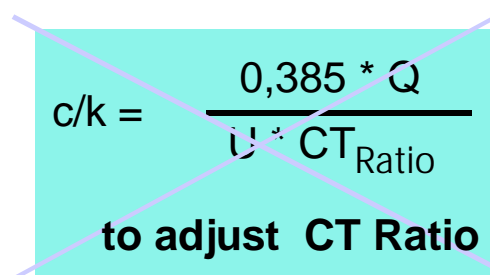
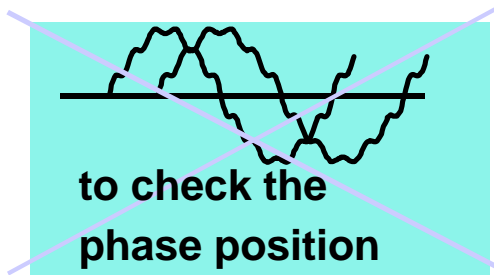
# Reactive Power Control Relay EMR 1100



FRAKO products :

Reactive Power Control Relay EMR 1100

Self-adapting :



Records and indicates:

Alarm

● Alarm

PF

● cos-phi

and the required capacitor rating:

**127** kvar

# Why power factor correction?



**economical use of:**

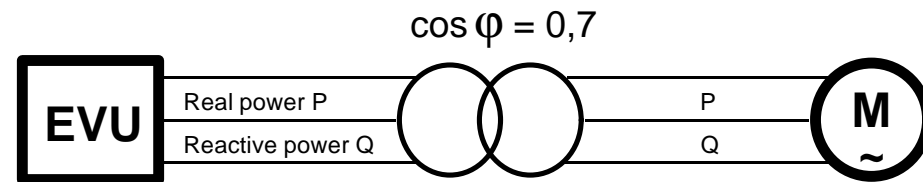
- transformers
- cables
- switchgears

**reduced losses**

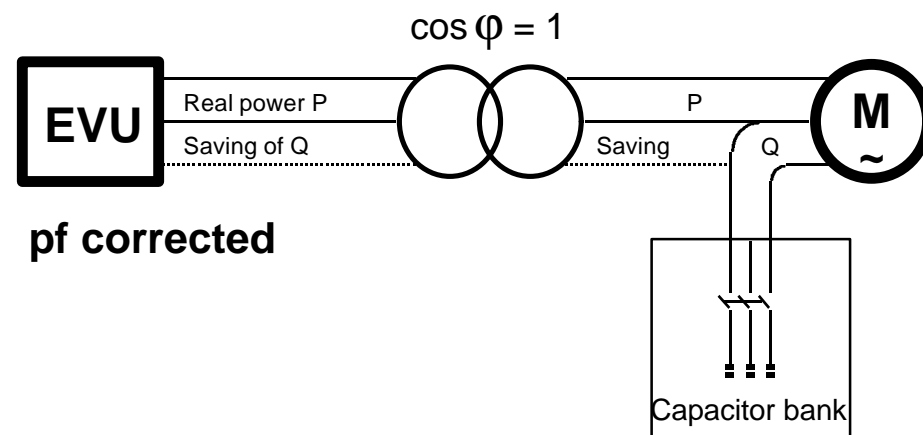
**reduced voltage drop**

**leading to:**

→ **reduced costs**



**no pf-correction**



**pf corrected**

# Basic Facts

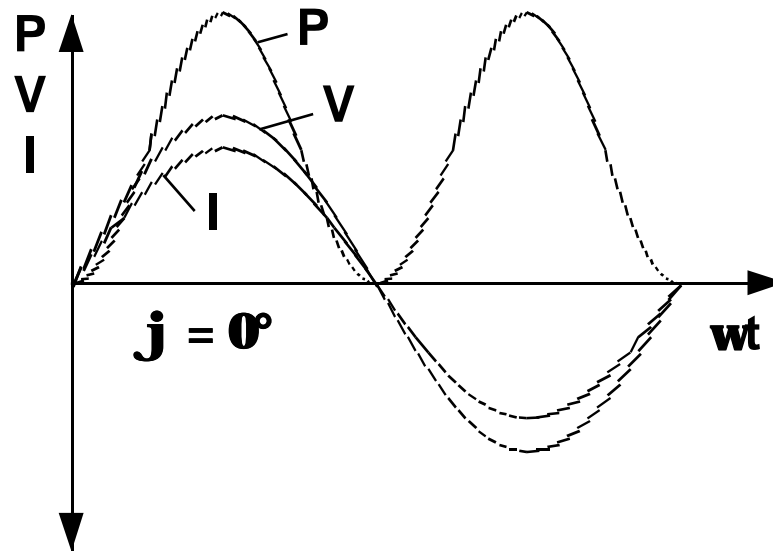


## Real Power

Non-reactive loads without inductive and capacitive components, such as electric heaters, give rise to simultaneous zero passages of voltage and current.

Voltage and current are in phase. The phase shift  $\varphi$  is zero:  $\varphi = 0^\circ$ .

Voltage, current and power at non reactive loads ( $\varphi = 0^\circ$ )



Real power is the component that is transformed into non-electrical power (e.g. heat, light, mechanical power). For non-reactive loads the power is being calculated as product of r.m.s.-values of voltage and current.

$$P = V \cdot I$$

[W] [V] [A]

# Basic Facts



## Real and reactive power

Practically loads are not purely non-reactive, but there is a reactive component involved. This applies for all loads that depend on magnetic fields, e.g. asynchronous motors, chokes and transformers. Rectifiers also consume reactive power.

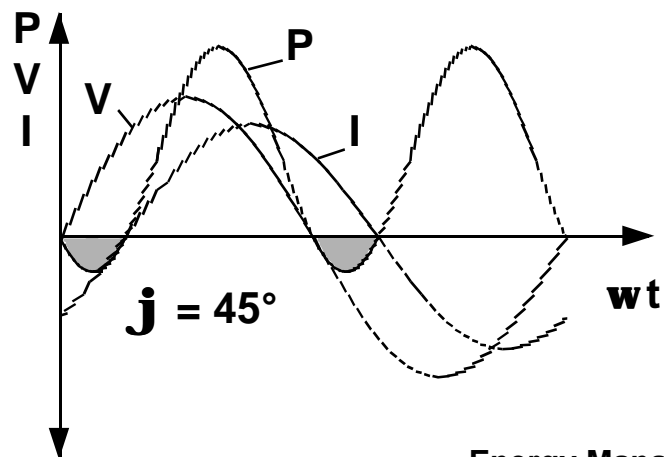
The energy for generating the magnetic field and its polarity reversal oscillates between generator and load.

Zero crossings of voltage and current do not occur at the same time. The phase shift  $\varphi$  is different from  $0^\circ$ .

Current lags for inductive and leads for capacitive loads.

The momentary values of  $P$  can be positive and negative, reflecting an oscillating part of energy flow.

[Voltage, current and power for load with non-inductive and inductive component \( \$\varphi = 45^\circ\$ \):](#)



An example with phase shift  $\varphi = 45^\circ$   
 $P(t)$  is temporarily negative.  
The real power is given by:

$$P = V \cdot I \cdot \cos \phi$$

[W] [V] [A]

# Basic Facts

## Power factor cos phi

The cosine of the phase shift between voltage and current relates active and apparent components of power  $P$ , work  $W$  and current  $I$ .

It is called power factor.



$$\cos \phi = \frac{P}{S}$$

[W] / [VA]

The type plate of electrical machines normally carries the power factor at full load



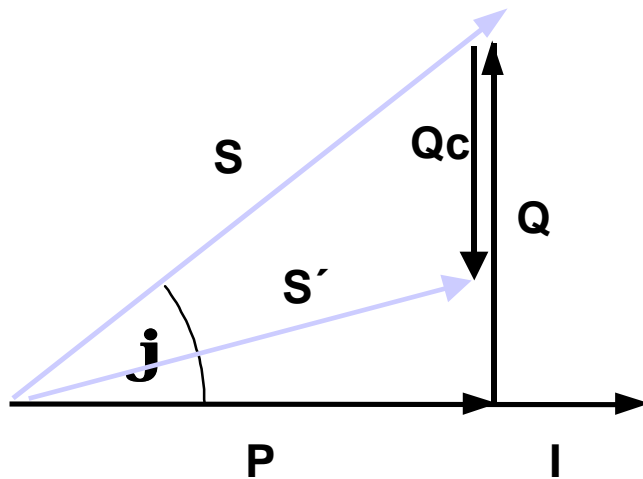
# Basic Facts

## Apparent power

The apparent power  $S$  is the all-important parameter for rating loads of electrical networks. Generators, transformers, switchboards, fuses and cross sections of cables have to be designed such that they can handle the maximum apparent power.

Apparent power is the product of r.m.s. voltage and r.m.s. current.

## Apparent, active and reactive power:



$$S = V \cdot I$$

[VA] [V] [A]

Apparent power is the geometric sum of active and reactive power:

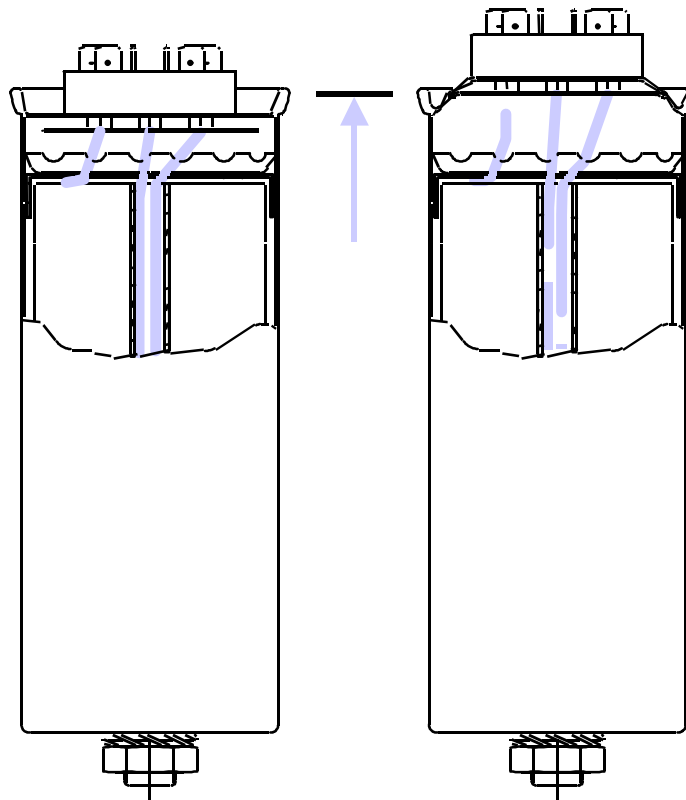
$$S = \sqrt{P^2 + Q^2}$$

[VA] [W] [VAR]

# Overpressure Disconnecter

Highest possible safety standard is met only when in addition to a very reliable normal functioning there is a device that

- reacts to inner build up of pressure
- disconnects the winding from the mains without leading to rupture of the casing



For this purpose FRAKO uses a seamed lid with a membrane function.

With an overpressure of three bars, the lid pushes 10mm upwards and disconnects the winding from the mains without arcing back.

# FRAKO Energie Management System (EMS)

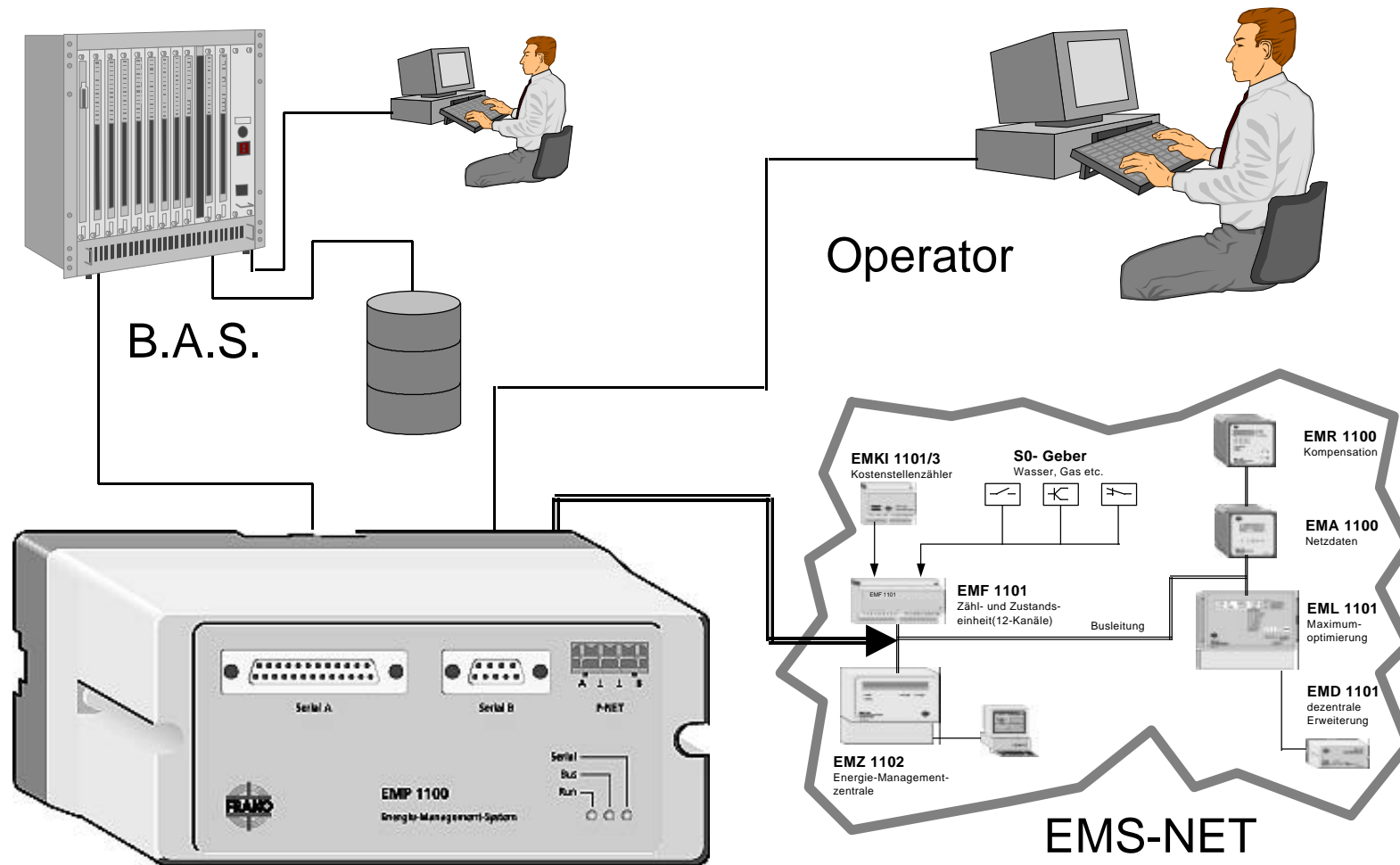


- 1. Basics of Energy Management (EM)
- 2. Mains Monitoring
- 3. Maximum Demand Control (Load Shedding)
- 4. Power Factor Correction with FRAKO EMS
- **5. Additional Components and Software**
- 6. FRAKO Energy Management Sets
  - Mains Monitoring Set
  - Maximum Demand Set
  - Maximum Demand Set +
- 7. Integrated FRAKO Energy Management
  - Various installations utilizing the FRAKO Starkstrombus™
  - Mains Monitoring / Load Shedding /
  - Metering electrical energy and other energies and media
- 8. Questions & Answers

## 5. Additional Components and Software



# Bus Interface EMP 1100



# Visualisation Software EM-Graph Diagram Settings



The screenshot shows the 'Diagram settings' window of the EM-Graph software. The window has a title bar 'example' and four tabs: 'Diagram settings' (active), 'Display', 'General Settings', and 'Utilities'. The main area is divided into several sections:

- Instrument:** A list of instrument files: ema1101.lbr, emf1101.lbr, emk1100.lbr, eml1101.lbr, and emr1100.lbr. The 'emr1100.lbr' file is selected. Below this is a 'Bus addr.' field with the value '30'.
- Interval:** 'Scan' is set to 15 and 'Refresh' is set to 15, both with up/down arrows and a '\$' symbol.
- Averaging:** 'Save data record after' is set to 1 Scans.
- Available data:** A list of data points including Actual tariff, Alarm, Cos(phi), Cos(phi) target, Counter st01 through st12, H05, H07, H11, H13, and I react 50Hz.
- Selected data:** A list of selected data points: EMR1100( 52): I real 50Hz, EMR1100( 52): I react 50Hz, EMR1100( 52): I rms, EMA1101( 50): I rms ph1, EMA1101( 50): I rms ph2, and EMA1101( 50): I rms ph3.
- Diagram:** 'Y-Max' is 450 A and 'Y-Min' is -200 A. There are 'Display' and 'Redraw' buttons.
- Displayed curves:** A list of curves with checkboxes: 'I real 50Hz' (checked, green bar), 'I react 50Hz' (checked, green bar), 'I rms' (unchecked, purple bar), 'I rms ph1' (unchecked, red bar), 'I rms ph2' (unchecked, blue bar), and 'I rms ph3' (unchecked, grey bar).
- Desc.:** A text field containing 'EMR current'.

At the bottom of the window, there is a breadcrumb trail: EMD4-6 / Power EML / EMR PF / EMR current / RM9806 stage 1-5 + Alarm. Below this are buttons for 'New diagram' and 'Delete diagram'. At the very bottom, there are buttons for 'Data' (New, Load, Save), 'Recording' (New start, Restart), 'Program' (Help, Exit).

# Visualisation Software EM-Graph Display Mode



example

Diagram settings **Display** General Settings Utilities

Status  
cursor measurement

Relais EML, EMD1-3, Alarme		Cursor Values	EMD4-6		Cursor Values
EML1101T( 19): Relais EML(19)		00100011	EML1101T( 19): Relays EMD 4		11000000
EML1101T( 19): Relais EMD 1(19)		11111111	EML1101T( 19): Relays EMD 5		00110111
EML1101T( 19): Relais EMD 2(19)		01111110	EML1101T( 19): Relays EMD 6		00000101
EML1101T( 19): Relais EMD 3(19)		00000111			
EML1101T( 19): Alarmflag 1(19)		00000000			
EML1101T( 19): Alarmflag 2(19)		00000001			

Power EML		Cursor Values	EMR PF		Cursor Values
EML1101T( 19): P act		232,9kW	EMR1100( 52): Cos(phi)		-0,999
EML1101T( 19): P accum		225,8kW	EMR1100( 52): Cos(phi) target		0,188
EML1101T( 19): P max		240kW	EMA1101( 50): Cos(phi) ph1		1
EML1101T( 19): P rem		223,7kW	EMA1101( 50): Cos(phi) ph2		-0,999
EML1101T( 19): P left		240,8kW	EMA1101( 50): Cos(phi) ph3		0,999

Display until  
 current time  
Day Hrs Min  
13.05.1999 00:00:00

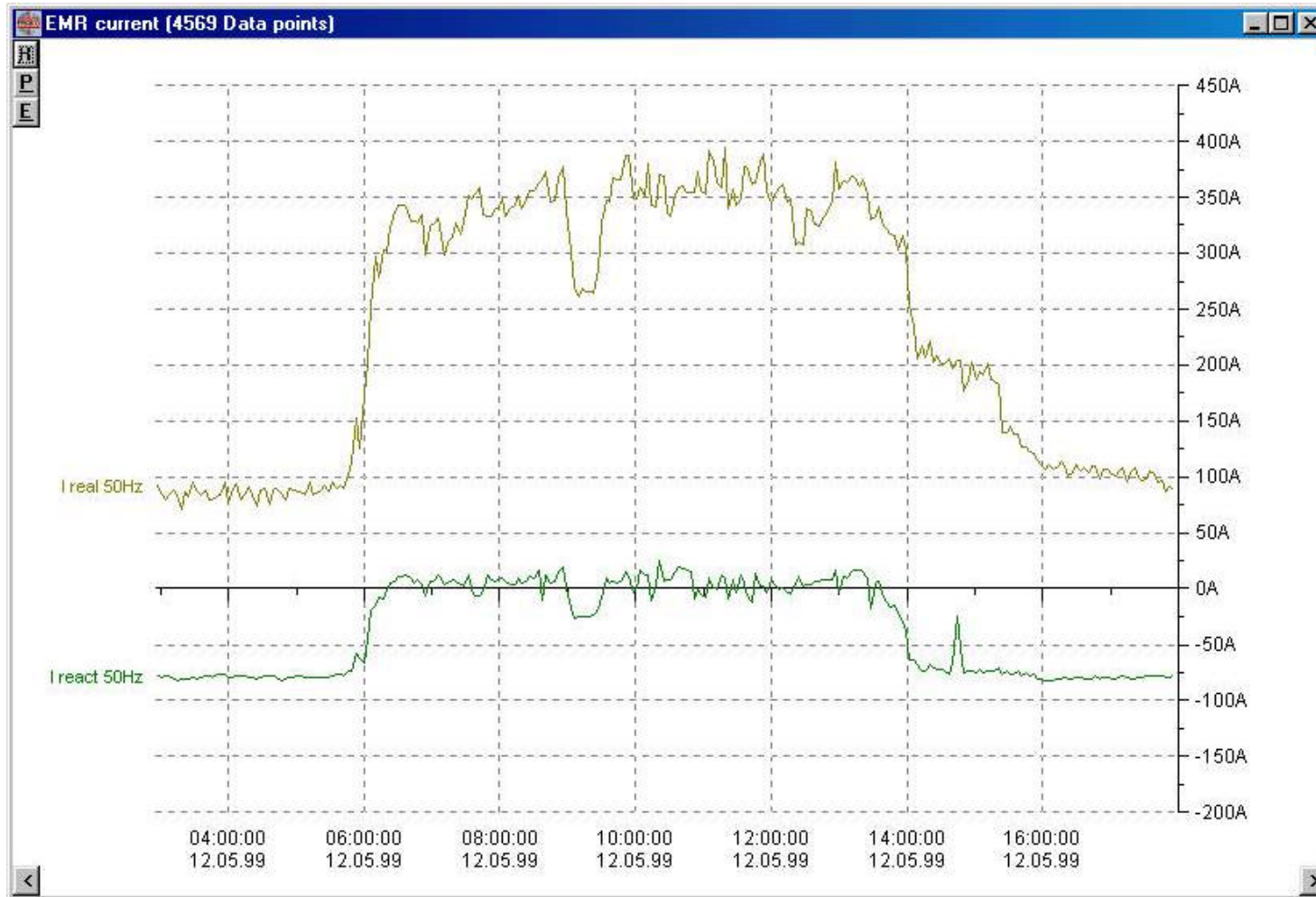
Display range  
Store Recall  
Days Hrs Min  
01Days 00Hrs. 00Min.

Jump  
< >  
Cursor-Time  
12.05.99 07:43:53

All diagrams  
Display  
Close  
Redraw

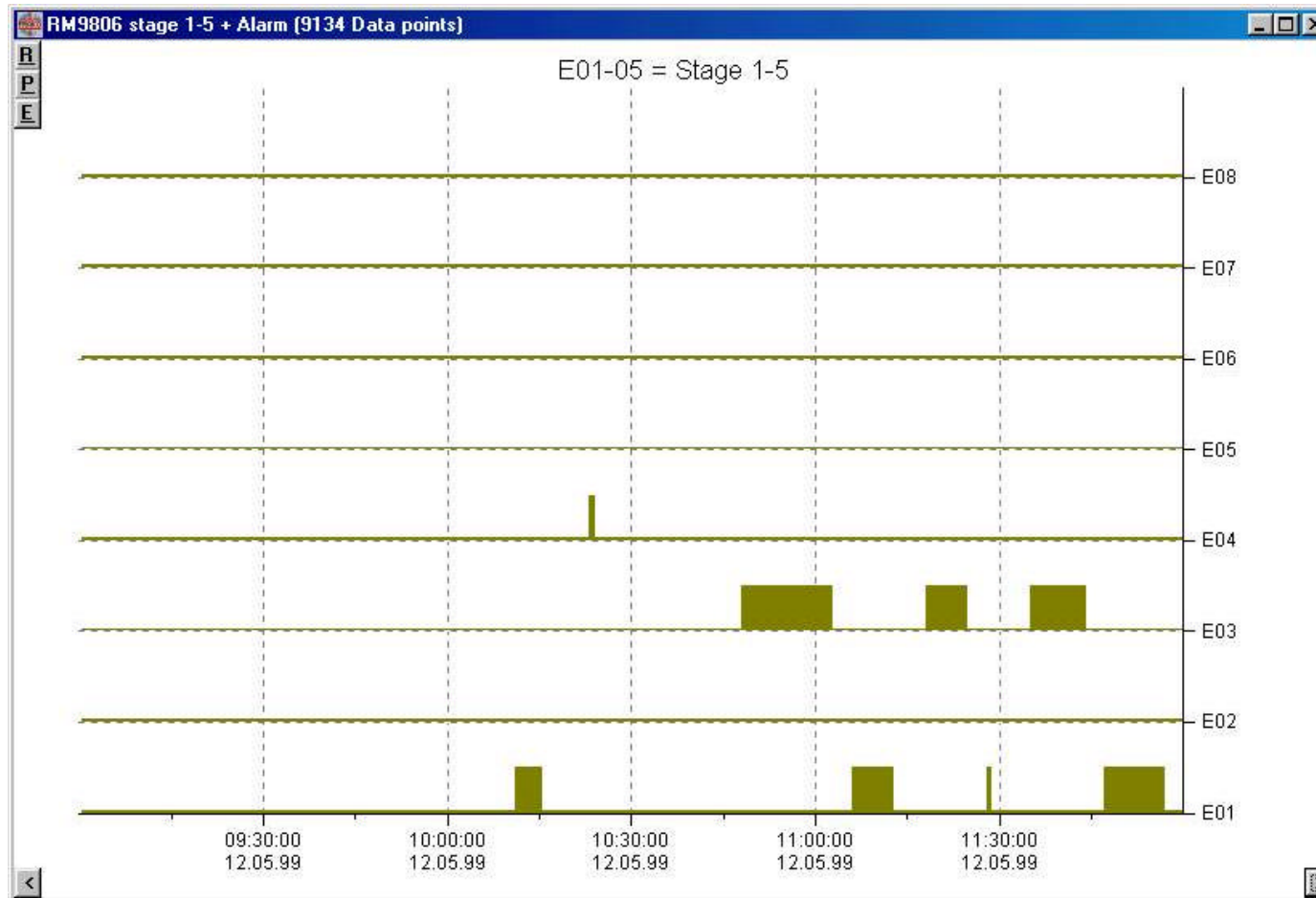
Data New Load Save Recording New start Restart Program Help Exit

# Visualisation Software EM-Graph Current Analysis

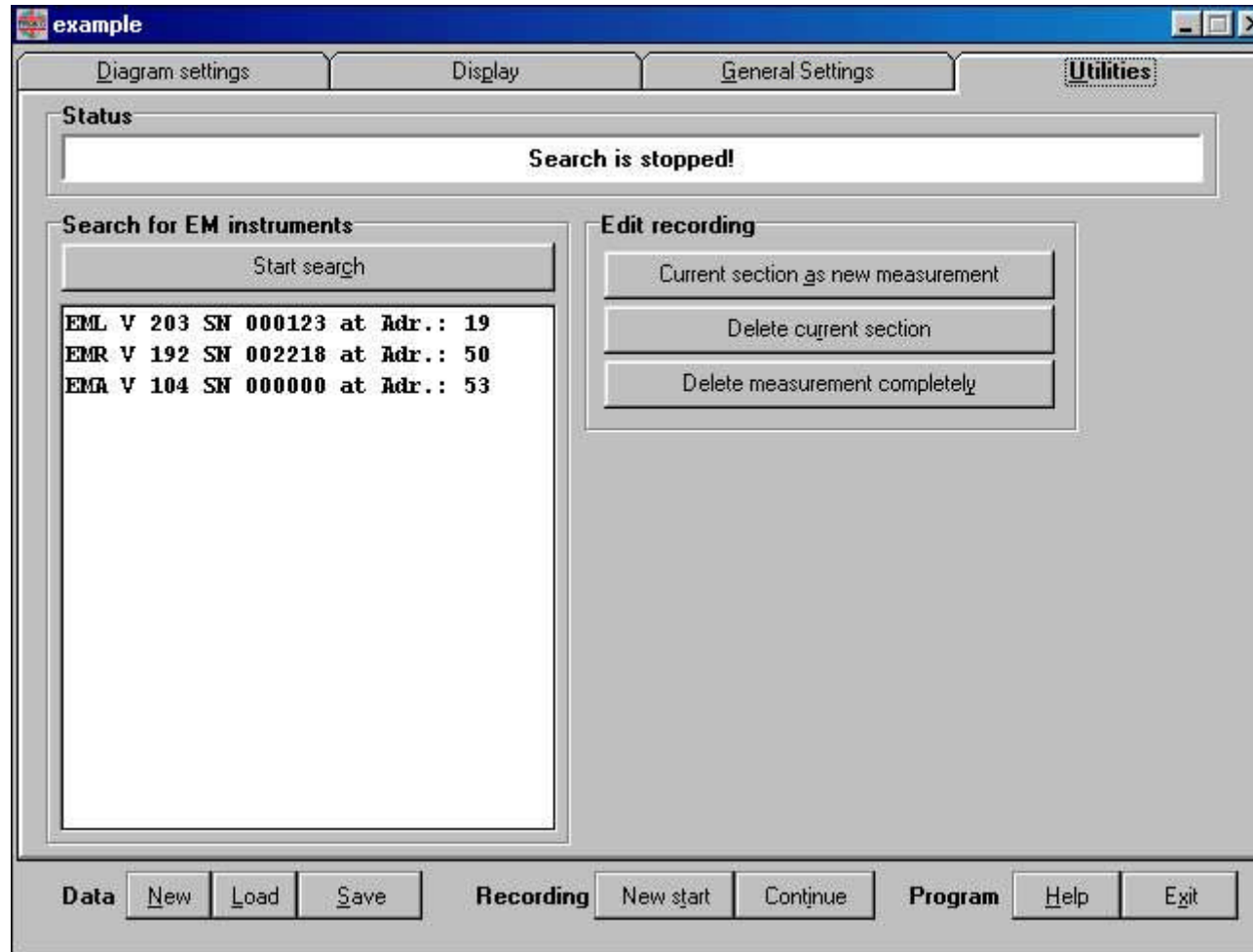




# Visualisation Software EM-Graph Reactive Power Stages



# Visualisation Software EM-Graph Utilities Screen



# Visualisation Software EM-Graph General Settings



The screenshot shows a Windows-style dialog box titled "example" with a blue title bar. The dialog has four tabs: "Diagram settings", "Display", "General Settings" (which is selected and highlighted with a dotted border), and "Utilities".

Under the "General Settings" tab, the settings are organized into several sections:

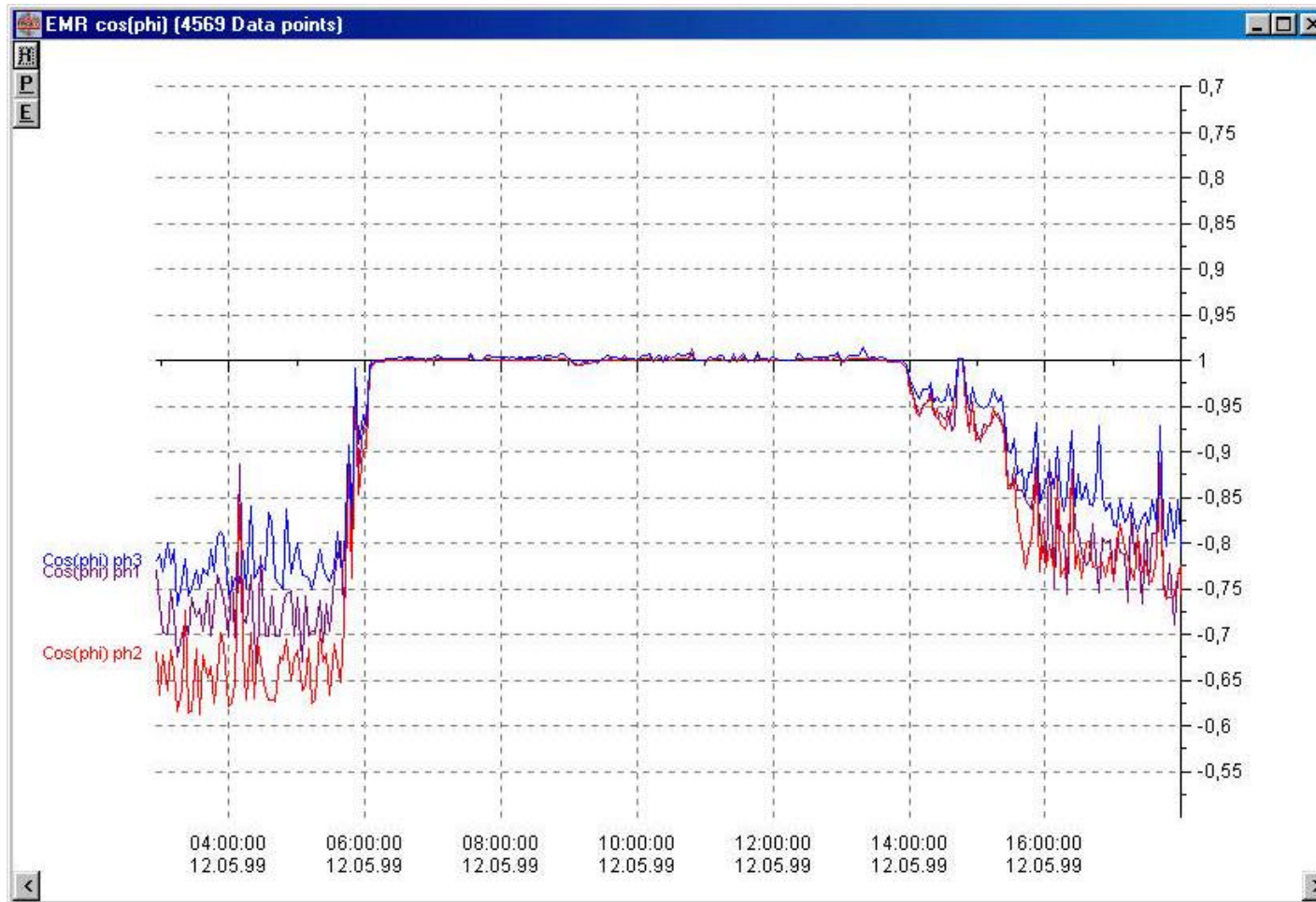
- Connection via:** Three radio buttons are present: "EMZ", "EMP" (which is selected), and "EML".
- Interface:** Four radio buttons are present: "COM1", "COM2", "COM3" (which is selected), and "COM4".
- Font size:** Two spinners are shown. The "Display" spinner is set to 30, and the "Printer" spinner is set to 50.
- Miscellaneous:** A group box containing four checked checkboxes: "Show help text", "Display diagrams at start", "Check if instrument accessible", and "Variable axis scaling".
- Diagrams:** A group box containing an unchecked checkbox for "Averaging" and a spinner for "Data points" set to 400.
- Printer:** A group box containing a "Setup" button.

At the bottom of the dialog, there is a "Register EMGRAPH" button. Below the main settings area, the text "V1.60E 03/99, Serial-No.: 1 Unlimited number of instruments supported" is displayed.

The bottom of the dialog features a row of buttons organized into four groups:

- Data:** "New", "Load", "Save"
- Recording:** "New start", "Restart"
- Program:** "Help", "Exit"

# Visualisation Software EM-Graph Power Factor Display

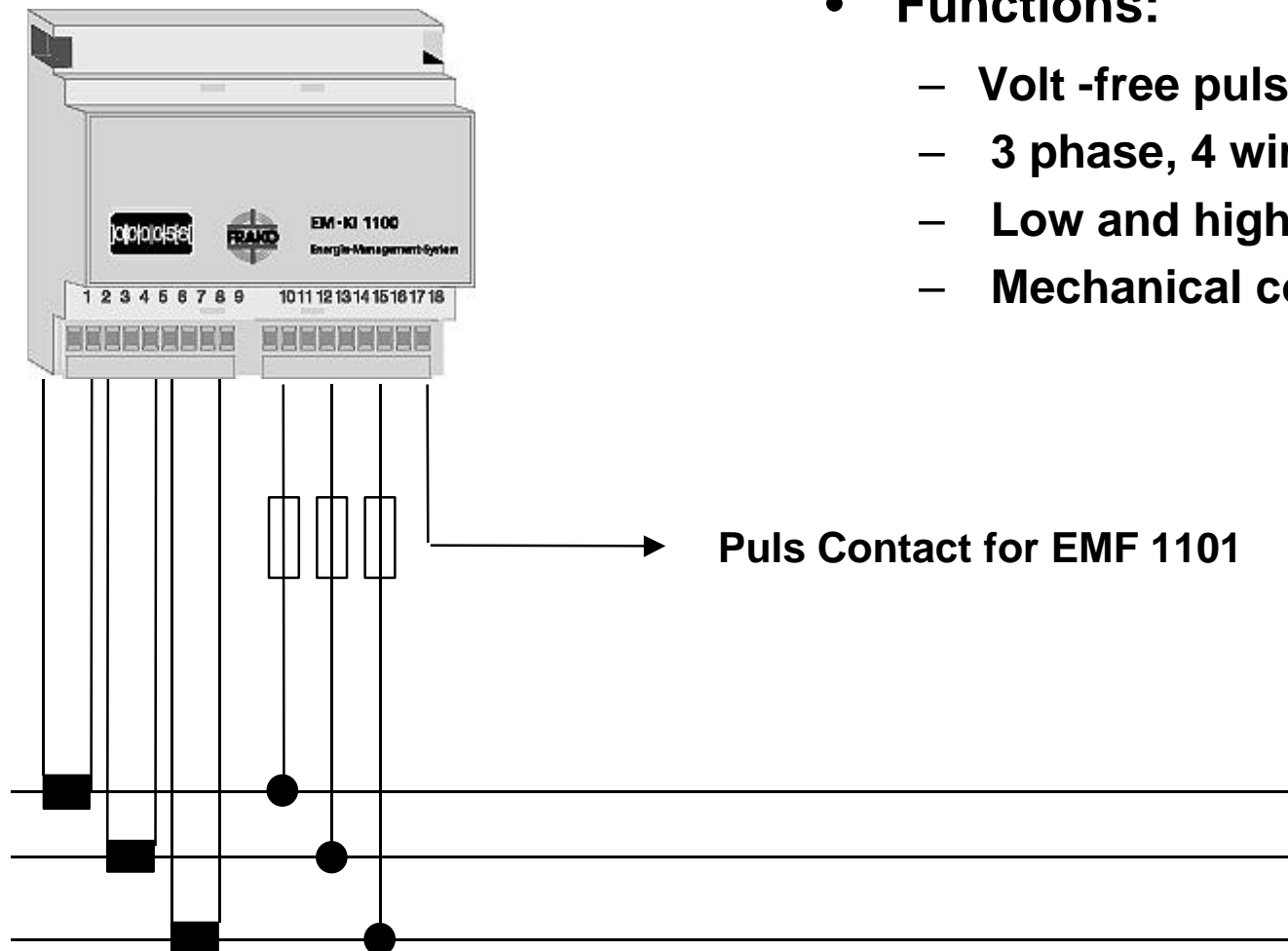


# Power Meter EMKI1101/1103

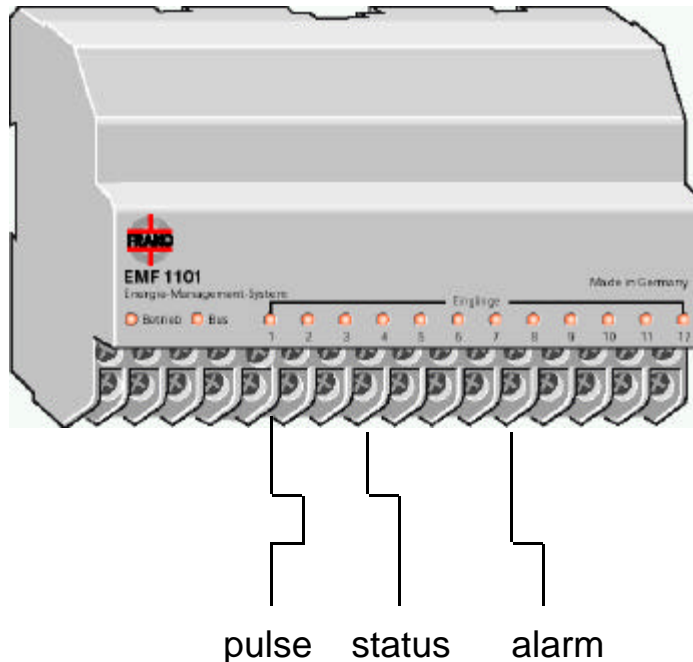


- **Functions:**

- Volt -free pulse output
- 3 phase, 4 wire connection
- Low and high voltage
- Mechanical counter in kWh



# Metering and Status Report Unit EMF 1101



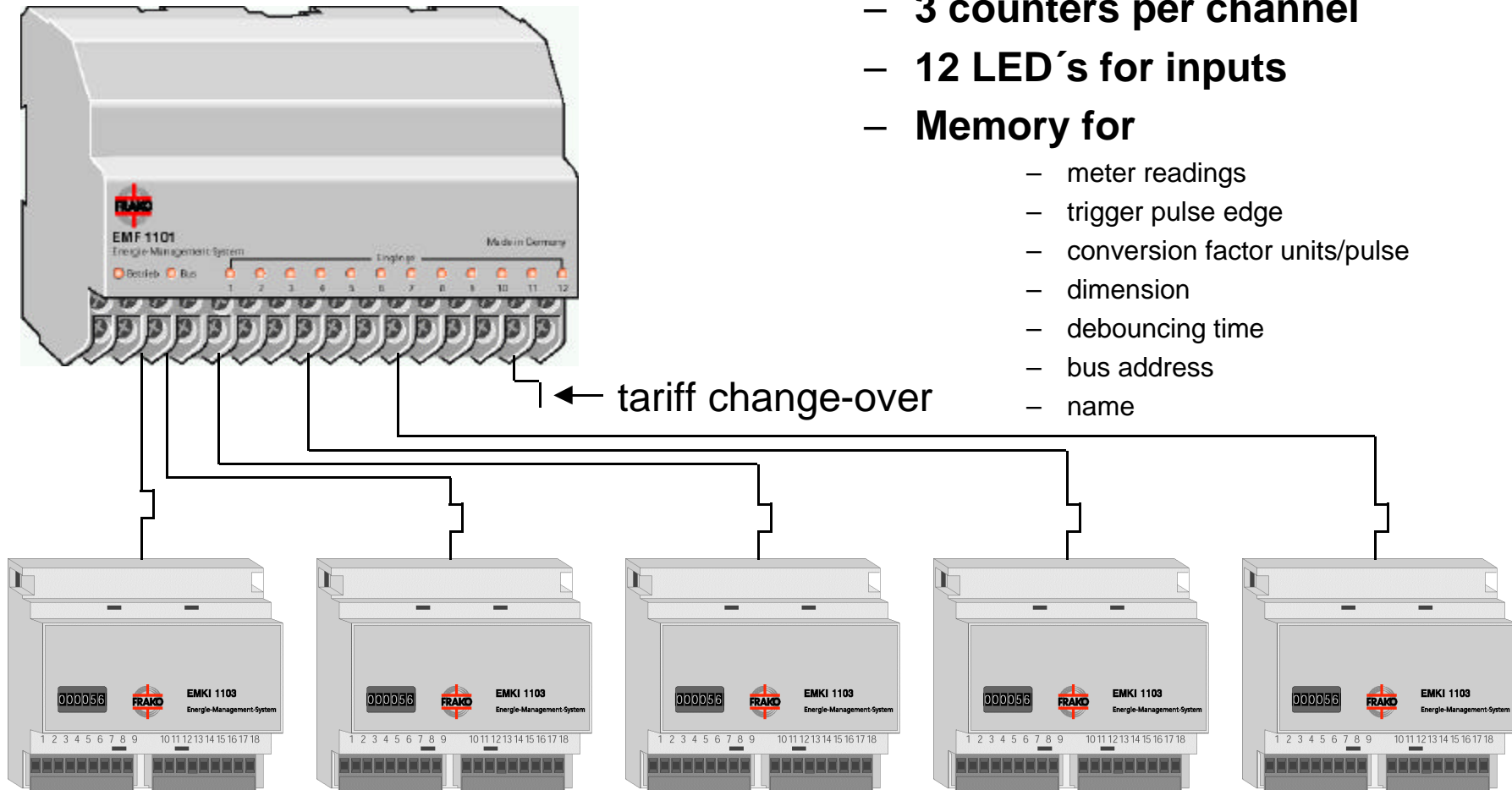
- Objectives:
  - Continues puls sampling independently from bus connection
  - Saves counts in case of power failures
  - Meter counts can be pre-set
  - Counter value is 5 byte on each counting port
  - 12 ports
  - Supplies power for external transformers
  - Channel 12 for HT/LT switching

# Metering and Status Report Unit EMF 1101

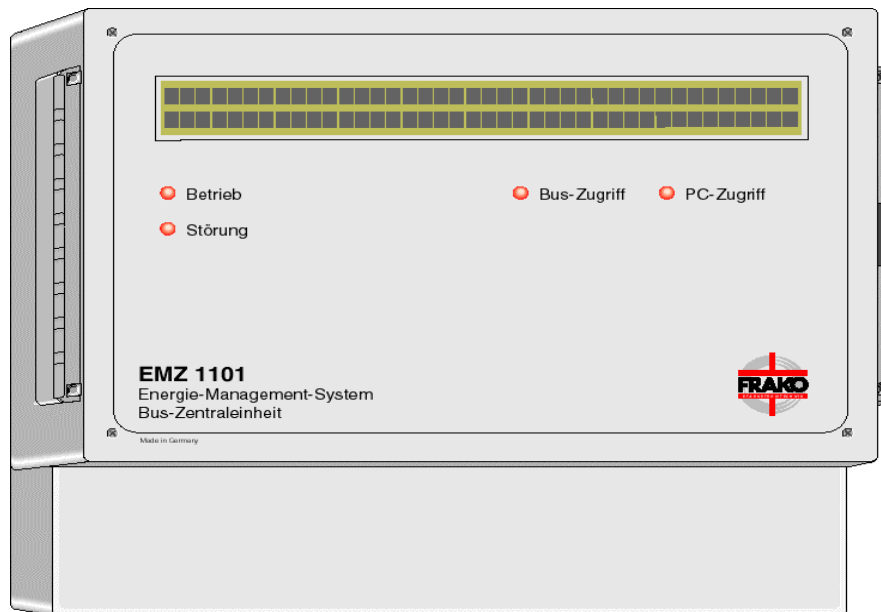


- **Functions:**

- 12 binary input channels
- 3 counters per channel
- 12 LED's for inputs
- **Memory for**
  - meter readings
  - trigger pulse edge
  - conversion factor units/pulse
  - dimension
  - debouncing time
  - bus address
  - name



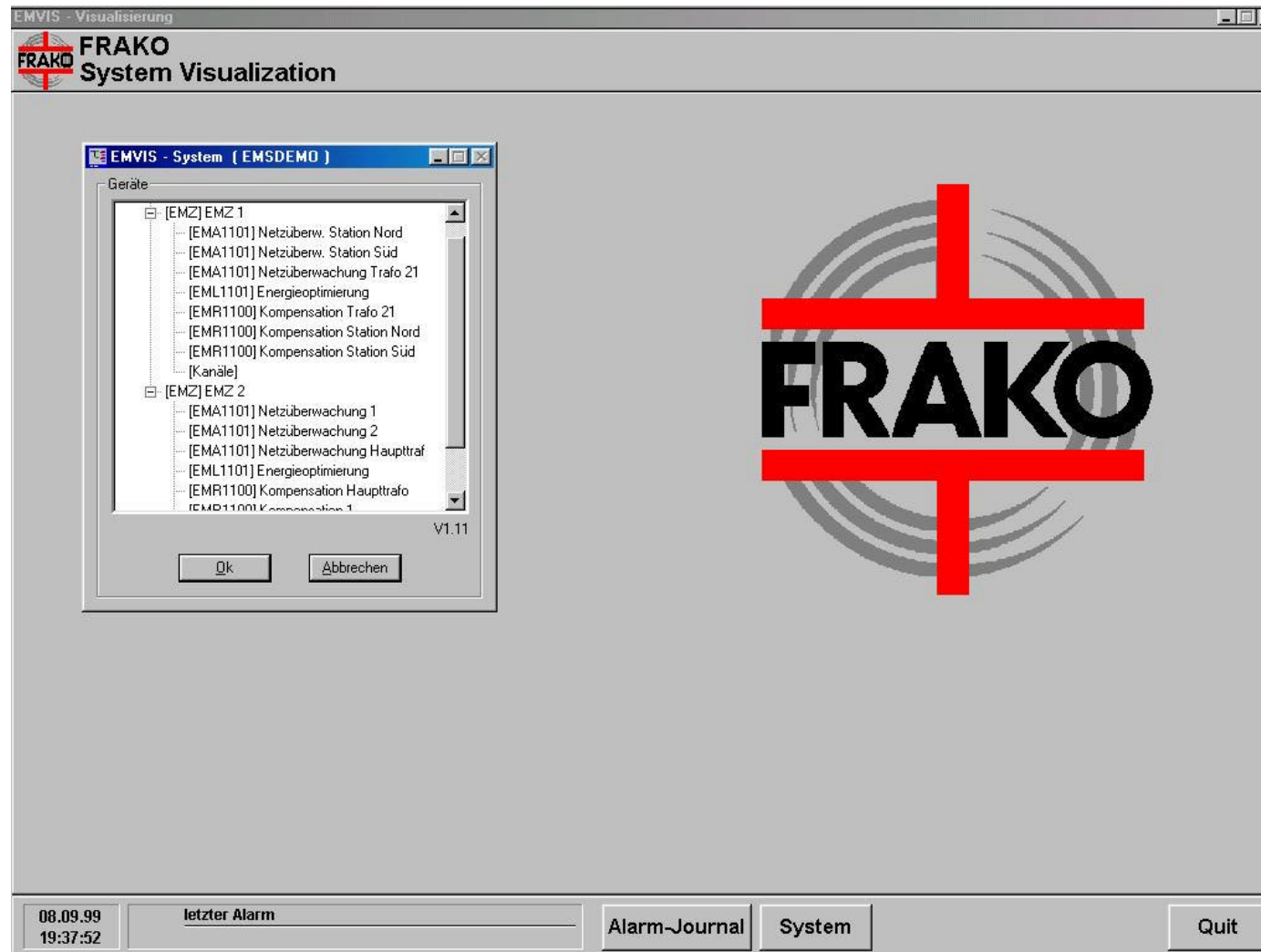
# Bus Central Unit EMZ 1200 S, M, L, XL



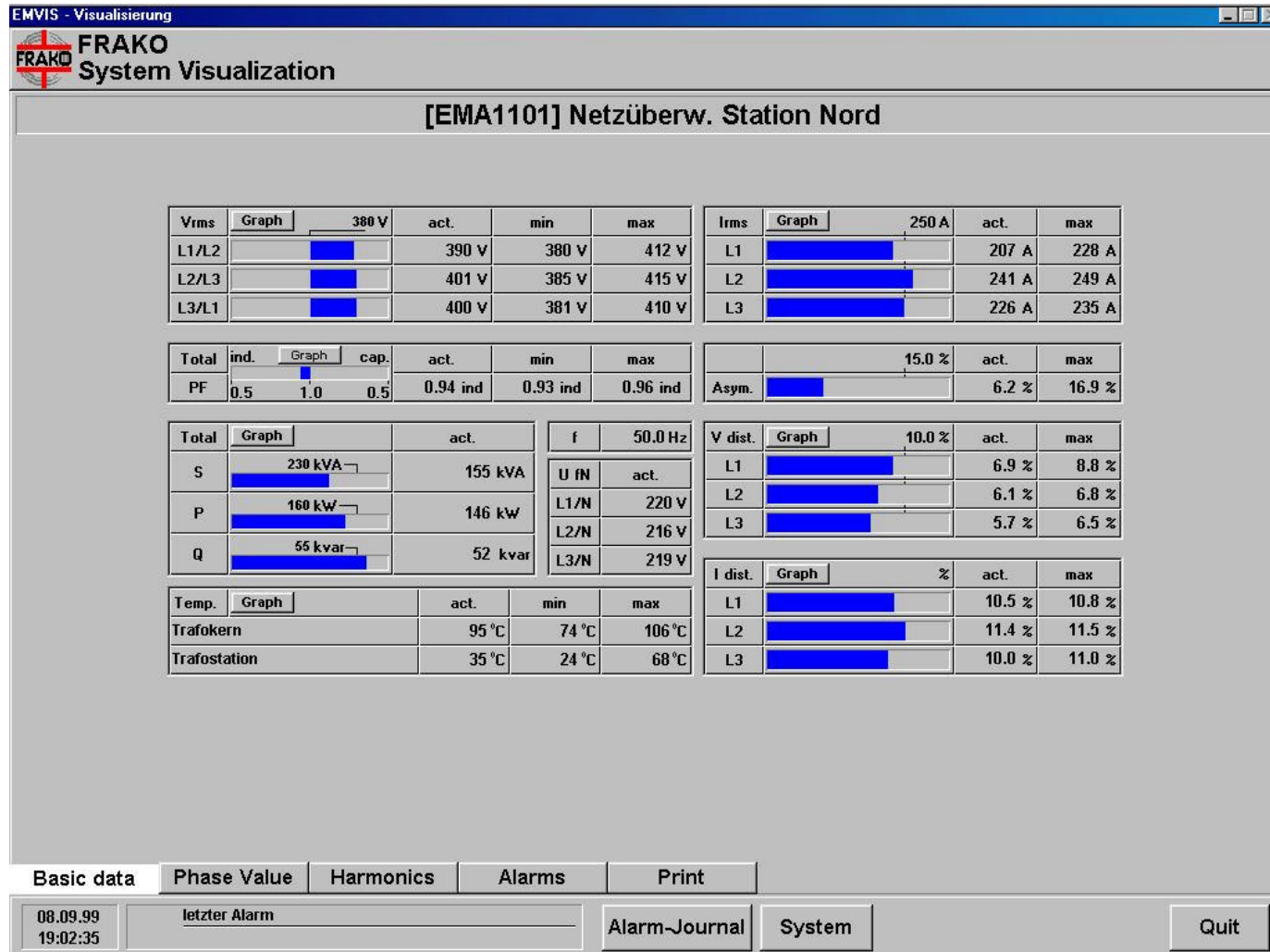
- **Data storage and interface:**
  - Display of time, date
  - Remaining storage capacity
  - Memory capacity: 100 days
  - Serials RS 232 and RS 485
  - Parallel interface (Centronics)
  - Built-in flash EPROM
  - Alarm messages via printer
  - Programmable alarm relay



# EMVIS Energy Management Visualization Software



# EMVIS Mains Monitoring



# EMVIS Maximum Demand Control



EMVIS - Visualisierung

**FRAKO**  
System Visualization

[EML1101] Energieoptimierung

Active Profile: 2

P act.	136 kW	<div style="width: 85%;"></div>
P act.1	56 kW	<div style="width: 40%;"></div>
P act.2	34 kW	<div style="width: 20%;"></div>
P act.3/Q act.	46 kW	<div style="width: 30%;"></div>
P acc	127 kW	<div style="width: 78%;"></div>
P acc prev	138 kW	<div style="width: 85%;"></div>
PF	1.00	<div style="width: 100%;"></div>
Time rem	02:08 min	<div style="width: 15%;"></div>

Target values		Power	
P max	160 kW	Forecast	138 kW
P peak	1000 kW	Corrective	57 kW
PF min	0.70	Remaining	238 kW

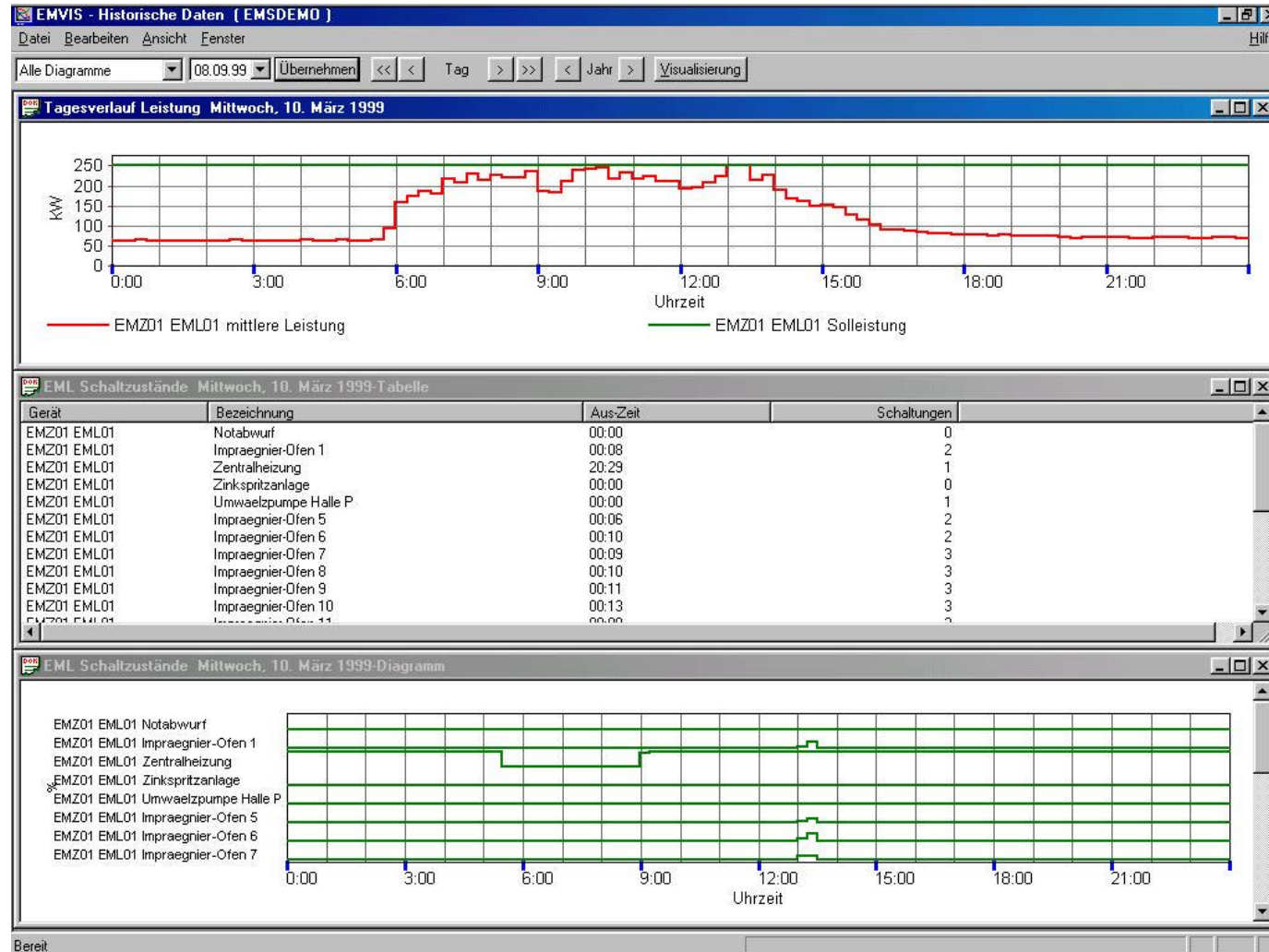
Graph day      Graph month/year

AUS	EML	Notabwurf
AUS		Impraegnier-Ofen 1
AUS		Zentralheizung
AUS		Zinkspritzeanlage
AUS		Umwaelzpumpe Halle P
AUS		Impraegnier-Ofen 5
AUS		Impraegnier-Ofen 6
AUS		Impraegnier-Ofen 7
AUS		Impraegnier-Ofen 8
EIN		Impraegnier-Ofen 9
EIN		Impraegnier-Ofen 10
AUS		Impraegnier-Ofen 11
EIN		Deckelheizung
		Relais Schaltkanal 13
		Relais Schaltkanal 14
		Relais Schaltkanal 15
		Relais Schaltkanal 16
		Relais Schaltkanal 17
		Relais Schaltkanal 18
		Relais Schaltkanal 19
		Relais Schaltkanal 20
		Relais Schaltkanal 21

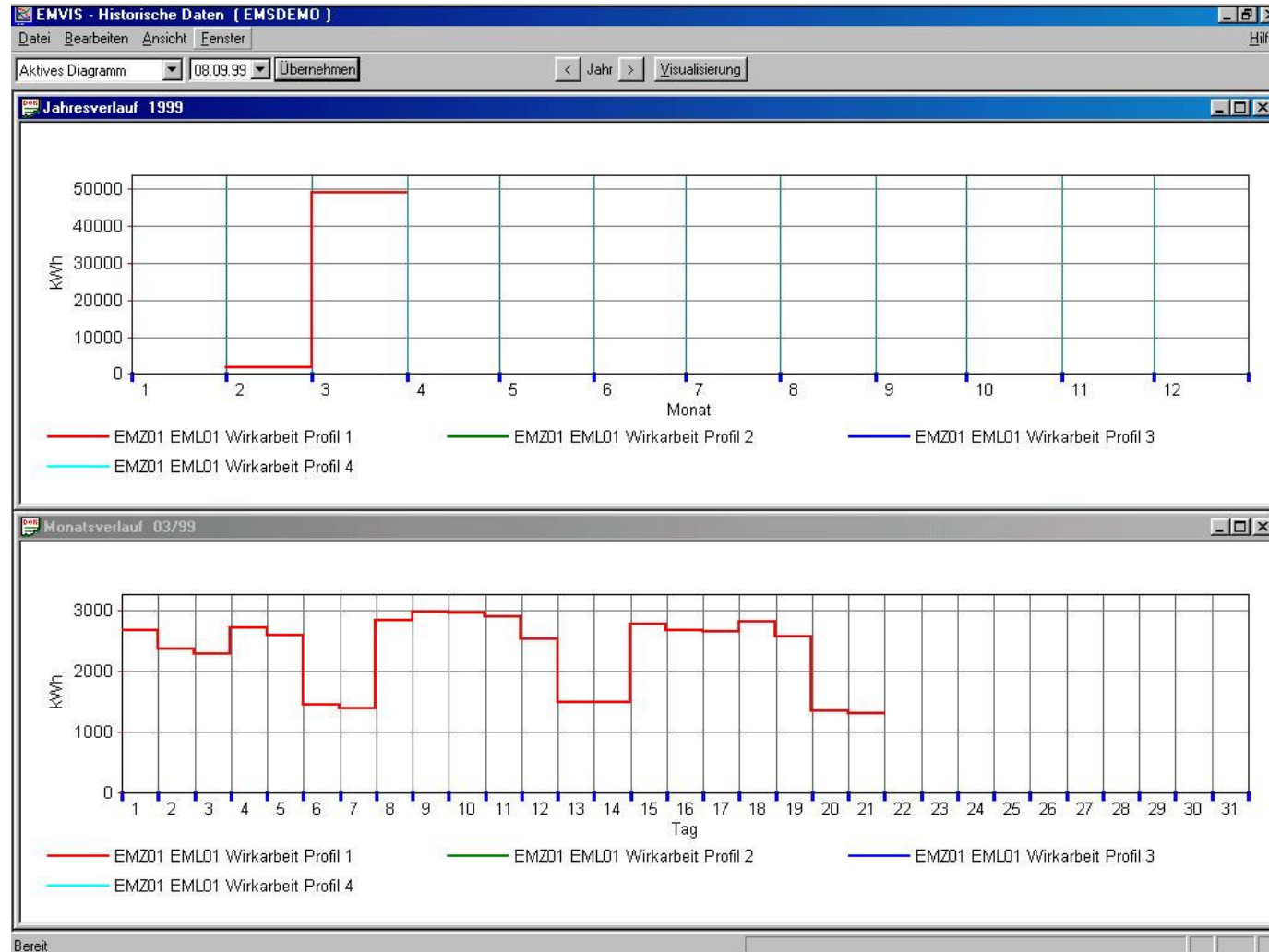
Basic data    Alarms    Print

08.09.99    letzter Alarm    Alarm-Journal    System    Quit  
19:06:31

# EMVIS Maximum Demand Control



# EMVIS Maximum Demand Control



# EMVIS Compensation



EMVIS - Visualisierung

**FRAKO**  
System Visualization

[EMR1100] Kompensation Trafo 21

Active profile

Graph

Target PF	0.96 ind	ind	1.0	cap
Actual PF	0.95 ind	ind	1.0	cap
in use	17 %			
V <sub>Δ</sub>	378 V			

Graph

V dist.	4.2 %	
V 05	4.5 %	
V 07	3.9 %	
V 11	2.2 %	
V 13	0.6 %	

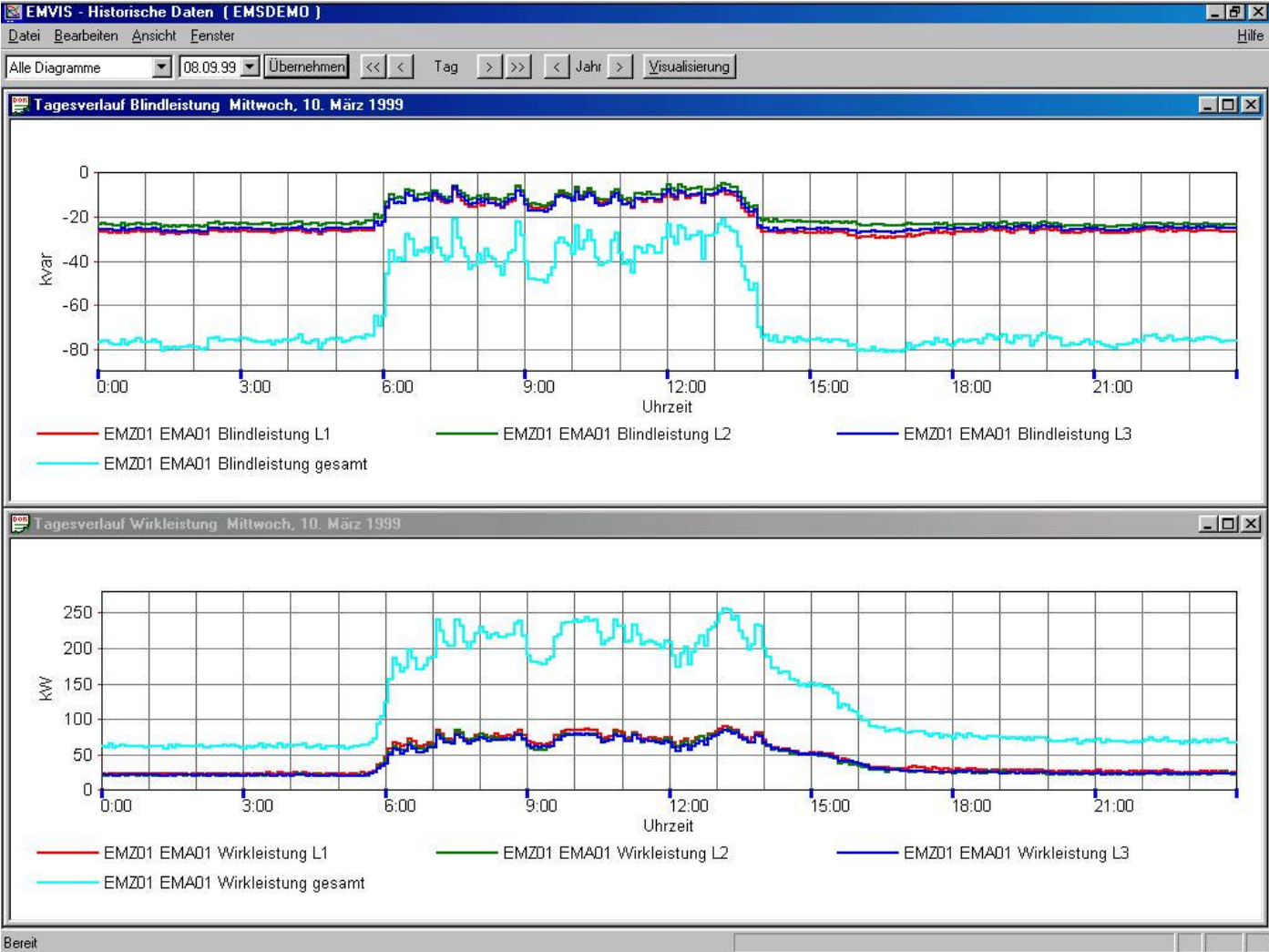
I active	189 A	
I reactive	48 A	

Stage	Reactive power		
1	25 kvar		
2	25 kvar		
3	50 kvar		
4	50 kvar		
5	50 kvar		
6	50 kvar		
7	50 kvar		
8	50 kvar		
9	50 kvar		
10	50 kvar		
11	0 kvar		
12	0 kvar		

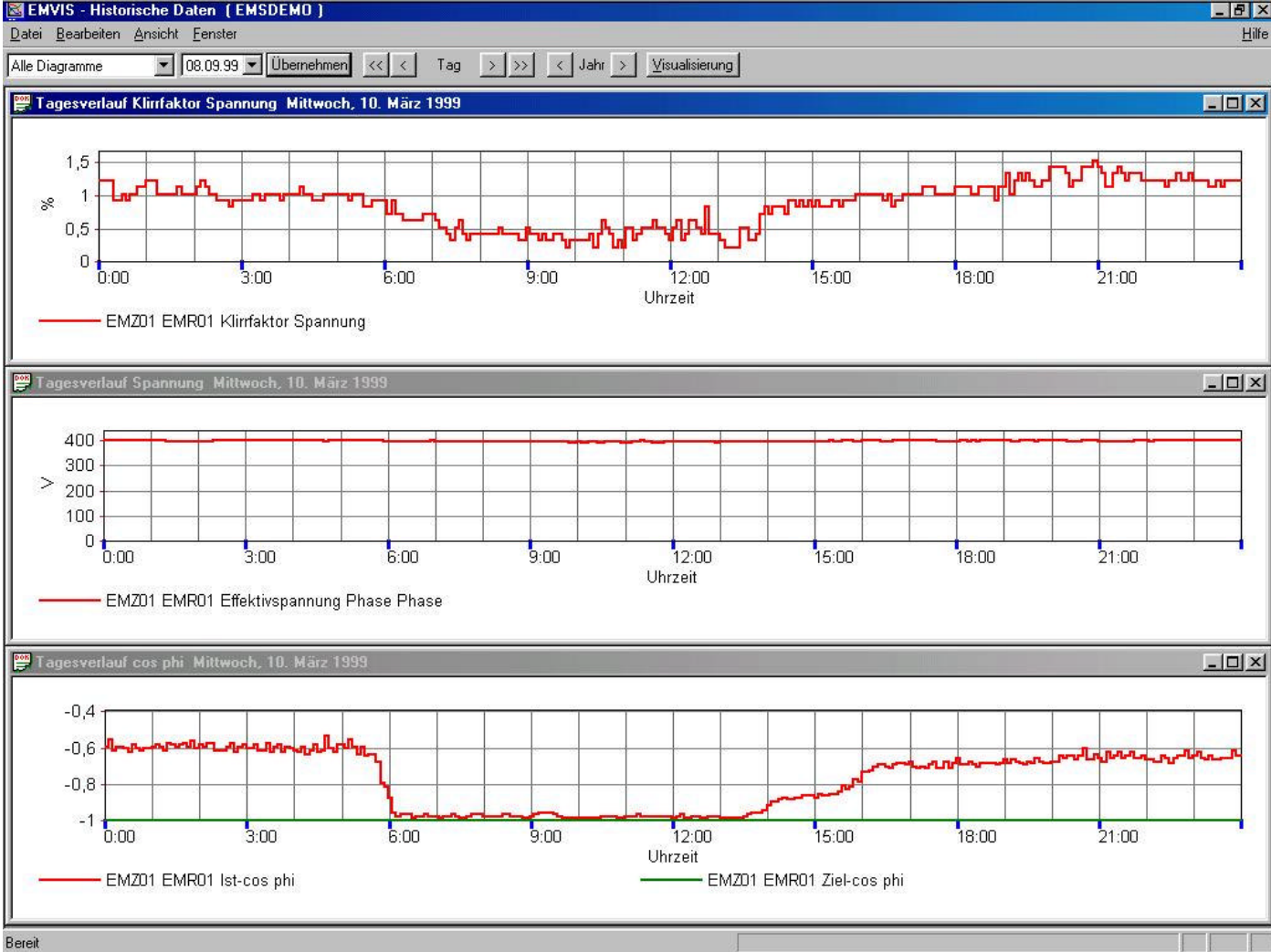
Basic data   Alarms   Print

08.09.99 19:23:08   letzter Alarm   Alarm-Journal   System   Quit

# EMVIS Mains Monitoring

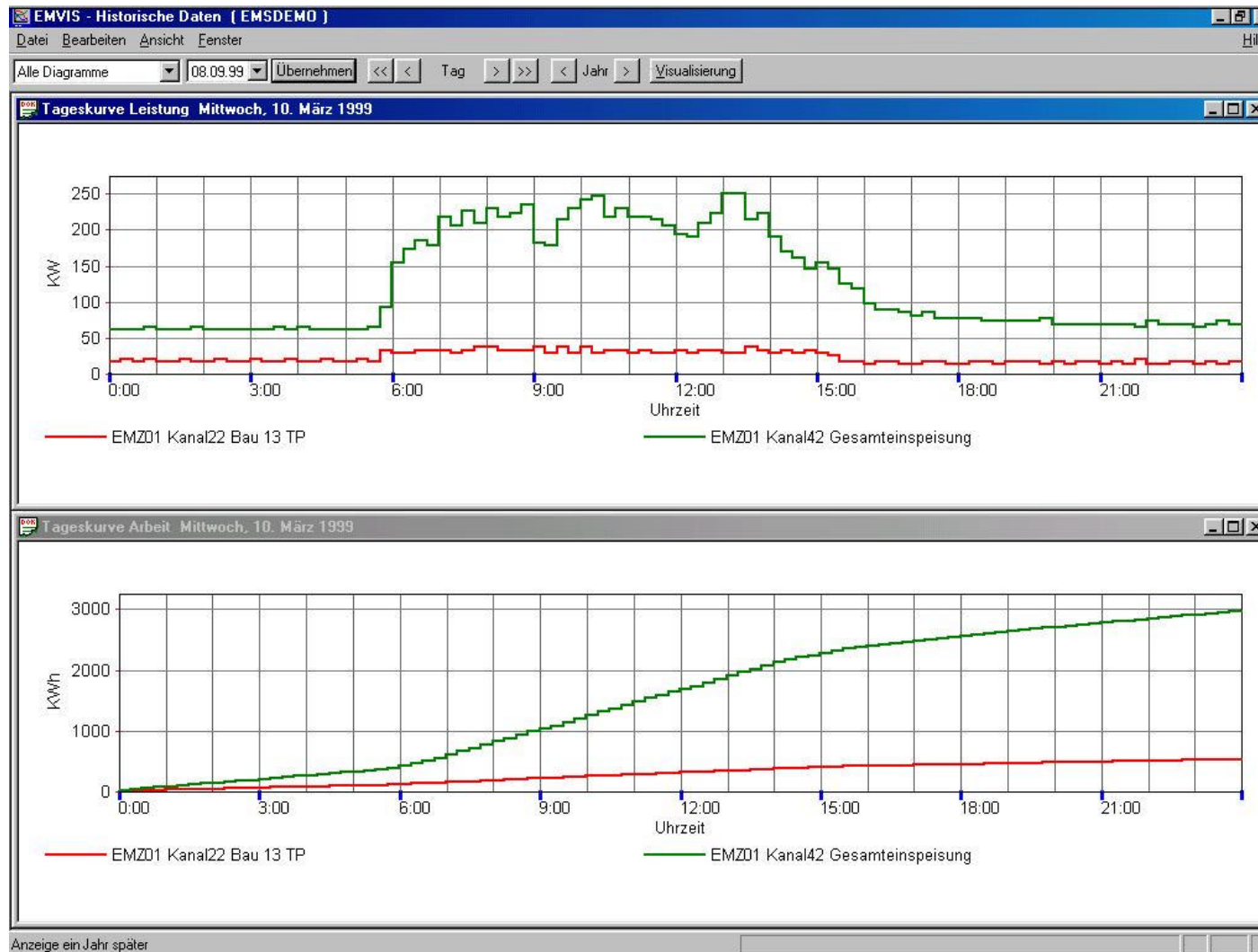


# EMVIS Mains Monitoring

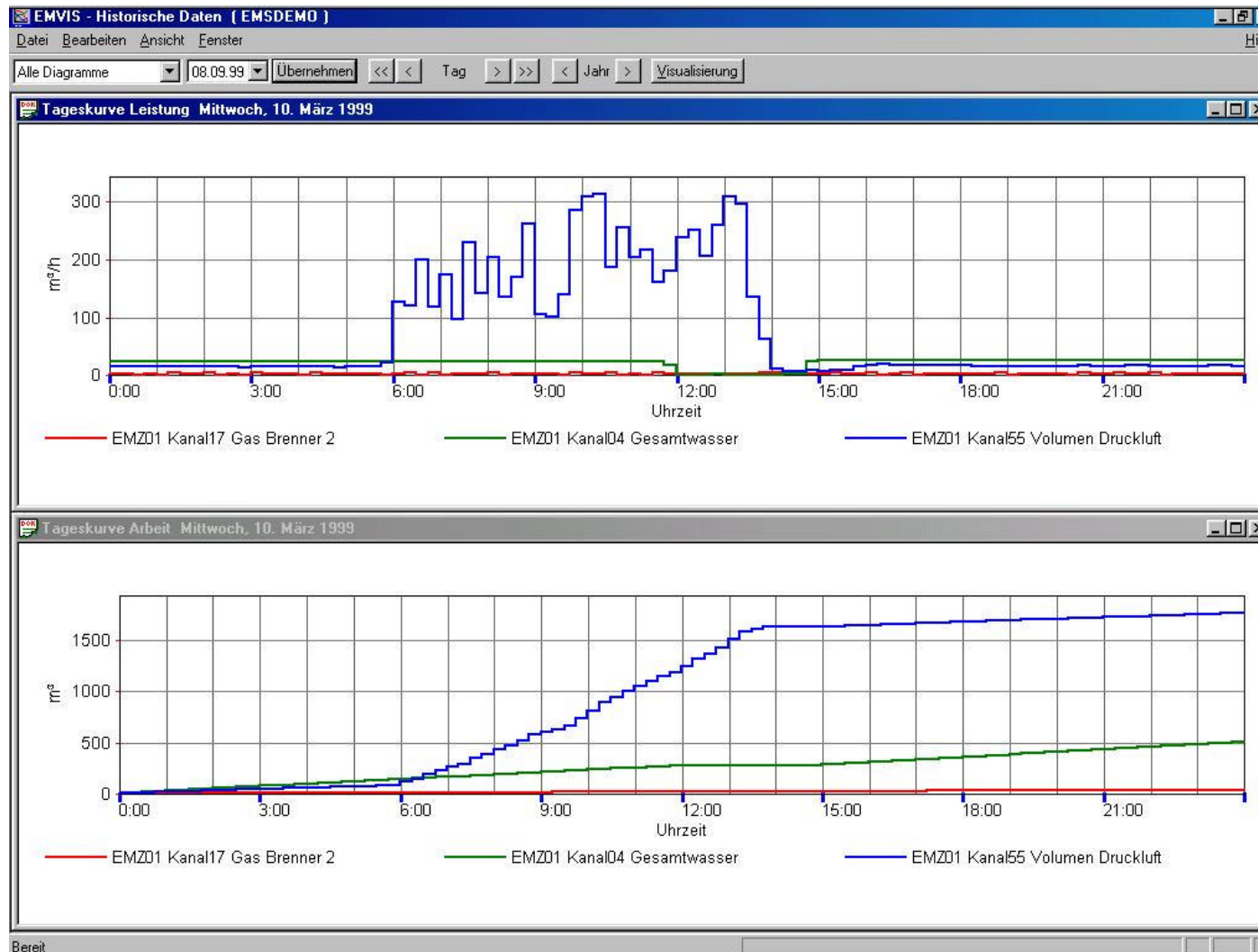




# EMVIS Energy Meters

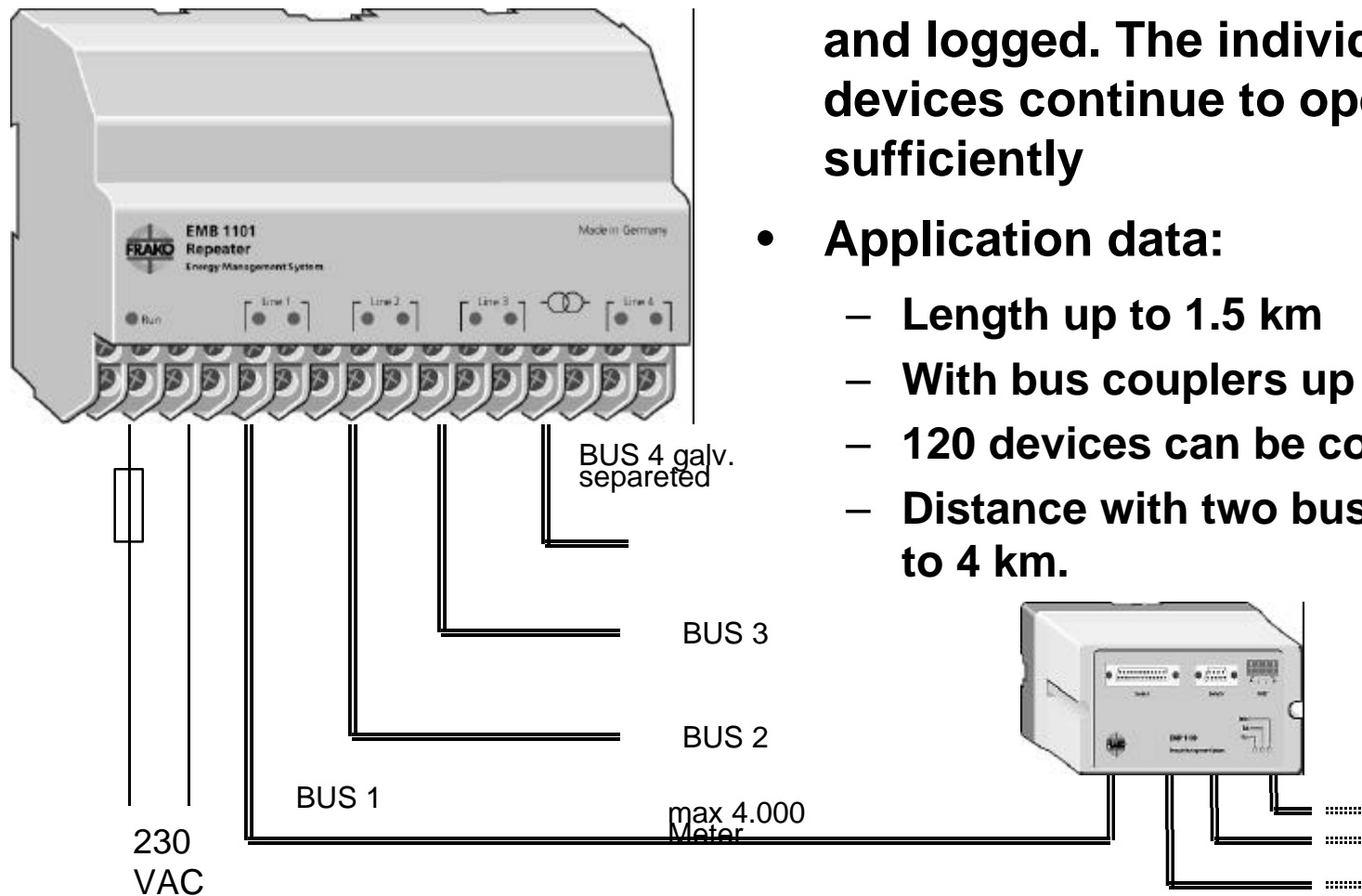


# EMVIS Metering of Media



# Repeater EMB 1101

- Bus structure with limitless modularity
- Bus faults are detected, reported and logged. The individual devices continue to operate self-sufficiently
- Application data:
  - Length up to 1.5 km
  - With bus couplers up to 15 km
  - 120 devices can be connected
  - Distance with two bus couplers up to 4 km.



# FRAKO Energie Management System (EMS)



- 1. Basics of Energy Management (EM)
- 2. Mains Monitoring
- 3. Maximum Demand Control (Load Shedding)
- 4. Power Factor Correction with FRAKO EMS
- 5. Additional Components and Software
- **6. FRAKO Energy Management Sets**
  - Mains Monitoring Set
  - Maximum Demand Set
  - Maximum Demand Set +
- 7. Integrated FRAKO Energy Management
  - Various installations utilizing the FRAKO Starkstrombus™
  - Mains Monitoring / Load Shedding /
  - Metering electrical energy and other energies and media
- 8. Questions & Answers



## **6. FRAKO Energy Management Sets**

**Mains Monitoring Set**  
**Maximum Demand Set**  
**Maximum Demand Set +**

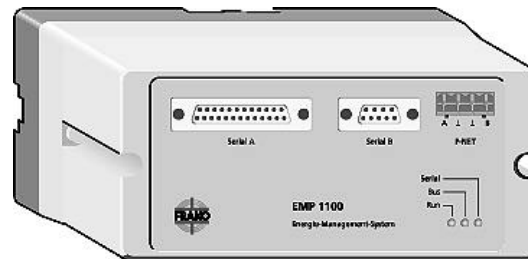
# Mains Monitoring Set



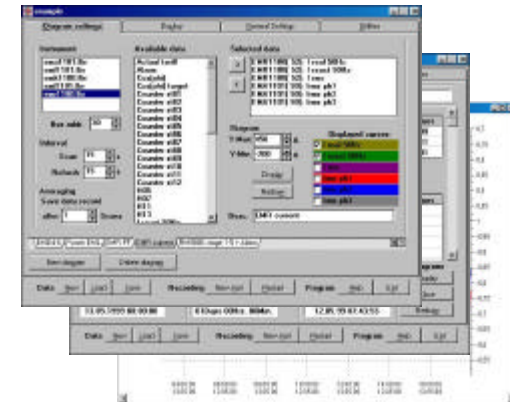
- consisting of
  - 1 Mains Monitoring Instrument **EMA 1101**
  - 1 Communication Interface **EMP 1100**
  - 1 Visualization Software **EM-Graph**



+



+



# Maximum Demand Sets



- for 4 channels, consisting of
  - 1 Maximum Demand Controller **EML 1101S**
  - 1 Optimizing Software for PC-Operation **OPT-SW**
- for 12 channels, consisting of
  - 1 Maximum Demand Controller **EML 1101S**
  - 1 Optimizing Software for PC-Operation **OPT-SW**
  - 1 Extension Module **EMD 1101**
- for 20 channels, consisting of
  - 1 Maximum Demand Controller **EML 1101S**
  - 1 Optimizing Software for PC-Operation **OPT-SW**
  - 2 Extension Modules **EMD 1101**



# Maximum Demand Sets+

- created like the Maximum Demand Sets plus
  - 1 Visualization Software **EM-Graph**

4 Channels



12 Channels



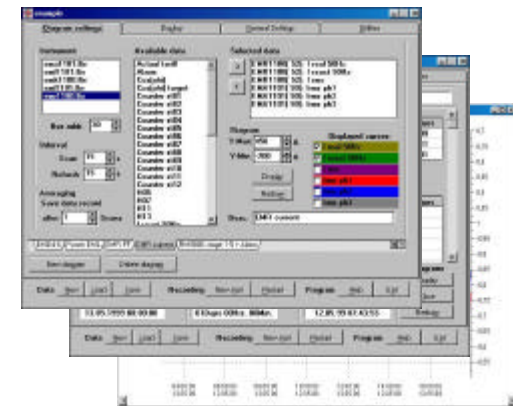
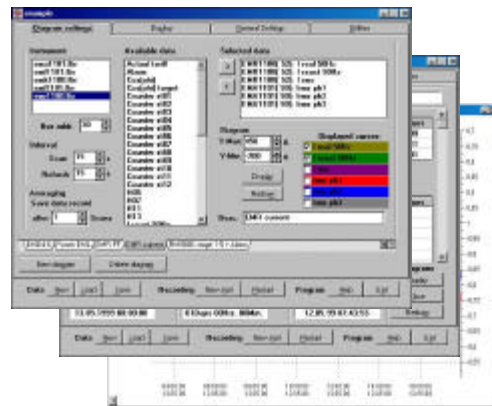
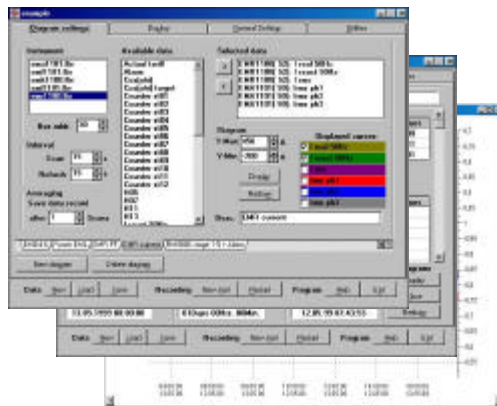
20 Channels



+

+

+





# Energy Management Packages



					Number of sets ordered:		
					1	5	10
<b>Mains Monitoring Set</b> , consisting of							
	-	1 EMA 1101			2.630,00	2.370,00	2.100,00
	-	1 EMP 1100					
	-	1 EMGraph					
<b>Maximum Demand Set</b> , consisting of					<b>Number of channels</b>		
	-	1 EML 1101S		<b>4</b>	1.980,00	1.760,00	1.590,00
	-	1 OPT-SW	- 1 EMD 1101	<b>12</b>	3.080,00	2.740,00	2.470,00
			- 2 EMD 1101	<b>20</b>	4.700,00	4.180,00	3.760,00
<b>Maximum Demand Set +</b> , consisting of							
	-	1 EML 1101S		<b>4</b>	2.780,00	2.470,00	2.230,00
	-	1 OPT-SW	- 1 EMD 1101	<b>12</b>	3.880,00	3.450,00	3.110,00
<b>+</b>	-	1 EMGraph	- 2 EMD 1101	<b>20</b>	5.500,00	4.890,00	4.400,00
					<b>Net Pricing in DM per Set</b>		

# FRAKO Energie Management System (EMS)



- **1. Basics of Energy Management (EM)**
- **2. Mains Monitoring**
- **3. Maximum Demand Control (Load Shedding)**
- **4. Power Factor Correction with FRAKO EMS**
- **5. Additional Components and Software**
- **6. FRAKO Energy Management Sets**
  - **Mains Monitoring Set**
  - **Maximum Demand Set**
  - **Maximum Demand Set +**
- **7. Integrated FRAKO Energy Management**
  - Various installations utilizing the FRAKO Starkstrombus™**
  - Mains Monitoring / Load Shedding /**
  - Metering electrical energy and other energies and media**
- **8. Questions & Answers**

## **7. Integrated FRAKO Energy Management**

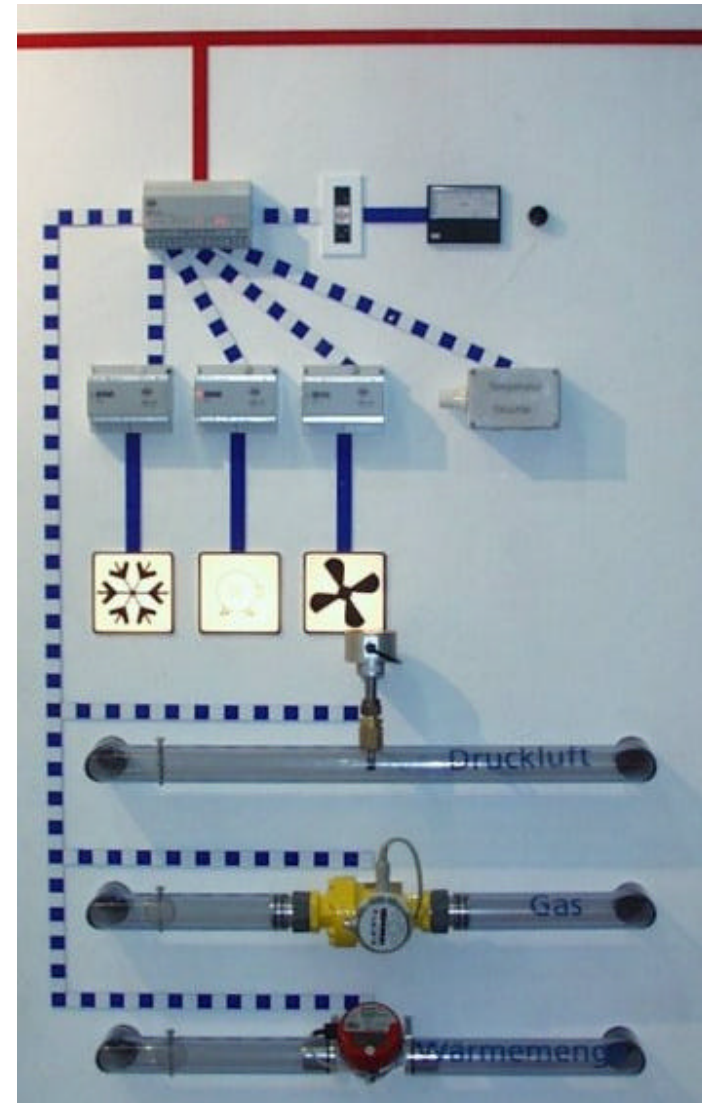
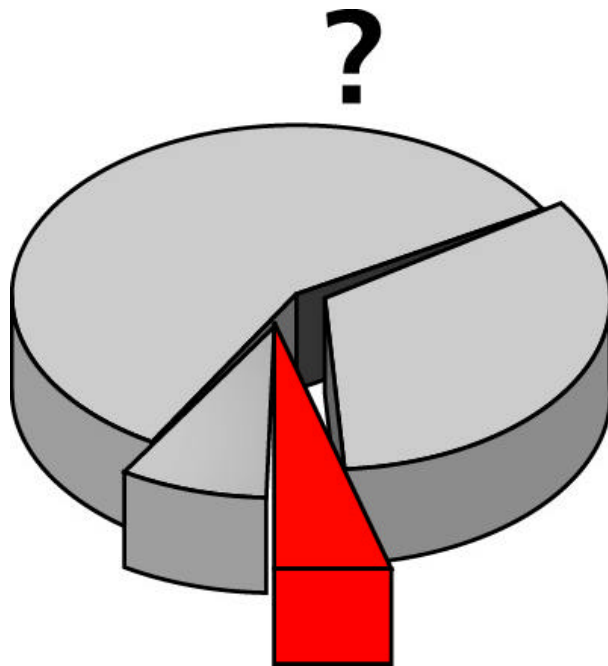


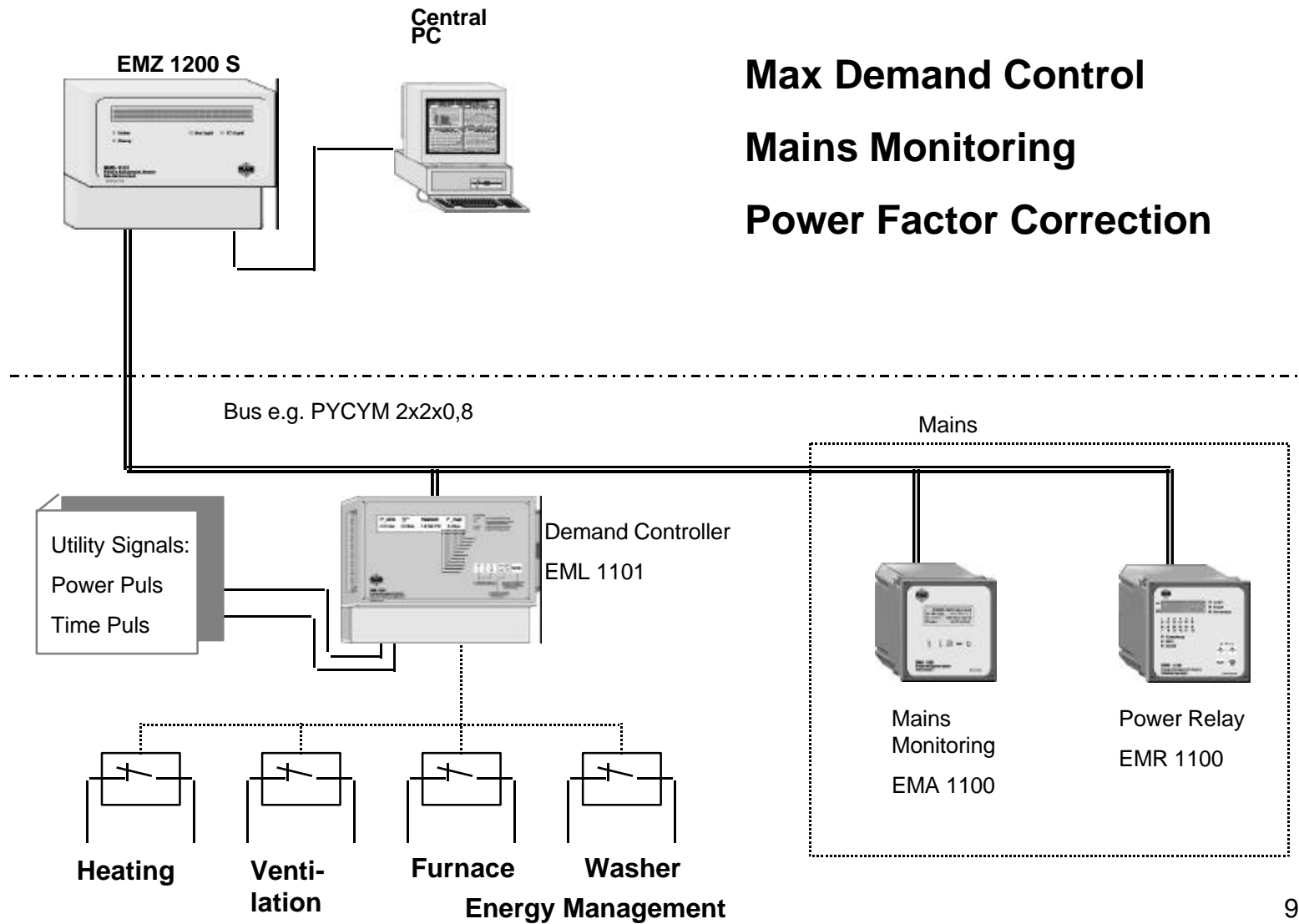
**Various installations utilizing the FRAKO  
Starkstrombus™**

# Samples of Integrated FRAKO EMS



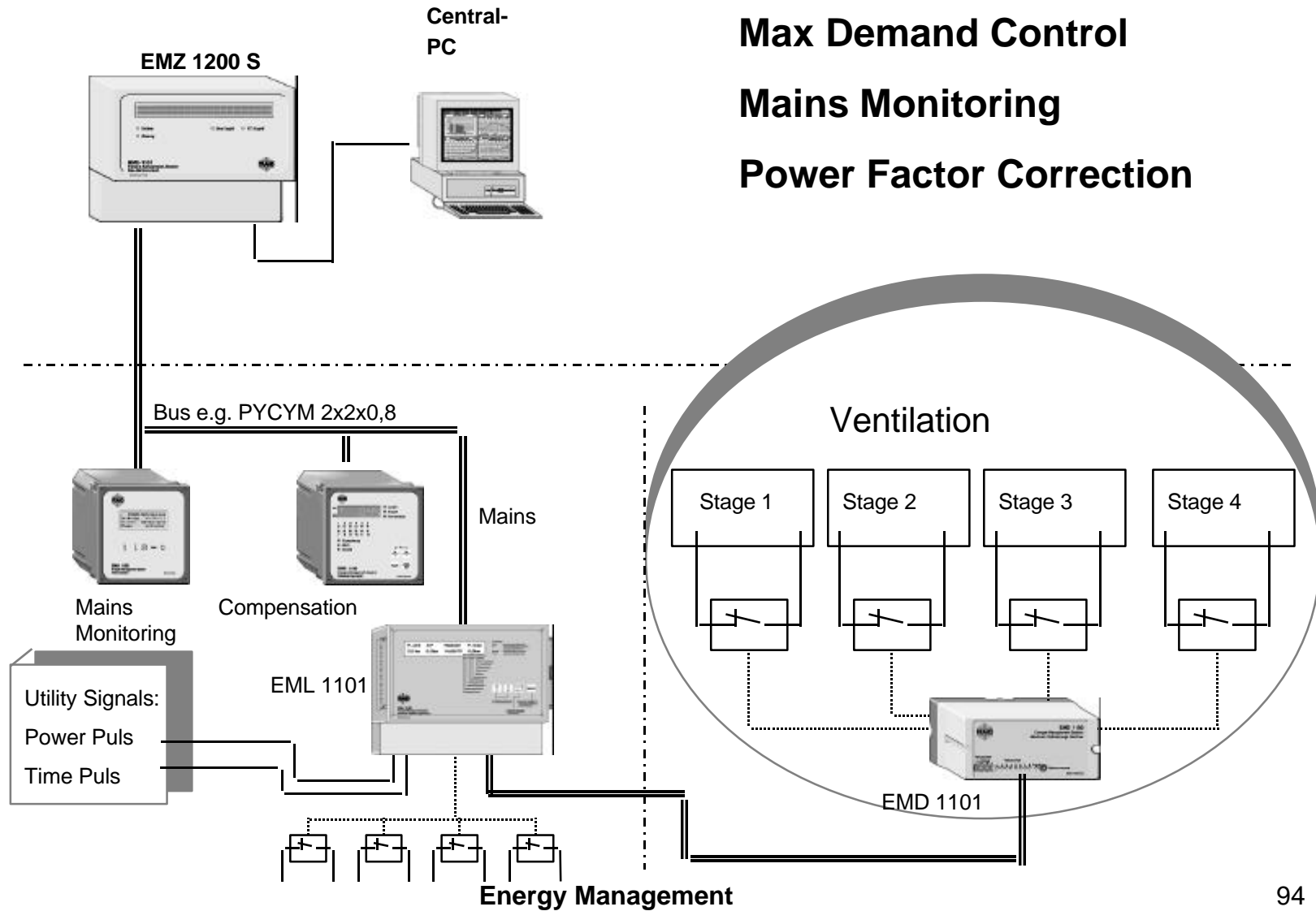
- Transparency of interrelations releases potential for savings





**Max Demand Control**  
**Mains Monitoring**  
**Power Factor Correction**

**Max Demand Control**  
**Mains Monitoring**  
**Power Factor Correction**



# Summary (1)



- **Reactive power compensation enables you to eliminate costs for reactive power**
- **Maximum Demand Control reduces costs for peak performance**
- **Energy Management systems originally designed for electrical power are also capable of mapping metering data and status information of other media**

## Summary (2)



- **Automatic recording, documentation and graphical processing of energy data create transparency**
- **Operational reliability increases**
- **Insight into and awareness of operational process is created**
- **It is not only possible to take cost-effective measures on specific processes but also to evaluate the results.**



It's all about saving your money

# FRAKO Power Factor Correction and Energy Management



Energy Management

# FRAKO Energie Management System (EMS)



- **1. Basics of Energy Management (EM)**
- **2. Mains Monitoring**
- **3. Maximum Demand Control (Load Shedding)**
- **4. Power Factor Correction with FRAKO EMS**
- **5. Additional Components and Software**
- **6. FRAKO Energy Management Sets**
  - **Mains Monitoring Set**
  - **Maximum Demand Set**
  - **Maximum Demand Set +**
- **7. Integrated FRAKO Energy Management**
  - Various installations utilizing the FRAKO Starkstrombus™**
  - Mains Monitoring / Load Shedding /**
  - Metering electrical energy and other energies and media**
- **8. Questions & Answers**



## 8. Questions & Answers