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Appendix A

Valid for

Control system SINUMERIK 840D sl / 840DE sl
SINUMERIK 828D

Software
CNC software version 4.5

02/2012
6FC5397-0EP40-3BA0
Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠️ DANGER
indicates that death or severe personal injury will result if proper precautions are not taken.

⚠️ WARNING
indicates that death or severe personal injury may result if proper precautions are not taken.

⚠️ CAUTION
with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

⚠️ CAUTION
without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

⚠️ NOTICE
indicates that an unintended result or situation can occur if the relevant information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by personnel qualified for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

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Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

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Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.
The SINUMERIK documentation is organized in the following categories:

- General documentation
- User documentation
- Manufacturer/service documentation

Additional information

You can find information on the following topics at www.siemens.com/motioncontrol/docu:

- Ordering documentation/overview of documentation
- Additional links to download documents
- Using documentation online (find and search in manuals/information)

Please send any questions about the technical documentation (e.g. suggestions for improvement, corrections) to the following address:

docu.motioncontrol@siemens.com

My Documentation Manager (MDM)

Under the following link you will find information to individually compile OEM-specific machine documentation based on the Siemens content:

www.siemens.com/mdm

Training

For information about the range of training courses, refer under:

- www.siemens.com/sitrain
  SITRAIN - Siemens training for products, systems and solutions in automation technology
- www.siemens.com/sinutrain
  SinuTrain - training software for SINUMERIK

FAQs

SINUMERIK

You can find information on SINUMERIK under the following link:
www.siemens.com/sinumerik

Hotline and Internet address

Technical Support

You will find telephone numbers for other countries for technical support in the Internet under
http://www.siemens.com/automation/service&support

EC Declaration of Conformity

The EC Declaration of Conformity for the EMC Directive can be found on the Internet at:
http://support.automation.siemens.com
Here, enter the number 15257461 as the search term or contact your local Siemens office.
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Introduction

The topics of energy efficiency and energy saving are also playing an increasingly important role in the machine tool environment.

With SINUMERIK Ctrl-Energy, Siemens is offering an extensive range of components, functions, software tools and services to increase the efficiency of machine tools.

Ctrl-Energy

You will find an overview of the complete range of functions under the following link:

www.siemens.com/sinumerik/ctrl-energy

Acquisition, evaluation, and control of energy consumption

The functions Ctrl-E Analysis to acquire and evaluate the energy consumption of the machine and Ctrl-E Profiles, to control energy-saving states of the machine are available in SINUMERIK Operate. Additional energy-saving functions or user know-how on this topic can be added in this area of SINUMERIK Operate.
Introduction
In order to sensitize users to the topic of energy efficiency, the power and energy data of the machine are first acquired.

**Acquiring and evaluating energy consumption**

A control system with SINUMERIK Operate without a connected measuring instrument determines the power directly from the drives and displays this.

Additional consumption-relevant data can be retrieved and displayed at the control using the additional SENTRON PAC Power Monitoring Device.

Depending on where the SENTRON PAC measuring transducer is installed, you have the possibility of either measuring the power of the whole machine or only a specific load.

With an integrated measuring function, the energy consumption during a measuring period can be acquired for all drives together with an additional measuring location – and the electrical power drawn for a selected load can be recorded with respect to time.

**Maximum measuring time**

The maximum measuring time for energy between start and stop as well as for an NC part program is, as a result of the trace recording, 922 seconds (00:15:22).
2.1 SENTRON PAC3200/4200

2.1.1 Hardware

Hardware components

You require the following hardware in order to be able to use all of the "Ctrl-Energy" functions:

- SENTRON PAC3200 (Firmware ≥ V2.2.0)
  [Link](http://support.automation.siemens.com/WW/view/de/25240652/130000)
- SENTRON PAC4200 (Firmware ≥ V1.4.0)
  [Link](http://support.automation.siemens.com/WW/view/de/31675630/130000)
- SENTRON PAC - accessories
  [Link](http://www.automation.siemens.com/btlv-static/Lowvoltage_LV10-1_complete_German_2011.pdf)
  - Power Monitoring Device (page 11/27 ff)
  - Current transformer (Page 11/39)
- The expansion modules must be temporarily removed in order to upgrade the firmware using powerconfig.
- Protection/fusing of the supply and measuring voltages according to Configuration Manual
- Expansion module PAC PROFINET; order number 7KM 9300-0AE00-0AA0
- Expansion module PAC PROFIBUS; order number 7KM 9300-0AB00-0AA0
• PC software powerconfig (≥ V2.2)
  http://support.automation.siemens.com/WW/view/de/50246395
• Current transformer depending on
  – the connection type at the SENTRON PAC
  – Accuracy requirements
  – Currents

⚠️ DANGER

Open current transformer circuits result in electric shock and arcing
If not observed, will cause death, serious injury or considerable property damage.

Only measure the current using external current transformers. DO NOT protect the circuits using a fuse. Do not open the secondary circuit of the current transformer under load. Short circuit the secondary current terminals of the current transformer before removing this device. The safety information for the current transformers used must be carefully followed.

Selection example

Catalog, Siemens LV 1/Accessories and spare parts:

For a three-phase measurement according to connection type 3P4W (four conductors, unbalanced load, without voltage transformers, with three current transformers), accuracy class 1, primary rated current 100 A, rated secondary current 1A, three window-type current transformers are recommended (4CN51 17-0CC20).

Note

When measuring the complete machine, it is recommended that the current is sensed directly after the main switch. For the voltage tap, please observe the usual protection/fusing.

References

Information on the installation, configuration and operation of the Power Monitoring Device and the expansion module can be found in the following references:

• SENTRON PAC3200 Power Monitoring Device manual
  (Document order number A5E01168664A-05)
• SENTRON PAC4200 Power Monitoring Device system manual
  (Document order number A5E02316180A-03)
• Manual, expansion module PAC PROFIBUS DP, SWITCHED ETHERNET PROFINET
  (document order number A5E01168846A-06)
2.1.2 Commissioning the Power Monitoring Device

A detailed description of commissioning of the SENTRON PAC Power Monitoring Device is provided in the corresponding manuals.

Preconditions

- The device has been installed.
- The optional expansion modules have been installed.
- The device has been connected in accordance with the possible connection methods.
- The battery has been inserted into the battery compartment (only for the SENTRON PAC4200).

General procedure when commissioning the device

- Connected the supply voltage
- Parameterizing SENTRON PAC
- Connect the measuring voltage
- Connect the current to be measured
- Check the displayed measured values
- Check the polarity and phase assignment of the measuring transducer

Parameterizing SENTRON PAC

You have the option of parameterizing the measuring device in the following ways:

- Using the input keys and display of the SENTRON PAC
- Using a PC connected to the SENTRON PAC, which has the software this has been supplied (powerconfig).

After booting select the language and the measuring device is then ready for operation.
2.1.3 Commissioning the PAC PROFIBUS expansion module (840D sl)

To communicate via Profibus, the SENTRON PROFIBUS module in combination with Sentron PAC3200/4200 must be parameterized differently.

1. Select SENTRON PAC "Settings" > "PROFIBUS modules".
   - OR -
   For SENTRON PAC4200, select "Settings" > "Expansion modules" > "MOD1" > "PROFIBUS MODULE".

2. Press "Enter".
   You obtain the following information in the subsequent window:
   - Order number
   - Serial number of the SENTRON PROFIBUS module
   - Firmware version of the SENTRON PROFIBUS module
   - PROFIBUS ADDR.:
     The DP address of module is displayed here.

3. Press "Enter".
   This means that you have the option of entering the same PROFIBUS address as in the automation system.

2.1.4 Commissioning the expansion module PAC PROFINET (828D)

To communicate via PROFINET, the SENTRON SWITCHED ETHERNET PROFINET module in combination with Sentron PAC3200/4200 must be parameterized differently.

1. Select SENTRON PAC "Settings" > "SWITCHED ETHERNET".
   - OR -
   Select SENTRON PAC "Settings" > "Expansion modules" > "MOD1" > "SWITCHED ETHERNET".

2. Press "ENTER".
   You obtain the following information in the subsequent window:
   - Order number
   - Serial number of the SENTRON SWITCHED ETHERNET PROFINET module
   - Firmware version of the SENTRON SWITCHED ETHERNET PROFINET module
   - The first character of the NameOfStation of the SENTRON SWITCHED ETHERNET PROFINET module that can be a maximum of 26 characters
   - IP-ADDR.:
     The IP address of the module is displayed here.

3. Using the menu item "- ->", open the next window and obtain among other things the information about the SUBNET address of the module.
Specifying/changing the device name

The device name can only be entered (it must be specified) using the powerconfig software in the submenu "Expansion slot1".

- Sentron PAC3200: pac3200-pn22
- Sentron PAC4200: pac4200-pn21

The next time that the 828D boots, the 828D IO controller assigns the correct IP address to the expansion module according to the device name:

- pac4200-pn21 --> 192.168.214.21
- pac3200-pn22 --> 192.168.214.22
2.2 Commissioning the PLC for SENTRON PAC

2.2.1 SINUMERIK 840D sl

2.2.1.1 Commissioning the PLC with PROFIBUS

PROFIBUS is commissioned with the PLC Toolbox 4.5 or higher.

Preconditions

- Configure the hardware, save and compile the project
- Generating the system data for the PLC
- Install the Toolbox software, which also contains the libraries for the PLC basic program of an NCU 7x0.3.

Note
Starting from STEP7 V5.5 SP1 and higher, SENTRON with PROFIBUS is listed as standard in the HW catalog.

Procedure

You are on the main screen of the SIMATIC Manager.

1. Select the "File" > "Open" menu and then click on the "Libraries" tab.
2. Select the library for the PLC basic program "bp7x0_45" and confirm the dialog with "OK".
3. You have inserted the library and selected the PLC program under "PLC-First-Startup 840D sl" > "SINUMERIK" > "PLC317F-3 PN/DP " > "S7 Program".
4. Copy the sources, modules and symbols to the PLC program

![Figure 2-1 Hardware catalog after incorporating the GSD file](image)

Figure 2-1  Hardware catalog after incorporating the GSD file
5. In HW Config, drag the selected module to the Profibus DP master system.

![Diagram showing Profibus DP master system and module connections]

6. In the hardware catalog, open the required module and assign the subslots as shown in the diagram.

<table>
<thead>
<tr>
<th>Slot</th>
<th>DP ID</th>
<th>Order Number / Designation</th>
<th>I Address</th>
<th>Q Address</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>65</td>
<td>Total Active Power</td>
<td>P01: P03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>66</td>
<td>Active Energy, Imp. Tariff 1 (F)</td>
<td>P04: P07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>66</td>
<td>Active Energy, Exp. Tariff 1 (F)</td>
<td>P08: P11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PROFIBUS interface

PROFIBUS must be configured with a data transfer rate of 12 Mbit/s.

Setting the PROFIBUS address

Set the PROFIBUS address of the expansion module either directly at the SENTRON PAC or enter using the powerconfig software.

References

Additional information about commissioning the PLC can be found in the following references:

CNC Commissioning Manual: NCK, PLC, drive / SINUMERIK 840D sl
2.2.1.2 Commissioning the PLC with PROFINET

PROFINET is commissioned with the PLC Toolbox 4.5 or higher. This requires SIMATIC STEP7 V5.5 or higher.

Preconditions

- Configure the hardware, save and compile the project
- Generating the system data for the PLC
- Install the Toolbox software, which also contains the libraries for the PLC basic program of an NCU 7x0.3PN.
- GSDML for PAC PROFINET
  
  http://support.automation.siemens.com/WW/view/de/50186868

Procedure

You are on the main screen of the SIMATIC Manager.

1. Select the "File" > "Open" menu and then click on the "Libraries" tab.
2. Select the library for the PLC basic program "bp7x0_45" and confirm the dialog with "OK".
3. You have inserted the library and selected the PLC program under "PLC-First-Startup 840D sl" > "SINUMERIK" > "CPU 317F-3 PN/DP" > "S7 Program".
4. Copy the sources, modules and symbols to the PLC program

![Figure 2-2 Hardware catalog after linking-in the GSDML file](image)
5. In HW Config, drag the selected module to the Profinet IO system.

6. In the hardware catalog, open the required module and assign the subslots as shown in the diagram.
Note

Port interconnection

To simplify commissioning, in HW Config configure the PAC PROFINET using port interconnection at the PROFINET ports of the NCU. This saves you from having to initialize PAC.

References

Additional information about commissioning the PLC can be found in the following references:

CNC Commissioning Manual: NCK, PLC, drive / SINUMERIK 840D sl
2.2 Commissioning the PLC for SENTRON PAC

### 2.2.2 SINUMERIK 828D

The PLC of the 828D has a fixed PLC I/O image.

Using the general machine data MD12986[...], the possible peripheral connections (addresses) are activated or deactivated. When delivered, these addresses are deactivated for the Sentron devices by entering the address.

#### Activating the peripheral connection

- **SENTRON PAC4200**

<table>
<thead>
<tr>
<th>I address</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>132 ... 135</td>
<td>Total active power (value saved from SENTRON PAC)</td>
</tr>
<tr>
<td>136 ... 139</td>
<td>Active energy, imported, tariff 1 (instantaneous value)</td>
</tr>
<tr>
<td>140 ... 143</td>
<td>Active energy, exported, tariff 1 (instantaneous value)</td>
</tr>
</tbody>
</table>

For example, you activate the logical input address 132 by changing the machine data MD[...] with entry 132 to -1.

- **SENTRON PAC3200**

<table>
<thead>
<tr>
<th>I address</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>144 ... 147</td>
<td>Total active power (value saved from SENTRON PAC)</td>
</tr>
<tr>
<td>148 ... 151</td>
<td>Active energy, imported, tariff 1 (instantaneous value)</td>
</tr>
<tr>
<td>152 ... 155</td>
<td>Active energy, exported, tariff 1 (instantaneous value)</td>
</tr>
</tbody>
</table>

For example, you activate the logical input address 144 by changing the machine data MD[...] with entry 144 to -1.

The measured values are transferred in the float format.

### References

Additional information about commissioning the PLC can be found in the following references:

- SINUMERIK 828D Turning and Milling Commissioning Manual
2.3 Commissioning the PLC for Ctrl-E Analysis

2.3.1 Configuring the energy consumption display for SINUMERIK 840D sl

The energy consumption is displayed in the "SINUMERIK Ctrl-E Analysis" window.

See also

Signals for controlling energy-saving profiles (Page 42)
Signals for parameterization (Page 43)

The data block can be imported via the Toolbox and is loaded into the NCU using the user program.

Data block

<table>
<thead>
<tr>
<th>DB1001.DBX0.0</th>
<th>PLC -&gt; HMI</th>
<th>Display manual value</th>
<th>ManualVal</th>
<th>BOOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB1001.DBX0.1</td>
<td>PLC -&gt; HMI</td>
<td>SENTRON PAC represents the complete machine</td>
<td>SentronPacMach</td>
<td>BOOL</td>
</tr>
<tr>
<td>DB1001.DBX0.2</td>
<td>PLC -&gt; HMI</td>
<td>Imported active energy is read from SENTRON PAC</td>
<td>FeedInEnergyReadSP</td>
<td>BOOL</td>
</tr>
<tr>
<td>DB1001.DBX0.3</td>
<td>PLC -&gt; HMI</td>
<td>Exported active energy is read from SENTRON PAC</td>
<td>FeedBackEnergyReadSP</td>
<td>BOOL</td>
</tr>
<tr>
<td>DB1001.DBX1.0</td>
<td>PLC -&gt; GP</td>
<td>Measuring request to PLC basic program</td>
<td>MeasAuto</td>
<td>BOOL</td>
</tr>
<tr>
<td>DB1001.DBX2.0</td>
<td>HMI -&gt; GP</td>
<td>Measurement is running</td>
<td>MeasAct</td>
<td>BOOL</td>
</tr>
<tr>
<td>DB1001.DBD4</td>
<td>PLC -&gt; HMI</td>
<td>Manual value</td>
<td>ManualValue</td>
<td>REAL</td>
</tr>
<tr>
<td>DB1001.DBD8</td>
<td>GP -&gt; HMI</td>
<td>Total active power</td>
<td>ActivePowerItem</td>
<td>REAL</td>
</tr>
<tr>
<td>DB1001.DBD12</td>
<td>MeasAuto == 0: PLC -&gt; HMI MeasAuto == 1: GP -&gt; HMI</td>
<td>Measured imported active energy in kWh to HMI</td>
<td>ActiveEnergyItem</td>
<td>REAL</td>
</tr>
</tbody>
</table>
### Ctrl-E Analysis

#### 2.3 Commissioning the PLC for Ctrl-E Analysis

<table>
<thead>
<tr>
<th>DB1001</th>
<th>Name: SentronPac</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Signal direction</strong></td>
</tr>
<tr>
<td>DB1001.DBD16</td>
<td>MeasAuto == 0: PLC -&gt; HMI</td>
</tr>
<tr>
<td>DB1001.DBD20</td>
<td>PLC -&gt; GP</td>
</tr>
<tr>
<td>DB1001.DBD24</td>
<td>PLC -&gt; GP</td>
</tr>
<tr>
<td>DB1001.DBD28</td>
<td>PLC -&gt; GP</td>
</tr>
<tr>
<td>DB1001.DBD32</td>
<td>GP -&gt; HMI</td>
</tr>
<tr>
<td>DB1001.DBD36</td>
<td>GP -&gt; HMI</td>
</tr>
<tr>
<td>DB1001.DBD40</td>
<td>GP -&gt; HMI</td>
</tr>
<tr>
<td>DB1001.DBD44</td>
<td>GP -&gt; HMI</td>
</tr>
<tr>
<td>DB1001.DBD48</td>
<td>GP -&gt; HMI</td>
</tr>
<tr>
<td>DB1001.DBD52</td>
<td>GP -&gt; HMI</td>
</tr>
<tr>
<td>DB1001.DBD56</td>
<td>GP -&gt; HMI</td>
</tr>
<tr>
<td>DB1001.DBD60</td>
<td>GP -&gt; HMI</td>
</tr>
<tr>
<td>DB1001.DBD64</td>
<td>GP -&gt; HMI</td>
</tr>
<tr>
<td>DB1001.DBD68</td>
<td>GP -&gt; HMI</td>
</tr>
<tr>
<td>DB1001.DBD72</td>
<td>GP -&gt; HMI</td>
</tr>
<tr>
<td>DB1001.DBD76</td>
<td>GP -&gt; HMI</td>
</tr>
</tbody>
</table>
Note

Evaluation of the energy consumption of the complete machine

If you have installed SENTRON PAC in the main circuit of the machine or SENTRON PAC evaluates the energy consumption of the complete machine, set bit DB1001.DBX0.1 to 1.

As a consequence, in the display for Ctrl-E Analysis, the line "SentronPAC" is removed and the measured value of the SENTRON PAC is entered into the line "Total machine".

2.3.1.1 PLC user program for SINUMERIK 840D sl programming

Via the expansion modules, SENTRON PAC devices provide the total active power in the unit W and the active energy data in Wh. In HMI the units kW and kWh are used.

PLC basic program

The PLC basic program offers the following functions:

- Provision of the total active power [kW]
- Provision of the values for imported and exported active energy [kWh]
  - for the current day, month and the current year as well as for the previous day, previous month and the previous year.

  The values of the current time periods are updated in every cycle. If one of the time periods changes (new day, new month or new year) then the "current" variables of the time period that changes is copied into its previous day, previous month or previous year variables and the "current" variables are accumulated again starting from 0.

- Two measuring procedures for imported and exported active energy [kWh]
  - Measuring carried out by the basic program
  - The user calculates and writes the measured values

  This allows user-specific measuring routines to be implemented.

The two values of measured imported energy [kWh] (DBD12) and the measured exported energy [kWh] (DBD16) are made available for the HMI. The source of the values as well as measuring procedure and measuring duration (start, stop) are defined using measurement control bits.
2.3 Commissioning the PLC for Ctrl-E Analysis

Programming the PLC user program

- You take the total active power from the input address and transfer the value to DB1001.DBD20.
- You take the imported active power from the input address and transfer the value to DB1001.DBD24.
- You take the exported active power from the input address and transfer the value to DB1001.DBD28.
- If the control bits DB1001.DBX0.2 and DBX0.3 are equal to 0, then the HMI counts the energy on the basis of the total active power transferred from the SENTRON between the start and stop.
- If the imported and exported energy is to be directly evaluated by SENTRON PAC (DB1001.DBX0.2 and DBX0.3 equal to 1), then program this measurement in the user program as follows:
  - SENTRON PAC devices permanently cumulate the "imported active energy (tariff 1)" or "the exported active energy (tariff 1)" separately when their supply voltages are connected.
  - With the positive edge of the signal "Measurement running" (DB1001.DBX2.0) you buffer these instantaneous values from SENTRON (imported and exported active energy T1)
  - Cyclically generate the differences between the energy data now being counted minus the initial values, divide the differences by 1000.0 and transfer the results to DB1001.DBD12 (for measured imported active energy T1) and DB1001.DBD16 (measured exported active energy T1) up to the STOP signal (falling edge).
  - During the measurement, the increasing difference (energy in kWh) is displayed on the HMI, which can then be read as measured value with Stop measurement.

Measurement control HMI → GP and PLC → GP

- With a 1 signal of the control bit "MeasAuto" (DBX1.0), the user requests that the basic program makes the measurement.
  If this bit is not set, then the user is responsible for calculating and writing the measured values.
- Using a 1 signal of the control bit "MeasAct" (DBX2.0), via the HMI it is signaled as to when the measurement should be made: 0→1 start measurement, 1→0 stop measurement.
  The basic program only evaluates this signal if control bit "MeasAuto" (DBX1.0) is set.
Measurement carried out by the basic program:

For these measurements, the cyclic increases in the energy values are accumulated in the measured variables.

The behavior for different signal sequences of both measurement control signals are described in the following:

- **DBX1.0 is set first**

  If DBX1.0 ("MeasAuto") is first set, and then remains statically present, every 0-1 edge of DBX2.0 ("MeasAct") deletes the measured value and then starts the measurement.

  If DBX2.0 is reset, the measurement is canceled and the measured value remains constant. The sequence is repeated at the next 0-1 edge of DBX2.0.

- **DBX2.0 is set first**

  If DBX2.0 ("MeasAct") is set first, and then remains statically present, every 0-1 edge of DBX1.0 ("MeasAuto") accumulates the measured value without deleting the previous value. If DBX1.0 is reset, the measurement is only interrupted and the measured value remains constant.
2.3 Commissioning the PLC for Ctrl-E Analysis

2.3.2 Configuring the display of energy consumption for SINUMERIK 828D

The energy consumption is displayed in the "SINUMERIK Ctrl-E Analysis" window.

See also

Signals for controlling energy-saving profiles (Page 45)
Signals for parameterization (Page 46)

Data block

<table>
<thead>
<tr>
<th>DB9907</th>
<th>Signal direction</th>
<th>Meaning</th>
<th>Symbol</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SentronPac</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DB9907.DBX0.0</td>
<td>PLC -&gt; HMI</td>
<td>Display manual value</td>
<td>ManualVal</td>
<td>BOOL</td>
</tr>
<tr>
<td></td>
<td>PLC -&gt; HMI</td>
<td>SENTRON PAC represents the complete machine</td>
<td>SentronPacMach</td>
<td>BOOL</td>
</tr>
<tr>
<td></td>
<td>PLC -&gt; HMI</td>
<td>Imported active energy is read from SENTRON PAC</td>
<td>FeedInEnergyReadSP</td>
<td>BOOL</td>
</tr>
<tr>
<td></td>
<td>PLC -&gt; HMI</td>
<td>Exported active energy is read from SENTRON PAC</td>
<td>FeedBackEnergyReadSP</td>
<td>BOOL</td>
</tr>
<tr>
<td></td>
<td>PLC -&gt; FW</td>
<td>Measuring request to PLC FW</td>
<td>MeasAuto</td>
<td>BOOL</td>
</tr>
<tr>
<td></td>
<td>HMI -&gt; FW</td>
<td>Measurement is running</td>
<td>MeasAct</td>
<td>BOOL</td>
</tr>
<tr>
<td></td>
<td>PLC -&gt; HMI</td>
<td>Manual value</td>
<td>ManualValue</td>
<td>REAL</td>
</tr>
<tr>
<td></td>
<td>FW -&gt; HMI</td>
<td>Total active power</td>
<td>ActivePowerItem</td>
<td>REAL</td>
</tr>
<tr>
<td></td>
<td>MeasAuto = 0; PLC -&gt; HMI</td>
<td>Measured imported active energy tariff1</td>
<td>ActiveEnergyItem</td>
<td>REAL</td>
</tr>
<tr>
<td></td>
<td>MeasAuto = 1; FW -&gt; HMI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MeasAuto = 0; PLC -&gt; HMI</td>
<td>Measured exported active energy tariff1</td>
<td>ReactiveEnergyItem</td>
<td>REAL</td>
</tr>
<tr>
<td></td>
<td>MeasAuto = 1; FW -&gt; HMI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PLC -&gt; FW</td>
<td>Total active power in watts from SENTRON</td>
<td>ActivePowerSentron</td>
<td>REAL</td>
</tr>
</tbody>
</table>
### Ctrl-E Analysis

#### 2.3 Commissioning the PLC for Ctrl-E Analysis

<table>
<thead>
<tr>
<th>Name: SentronPac</th>
<th>Signal direction</th>
<th>Meaning</th>
<th>Symbol</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB9907.DBD24</td>
<td>PLC -&gt; FW</td>
<td>Imported active energy at tariff 1 (F) in Wh from SENTRON</td>
<td>ActiveEnergySentron</td>
<td>REAL</td>
</tr>
<tr>
<td>DB9907.DBD28</td>
<td>PLC -&gt; FW</td>
<td>Exported active energy at tariff 1 (F) in Wh from SENTRON</td>
<td>ReactiveEnergySentron</td>
<td>REAL</td>
</tr>
<tr>
<td>DB9907.DBD32</td>
<td>FW -&gt; HMI</td>
<td>Imported active energy in kWh current day to HMI</td>
<td>ActiveEnergyDay</td>
<td>REAL</td>
</tr>
<tr>
<td>DB9907.DBD36</td>
<td>FW -&gt; HMI</td>
<td>Exported active energy in kWh current day to HMI</td>
<td>ReactiveEnergyDay</td>
<td>REAL</td>
</tr>
<tr>
<td>DB9907.DBD40</td>
<td>FW -&gt; HMI</td>
<td>Imported active energy in kWh previous day to HMI</td>
<td>ActiveEnergyPrevDay</td>
<td>REAL</td>
</tr>
<tr>
<td>DB9907.DBD44</td>
<td>FW -&gt; HMI</td>
<td>Exported active energy in kWh previous day to HMI</td>
<td>ReactiveEnergyPrevDay</td>
<td>REAL</td>
</tr>
<tr>
<td>DB9907.DBD48</td>
<td>FW -&gt; HMI</td>
<td>Imported active energy in kWh month to HMI</td>
<td>ActiveEnergyMonth</td>
<td>REAL</td>
</tr>
<tr>
<td>DB9907.DBD52</td>
<td>FW -&gt; HMI</td>
<td>Exported active energy in kWh month to HMI</td>
<td>ReactiveEnergyMonth</td>
<td>REAL</td>
</tr>
<tr>
<td>DB9907.DBD56</td>
<td>FW -&gt; HMI</td>
<td>Imported active energy in kWh previous month to HMI</td>
<td>ActiveEnergyPrevMonth</td>
<td>REAL</td>
</tr>
<tr>
<td>DB9907.DBD60</td>
<td>FW -&gt; HMI</td>
<td>Exported active energy in kWh previous month to HMI</td>
<td>ReactiveEnergyPrevMonth</td>
<td>REAL</td>
</tr>
<tr>
<td>DB9907.DBD64</td>
<td>FW -&gt; HMI</td>
<td>Imported active energy in kWh year to HMI</td>
<td>ActiveEnergyYear</td>
<td>REAL</td>
</tr>
<tr>
<td>DB9907.DBD68</td>
<td>FW -&gt; HMI</td>
<td>Exported active energy in kWh year to HMI</td>
<td>ReactiveEnergyYear</td>
<td>REAL</td>
</tr>
<tr>
<td>DB9907.DBD72</td>
<td>FW -&gt; HMI</td>
<td>Imported active energy in kWh previous year to HMI</td>
<td>ActiveEnergyPrevYear</td>
<td>REAL</td>
</tr>
<tr>
<td>DB9907.DBD76</td>
<td>FW -&gt; HMI</td>
<td>Exported active energy in kWh previous year to HMI</td>
<td>ReactiveEnergyPrevYear</td>
<td>REAL</td>
</tr>
</tbody>
</table>
Note

Evaluation of the energy consumption of the complete machine

If you have installed SENTRON PAC in the main circuit of the machine or SENTRON PAC evaluates the energy consumption of the complete machine, set bit DB9907.DBX0.1 to 1.

As a consequence, in the display for Ctrl-E Analysis, the line "SentronPAC" is removed and the measured value of the SENTRON PAC is entered into the line "Total machine".

2.3.2.1 Programming the PLC user program for SINUMERIK 828D

Via the expansion modules, SENTRON PAC devices provide the total active power in the unit W and the active energy data in Wh. In HMI the units kW and kWh are used.

PLC firmware

The PLC firmware offers the following functions:

- Provision of the total active power [kW]
- Provision of the values for imported and exported active energy [kWh]
  - for the current day, month and the current year as well as for the previous day, previous month and the previous year.
  - The values of the current time periods are updated in every cycle. If one of the time periods changes (new day, new month or new year) then the "current" variables of the time period that changes is copied into its previous day, previous month or previous year variables and the "current" variables are accumulated again starting from 0.
- Two measuring procedures for imported and exported active energy [kWh]
  - Measurement carried out by the PLC firmware (see "Measurement control HMI → FW and PLC → FW")
  - The user calculates and writes the measured values
    - This allows user-specific measuring routines to be implemented.

The two values of measured imported energy [kWh] (DBD12) and the measured exported energy [kWh] (DBD16) are made available for the HMI. The source of the values as well as measuring procedure and measuring duration (start, stop) are defined using measurement control bits.
Programming the PLC user program

- You take the total active power from the input address and transfer the value to DB9907.DBD20. This must be realized according to the following point "Adapt byte sequence".

- You take the imported active power from the input address and transfer the value to DB9907.DBD24. This must be realized according to the following point "Adapt byte sequence".

- You take the exported active power from the input address and transfer the value to DB9907.DBD28. This must be realized according to the following point "Adapt byte sequence".

- If the control bits DB9907.DBX0.2 and DBX0.3 are equal to 0, then the HMI counts the energy on the basis of the total active power transferred from the SENTRON between the start and stop.

- If the imported and exported energy is to be directly evaluated by SENTRON PAC (DB9907.DBX0.2 and DBX0.3 equal to 1), then program this measurement in the user program as follows:
  - SENTRON PAC devices permanently cumulate the "imported active energy (tariff 1)" or "the exported active energy (tariff 1)" separately when their supply voltages are connected.
  - With the positive edge of the signal "Measurement running" (DB9907.DBX2.0) you buffer these instantaneous values from SENTRON (imported and exported active energy T1)
  - Cyclically generate the differences between the energy data now being counted minus the initial values, divide the differences by 1000.0 and transfer the results to DB9907.DBD12 (for measured imported active energy T1) and DB9907.DBD16 (measured exported active energy T1) up to the STOP signal (falling edge).
  - During the measurement, the increasing difference (energy in kWh) is displayed on the HMI, which can then be read as measured value with Stop measurement.

Adapting the byte sequence

Save the values of the SENTRON PAC so that the byte sequence of the double words is swapped over (Endian conversion).

The CTRL_E and SENTRON blocks are located in the following directory:
Example for SINUMERIK 828Dsl with SENTRON PAC3200

Swap over the byte sequence of the total active power in ID144:

For the total active power, the numerical value of 18.4 is supplied from SENTRON. This corresponds to a hexadecimal value of 0x41933334, which is located just like this in the double word ID144. To be further processed by the PLC, the sequence of these four bytes must be swapped over: 0x34339341.

Also the values for the active energy import tariff 1 and active energy export tariff 1 must be handled in this way.

---

**Figure 2-5** SWAP_DW subroutine

---

You can find the SWAP_DW subroutine on the Toolbox-CD under Examples\PLC
Measurement control HMI → FW and PLC → FW

- With a 1 signal of the control bit "MeasAuto" (DBX1.0), the user requests that the firmware makes the measurement.
  
  If this bit is not set, then the user is responsible for calculating and writing the measured values.

- Using a 1 signal of the control bit "MeasAct" (DBX2.0), via the HMI it is signaled as to when the measurement should be made: 0→1 start measurement, 1→0 stop measurement.
  
  The firmware only evaluates this signal if control bit "MeasAuto" (DBX1.0) is set.

Measurement carried out by the firmware

For these measurements, the cyclic increases in the energy values are accumulated in the measured variables.

The behavior for different signal sequences of both measurement control signals are described in the following:

- DBX1.0 is set first
  
  If DBX1.0 ("MeasAuto") is first set, and then remains statically present, every 0-1 edge of DBX2.0 ("MeasAct") deletes the measured value and then starts the measurement.
  
  If DBX2.0 is reset, the measurement is canceled and the measured value remains constant. The sequence is repeated at the next 0-1 edge of DBX2.0.

  ![Figure 2-7 Measurement control signal DBX1.0 is set first](image)

- DBX2.0 is set first
  
  If DBX2.0 ("MeasAct") is set first, and then remains statically present, every 0-1 edge of DBX1.0 ("MeasAuto") accumulates the measured value without deleting the previous value. If DBX1.0 is reset, the measurement is only interrupted and the measured value remains constant.

  ![Figure 2-8 Measurement control signal DBX2.0 is set first](image)
2.4 Commissioning the HMI for Ctrl-E Analysis

No additional adaptation is required.

As soon as the DB1001 (840D sl) or the DB9907 (828D) is available and actively assigned with data words, then the HMI automatically accepts this data.

2.5 Long time measurement

In order that you can read the usage values in the "Long time measurement" window, program the PLC user program as specified in Chapter 2.3.1.1 (840D sl) or 2.3.2.1 (828D).
To optimize the energy consumption, you have the option of defining energy saving profiles and saving them.

**Controlling the energy-saving states of the machine**

The following pre-defined energy-saving profiles are available when the system is delivered:

- **Simple energy-saving mode (machine standby)**
  
  A specific interface signal is initiated if the control has not exited the reset state after a defined time. Using this signal, with the PLC a pre-defined energy state is established, where, for example it is still possible to operate the machine for setting-up purposes.

- **Full energy-saving mode (NC standby)**
  
  A specific interface signal is initiated if none of the keys on the machine control panel at the control has been pressed for a specific time. A pre-defined energy state can be established with the PLC using this signal, where it is still possible, for example, to transfer programs to the control or edit them.

- **Maximum energy-saving mode (auto shut-off)**
  
  An additional interface signal is initiated if, at the control, no key on the operator panel and machine control panel has been pressed for a defined time and there is no active communication with the external device. Via the PLC, the main switch is automatically opened, e.g. using the undervoltage release function.

These predefined energy-saving profiles only become effective if the control system is in the reset state. They can be blocked using a PLC user signal. The energy-saving profiles can be changed at any time and supplemented to include up to a total of 8 profiles.

For instance, you have the option of assigning a customer key to an energy-saving profile, with which the control can be immediately shut down.
3.1 Commissioning the PLC for Ctrl-E Profiles

3.1.1 Overview

In every machine tool, the PLC is the central part of the control for the peripherals and mounted equipment/devices. Each machine can have several operating stations. The energy-saving profiles are managed and stored in the PLC. The signals to monitor energy within the machine are available in the PLC; these signals can then be appropriately logically combined in the PLC user program.

SINUMERIK 840D sl

In SINUMERIK 840D sl, "Ctrl+Energy" is integrated in the basic program (FB15). Data for each energy-saving profile is saved in DB1000, which is supplied with the Toolbox.

SINUMERIK 828D

In SINUMERIK 828D, "Ctrl+Energy" is integrated in the PLC firmware. The data for each energy-saving profile is saved in the DB9906, which is included in the Programming Tool 828D. In the other versions, for the "basic program (FB15)" for 828D, "PLC firmware" applies.

Energy-saving profiles

The PLC supports 8 energy-saving profiles. After the relevant configured delay times have expired, the energy-saving profiles are individually active. The total time up until the energy-saving profile is activated is obtained from its activation time plus the prewarning time. During the two time intervals, the selected signals, enabled using masking, are monitored for any activity and the profile only becomes finally active when the signals are completely inactive. Of course, when required OEMs can configure either one or both times with zero.

The energy-saving profile in the PLC is characterized by the following data:

- the maximum time for T1 – the activation time
- the maximum time for T2 – the prewarning limit time of the user
- the actual value for T1
- the actual value for T2
- masking of the signals to assume/exit the energy-saving state

The times have the units of seconds, are 16 bits wide and unsigned. A maximum time is therefore approximately 18 hours.

Note

The time until the energy-saving profile has been finally activated is obtained by adding the actual values of T1 and T2.
The data for each energy-saving profile is saved in DB1000 for the 840Dsl and in DM9906 for the 828D.

### 3.1.2 Automatic state machine PLC functions

The automatic state machine shows the functionality in the PLC.

The state transition "OFF" results in a change into the "Energy-saving state inactive" from every other state. This corresponds to "waking up" the machine.

After the NCU powered up, every energy-saving profile in the state "Energy-saving state inactive" and the actual values of the times T1 and T2 are set to the maximum values.

An energy-saving profile runs through the displayed automatic state machine if the associated "energy-saving profile initialized" bit is set. The HMI resets this bit before changing the times or the signal mask, and sets it after the values have been consistently written into the PLC.

When the "Energy-saving profile active" bit is set, then an energy-saving profile is considered to have been assigned.
Figure 3-1 State monitoring

**Transition to "RUN"**
All of the signals that have been enabled for evaluation using the following masking bits, are inactive
(also see Chapter 3.1.5.2.):

- DBX 11.0, DBX 11.1, DBX 11.2: HMI activities
- DBX 12.0: MCP activities
- DBX 13.0 – DBX 13.7: NCK channel activities
- DBX 14.0, DBX 14.1: NCK channel activities
- DBX 15.0, DBX 15.1: Master computer and PLC prohibit signals

The specified signals refer to energy-saving profile 1.
3.1 Commissioning the PLC for Ctrl-E Profiles

Transition to "OFF"
DBX 10.1 == 1 ("deactivate profile") or delete the profile: highest priority and independent of the profile initialization
- OR -
0-1 edge at the DBX 10.0 ("profile is initialized")
- OR -
At least one of the signals that have been enabled for evaluation using the following masking bits, is inactive (also see Chapter 3.1.5.2.):

DBX 11.0, DBX 11.1, DBX 11.2  HMI activities
DBX 12.0  MCP activities
DBX 13.0 – DBX 13.7  NCK channel activities
DBX 14.0, DBX 14.1  NCK channel activities
DBX 15.0, DBX 15.1  Master computer and PLC prohibit signals

The specified signals refer to energy-saving profile 1.

3.1.3 Checking the energy-saving states

The following signals are checked when entering or retaining the energy-saving profile. The signals can be masked for each energy-saving profile.
### 3.1 Commissioning the PLC for Ctrl-E Profiles

<table>
<thead>
<tr>
<th>Signal</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Generated by the HMI</strong></td>
<td></td>
</tr>
<tr>
<td>Keyboard has been used (state condition &quot;No key pressed on the operator panel&quot;)</td>
<td>This signal is set if in the last second the keyboard of the SINUMERIK control was used. This signal is only available once for each control system and is automatically linked through the masking. In the case of several operator panels, the group signal of all keyboards is used. For a keystroke, the HMI sets this bit and the PLC handles the reset process.</td>
</tr>
<tr>
<td>Data transfer active (state condition &quot;No communication with an external device active (USB, Ethernet, V24)&quot;)</td>
<td>This signal is set if data is being transferred. After completion of the data transfer, the HMI resets this bit. This includes the use of a USB memory medium, a V24 connection or a network drive. This signal is also set when generating or importing a commissioning archive. This signal is only available once for each control system and is automatically linked through the masking. In the case of several operating stations, the group signal is formed. Acyclic S7 communication in the sense of a connected engineering system or an external HMI does not apply as data transfer in the sense of this signal.</td>
</tr>
<tr>
<td>Screen change active (state condition &quot;No screen change realized&quot;)</td>
<td>This signal is set if a screen is being changed. After processing, the PLC resets the bit. This signal is only available once for each control system and is automatically linked through the masking. For several operator stations, the group signal is formed here.</td>
</tr>
<tr>
<td><strong>Generated by the PLC basic program (828D: PLC firmware)</strong></td>
<td></td>
</tr>
</tbody>
</table>
| Machine control panel used (state condition "No key pressed on the machine control panel") | This signal is set if the machine control panel in the PLC is used. To do this, a specified address range of the inputs is monitored in the PLC.  
  - For 840D sl, the ranges addressed via parameters DB7 MCP1In and MCP2IN  
  - For 828D, the input range of the PN-MCP  
  This signal is only available once for each control system and is automatically linked through the masking. The group signal is formed when several machine control panels are being used. |
| NCK activity (state condition "NC channel/channels in reset") | This signal is set if the NCK channel is not in the Reset channel state.  
  **Note:** Static synchronized actions, which are also active in the Reset channel state = TRUE, are not detected and must be taken into account by the user. |
| **From the PLC user program interface** | |
| Master computer prohibits (state condition "master computer signal prohibits") | Using this signal, an external master computer or a coupled control system can prevent that the energy-saving profile is activated. This signal is available in the user interface for each energy-saving profile. |
| PLC user program signal (state condition "PLC user signal prohibits") | Using this signal, from the user program in the PLC, an energy-saving profile can be prevented from being activated. This signal is available in the user interface for each energy-saving profile. |
3.1.4 PLC user program

The following signals are available in the user program for controlling the energy-saving profiles. These signals are not masked within the energy profile, and are available for each profile.

<table>
<thead>
<tr>
<th>Signal</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control signal to &quot;directly activate the energy-saving profile&quot;</td>
<td>The energy-saving profile is immediately activated when this signal is set. The two timers are set to zero. For the case that the energy profile has already been activated, no change is made.</td>
</tr>
<tr>
<td>Set time to prewarning limit</td>
<td>When setting this signal, the timer for the prewarning limit $T_2$ is set to its setpoint and is then restarted. This is also the case, even if the energy-saving profile is already active. The activation is then reset, and after the prewarning time is set again.</td>
</tr>
<tr>
<td>Feedback signal, &quot;prewarning time $T_1$ expired&quot;</td>
<td>This signal is set by the basic PLC program (FB15) if the timer has expired and the prewarning is output on the HMI.</td>
</tr>
<tr>
<td>Feedback signal, &quot;prewarning time $T_2$ expired&quot;</td>
<td>This signal is set by the basic PLC program (FB15) if, after the prewarning limit has been reached, also the prewarning time of the corresponding energy profile has expired. This means that this signal is equivalent to the information &quot;Energy-saving state active&quot;.</td>
</tr>
</tbody>
</table>

**Note**

**Shutdown auxiliary equipment**

If auxiliary equipment is also to be shut down using the "Prewarning time expired" signal, which acknowledges the shutdown process, then using a normal PLC timer and the signal "PLC user program signal", a monitoring function can be installed in the basic PLC program. If the auxiliary equipment has still not been run down after the PLC timer has expired, then the energy-saving state can be exited again using the "PLC user program signal".
3.1.5 Interface signals 840D sl

3.1.5.1 Signals for controlling energy-saving profiles

Dynamic data are cleared when the control powers up.

The signals described in the following section refer to energy-saving profile 1.

Control signals (user program)

<table>
<thead>
<tr>
<th>DB1000</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DBX0.0</td>
<td>Directly activate energy-saving profile</td>
</tr>
<tr>
<td>DBX0.1</td>
<td>Set time to prewarning limit</td>
</tr>
</tbody>
</table>

Control signals (HMI)

<table>
<thead>
<tr>
<th>DB1000</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DBX1.0</td>
<td>Directly activate energy-saving profile</td>
</tr>
</tbody>
</table>

Signals to check the energy-saving state (user program)

<table>
<thead>
<tr>
<th>DB1000</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DBX2.0</td>
<td>Master computer prohibits energy-saving state</td>
</tr>
<tr>
<td>DBX2.1</td>
<td>PLC user program signal prohibits energy-saving state</td>
</tr>
</tbody>
</table>

Status signals

<table>
<thead>
<tr>
<th>DB1000</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DBX4.0</td>
<td>Energy-saving profile is active</td>
</tr>
<tr>
<td>DBX4.1</td>
<td>Prewarning limit T1 reached</td>
</tr>
</tbody>
</table>

Actual values

<table>
<thead>
<tr>
<th>DB1000</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DBW6</td>
<td>Actual value T1</td>
</tr>
<tr>
<td>DBW8</td>
<td>Actual value T2</td>
</tr>
</tbody>
</table>
3.1.5.2 Signals for parameterization
Retentive parameterization data.

Effectiveness (HMI → PLC)

| DB1000 | DBX 10.0 | Energy-saving profile configured |
|        | DBX 10.1 | Disable energy-saving profile   |

Masking (HMI → PLC)

| DB1000 | DBX 11.0 | Keyboard has been used |
|        | DBX 11.1 | Data transfer active   |
|        | DBX 11.2 | Screen change active   |
|        | DBX 12.0 | Machine control panel used |
|        | DBX 13.0 | NCK channel 1          |
|        | DBX 13.1 | NCK channel 2          |
|        | DBX 13.2 | NCK channel 3          |
|        | DBX 13.3 | NCK channel 4          |
|        | DBX 13.4 | NCK channel 5          |
|        | DBX 13.5 | NCK channel 6          |
|        | DBX 13.6 | NCK channel 7          |
|        | DBX 13.7 | NCK channel 8          |
|        | DBX 14.0 | NCK channel 9          |
|        | DBX 14.1 | NCK channel 10         |
|        | DBX 15.0 | Master computer prohibits* |
|        | DBX 15.1 | PLC user program signal prohibits* |

*prohibits changing into the energy-saving mode

Maximum times (HMI → PLC)

| DB1000 | DBW 16 | Activation time T₁ |
|        | DBW 18 | Time for the prewarning limit T₂ |
3.1 Commissioning the PLC for Ctrl-E Profiles

Additional profile instances

<table>
<thead>
<tr>
<th>DB1000</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DBW 20</td>
<td>Energy-saving profile 2</td>
</tr>
<tr>
<td>DBW 40</td>
<td>Energy-saving profile 3</td>
</tr>
<tr>
<td>DBW 60</td>
<td>Energy-saving profile 4</td>
</tr>
<tr>
<td>DBW 80</td>
<td>Energy-saving profile 5</td>
</tr>
<tr>
<td>DBW 100</td>
<td>Energy-saving profile 6</td>
</tr>
<tr>
<td>DBW 120</td>
<td>Energy-saving profile 7</td>
</tr>
<tr>
<td>DBW 140</td>
<td>Energy-saving profile 8</td>
</tr>
</tbody>
</table>
3.1.6 Interface signals 828D

3.1.6.1 Signals for controlling energy-saving profiles

Dynamic data are cleared when the control powers up.

Control signals (user program)

<table>
<thead>
<tr>
<th>DB9006</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DBX0.0</td>
<td>Directly activate energy-saving profile</td>
</tr>
<tr>
<td>DBX0.1</td>
<td>Set time to prewarning limit</td>
</tr>
</tbody>
</table>

Control signals (HMI)

<table>
<thead>
<tr>
<th>DB9006</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DBX1.0</td>
<td>Directly activate energy-saving profile</td>
</tr>
</tbody>
</table>

Signals to check the energy-saving profile (user program)

<table>
<thead>
<tr>
<th>DB9006</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DBX2.0</td>
<td>Master computer prohibits energy-saving state</td>
</tr>
<tr>
<td>DBX2.1</td>
<td>PLC user program signal prohibits energy-saving state</td>
</tr>
</tbody>
</table>

Status signals

<table>
<thead>
<tr>
<th>DB9006</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DBX4.0</td>
<td>Energy-saving profile is active</td>
</tr>
<tr>
<td>DBX4.1</td>
<td>Prewarning limit T1 reached</td>
</tr>
</tbody>
</table>

Actual values

<table>
<thead>
<tr>
<th>DB9006</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DBW6</td>
<td>Actual value T₁</td>
</tr>
<tr>
<td>DBW8</td>
<td>Actual value T₂</td>
</tr>
</tbody>
</table>
3.1 Commissioning the PLC for Ctrl-E Profiles

3.1.6.2 Signals for parameterization

Retentive parameterization data.

Effectiveness (HMI → PLC)

<table>
<thead>
<tr>
<th>DB9906</th>
<th>DBX10.0</th>
<th>Energy-saving profile configured</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DBX 10.1</td>
<td>Disable energy-saving profile</td>
</tr>
</tbody>
</table>

Masking (HMI → PLC)

<table>
<thead>
<tr>
<th>DB9906</th>
<th>DBX11.0</th>
<th>Keyboard has been used</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DBX11.1</td>
<td>Data transfer active</td>
</tr>
<tr>
<td></td>
<td>DBX11.2</td>
<td>Screen change active</td>
</tr>
<tr>
<td></td>
<td>DBX12.0</td>
<td>Machine control panel used</td>
</tr>
<tr>
<td></td>
<td>DBX13.0</td>
<td>NCK channel 1</td>
</tr>
<tr>
<td></td>
<td>DBX15.0</td>
<td>Master computer prohibits*</td>
</tr>
<tr>
<td></td>
<td>DBX15.1</td>
<td>PLC user program signal prohibits*</td>
</tr>
</tbody>
</table>

*prohibits changing into the energy-saving mode.

Maximum times (HMI → PLC)

<table>
<thead>
<tr>
<th>DB9906</th>
<th>DBW16</th>
<th>Activation time $T_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DBW18</td>
<td>Time for the prewarning limit $T_2$</td>
</tr>
</tbody>
</table>

Additional instances

<table>
<thead>
<tr>
<th>DB9906</th>
<th>DBW20</th>
<th>Energy profile 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DBW40</td>
<td>Energy profile 3</td>
</tr>
<tr>
<td></td>
<td>DBW60</td>
<td>Energy profile 4</td>
</tr>
<tr>
<td></td>
<td>DBW80</td>
<td>Energy profile 5</td>
</tr>
<tr>
<td></td>
<td>DBW100</td>
<td>Energy profile 6</td>
</tr>
<tr>
<td></td>
<td>DBW120</td>
<td>Energy profile 7</td>
</tr>
<tr>
<td></td>
<td>DBW140</td>
<td>Energy profile 8</td>
</tr>
</tbody>
</table>
3.2 Creating and editing energy-saving profiles

You can make the following changes in the list of energy-saving profiles in the commissioning mode:

- Creating new energy-saving profiles with prewarning time and activation time period.
- Changing state conditions, prewarning time and activation time period
- Deleting energy-saving profiles
- Importing externally generated energy-saving profiles into the system
- Backing up energy-saving profiles on an external medium

**Note**

**Maximum number of energy-saving profiles**

A maximum of 8 energy-saving profiles can be created.

If the maximum number of profiles already exists, then the "New" softkey is no longer available. To create a new energy-saving profile, remove a profile using the "Delete" softkey or change an existing profile using the "Change" softkey.

**Note**

**Access level of the energy-saving profiles for users**

You specify the access level for the "Energy-saving profiles" softkey in the "Parameter" operating area using the machine data 51071 $MNS_ACTIVATE_CTRL_E (protection level 1 as standard; this must be explicitly enabled by the manufacturer).

**Note**

**Designations of energy-saving profiles that have been created**

The names of the new energy-saving profiles that have been created are only visible at the control where you generated them.

**Energy conditions**

The following criteria are available for configuring an energy-saving profile:

<table>
<thead>
<tr>
<th>State conditions</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>No key on the operator panel pressed</td>
<td>To activate the energy-saving profile, it is not permissible that an operator panel key is pressed.</td>
</tr>
<tr>
<td>No key on the machine control panel pressed</td>
<td>To activate the energy-saving profile, it is not permissible that a machine control panel key is pressed.</td>
</tr>
<tr>
<td>No screen change realized</td>
<td>To activate the energy-saving profile it is not permissible that a screen is being changed.</td>
</tr>
<tr>
<td>No communication with an external device active (USB, Ethernet, V24)</td>
<td>To activate the energy-saving profile, it is not permissible that data is being exchanged with an external device, for example.</td>
</tr>
</tbody>
</table>
### Ctrl-E Profiles

#### 3.2 Creating and editing energy-saving profiles

<table>
<thead>
<tr>
<th>State conditions</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>NC channel/channels in Reset</td>
<td>To activate the energy-saving profile, NC channel/channels must be in the Reset state.</td>
</tr>
<tr>
<td>Master computer signal prohibits</td>
<td>To activate the energy-saving profile, it is not permissible that a signal is received from the master computer.</td>
</tr>
<tr>
<td>PLC user signal prohibits</td>
<td>To activate the energy-saving profile, it is not permissible that a signal is received from the PLC user program. The OEM can logically combine other state conditions with this signal and influence the profiles.</td>
</tr>
<tr>
<td>Activation of the energy-saving profile after</td>
<td>Here, you enter the time period after which the energy-saving profile is activated.</td>
</tr>
<tr>
<td>Prewarning after</td>
<td>Here, you enter when the system starts to display the prewarning.</td>
</tr>
<tr>
<td><strong>Note:</strong></td>
<td>If you enter the same value into the &quot;Activation of the energy-saving profile after&quot; and &quot;Prewarning after&quot; fields, then no message is displayed specifying the remaining time up until the energy-saving profile is activated.</td>
</tr>
</tbody>
</table>

**Note**

**Protection levels for editing energy-saving profiles**

You define the protection level that is required in order to create or edit an energy-saving profile in machine data 51072 $MNS_ACCESS_EDIT CTRL_E (default, protection level 2 (service)).

**Procedure**

1. Select the "Startup" operating area.

Newly creating/changing energy profiles

3. Position the cursor on the line where you wish to create a new energy-saving profile and press the "New" softkey.
   The window "SINUMERIK Ctrl-Energy: Definition energy-saving profile" is opened.
   In the "Designation" field, enter the desired name for the new energy-saving profile. Activate the required state conditions. Specify the times to display the prewarning limit and to activate the energy-saving profile.
   - OR -
   Position the cursor on the energy-saving profile that you want to edit and press the "Change" softkey.
   The window "SINUMERIK Ctrl-Energy: Definition energy-saving profile" is opened.
   In the "Designation" entry field, enter the modified name of the energy-saving profile. Select or deselect the state conditions that should be effective for the modified energy-saving profile - and when required, change the time data.

4. Press the "OK" softkey.
   The new or modified energy-saving profiles are activated.
   The modified texts (def_conditions<long>.ts) are saved in the \oem\sinumerik\hmi\lng directory.

Importing energy-saving profiles

5. Press the "Import profile" softkey.
   The "Import energy-saving profiles" window is displayed.
   Select the required XML file and press the "OK" softkey. After a prompt, the energy-saving profiles are downloaded into the PLC.
   The associated text files (def_conditions<long>.ts) are saved in the \oem\sinumerik\hmi\lng directory.
   **Note:**
   After importing the energy-saving profiles, a restart is required in order to make the profiles effective.

Exporting energy-saving profiles

6. Press the "Export profiles" softkey.
   The window "Export energy-saving profiles: Select storage location" opens.
7. Select the required storage location and press the "OK" softkey.

The language-neutral state data are stored in the XML format, the associated texts in a .ts file. You have the option of selecting a name for the XML file (default: def_conditions.xml).

The text files are saved under a fixed name. All of the defined energy-saving profiles are always exported.

**Note:**

Please note that the energy-saving profiles supplied from Siemens are also deleted. It is recommended that the energy-saving profiles are always exported and backed up.

**Deleting energy-saving profiles**

8. Select the energy-saving profile that you want to delete from the list and press the "Delete" softkey.

9. Confirm the prompt with "OK" to remove the profile.
Reactive power compensation

The Active Line Modules of the SINAMICS S120 series offer the option of compensating capacitive or inductive reactive current. As standard, this function is used to compensate for the system's own modules.

In addition, within a sensible scope, this feature can be used to compensate other (generally inductive) loads connected to machine.

As a result of the properties of the SINAMICS S120 Active Line Module as actuator on one hand, the properties of SENTRON PAC4200 as measuring element as well as additional PLC blocks (also as controller), this function can be implemented with the SINUMERIK 840D sl also independent of NC software releases.

Further information

Please contact your local sales organization if you require additional information regarding reactive power compensation.

Function schematic

![Function schematic](image)

Figure 4-1 Principle of operation of reactive power compensation
Flux reduction

In the drive parameters (p1581 [0..n]), the rated magnetization for induction motors – which is normally 100% – can be permanently reduced. This includes the switching times for reducing and building up the flux (r1578, r1579[0…n]).

In this case, not only can the magnetizing losses in the motors be reduced at standstill, but also during operations that only require a lower power.

Optimization criterion

Under no-load conditions, the percentage value of the rated magnetization is reduced in steps of between 5-10% to just above a value where the no-load behavior starts to become uneven.

From this limit value onwards, rough operating behavior can be heard as a result of the significantly fluctuating active current.

It makes sense to monitor the current characteristic and this transition point using a trace function.

Options for use

You have various options to specifically use this.

- Permanently set the actual parameter set p1581 [0] to the determined value <100%.

  Taking into consideration the time constants, the flux is automatically reduced if the instantaneous active power permits this. If more active power is demanded, then the flux automatically increases back up to 100% with the corresponding time constant. This does not have a negative impact on the process.

- Preselecting various parameter sets

  If load changes are to be expected in a time shorter than the time constant (e.g. for an interrupted roughing cut with facing head milling tools), it may be more favorable for the process if the flux is permanently controlled by pre-selecting various parameter sets by knowing the machining to be expected or the tool involved.

  Example ((see the interface signals at the spindle DB31-61.DBB21))

  Bit0: = 0:
  p1581 [0] = 100%;
  p1578 [0] and p1579 [0] = factory setting, e.g. for an interrupted cut

  Bit0: = 1:
  p1581 [1] < 100%;
  p1578 [1], p1579 [1], adapted for partial load or no load
User know-how

Machine manufacturers are being increasingly confronted with special demands from users regarding proving energy consumption data or displaying limit values, for example. Using SINUMERIK Integrate Run MyScreens (Easy Screen), it is possible to visualize the functions obtained from these requirements, and also position them in the context of Ctrl-Energy.

Displaying additional measuring data

The SENTRON PAC 3200/4200 Power Monitoring Devices provide, in different expansion stages, a wealth of electrical measured data.

In addition to the active power/active energy displayed today in SINUMERIK Operate, using Easy Screen, you have the option of displaying, for example, the reactive power/reactive energy and the apparent power/apparent energy of the measuring location in customized screen forms.

References

More information on the various measuring options is available in the following references:

- SENTRON PAC3200 Power Monitoring Device Manual
- SENTRON PAC4200 Power Monitoring Device System Manual

6.1 Commissioning user screen forms

General procedure

- You create your own screen forms in SINUMERIK Integrate Run MyScreens (Easy Screen), for example in a xxx.com file.
- You insert the new "xxx.com" project file name in "easyscreen.ini" in the "Parameter" area.
- Save the modified "easyscreen.ini" in the following directory: oem\sinumerik\hmi\cfg\.
- If the released horizontal softkey 7 in the extended softkey bar of the "Parameter" operating area is already used with a "yyy.com", then you have the option of programming the vertical softkey 4 behind the "Ctrl-Energy" softkey for an additional "xxx.com".
6.1 Commissioning user screen forms

An additional neutral "aufruf.com" file is created with the following start softkeys:

```plaintext
//S(START)
VS4="Start XXX"
PRESS(VS4)
LM("maske_xxx","xxx.com")
END_PRESS

HS7="Start YYY"
PRESS(HS7)
LM("maske_yyy","yyy.com")
END_PRESS
//END
```

These start calls directly access the specified screen forms of the relevant *.com files. A start softkey in these particular *.com files can be omitted.

- Save the project files "xxx.com", "yyy.com" and "aufruf.com" in the following directory: oem\sinumerik\hmi\proj\.

References

Additional information on the design and configuration of user interfaces is provided in the following references on SINUMERIK Integrate Run MyScreens (Easy Screen):

Programming Manual Easy Screen (BE2); SINUMERIK 840D sl
Appendix

A.1 Overview

SINUMERIK 840D sl Documentation Overview

General Documentation

- SINUMERIK 840D sl
  - Sales Brochure

- SINUMERIK 840D sl
  - Catalog NC 62

- SINAMICS S120
  - Catalog PM 21 SIMOTION, SINAMICS S120 and motors for production machines

User Documentation

- SINUMERIK 840D sl
  - Operating Manual
    - Universal
    - Turning
    - Milling
    - HMI Advanced

- SINUMERIK 840D sl
  - Operating Manual
    - Turning
    - Milling

- SINUMERIK 840D sl
  - Programming Manual
    - Fundamentals
    - Job Planning
    - Measuring Cycles

- SINUMERIK 840D sl
  - Programming Manual
    - ISO Turning
    - ISO Milling

- SINUMERIK 840D sl
  - Diagnostics Manual

Manufacturer / Service Documentation

- SINUMERIK 840D sl
  - Equipment Manual
    - NCU
    - Operator components and networking

- SINUMERIK 840D sl
  - System Manual Guidelines for Machine Configuration

- SINUMERIK 840D sl
  - System Manual Ctrl Energy

- SINUMERIK 840D sl
  - Commissioning Manual
    - CNC; NCK, PLC, Drive
    - Base software and Operating Software
    - Base software and HMI Advanced

- SINUMERIK 840D sl
  - Parameter Manual
    - Part 1
    - Part 2
    - Detailed Machine Data Description
    - System Variables

- SINUMERIK 840D sl
  - Function Manual
    - Basic Functions
    - Extended Functions
    - Special Functions
    - Synchronized Actions
    - Tool Management

- SINUMERIK 840D sl
  - Function Manual
    - ISO Dialects

- SINUMERIK 840D sl
  - Function Manual
    - Drive functions

- SINAMICS S120
  - Function Manual Safety Integrated

- SINUMERIK 840D sl
  - Configuration Manual
    - EMC Design Guidelines

Info / Training

- SINUMERIK 840D sl
  - Beginners instructions
    - Milling and turning

- SINUMERIK 840D sl
  - Training documents
    - Easy milling with ShopMill
    - Turning made easy with ShopTurn

- SINUMERIK 840D sl
  - Manuals Tool and mold making

Electronic documentation

- DOConCD
- My Documentation Manager
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