

# *Rico-Werk*

# Prometos



## **X** Generation

Bestell - Nr. : 591604 / 591605

# **user information**

User Information  
**Prometos X**  
Realtime Computer System for the High-Voltage Supply of Electrofilters

**General**

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This User Information describes the function and the local control of a high voltage regulation system consisting of:

- Prometos real-time industrial computer
- trigger pulse amplifier
- digital connection board
- analogue connection board
- analogue signal isolation

These components are built into an electrical cabinet together with the switch-gear and the thyristor controller.

Each high voltage regulator can be controlled by binary signals from a control room. In the Prometos-DP version, the devices have a Profibus-DP interface for communication with a central control device (operator panel, touch panel) or a control pulpit.

In addition, there is the possibility of local control in any high voltage system. The LCD VGA monitor shows all the necessary information on the state of the high voltage system. All the monitoring functions and the fault reporting system are in operation so that a secure high voltage supply is also guaranteed independently of the serial bus.

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**Safety Notices**

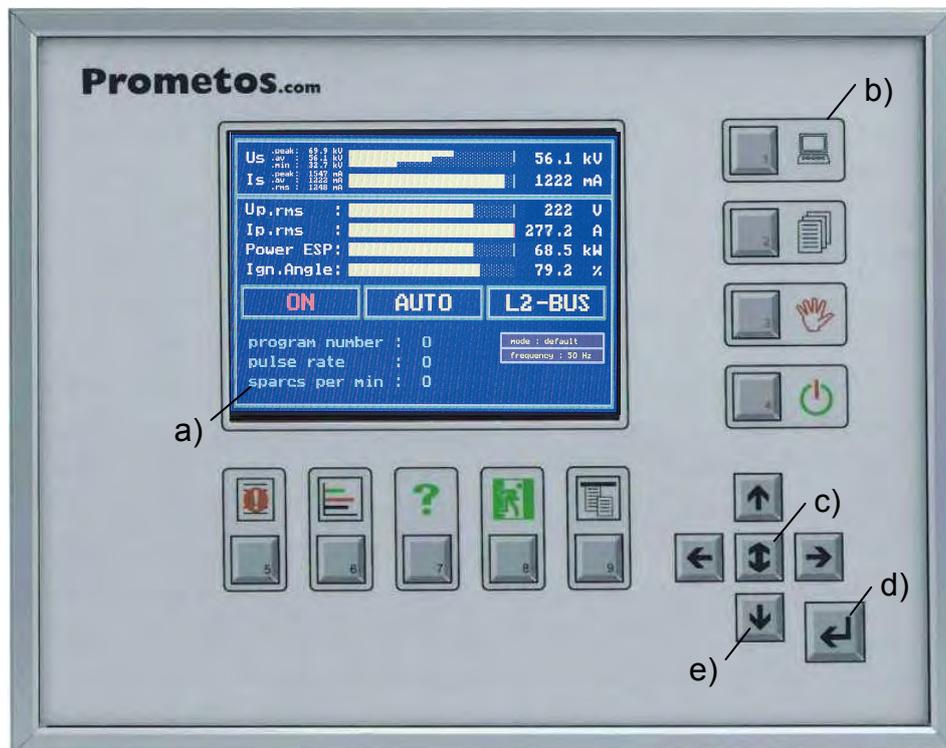
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ATTENTION: Be aware that you are putting a high voltage system into operation, which generates voltages that can be a danger to life!

1. Observe the 5 basic rules of electrical safety:
  - switch off
  - secure against switching on
  - verify that the voltage is zero
  - earth and short-circuit
  - protect from neighbouring voltage sources
  
2. Observe the basic rules of personal protection:
  - convince yourself, before switching on, that all safety systems are in proper order, e.g.
    - enclosures
    - earthing arrangements
    - door switches
    - coverings and fences
    - tubes and conduit shielding conductors
  
  - convince yourself, before switching on, that no one is present in danger areas or in the electrofilter. All access (doors, manholes etc.) must be closed and locked.
  
  - consider the possibilities of errors when first commissioning. For example, could whole sections of a filter be interchanged because of incorrect wiring or marking notices!

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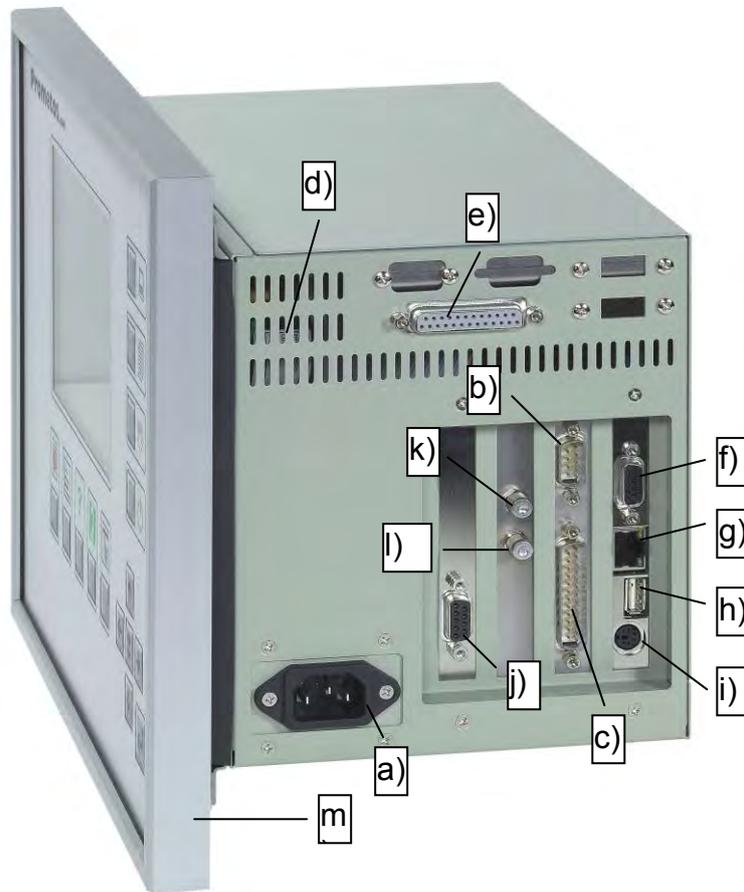
Front View



- a) LCD monitor
- b) Input keys:
  - key 1: switching between local and control room control or pass number input
  - key 2: setting of program parameters or pass number input
  - key 3: Switching between manual and automatic control or pass number input
  - key 4: switching high-voltage system on or off or pass number input
  - key 5: fault report list
  - key 6: graphic status display
  - key 7: online help for the current menu item
  - key 8: cancel current operation/setting
  - key 9: activate pull down menu (menu bar at the top of the display window)
- c) Select key: select parameters in control windows
- d) Enter key: enter current settings
- e) Arrow keys:
  - UP/DOWN: select menu item or change numbers when entering parameters
  - LEFT/RIGHT: select menu item or change direction

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Side View, Right, Connectors



Prometos /X      Part No. 591604  
Prometos-DP /X    Part No. 591605

- a) Power connector, 3 pin, for supply voltage to the regulator, 90 – 264 V AC, 50/60 Hz (ground+neutral +supply)
- b) Analogue sensor inputs, 9-pin SUB-D male connector, connection to:  
“analogue signal isolation”,                      part No. 591 296  
or, alternatively:                                      part No. 591 302  
with 9-core connection cable,                      part No. 584 812
- c) Digital outputs, 25-pin SUB-D male connector, connection to:  
“digital connection board”,                      part No. 591 297  
with 25-core connection cable,                      part No. 584 810
- d) Ventilation holes; must not be obstructed!
- e) Digital inputs, 25-pin SUB-D female connector, connection to:  
“digital connection board”,                      part No. 591 297  
with 25-core connection cable,                      part No. 584 810
- f) Monitor output, 15-pin SUB-D female connector, can, if required, for training sessions for example, be used to connect an external monitor using a standard monitor cable. The output is automatically activated on booting if an external monitor is recognised.

Side View, Right, Connectors

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- g) Network connection  
h) USB-Port  
i) Keyboard
- } These connections are not supported by the Prometos software and may not be used.
- j) \* Profibus-DP interface, 9-pin SUB-D female connector, connection to bus terminal bar type 6GK1 500-0AA10 with the connection cable of the terminal bar.
- k) Optical output (transmitter) for trigger angle information, SMA-Standard, connection to trigger pulse amplifier, part No. 591 293 (230 V) with made-up fibre optic cable, part No. 545747
- l) Optical input (receiver) for synchronisation information (voltage zero-crossing and frequency of the supply to the thyristor power stage), SMA-Standard, connection to trigger pulse amplifier, part No. 591 293 (230 V) with made-up fibre optic cable, part No. 545 747
- m) Aluminium frame section with sealing ring and domed nuts for fitting a Prometos regulator in the door of an electrical cabinet or similar.

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\* : only Prometos-DP, part No. 591605

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Side View, Left, Fan and Disk Drive

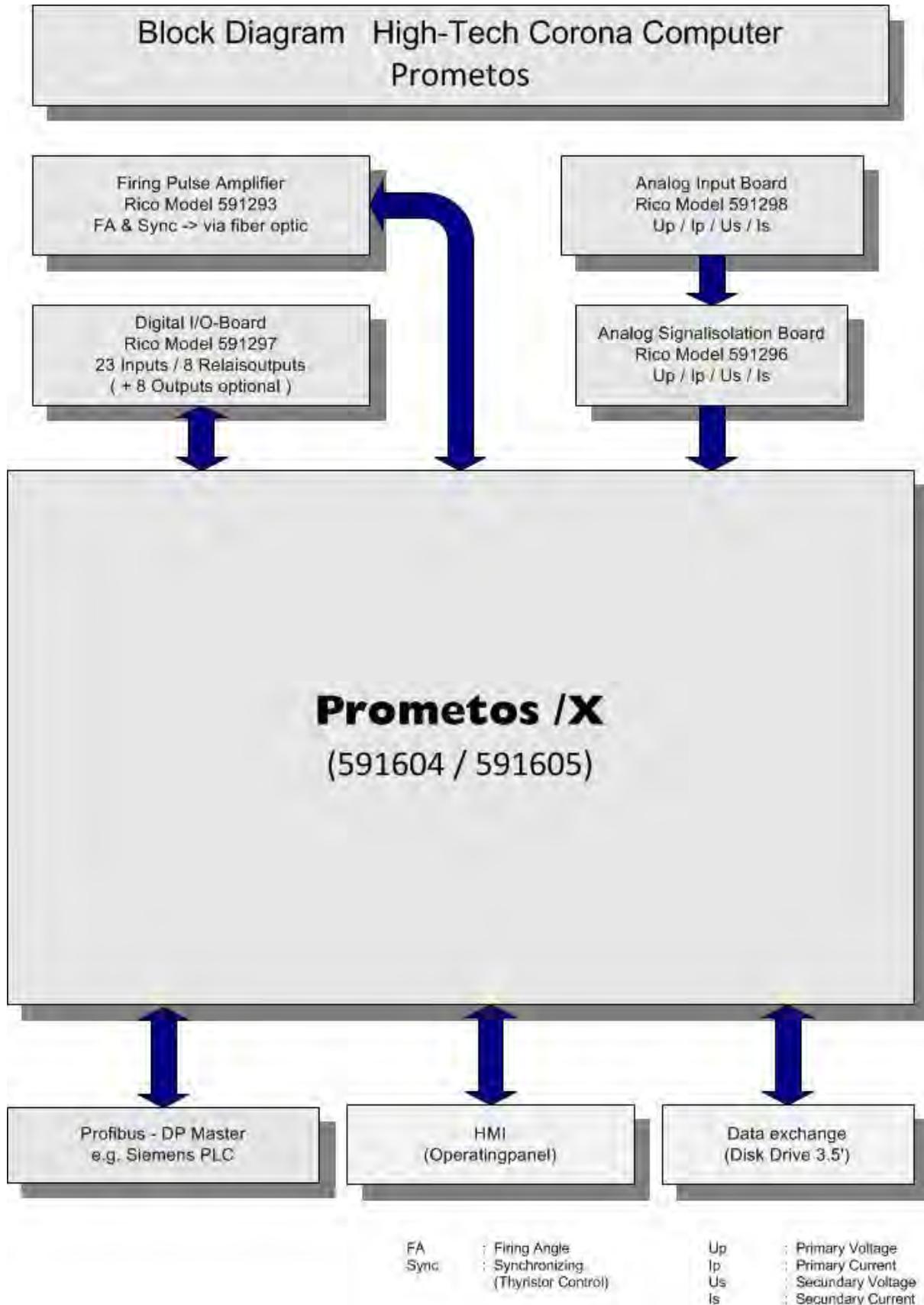


- a) Protective cover for fan.
- b) Ventilation holes, must not be obstructed!
- c) Screw to open protective cover, a).  
By opening the protective cover, the filter pad can be removed for cleaning.
- d) Functional check LED (watchdog monitor)  
The LED should flash during operation. The flash-rate can vary.  
If the LED is lit continuously or not lit at all then the supply has just been connected and the operating program is being loaded, (boot process, approx. 20 s) or there is system failure.  
In the case of a system failure, the equipment must be exchanged.
- e) 3,5" diskette drive
- f) Eject button for diskettes.
- g) Diskette drive, e), operating LED; lights when data are being read from or written to diskette.
- h) Key, "UPDATE SOFTWARE [Y]"
- i) Main switch with red pilot light; after pressing the button the pilot should light, otherwise, check supply voltage.
- j) Security Seal label: Attention! The warranty seal must not be destroyed, otherwise void the warranty.
- k) Nameplate of the appliance.

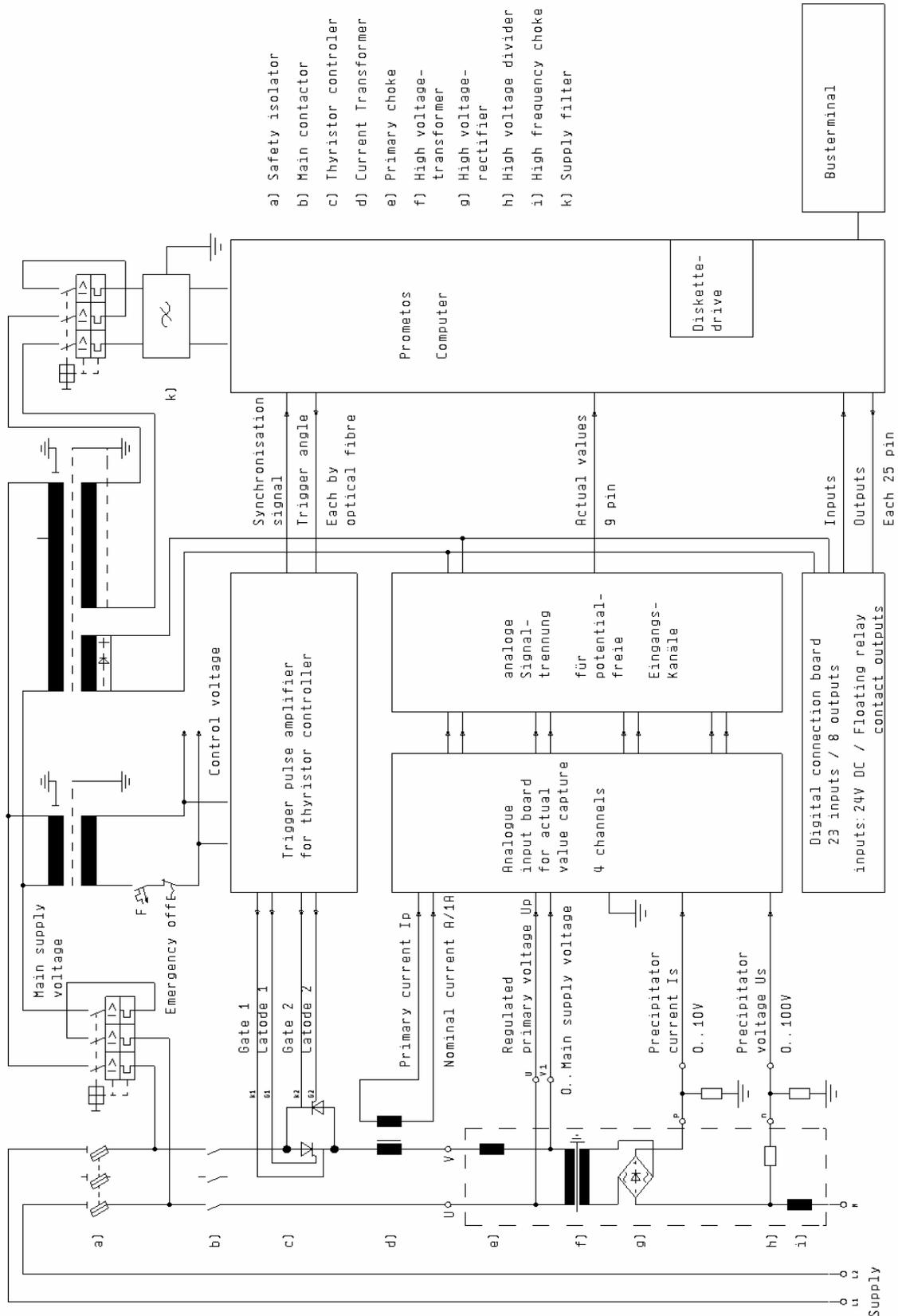
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Block Diagram



Main Circuit Diagram



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**Commissioning**

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The following measures must be taken in the order shown:

1. Check grounding: HV unit and electrical cabinet.
2. Check all cable connections between the HV unit and the electrical cabinet against the system documentation.
3. Check that there are no loose connections on any main supply lines:
  - in the HV unit terminal box
  - in the electrical cabinet (possible loosening during transport)
4. Switch on supply to electrical cabinet. Measure supply voltage, control voltage and auxiliary voltage.
5. Switch on Prometos computer system at the switch on the computer, e) (see page 5). During the next 20 s or so, the operating programs will be loaded (boot process). On the monitor will appear the home display with the menu bar and time across the top (see page 13). You can return to this display at any time and from any application by pressing key 8 (see page 4)!
6. Select program No. 0 (zero) and the control functions "LOCAL" and "AUTOMATIC".
7. Check all the alarms by breaking the connections at the input terminals – see system documentation.  
The alarm messages can be acknowledged by pressing the Enter key, d) (see page 4).
8. In the home display, 50 HZ or 60 Hz should be shown under "frequency", depending on the supply system. Without this frequency indication, the Prometos computer is not ready for operation and the cause of the missing frequency measurement must be corrected before proceeding further (see "troubleshooting", page 36).
9. Switch on high voltage system (key 4). The high voltage should now rise to the breakdown limit or to a voltage, current or power limit.
10. After some three months in operation, all main connections and terminals should be checked for tightness – especially where copper bus bars have been used.

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**Synchronisation**

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### 1. General

Synchronisation is to be understood as the allocation of the trigger pulses to the correct thyristors of the thyristor controller in the main circuit. If this allocation is incorrect, the high voltage system cannot function since the regulating arm of the control loop does not work. A new system has passed the factory tests and is, therefore, synchronised. Nevertheless, for the sake of general understanding, the relationships will be explained below. It can, in fact, often happen in new systems that the distribution of the trigger pulses may go wrong as the result of later modifications or the changing of spare parts, for example. When modifying older systems, the synchronisation must always be checked when carrying out modifications.

### 2. Trigger pulse Amplifier

If we limit ourselves to single phase systems that are controlled by an anti-parallel pair of thyristors, there are always two twin conductor trigger pulse channels. One conductor of a channel (red) is connected to the cathode of the appropriate thyristor (reference voltage), the other is connected to the gate. The appropriate terminals on the trigger pulse amplifier are marked with G1 (gate 1, white), K1 (cathode 1, red) and G2 (gate 2, white), K2 (cathode 2, red). The gate and cathode connections are also clearly marked on the thyristor module. Under no circumstances should gate and cathode connections be confused.

If the connections to the gates and cathodes are correct, there still remain two possibilities for the allocation of the trigger pulse channels. The correct one applies the trigger pulse to the thyristor that has a positive voltage on its anode and will therefore conduct when triggered.

The synchronisation is not, however, only influenced by this allocation.

### 3. Principle

The main circuit phases L1 and L2 are mostly hard-wired within the control cabinet (see "Main Circuit Diagram", page 9). The arrangement of the two thyristors, V1.1 and V1.2, in the main circuit is also fixed.

In order to determine the timing of the trigger pulse correctly, the Prometos computer requires an image of the supply voltage. From this it finds the zero crossings and sets the timing. Prometos receives the zero crossing information in the form of the synchronising signal from the trigger pulse amplifier through an optical fibre connection (see page 5, optical input, q).

The trigger pulse amplifier derives this signal from its own 230 V AC supply, delivered by the control transformer, whose waveform corresponds to the main supply voltage.

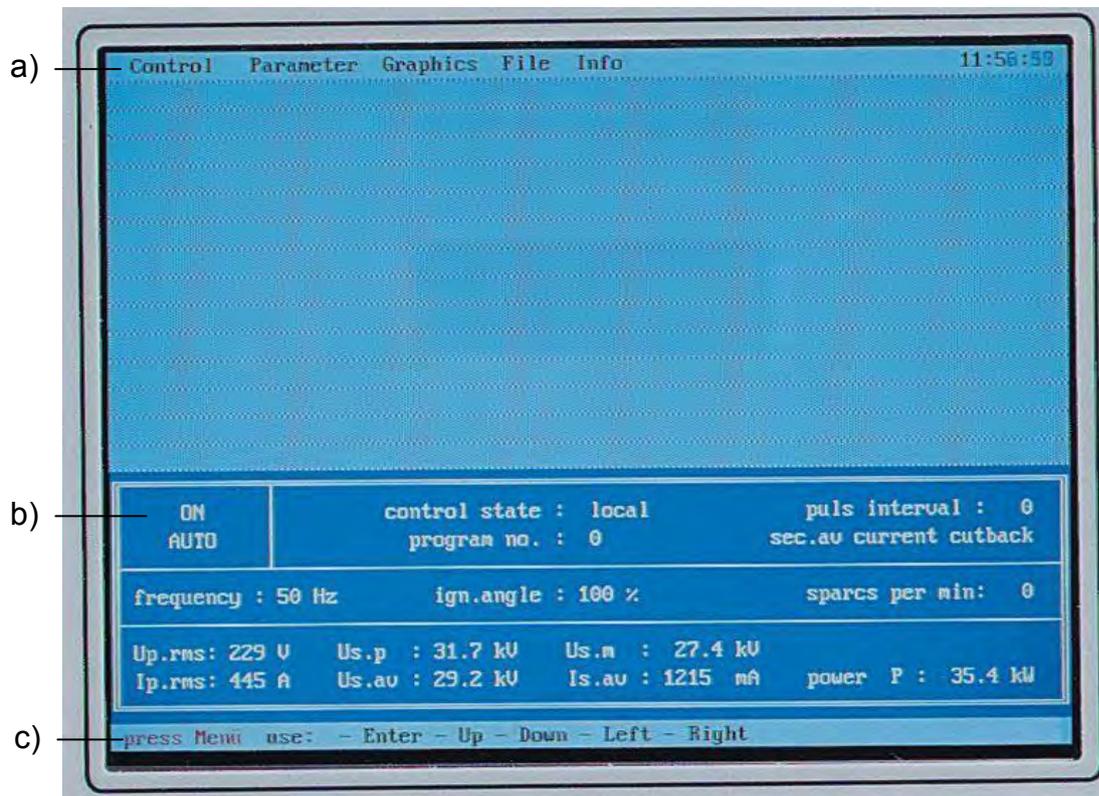
**Synchronisation**

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Any error in this chain leads to a loss of synchronisation and a failure of the system. This could result, for example, from swapping the primary connections when changing the control transformer or reversing the 230 V AC (110 V AC) supply lines to the trigger pulse amplifier (terminals 7 & 8). Although we are dealing with an alternating current system, the lines must not be crossed, as phasing is important for correct triggering of the thyristors.

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Home Display



The home display appears after switching on the Prometos regulator or pressing key 8.

The home display contains the following elements:

- a) At the top is the menu bar. This is activated by pressing key 9. The cursor (arrow) keys can then be used to select the individual Prometos functions. Pressing key 8 causes the system to return from any individual setting to the home display. The individual functions are:
- **Control:** On/Off; Manual/Automatic; Local/Remote  
The control functions can also be selected directly using the keys 4,3 and 1.
  - **Parameters,** Entry and output of parameters  
Program parameters  
System parameters  
Date and time entry (Edit Date/Time)  
Entry of access codes (Edit Codes)
  - **Graphics,** graphical output displays  
Oscilloscope display of actual electrical values (scope values)  
Voltage current diagrams for filter zones (V/I diagram)  
Graphical display of the behaviour with flash-over (regulation reaction)  
Return to status display (status) – also possible with key 6

## Home Display

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- **Loading and saving of files (file)**  
Loading program parameters from a diskette (load program parameters)  
Loading system parameters from a diskette (load system parameters)  
Saving program parameters to a diskette (save program parameters)  
Saving system parameters to a diskette (save system parameters)  
Saving fault message tables to a diskette (save fault events)  
Saving voltage-current diagrams to a diskette (save V/I diagrams)  
Possibility to make a full update of the regulator programs from a diskette (update)
  
- **Information output to the display**  
Fault report list (fault reports) can either be displayed (display) or deleted (delete)  
Information about the manufacturer, software versions and serial number of the Prometos regulator (about)  
This information can be important in the event of queries to the manufacturer.
  
- **Current time**  
The time can be set in the menu Parameter, Edit Date/Time.

- b) Information field for the state of the system and the measured values.  
Apart from the supply frequency, all the details in this field are shown in exactly the same way in the status display (key 6). The individual items will therefore be discussed in the explanation of the status display (see page 15).

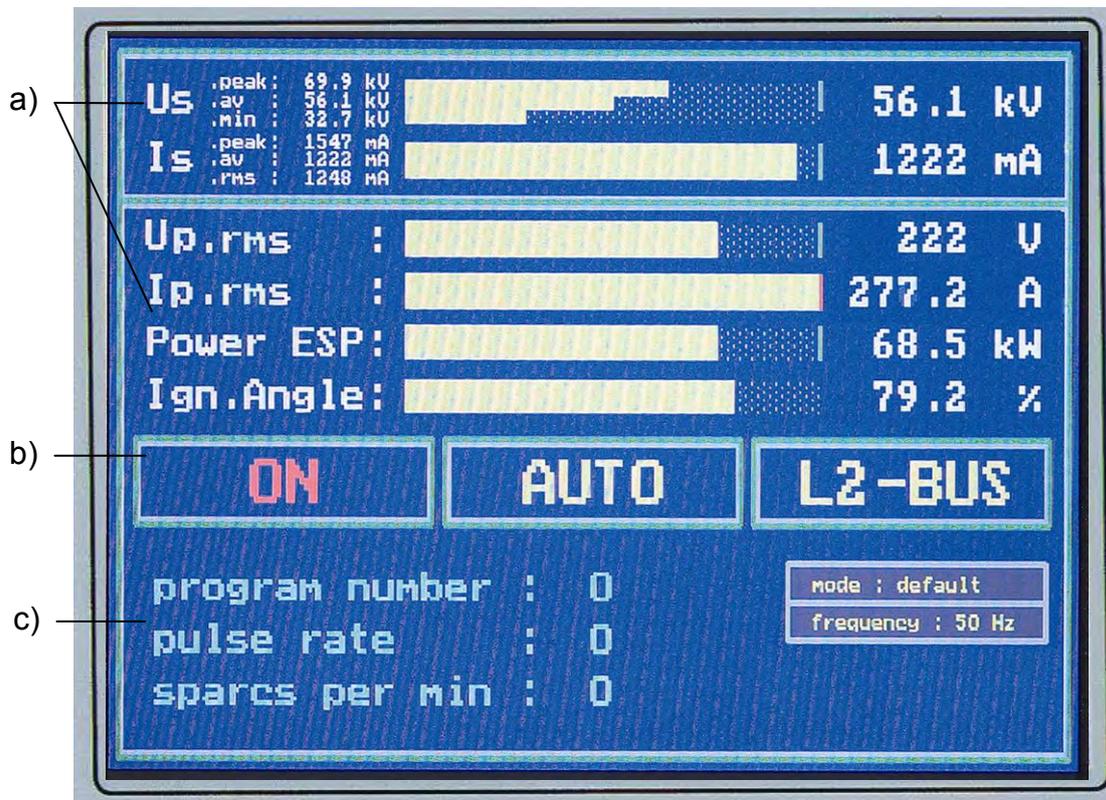
In the position for supply frequency (frequency), either 50 Hz or 60 Hz must appear. This indication does not change, although the frequency is calculated very precisely within the system.

If no frequency indication appears, the system is not ready for operation. A check must be made to find out why the calculation of the frequency is not possible (see "troubleshooting", page 36).

- c) Control hints  
In this bar, the keys are named that can be used to activate further functions (see also the listing of the key functions in "Front View", page 4).

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Status Display



The status display is the operational display for the high-voltage supply system. It gives a clear summary of all measured values and the state of the system. Its bar chart representation with coloured marking of the required values gives an immediate view of the regulation dynamics.

The details of the information in the status display are as follows:

a) **Field for display of actual values.**

In this field, the actual values are shown in figures and as a bar chart. The bar chart display includes additional colour markings for the required values. The required value marks change colour from green to red when the actual value reaches the required value. Five such required values are continuously monitored:

- Primary current (r.m.s.)
- Secondary voltage (peak value)
- Secondary voltage (arithmetic mean)
- Secondary current (arithmetic mean)
- Filter power

If required values are not expressly given for these quantities, the nominal values (from the type plate) are taken as required.

Status Display

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**Actual value measurements:**

In each channel, 64 measurements per half-wave of the supply are used to determine the waveform of the input signal. That is 32,000 measurements per second for a supply frequency of 50 Hz (38,400 per second at 60 Hz). All the measured values are stored and the following are calculated for each half-wave and channel:

- arithmetic mean
- minimum value
- maximum (peak) value
- r.m.s. value (by squaring, integration and square root calculation over all 64 values)
- output power

The results of these calculations are available individually for each channel after each half wave. The results are calculated exactly and independently of the signal waveforms, even in cases such as pulsed operation.

The following individual actual values are displayed:

- Up.rms: Primary voltage of the high voltage transformer
- Ip.rms: Primary current of the high voltage transformer
- Us...: Average filter voltage. The bar is divided into three sections showing minimum, average and peak values
- Us.s: filter voltage peak value
- Us.av: Filter voltage as arithmetic mean
- Us.m: Filter voltage as minimum value
- Is.s: Filter current peak value
- Is.av: Average filter current
- Is.rms: Filter current as arithmetic mean
- P.ESP: Power delivered to the filter zone (output power of the high-voltage unit)
- Ign.An: Trigger (ignition) angle of the thyristor controller in %. 100 % represents the maximum possible trigger angle for safe switching

Notice: All numerical values of voltages and currents are displayed, in addition, under "Scope Values" in the "Graphics" menu.

b) In this line, indications of the state of the system control are shown.

- ON/OFF
- MANUAL/AUTO
- LOCAL/REMOTE

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**Status Display**

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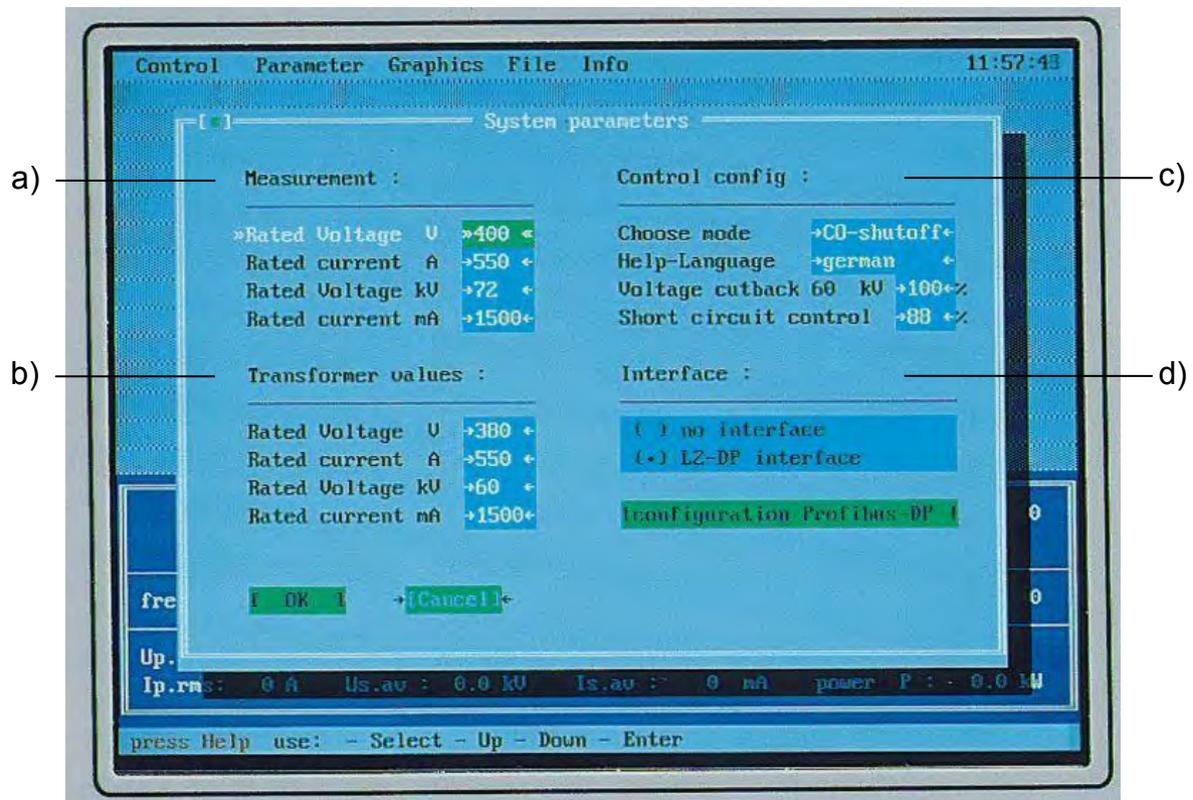
c) This field displays the following information:

- Program No:  
The currently selected program number is shown. The system automatically reverts to program number 0 (zero).
- Pulse rate:  
For pulsed operation, which can be selected in a user-program (non-zero program number), the selected pulse interval is shown in supply half-periods.
- Sparks per minute:  
Information on the number of flash-overs per minute in the filter zone.  
In the right-hand section of the field, the following further indications can appear under certain operating conditions:
  - default
  - CO-shutoff
  - BC-mode (if red -> active)
  - decidable

The determined frequency is also displayed (0/50/60 Hz). In the absence of synchronous signal, this value is red.

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**“System Parameters” Window**



In the “System Parameters” window, the nominal values entered for the high-voltage unit and the measuring device are shown and can be edited. The operating mode, help text language, external voltage cutback and short-circuit detection can also be configured. A further field shows whether the Prometos is equipped with a Profibus-DP interface. If so, the Profibus address (L2-DP interface) must be selected.

For a new system, these settings are factory pre-set. In other cases, the settings and configuration must be made in the course of commissioning. For normal operation of the system, this window does not, as a rule, need to be called up.

The following individual entries must be made:

a) **Measurement:**

The data for the measuring device are entered here. These data are to be taken from the system documentation.

- Rated voltage V: enter the supply voltage range in volts. A jumper on the analogue input board (part No. 591 298) is set for the supply voltage range. The entry on this line should be the same as the jumper setting.
- Rated current A: enter here the conversion factor of the current sampler in the main circuit. For example, for 550 A / 1 A, enter “550”.
- Rated voltage kV: enter the measuring range of the high-voltage divider in kV.

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**“System Parameters” Window**

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- Rated current, mA: the measuring range of the current sensing resistor (shunt) should be entered here.

b) **Transformer values:**

In this section, the nominal values of the high-voltage unit should be entered. The nominal values are to be found in the system documentation or on the type plate of the unit.

- Rated voltage V: the rated supply voltage should be entered here.
- Rated current A: enter the primary current rating of the unit.
- Rated voltage kV: enter here the open-circuit secondary peak voltage rating of the high-voltage unit.
- Rated current, mA: the rated arithmetic mean output current of the unit should be entered here.

c) **Control config:**

In this section, certain general configuration settings for the Prometos regulator are made. These are, in detail:

- Choose mode: settings for the operating mode of the regulator can be entered here:
  1. Default: standard setting.
  2. CO-Shutoff: CO shutoff when external voltage cutback is active and after arc quenching.
  3. BC-Cutback: back-corona detection active. The secondary current limiting or, in the case of pulsed operation, the pulse/base ratio is set to the value derived from the characteristic curves in order to inhibit back-corona.
  4. Decidable: selection of two special functions:
    - by connecting the “wet filter” input (10), the regulation behaviour is more strongly influenced by the primary measured values.
    - by connecting the “short-circuit detection not active” input (11) the short-circuit detection (broken electrode monitoring) can be de-activated, e.g. for flushing operations. Only use in connection with limiting functions!

**“System Parameters” Window**

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- Help-language:  
select here the desired language for the help texts.
- Voltage Cutback: external voltage limitation. When the “voltage cutback” input is connected, the regulator limits to the value set in kV. On reaching this voltage, the “voltage cutback” output is set.  
  
This function is often used for CO operating modes. If CO shutoff mode is active and the “voltage cutback” input is connected, the regulator switches off in the event of a flash-over and displays the fault message, “CO fault”.
- Short-circuit control: a setting for the short-circuit monitoring (broken electrode detection) can be made here (0 – 99 %). Recommended setting in the range 30 – 50 %. An entry of 0 % de-activates the short-circuit monitoring.  
  
The higher the selected percentage, the sooner the short-circuit monitoring will respond.

d) **Interface:**

This position gives information on the Profibus interface. If the regulator has no Profibus interface, “no interface” must be selected.

If the regulator has a Profibus (L2) DP interface, “L2 DP Interface“ must be selected.

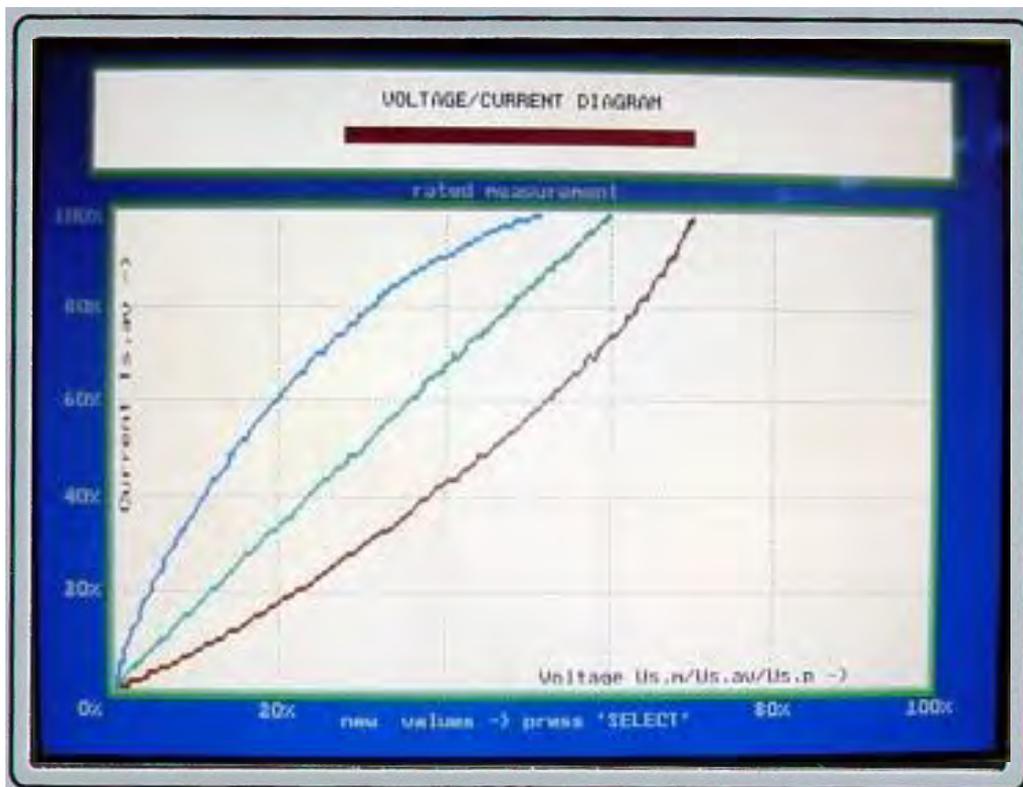
If this is the case, the menu item, “Configuration Profibus-DP” must also be selected. The bus address of the regulator can then be set. An address between 1 ad 64 can be selected. After setting the address, the computer must be reset and restarted.

On the Profibus-DP master, the GSD file (RICO 0528.GSD) of the regulator must be installed.

The regulator can be connected to a Profibus with a maximum transfer rate of 12 MBit/s!

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“Voltage Current Diagram” Display



This display shows the voltage/current curve of the filter zone. Current is shown on the vertical axis, voltage on the horizontal. The values are shown in percentages. 100% corresponds to the rated value for the high-voltage unit. A voltage of 100% is thus the open-circuit peak voltage rating of the unit. A current of 100% is equal to the rated arithmetic mean direct current of the unit.

In all, three curves are shown. These are, from left to right, the minimum, average and peak values of the output voltage. This gives an immediate view of the output voltage ripple.

The slope of the minimum voltage curve is also used by Prometos for the evaluation of critical back-corona events in the filter zone. If the slope becomes steep or even negative, the emission of charge carriers will be automatically reduced by current limiting intervention in the regulation.

The characteristic curves are always recorded by reducing the current from the current operating point to zero. For the fullest possible representation, the system should be run up to the highest possible operating point or limited only by the flash-over point. The recording of the characteristic curves is started with the “Select” key (c). To leave the display, press key 8

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**“Voltage Current Diagram” Display**

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When this display is called up, the last recorded curve is shown. If this curve is to be stored for the documentation of the filter properties, the data can be saved to diskette using the menu item, “File” / “save V/I diagram”. The file can be read using the MS Excel spread sheet software on any computer running DOS or Windows 95 or higher. The saved values can be displayed as a table or a graph. When displayed as a graph, the axes will no longer be scaled in % but as absolute values in mA and kV (Excel). The PC must have the program, “Ricotool” or “Ricotool.xls” installed. They are supplied ex works with every Prometos computer.

It is recommended that the filter curves should always be recorded and saved since useful deductions can be made from changes in the curves in the event of problems. It is also recommended that, when first commissioning new electrofilters, curves should be recorded for the clean filter in air, for the filter with normal dirt in air, and for nominal operation with gas.

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Operating Program Selection Window



As a result of the Prometos regulation principle, the filter is optimally regulated under all operating conditions, be it with low breakdown voltage or with the voltage conversion unit running at maximum output. Required values are always reached as quickly as possible, without overshoot (integral behaviour). The regulation works equally well throughout its range so that the correct asymptotic curves of voltage and current are always followed when running up.

In the main program (program 0), no entry of operating parameters is required. Run-up times, cutbacks and extinction times are continuously and independently adapted to the filter process conditions. Depending on the operating conditions, the regulator changes its required values (dynamic asymptote adaptation). Optimum behaviour is thus guaranteed in all operating ranges.

In addition, it has been made possible to save seven individual operating programs (user programs). In each of these programs, 10 different parameters can be individually set. For more details, see the explanation of the "Program Parameters" window. The user thus has individual influence on the behaviour of the regulator with flash-over, in pulsed operation, and in its limiting functions.

The programs are listed in the "Active Program" window and this can be used to activate the desired program. The window can be called up using key 2 or from the menu bar under "Parameters" / "Program Parameters". The currently active program is indicated in the home display and the status display.

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**Operating Program Selection Window**

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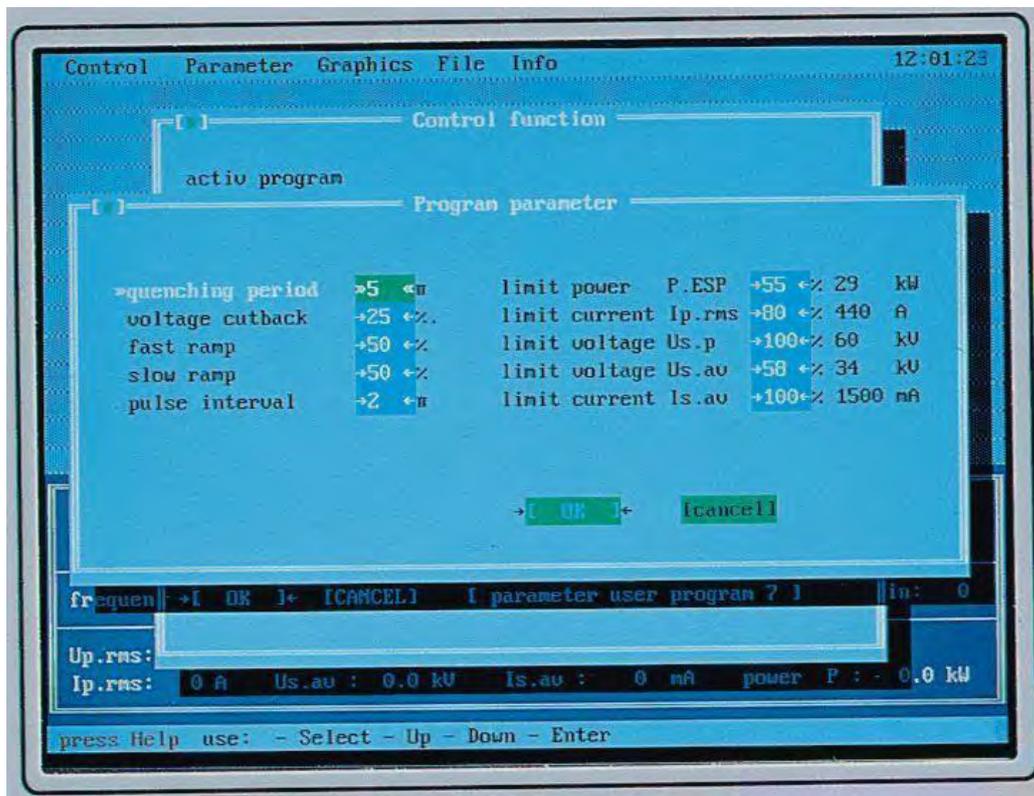
Prior to leaving the factory, default parameter values are set in all the programs. Using the menu item, "Recall defaults in active program" the parameters in a program that has been altered can be reset to works values at any time.

In the "Remote" setting, program selection can be made from a control room, via, the inputs 6, 7 and 18. Program selection is also possible via the Profibus interface.

The use of individual operating programs can, under certain circumstances, be of advantage during knocking or flushing procedures or in pulsed operation under the control of energy optimisation systems.

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“Program Parameters” Window



The “Program Parameters” window opens when one of the “parameters, user program  $n$ ” fields in the “Control Function” window is activated. A total of 10 adjustable parameters is shown.

These are, in detail:

- **Quenching period:** enter the arc quenching period in supply half-waves ( $\pi$ ), setting range, 5-50, recommended usual setting range, 5-10 half-waves. Further clarification of the effects of this parameter can be found in the Prometos help text.
- **Voltage cutback:** enter the voltage cutback after flash-overs. The voltage cutback is given in per mill of the voltage before flash-over. Possible settings, 1-100 ‰; recommended setting range, 15-50 ‰.  
Small cutbacks lead to more frequent flash-overs. Large cutback values lead to quieter operation with few flash-overs, however, under certain circumstances, the voltage could be reduced so far that the maximum possible voltage is only reached after a rather long interval. Further information can be found in the help text.
- **Fast ramp:** enter recovery time 1. Possible entries, 1-100 ‰; recommended setting, 40-75 ‰. The smaller the selected percentage, the faster the voltage rises again after a flash-over.  
Rapid recovery, requiring the smallest possible values, is desirable. However, if the voltage rises too rapidly, this could lead to undesirable after-flashes. Recovery time 1 and recovery time 2 are directly related.

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“Program Parameters” Window

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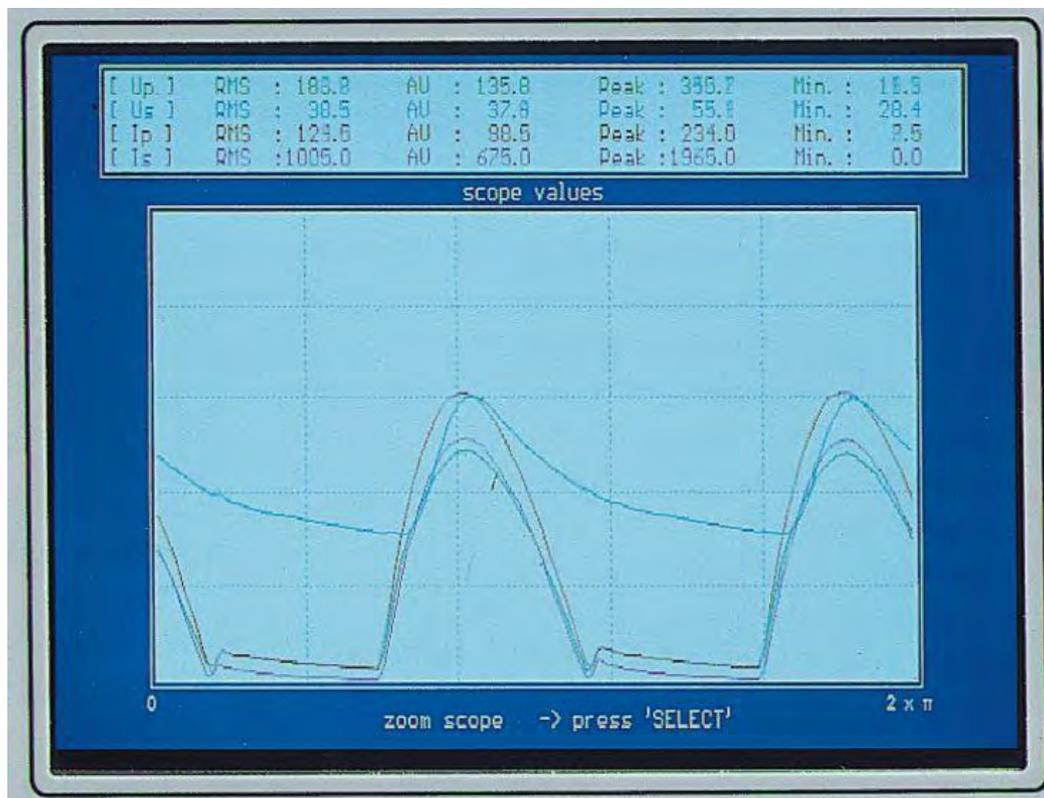
- **Slow ramp:** enter recovery time 2. Possible entries, 1-100 %; recommended setting, 40-75 %. The smaller the selected percentage, the faster the voltage rises again after a flash-over. For comments, see recovery time 1 (fast ramp).
- **Pulse interval:** enter the pause time for pulsed operation. The value is given in supply half-periods ( $\pi$ ). Possible entries, 0-16.  
0 half-periods correspond to continuous operation. 2-16 half-periods correspond to pulsed operation (semi-pulsed operation).  
The maximum trigger angle for the pulse half-period is given as “limit voltage Vs.p”. The base trigger angle, the trigger angle during the selected pause time, can be influenced by all the other limiting functions. Both trigger angles are regulated by Prometos. Since the measured average and r.m.s. values relate to the whole pulse period, the pulse also has an indirect influence on the base voltage during the pauses.
- **Limit power P.ESP:** limit output power in kW. The entry is made in percent. Prometos makes an immediate calculation, from the rating of the unit, of the power in kW. The result appears alongside the entry field.
- **Limit current Ip.rms:** limit primary current (r.m.s.). The entry is made in percent. Prometos calculates the primary current in A r.m.s. from the rating of the unit.
- **Limit voltage Vs.p:** limit secondary voltage (peak value). The entry is made in percent. Prometos calculates the peak value in kV from the rating of the unit.
- **Limit voltage Vs.av:** limit secondary voltage (arithmetic mean). The entry is made in percent. Prometos calculates the average value in kV from the rating of the unit.
- **Limit current Is.av:** limit secondary current (arithmetic mean). The entry is made in percent. Prometos calculates the average value in mA from the rating of the unit.

In order for the values entered to be saved and applied, the “Select” key (c) must be used to select “OK” followed by “Enter”. If the new values are to be rejected, select “Cancel”. Key 8 can also be used to reject the changes.

User Information  
**Prometos X**

Realtime Computer System for the High-Voltage Supply of Electrofilters

“Scope Values” Display (oscilloscope display)



User Information  
**Prometos X**

Realtime Computer System for the High-Voltage Supply of Electrofilters

“Scope Values” Display (oscilloscope display)



The “Scope Values” display is called up through the menu item “Graphics” / “Scope Values”. This display can be cancelled by using key 8 to return to the home display.

The following is shown:

- a) Field for the numerical display of the measured values

the following values are shown:

- Vp: Primary voltage
- Vs: Secondary voltage (filter voltage)
- Ip: Primary current
- Is: Secondary current (filter current)

The following calculations based on the measured values are shown:

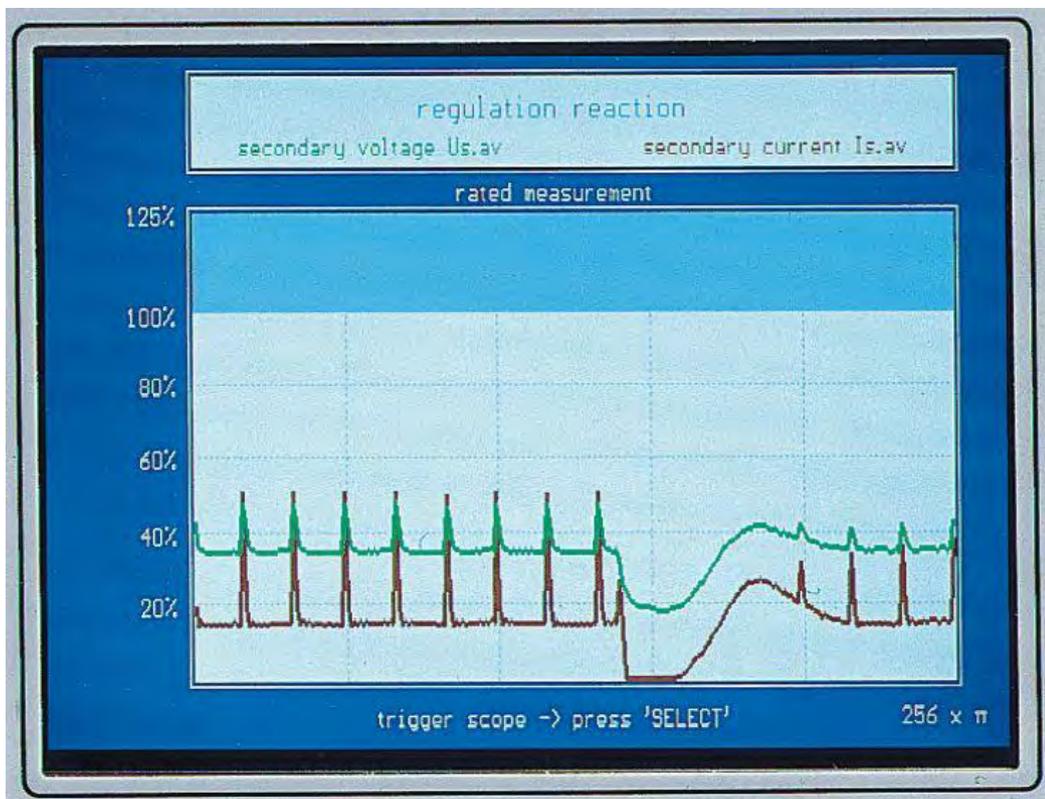
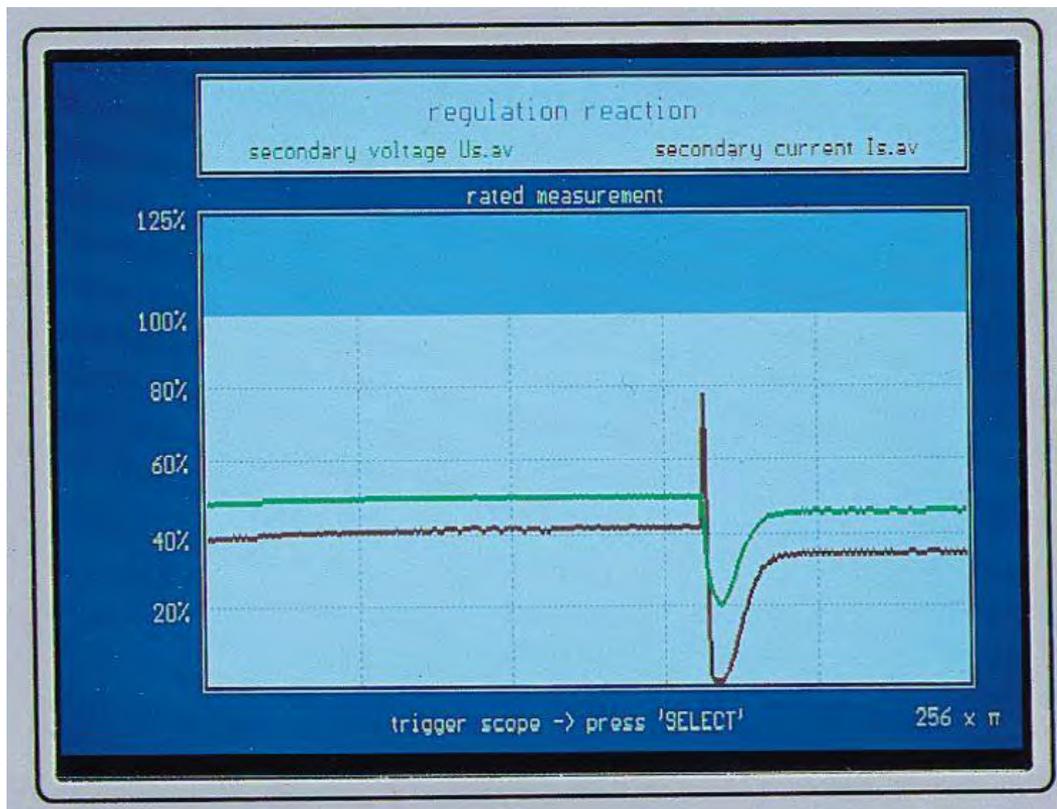
- RMS: r.m.s. value
- AV: arithmetic mean value
- peak: peak value
- min: minimum value

- b) In this field, the values are shown graphically. To use the space more effectively the alternating values are “rectified” – the negative half-cycles are “folded upwards”. Using the “Select” key (c), the resolution of the display can be changed. The time scale is shown at bottom right in supply half-waves ( $n \times \pi$ ). The maximum resolution is one supply half-wave ( $1 \times \pi$ ).

User Information  
**Prometos X**

Realtime Computer System for the High-Voltage Supply of Electrofilters

“Regulation Reaction” Display (Regulation response to flash-over)



**“Regulation Reaction” Display (Regulation response to flash-over)**

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The “Regulation Reaction” display shows the response to flash-overs and the behaviour in pulsed operation. For this purpose, only the average values of filter voltage and filter current are shown. The time-scale is fixed at 256 supply half-waves across the display (corresponding to 2.56 seconds at 50 Hz).

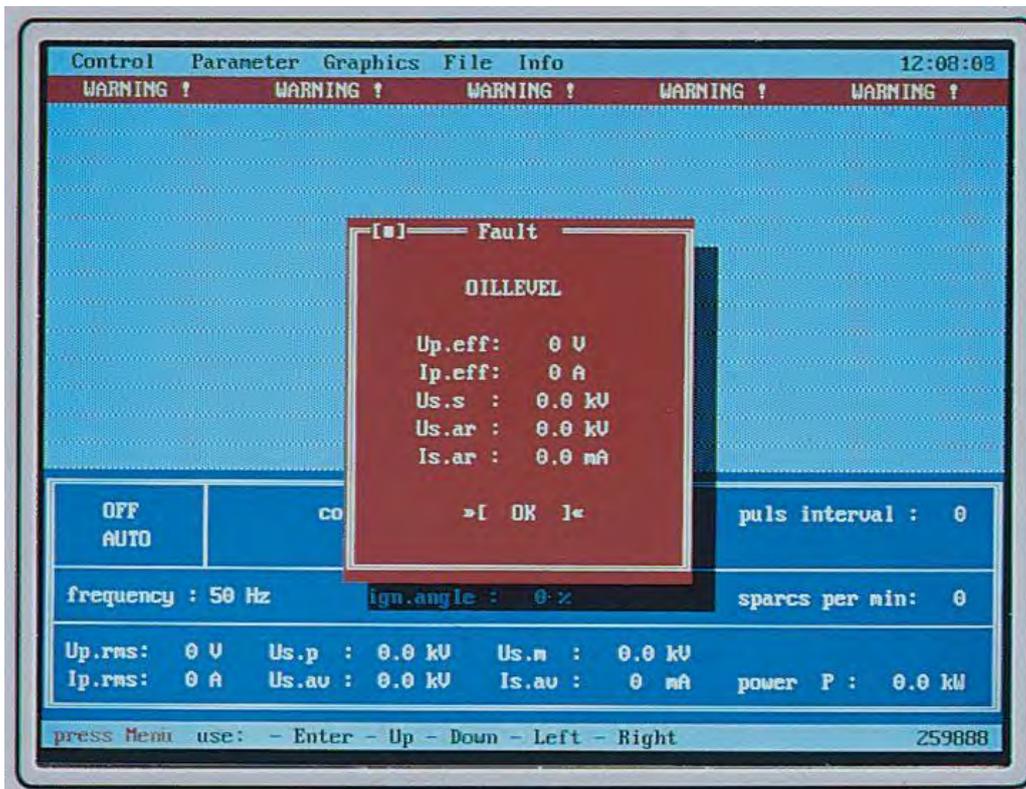
Since the peak value of the current during a flash-over can be greater than the rated current, the display is extended to 125 %.

The display is started (triggered) by pressing the “Select” key (c).

User Information  
**Prometos X**

Realtime Computer System for the High-Voltage Supply of Electrofilters

“Fault” (Fault Report) and “Fault Window” (Fault Table) Windows



**“Fault” (Fault Report) and “Fault Window” (Fault Table) Windows**

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Prometos monitors the orderly and proper operation of the high voltage supply system in many ways. As soon as a fault is identified, the trigger pulses to the thyristors are blocked and the main circuit breaker is then operated. The system is thus switched off. A blinking fault report window (“Fault”) appears in the display. This window contains information on the type of fault and all the last measured values of electrical parameters just prior to the occurrence of the fault.

In the example shown, an “Oil Level” fault has been identified. The measured values at the time were all zero, showing that the high-voltage system was switched off. In this case, the high-voltage unit tank must be checked for leaks.

At the same time, the fault report is recorded with date and time in a fault table. This can be viewed in the “Fault Window”, called up using the menu item “Info” / “Fault Report” / “Display”. The entire table can be deleted using “Info” / “Fault Report” / “Delete”.

The fault report table stores a total of 30 fault reports in the reverse order of occurrence (most recent first). Once the table is full, it behaves like a shift-register, the oldest report being deleted each time that a new one occurs.

The fault report table can be saved to diskette using the menu item “File” / “Save Fault Events”.

The following is a complete list of possible fault reports:

- **Frequency Fault:** The supply frequency cannot be measured.
- **Interlock:** The operation of the high-voltage supply system is blocked by input 17 (Interlock). This input is used to interrupt the high-voltage supply in circumstances such as a CO (carbon monoxide) warning from an analysis system.
- **Over-temperature:** The temperature monitor in the high-voltage unit indicates excess.
- **Thyristor Fault:** The temperature monitor on the thyristor controller heat sink indicates excess temperature. If the temperature in the control cabinet is normal, this may well be caused by a fault condition in the thyristor assembly.
- **Earthing switch:** If the high-voltage supply system is equipped with an earthing switch, this is in the “earthed” position and the high-voltage supply cannot be switched on.
- **Over-pressure:** The pressure sensor in the high-voltage unit indicates excess pressure. This can have several causes. For more details, see “Troubleshooting” page 36.
- **Oil level:** The high-voltage unit is no longer completely filled with insulating (transformer) oil. The level detector has been activated. This could be due to a leak in the high-voltage unit tank or gas development within the tank. For more details, see “Troubleshooting” page 36.
- **L2-Card:** There is an error in the Profibus coupling hardware. It may be that the unit does not have a Profibus interface but was, nevertheless, configured as such.

**“Fault” (Fault Report) and “Fault Window” (Fault Table) Windows**

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- **Critical measurement:** This fault report is generated by the Prometos regulator itself. It means that the measured electrical values no longer correspond to fault-free operation of the electrofilter. Possible causes include a broken electrode in the filter itself or a major electrical failure in the high-voltage supply system. For more details, see “Troubleshooting” page 36.
- **New boot:** This is not a fault in the usual sense. It indicates that the Prometos computer has been restarted (boot process). This will occur, for example, whenever the power supply to the unit is interrupted and is helpful in fault tracing.

User Information  
**Prometos X**  
 Realtime Computer System for the High-Voltage Supply of Electrofilters

Inputs / Outputs

Inputs:

Terminal No.	Function
1	system on
2	select digital / Profibus from control room
3	oil level, hv unit
4	over-pressure, hv unit
5	earthing switch
6	Program No, bit 2
7	program No, bit 0
8	manual, step voltage up
9	input available via Profibus-DP
10	wet precipitators
11	disable short circuit detection
12	general warning
13	system off
14	voltage cutback
15	over-temperature, thyristor
16	over-temperature, hv unit
17	CO interlock
18	program No, bit 1
19	manual, step voltage down
20	automatic / manual
21	memory release <small>(ex V1.10)</small>
22	input available via Profibus-DP
23	input available via Profibus-DP
(24)	internal use

Outputs:

Terminal No.	Function
43/44/45	back-corona (0)
46/47/48	external voltage cutback (0)
49/50/51	manual (1) / automatic (0)
52/53/54	general fault (1)
55/56/57	control, local (1) / control room (0)
58/59/60	main circuit breaker off (0) / on (1)
61/62/63	critical measurement (1)
64/65/66	flashover (0-1 pulse)

( relay contact, 8A/250V~ )

( quiescent state )

Technical Data

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Supply voltage	: 90...264V; 50/60Hz
Power requirement	: 65W
Digital inputs	: 23 inputs; 24VDC
Digital outputs	: 8 outputs (plus space for 8) floating outputs (relay contacts) 250VAC, 8A
Analogue inputs	: 5 inputs
1. Filter voltage	: 0...100V, $R_i = 1M\Omega$
2. Filter current	: 0...10V average 25V peak
3. "Regulated" primary voltage	: 100...735V RMS
4. Primary current	: 0...1A RMS, $R_i = 5\Omega$
5. Optional	: 0...10V (adaptable)
Profibus interface	
- GSD file	: RICO0528.GSD
- DP slave, intelligent	: up to 12.5 Mbit/s
Display	: LCD, TFT 6.5 inch VGA colour display
Keyboard	: Foil keyboard with pressure point and acoustic feedback, screened
Processor system	: Low-power AMD LX800, 500MHz
Data and program memory	: Chip Disk, 32MB, non-volatile
Diskette drive	: 3.5 inch, 1.44MB
Thyristor control	: optical
Storage temperature	: -20°C....+60°C
Operating temperature	: 0°C....+40°C

**User Information**  
**Prometos X**  
**Realtime Computer System for the High-Voltage Supply of Electrofilters**

**Technical Data**

Measures at System Fault Occurrence

Attention! When the high voltage power supply is switched off by the **Prometos** controller due to disturbances or failures in the system, the high voltage power supply must not be switched on without detailed and systematic check up of the system.

The Prometos controller detects occurring failures in time and reacts by immediate switching off to avoid further damages.

Ignoring this and switching on the high voltage system without thorough check of the high voltage system and eliminating the fault, secondary failures may occur which lead to a total damage of the high voltage power supply.

For the correct operation with switching off in case of failure only the user of the high voltage system is responsible.

Error message	Description	Parts to Check	Q (Quitting)
Frequency Fault	Synchron signal is faulty.	Power input, synchronisation system, grid frequency, pulse amplifier, optical fiber connections	A
Interlock	Input open (terminal 17)	Analysis unit, IO-board, wiring	B
Overtemperature	Input open (terminal 16)	High voltage transformer rectifier set, IO-board, wiring	B
Thyristor-Fault	Input open (terminal 15)	High voltage transformer rectifier set, thyristor module, IO-board, wiring	B
Earthing switch	Input open (terminal 5)	Earthing switch, IO-board, wiring	B
Overpressure	Input open (terminal 4)	High voltage transformer rectifier set, IO-board, wiring	B
Oil level	Input open (terminal 3)	High voltage transformer rectifier set, IO-board, wiring	B
BUS-Card	Faulty BUS-hardware	gamma-controller, BUS-terminal, wiring	C
CM: plausibility	Measurement values not plausible	Primary current measurement transducer, connection board, signal barrier, pulse amplifier, wiring	C
CM: short circuit	Short circuit in the electrostatic precipitator	Electrostatic precipitator, high voltage transformer rectifier set, high voltage wiring, earthing switch, damping resistors, current transducer, connection board, signal barrier, wiring	C
CM: Ip range to high	Supply phases load unsymmetrical	High voltage transformer rectifier set, current transducer, connection board, signal barrier, pulse amplifier, wiring	C
New boot	New boot of the system	Prometos-controller, power supply	A

A: Not necessary

B: When failure is no longer present

C: After switching off the system