SIEMENS

Power Meter

SICAM P

Modbus

Manual

E50417-B1076-C241-A5

Note

Please observe the instructions and warnings for your safety in the foreword.

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Foreword

Purpose of the manual

This manual describes the functions of the Modbus communication protocol of the Power Meter SICAM P.

Target audience

This manual is directed to the user of the Power Meter SICAM P.

Standard

The development of the equipment was executed after the guidelines of the ISO 9000.

Validity of the manual

This manual is valid for the SICAM P (7KG7xxx) device.

Additional support

For any questions concerning your system, please contact your local Siemens representative.

Hotline

Our Customer Support Center provides around-the-clock service.

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Internet: http://www.powerquality.de/pq_da/index_e.htm

Training courses

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Information for your safety

This manual does not represent a complete listing of all the safety measures required to operate the equipment (module, device) since specific operating conditions may make further measures necessary. However, it contains information which you have to observe in order to ensure your personal safety and in order to avoid material damage. The information is highlighted by a warning triangle and, depending on the degree of danger, is shown as follows:

Danger

indicates that death, severe personal injury or substantial material damage **will** result if appropriate precautions are not taken.

Warning

indicates that death, severe personal injury or substantial material damage **may** result if appropriate precautions are not taken.

Caution

indicates that minor bodily injury or material damage may result if appropriate precautions are not taken.

Important

indicates that material damage may result if appropriate precautions are not taken.

Note

indicates important information about the device, its handling or the respective part of the instruction manual to which attention should be drawn.

Qualified personnel

Commissioning and operation of the equipment (module, device) described in this manual may only be carried out by qualified personnel. Qualified personnel in the sense of the safety instructions in this manual are persons who are entitled to commission, enable, earth and identify devices, systems and circuits in accordance with the standards of safety technology.

Use as prescribed

The equipment (device, module) may only be used for the applications described in the catalogue and the technical specifications and only in combination with third party equipment recommended or approved by Siemens.

The successful and safe operation of this device is dependent on proper handling, storage, installation, operation, and maintenance.

Hazardous voltages are present in parts of this electrical equipment during operation. Severe personal injury or material damage may result if the device is not handled properly.

- The device is to be earthed to the protective-earth terminal before any other connections are made.
- Hazardous voltages may occur in all the circuit parts connected to the power supply.
- Hazardous voltages may be present in the equipment even after the power supply has been removed (capacitors may still be charged).
- Equipment with current transformer circuits must not be operated openly.
- The limit values specified in the manual or in the operating instructions must not be exceeded; this must also be observed during testing and commissioning.

Indication of conformity

CE	This product complies with the directive of the Council of the European Communities on the approximation of the laws of the member states relating to electromagnetic compatibility (EMC Council Directive 2004/108/EC) and concerning electrical equipment for use within specified voltage limits (Low Voltage Directive 2006/95/EC). This conformity has been proved by tests performed according to the Council Directives in agreement with the generic standards EN 61000-6-2 and EN 61000-6-4 (for EMC Directive) and with the standard EN 61010-1 (for Low Voltage Directive) by Siemens AG. This device was designed and produced for industrial use according to the standard EN 61000-6-4. The product conforms to the standards IEC 60688, EN 60688 or DIN EN 60688.

Contents

Preface

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Structure of the manual

The manual consists of the following sections:

- Bus-specific parameters
- Modbus functions
- Error messages
- Data type definitions
- Register map
- Technical data
- Glossary

Contents of the manual

The manual describes the functional scope, the register assignment and the hardware interface of the Modbus slave of the SICAM P Power Meter. The Modbus specification with a detailed explanation of the Modbus protocol is contained in:

- Modbus over Serial Line
  Specification & Implementation Guide
  http://www.modbus.org

- Modbus Application Protocol Specification
  http://www.modbus.org

Bus-Specific Parameters

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The following settings for serial communication between the Modbus master and the Modbus slave of the SICAM P must be defined when the device parameters are set or are required for parameterizing the Modbus master.

Slave address

The valid slave address range is 1 to 247.

Modbus transmission modes

The device supports the two serial transmission modes ASCII and RTU:

- In ASCII mode, data is transferred in the form of readable ASCII characters, error protection is ensured by an LRC.
- In the RTU mode, data is exchanged in binary format with CRC16 check.

Baud rate

The Modbus slave of the SICAM P device is usable with the following baud rates:

300 bit/s, 600 bit/s, 1200 bit/s, 2400 bit/s, 4800 bit/s, 9600 bit/s, 19200 bit/s, 38400 bit/s, 57600 bit/s and 115200 bit/s.

Parity

The parity is adjustable to:

Even, odd or none parity bit (EVEN, ODD, NONE) in ASCII mode and RTU mode.

Stop bits

Only one stop bit is used with serial communication, even if the parity is NONE in the RTU mode. This setting cannot be changed.

Note:

Modbus Plus is not supported by the Modbus slave of the SICAM P devices.

Modbus Functions

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The following Modbus functions are supported by the Modbus slave of the SICAM P device:

Table 3-1 Supported Modbus functions

Function code	Function name	Description	Broadcast supported ? [1])
3	Read Holding Registers (4X register)	Reading one or several holding registers of the Modbus slave. A maximum of 125 registers in RTU mode resp. 60 registers in ASCII mode can be read with one message. The holding registers contain indications, measurand values and metered measurands.	no
6	Write Single Register (4X register)	Writing a holding register. Function 16 is used to write several holding registers via a Modbus message.	yes
16	Write Multiple Registers (4X register)	Writing one or several holding registers. A maximum of 123 registers in RTU mode resp. 60 registers in ASCII mode can be written with one message.	yes
8	Diagnostics	Subfunction: 00 Return Query Data	no

[1]) Broadcast messages from Modbus master to all Modbus slaves using slave address 0 in the Modbus message.

Error Messages

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The Modbus slave checks the master queries for consistency in several ways and creates Modbus exception codes if errors have occurred. The following codes are created by the Modbus slave and sent to the Modbus master in an error message:

Exception Code 01 ILLEGAL_FUNCTION

The Modbus master has used a function that is not supported by the Modbus slave of the SICAM P (the supported Modbus functions are listed in chapter 3).

Exception Code 02 ILLEGAL_DATA_ADDRESS

The Modbus master has addressed a register for which no entry is provided, i.e. a register that has not been assigned.

Exception Code 03 ILLEGAL_DATA_VALUE

- The Modbus master has tried to write to a register for which only read access is permitted.
- A wrong value has been parameterized (see chapter 6.14).

Exception Code 08 NEGATIVE_ACKNOWLEDGE

The Modbus master has tried to request diagnostic data with a subfunction other than *00 Return Query Data*.

Data Type Definitions

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Data types

The following data types are used for storing variables in Modbus registers:

- Single commands / Single-point indications
- Measured value
- Metered measurand
- Time / Date

Note:

The storage of variables of more complex data types in the Modbus holding registers (i. e. variables greater than one holding register, e. g. 32-bit measurands) is processed according to the following convention:

The register which has the lower address contains the most significant byte (MSB) of the variable and the register with the higher address contains the least significant byte (LSB).

5.1 Single Command (SC) / Single-Point Indication (SP)

Range of values:

0 off

1 on

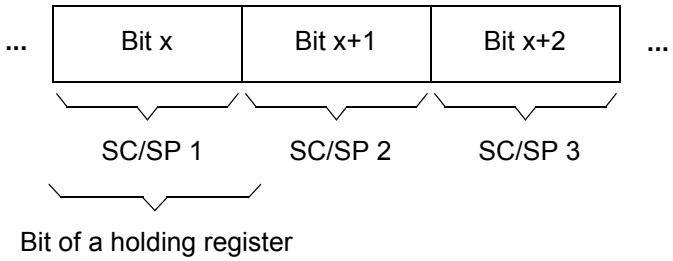

Figure 5-1 Data type: Single command / Single-point indication

5.2 Measured Values

5.2.1 Measured Value (Float)

Range of values:

$\pm 1.7 * 10^{38}$

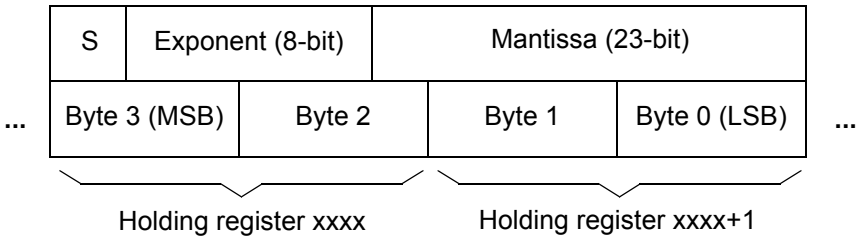

Figure 5-2 Data type: Measured value (float)

S = Sign bit

The following applies for the numerical value of the measured value:

Exponent = 0: Measured value = 0

0 < exponent < 255: Measured value = $(-1)^{<\text{Sign bit}>} * 2^{<\text{Exponent}> - 127} * 1,<\text{Mantissa}>$

Exponent = 255 and mantissa unequal 0: invalid measured value

5.2.2 Measured Value (Integer - 16-bit)

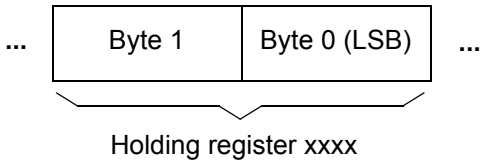

Figure 5-3 Data type: Measured value (integer)

5.2.3 Measured Value Selection and Measured Value Scaling

Register 40050 defines the transmission format of measured values.

Register	Description	Comment
40050	Selection of the measured value format	0 = Float 1 = Integer

The currently set measured value format is responded from the device to the master when reading the register 40050. When the device is delivered, the Float format has been set by default. Changes to the measured value format are saved permanently, thus the format that has been set last will be maintained even after the device has been switched off.

Every measured value is always assigned to two holding registers. For transmissions in the floating-point format, both holding registers are used and for transmissions in the integer format, only the first of the two holding registers intended for the measured value is used (see register description, chapter 6.7 to chapter 6.13).

If the measured values are transmitted in the integer format, additional information is required for their scaling, so as to enable the Modbus master to reconvert the values correctly into the floating-point format.

The table below contains these factors for the corresponding measured values.

Table 5-1 Factors for the measurement ranges

Measurement	Range	Factor	Example
Current (I), voltage (V)	0.0 to 9.9995 10.0 to 99.995 100.0 to 999.95 1000.0 to 9999.5 10000.0 to 99995.0 100000.0 to 999950.0 etc.	0.001 0.01 0.1 1 10 100 etc.	834 A * 0.001 = 0.834 A (range 1 A) 3805 V * 10 = 38.05 kV (range 30 kV)

Table 5-1 Factors for the measurement ranges (Forts.)

Measurement	Range	Factor	Example
Power (P, Q, S)	Power range = range I * range U 0.0 to 9.9995 10.0 to 99.995 etc.	 0.001 0.01 etc.	
cos, PF		0.001	986 * 0.001 = 0.986
Frequency, PHI		0.01	5001 Hz * 0.01 = 50.01 Hz 12036° * 0.01 = 120.36°
SYMU, SYMI THD		0.1	996 % * 0.1 = 99.6 %
Harmonic		0.01	1247 % * 0.01 = 12.47 %
Energy (Wpxxx, Wqxxx etc.)	Power range = range I * range U 0.0 to 9.9995 10.0 to 99.995 100.0 to 999.95 1000.0 to 9999.5 10000.0 to 99995.0 etc.	 1 10 100 1000 10000 etc.	Range I = 1000 A Range U = 2 kV 1 kA * 2 kV = 2 MW Factor = 1000000 1345 Wh * 1 M = 1345 MWh

5.3 Metered Measurand (Unsigned Long)

Range of values:

0 to +4,294,967,295

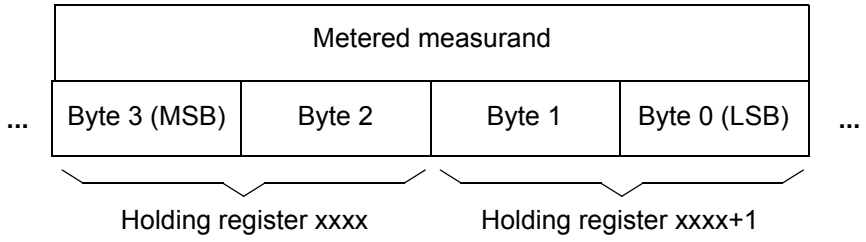

Figure 5-4 Data type: Metered measurand (unsigned long)

5.4 Time/Date

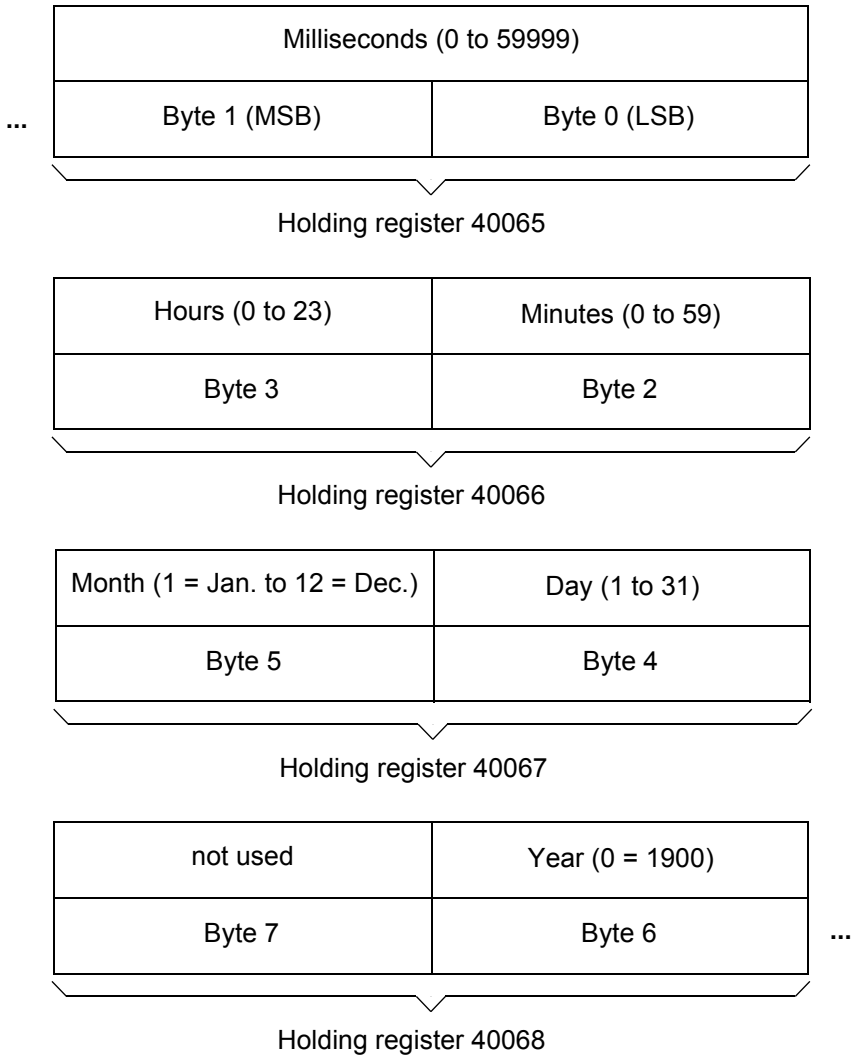

Figure 5-5 Data type: Time/Date

Register Map

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6.1 Register Addresses 40001 to 40048: System Information

Registers are write-protected. A write access is rejected with exception code 03 (ILLEGAL_DATA_VALUE).

Register address	Designation	Comments
40001 to 40016	MLFB (order number) of the SICAM P (string, max. 32 characters)	Example: String "7KG7750"
40020 to 40030	Serial number (string, max. 20 characters)	Example: String "BF0703100052"
40040 to 40042	Firmware version numbers	Example: Register 40040 = 0001H, Register 40041 = 0001H , Register 40042 = 0002H → Version 1.1.2
40045 to 40048	Date of calibration	Example: "07032001" corresponds to 2001.03.07

6.2 Register Address 40050: Measured Value Format

For explanations regarding the register *Measured Value Format,* see chapter 5.2.3.

Register address	Designation	Comments
40050	Selection of the measured value format	0 = Float 1 = Integer

6.3 Register Addresses 40065 to 40068: Time Synchronization

For explanations regarding the data type *Time/Date,* see chapter 5.4.

Time synchronization of the devices is performed after writing to the Time/Date transfer registers 40065 to 40068 with Modbus function *Write Multiple Registers* (function number 16) - Broadcast commands (slave address = 0).

Register address	Designation	Comments
40065	Milliseconds	0 ms to 59999 ms
40066	Hours / Minutes	0 h to 23 h / 0 min to 59 min
40067	Month / Day	1 = January to 12 = December / 1 to 31
40068	Year	0 = 1900

6.4 Register Address 40129: Status of Binary Outputs and Device

The binary (BO) and relay outputs (RO) that have been assigned no function during parameterization can be controlled via Modbus.

Status BO3 to BO6 can only be called in the device 7KG7610 and 7KG7660, as well as in 7KG775x (slot A only), provided these have been equipped with I/O modules (slot A, B) that have binary (BO module) or relay outputs (RO module).

Register address	Designation	Comments
40129 / 2^0	BO1	Binary output 1 (terminal G3)
40129 / 2^1	BO2	Binary output 2 (terminal G2)

Register address	Designation	Comments
	No modules	
40129 / 2^2 to 40129 / 2^5	reserved	-
	Additional modules ***1) 1 RO module***	
40129 / 2^2	BO3	Relay output 1 at RO module in slot A (terminal A1)
40129 / 2^3	BO4	Relay output 2 at RO module in slot A (terminal A2)
40129 / 2^4	BO5	Relay output 3 at RO module in slot A (terminal A3)
40129 / 2^5	reserved	-
	2) 1 BO Module in slot A	
40129 / 2^2	BO3	Binary output 1 at BO module in slot A (terminal A2)
40129 / 2^3	BO4	Binary output 2 at BO module in slot A (terminal A3)
40129 / 2^4 **40129 / 2^5**	reserved	-
	3) 1 BO Module in slot B	
40129 / 2^2 **40129 / 2^3**	reserved	-
40129 / 2^4	BO3	Binary output 1 at BO module in slot B (terminal B2)
40129 / 2^5	BO4	Binary output 2 at BO module in slot B (terminal B3)
	4) 2 BO Modules in slot A and slot B	
40129 / 2^2	BO5	Binary output 1 at BO module in slot A (terminal A2)
40129 / 2^3	BO6	Binary output 2 at BO module in slot A (terminal A3)
40129 / 2^4	BO3	Binary output 1 at BO module in slot B (terminal B2)
40129 / 2^5	BO4	Binary output 2 at BO module in slot B (terminal B3)
40129 / 2^6 to 40129 / 2^{14}	reserved	-
40129 / 2^{15}	Battery failure	0: Battery OK, 1: Battery failure

Note:

The following steps are necessary for switching binary outputs:

1. Read the register 40129.
2. Change the bit of the binary output to be switched in the value that has been read.
3. Write back the updated value to register 40129.

6.5 Register Address 40130: Status of Binary Inputs

Registers are write-protected. A write access is rejected with exception code 03 (ILLEGAL_DATA_VALUE).

Status BI_A12 to BI_D34 can only be called in the device 7KG7610 and 7KG7660, as well as in 7KG775x (slot A only), provided these have been equipped with I/O modules (slot A to D) that have binary inputs (BI module).

Register address	Designation	Comments
40130 / 2^0	BI_A12	Binary input 1 at BI module in slot A (terminals A1-A2)
40130 / 2^1	BI_A34	Binary input 2 at BI module in slot A (terminals A3-A4)
40130 / 2^2	BI_B12	Binary input 1 at BI module in slot B (terminals B1-B2)
40130 / 2^3	BI_B34	Binary input 2 at BI module in slot B (terminals B3-B4)
40130 / 2^4	BI_C12	Binary input 1 at BI module in slot C (terminals C1-C2)
40130 / 2^5	BI_C34	Binary input 2 at BI module in slot C (terminals C3-C4)
40130 / 2^6	BI_D12	Binary input 1 at BI module in slot D (terminals D1-D2)
40130 / 2^7	BI_D34	Binary input 2 at BI module in slot D (terminals D3-D4)
40130 / 2^8 to 40130 / 2^{15}	reserved	-

6.6 Register Address 40133: Commands

Register address	Designation	Comments
40133 / 2^0	Reset min/max	1 = Reset min/max values
40133 / 2^1	Reset Energy	1 = Reset energy values
40133 / 2^2	Reset Alarm	1 = Reset alarm counter
40133 / 2^3 to 40133 / 2^{15}	reserved	-

6.7 Register Address 40200: Status of Overflow at Measuring

This register is only available from device version V4.10.

When measuring current and voltage, register 40200 is used to signal a measured value overflow in each of the measuring channels concerned, if the value to be measured exceeds the maximum value (120% of the nominal value).

Registers are write-protected. A write access is rejected with exception code 03 (ILLEGAL_DATA_VALUE).

Register address	Designation	Comments
40200 / 2^0	OV-UL1	Overflow voltage L1 - N
40200 / 2^1	OV-UL2	Overflow voltage L2 - N
40200 / 2^2	OV-UL3	Overflow voltage L3 - N
40200 / 2^3	OV-IL1	Overflow current L1
40200 / 2^4	OV-IL2	Overflow current L2
40200 / 2^5	OV-IL3	Overflow current L3
40200 / 2^6 to 40200 / 2^{15}	reserved	-

6.8 Register Addresses 40201 to 40292: Measured Values

For explanations regarding the data type *Measured Value,* see chapter 5.2.

Registers are write-protected. A write access is rejected with exception code 03 (ILLEGAL_DATA_VALUE).

Register address	Designation	Comments	Unit
40201	U L1	Voltage L-N	V
40203	U L2	Voltage L-N	V
40205	U L3	Voltage L-N	V
40207	U NE	Sum of voltages L-N (calculated)	V
40209	I L1	Current	A
40211	I L2	Current	A
40213	I L3	Current	A
40215	I NE	Current	A
40217	U L12	Voltage L-L	V
40219	U L23	Voltage L-L	V
40221	U L31	Voltage L-L	V
40223	U SUM	Voltage sum	V
40225	I SUM	Current sum	A
40227	P L1	Active power	W
40229	P L2	Active power	W
40231	P L3	Active power	W
40233	P	Active power	W
40235	Q L1	Reactive power	var
40237	Q L2	Reactive power	var
40239	Q L3	Reactive power	var
40241	Q	Reactive power	var
40243	S L1	Apparent power	VA
40245	S L2	Apparent power	VA
40247	S L3	Apparent power	VA
40249	S	Apparent power	VA
40251	COS PHI L1	Active factor cos ϕ	-

Register address	Designation	Comments	Unit
40253	COS PHI L2	Active factor cos ϕ	-
40255	COS PHI L3	Active factor cos ϕ	-
40257	COS PHI	Active factor cos ϕ	-
40259	PF L1	Power factor	-
40261	PF L2	Power factor	-
40263	PF L3	Power factor	-
40265	PF	Power factor	-
40267	PHI L1	Phase angle	° (degree)
40269	PHI L2	Phase angle	° (degree)
40271	PHI L3	Phase angle	° (degree)
40273	PHI SUM	Phase angle	° (degree)
40275	f	Frequency	Hz
40277	ASYM U	Voltage unbalance	%
40279	ASYM I	Current unbalance	%
40281	THDU L1	THD voltage	%
40283	THDU L2	THD voltage	%
40285	THDU L3	THD voltage	%
40287	THDI L1	THD current	%
40289	THDI L2	THD current	%
40291	THDI L3	THD current	%

6.9 Register Addresses 40293 to 40364: Harmonic 1

For explanations regarding the data type *Measured Value,* see chapter 5.2.

Registers are write-protected. A write access is rejected with exception code 03 (ILLEGAL_DATA_VALUE).

Register address	Designation	Comments	Unit
40293	HU L1 - 5	Harmonic voltage, 5th harmonic wave	%
40295	HU L2 - 5	Harmonic voltage, 5th harmonic wave	%
40297	HU L3 - 5	Harmonic voltage, 5th harmonic wave	%
40299	HU L1 - 7	Harmonic voltage, 7th harmonic wave	%
40301	HU L2 - 7	Harmonic voltage, 7th harmonic wave	%
40303	HU L3 - 7	Harmonic voltage, 7th harmonic wave	%
40305	HU L1 - 11	Harmonic voltage, 11th harmonic wave	%
40307	HU L2 - 11	Harmonic voltage, 11th harmonic wave	%
40309	HU L3 - 11	Harmonic voltage, 11th harmonic wave	%
40311	HU L1 - 13	Harmonic voltage, 13th harmonic wave	%
40313	HU L2 - 13	Harmonic voltage, 13th harmonic wave	%
40315	HU L3 - 13	Harmonic voltage, 13th harmonic wave	%
40317	HU L1 - 17	Harmonic voltage, 17th harmonic wave	%
40319	HU L2 - 17	Harmonic voltage, 17th harmonic wave	%
40321	HU L3 - 17	Harmonic voltage, 17th harmonic wave	%
40323	HU L1 - 19	Harmonic voltage, 19th harmonic wave	%
40325	HU L2 - 19	Harmonic voltage, 19th harmonic wave	%
40327	HU L3 - 19	Harmonic voltage, 19th harmonic wave	%
40329	HI L1 - 5	Harmonic current, 5th harmonic wave	A
40331	HI L2 - 5	Harmonic current, 5th harmonic wave	A
40333	HI L3 - 5	Harmonic current, 5th harmonic wave	A
40335	HI L1 - 7	Harmonic current, 7th harmonic wave	A
40337	HI L2 - 7	Harmonic current, 7th harmonic wave	A
40339	HI L3 - 7	Harmonic current, 7th harmonic wave	A
40341	HI L1 - 11	Harmonic current, 11th harmonic wave	A
40343	HI L2 - 11	Harmonic current, 11th harmonic wave	A

Register address	Designation	Comments	Unit
40345	HI L3 - 11	Harmonic current, 11th harmonic wave	A
40347	HI L1 - 13	Harmonic current, 13th harmonic wave	A
40349	HI L2 - 13	Harmonic current, 13th harmonic wave	A
40351	HI L3 - 13	Harmonic current, 13th harmonic wave	A
40353	HI L1 - 17	Harmonic current, 17th harmonic wave	A
40355	HI L2 - 17	Harmonic current, 17th harmonic wave	A
40357	HI L3 - 17	Harmonic current, 17th harmonic wave	A
40359	HI L1 - 19	Harmonic current, 19th harmonic wave	A
40361	HI L2 - 19	Harmonic current, 19th harmonic wave	A
40363	HI L3 - 19	Harmonic current, 19th harmonic wave	A

6.10 Register Addresses 40500 to 40738: Harmonic 2

For explanations regarding the data type *Measured Value,* see chapter 5.2.

Registers are write-protected. A write access is rejected with exception code 03 (ILLEGAL_DATA_VALUE).

Register address	Designation	Comments	Unit
40500	HU L1 - 2	Harmonic voltage, 2nd harmonic wave	%
40502	HU L2 - 2	Harmonic voltage, 2nd harmonic wave	%
40504	HU L3 - 2	Harmonic voltage, 2nd harmonic wave	%
40506	HU L1 - 3	Harmonic voltage, 3rd harmonic wave	%
40508	HU L2 - 3	Harmonic voltage, 3rd harmonic wave	%
40510	HU L3 - 3	Harmonic voltage, 3rd harmonic wave	%
40512 to 40612	HU Lx - 4 to HU Lx- 20	Harmonic voltage, 4th to 20th harmonic wave	%
40614	HU L1 - 21	Harmonic voltage, 21th harmonic wave	%
40616	HU L2 - 21	Harmonic voltage, 21th harmonic wave	%
40618	HU L3 - 21	Harmonic voltage, 21th harmonic wave	%
40620	HI L1 - 2	Harmonic current, 2nd harmonic wave	%
40622	HI L2 - 2	Harmonic current, 2nd harmonic wave	%
40624	HI L3 - 2	Harmonic current, 2nd harmonic wave	%
40626	HI L1 - 3	Harmonic current, 3rd harmonic wave	%
40628	HI L2 - 3	Harmonic current, 3rd harmonic wave	%
40630	HI L3 - 3	Harmonic current, 3rd harmonic wave	%
40632 to 40732	HI Lx - 4 to HI Lx - 20	Harmonic current, 4th to 20th harmonic wave	%
40734	HI L1 - 21	Harmonic current, 21th harmonic wave	%
40736	HI L2 - 21	Harmonic current, 21th harmonic wave	%
40738	HI L3 - 21	Harmonic current, 21th harmonic wave	%

6.11 Register Addresses 40801 to 40858: Energy Values

For explanations regarding the data type *Measured Value,* see chapter 5.2.

Registers are write-protected. A write access is rejectedcapacitive with exception code 03 (ILLEGAL_DATA_VALUE).

Register address	Designation	Comments	Unit
40801	WpL1d	Active energy L1 demand	Wh
40803	WpL2d	Active energy L2 demand	Wh
40805	WpL3d	Active energy L3 demand	Wh
40807	WpΣd	Active energy Σ demand	Wh
40809	WpL1s	Active energy L1 supply	Wh
40811	WpL2s	Active energy L2 supply	Wh
40813	WpL3s	Active energy L3 supply	Wh
40815	WpΣs	Active energy Σ supply	Wh
40817	WpL1t	Active energy L1 total	Wh
40819	WpL2t	Active energy L2 total	Wh
40821	WpL3t	Active energy L3 total	Wh
40823	WpΣt	Active energy Σ total	Wh
40825	WqL1t	Reactive energy total L1	varh
40827	WqL2t	Reactive energy total L2	varh
40829	WqL3t	Reactive energy total L3	varh
40831	WqΣt	Reactive energy total Σ	varh
40833	WqL1i	Reactive energy L1 inductive	varh
40835	WqL2i	Reactive energy L2 inductive	varh
40837	WqL3i	Reactive energy L3 inductive	varh
40839	WqΣi	Reactive energy Σ inductive	varh
40841	WqL1c	Reactive energy L1 capacitve	varh
40843	WqL2c	Reactive energy L2 capacitve	varh
40845	WqL3c	Reactive energy L3 capacitve	varh
40847	WqΣc	Reactive energy Σ capacitve	varh
40849	WL1	Apparent energy L1	VAh
40851	WL2	Apparent energy L2	VAh
40853	WL3	Apparent energy L3	VAh
40855	WΣ	Apparent energy Σ	VAh
40857	Wpnet	Active energy (3L) demand net	Wh

6.12 Register Addresses 40901 to 40908: Counter of Limit Values (Alarm Counter)

For explanations regarding the data type *Metered Measurand,* see chapter 5.3.

Registers are write-protected. A write access is rejected with exception code 03 (ILLEGAL_DATA_VALUE).

Register address	Designation	Comments	Unit
40901	CT1	Counter 1 – Limit value 1	-
40903	CT2	Counter 2 – Limit value 2	-
40905	CT3	Counter 3 – Limit value 3	-
40907	CT4	Counter 4 – Limit value 4	-

6.13 Register Addresses 40951 to 40982: Analog Inputs and Outputs

For explanations regarding the data type *Measured Value,* see chapter 5.2.

Registers 40951 to 40966 and 40971 to 40982 are write-protected. A write access is rejected with exception code 03 (ILLEGAL_DATA_VALUE).

Registers AI_A12 to AI_D34 can only be called in the devices 7KG7610 and 7KG7660, as well as in 7KG775x (slot A only), provided these have been equipped with I/O modules (slotA to D) that have analog inputs (AI module).

Registers 40967 to 40970 (AO_A12 and AO_A34) can only be called in the devices in 7KG775x, provided these have been equipped with Analog Outputs (AO module) in slot A. This registers can be written and read.

Register address	Designation	Comments	Unit
40951	AI_A12	Analog input 1 at AI module in slot A (terminals A1-A2)	mA
40953	AI_A34	Analog input 2 at AI module in slot A (terminals A3-A4)	mA
40955	AI_B12	Analog input 1 at AI module in slot B (terminals B1-B2)	mA
40957	AI_B34	Analog input 2 at AI module in slot B (terminals B3-B4)	mA
40959	AI_C12	Analog input 1 at AI module in slot C (terminals C1-C2)	mA

Register address	Designation	Comments	Unit
40961	AI_C34	Analog input 2 at AI module in slot C (terminals C3-C4)	mA
40963	AI_D12	Analog input 1 at AI module in slot D (terminals D1-D2)	mA
40965	AI_D34	Analog input 2 at AI module in slot D (terminals D3-D4)	mA
40967	AO_A12	Analog output 1 at AO module in slot A (terminals A1-A2)	mA
40969	AO_A34	Analog output 2 at AO module in slot A (terminals A3-A4)	mA
40971	AO_B12	Analog output 1 at AO module in slot B (terminals B1-B2)	mA
40973	AO_B34	Analog output 2 at AO module in slot B (terminals B3-B4)	mA
40975	AO_C12	Analog output 1 at AO module in slot C (terminals C1-C2)	mA
40977	AO_C34	Analog output 2 at AO module in slot C (terminals C3-C4)	mA
40979	AO_D12	Analog output 1 at AO module in slot D (terminals D1-D2)	mA
40981	AO_D34	Analog output 2 at AO module in slot D (terminals D3-D4)	mA

6.14 Register Addresses 41000 to 41209: Parameterization for Limit Value Groups

These registers are only available from device version V4.10.

If the parameterized values are invalid (see chapter 6.14.4, Valid Range of Values), write access will be rejected with exception code 03 (ILLEGAL_DATA_VALUE).

6.14.1 Addressing for Limit Value Groups

Up to seven limit value groups (LVG) can be parameterized:

Limit value group	Start address	End address
No. 1	41000	41029
No. 2	41030	41059
No. 3	41060	41089
No. 4	41090	41119
No. 5	41120	41149
No. 6	41150	41179
No. 7	41180	41209

With the exception of limit value group no. 7, it can be monitored for up to six measured quantities (except for power values), whether the measured value is exceeded or not reached in each of the limit value groups no. 1 to no. 6:

- Voltage, current
- Active power, reactive power, apparent power
- Active factor, power factor
- Phase angle, frequency
- Unbalance voltage, unbalance current
- THD U, THD I
- Harmonic wave voltage, harmonic wave current
- I/O channel (when AI module is in slot A)

In limit value group no. 7, only voltage quantities can be parameterized.

If several measured quantities are monitored within a limit value group, these must be ANDed or ORed during parameterization.

Note:

Limit value violations are recorded reliably only from a duration of ≥ 1 second.

6.14.2 Limit Value Group No. 1

Register address	Designation	Comments
41000	Limit value group No. 1	1: Limit value group No. 1 (read only)
41001	Condition 1: test point (lower byte)	0: no; 1: L1; 2: L2; 3: L3; 4: NE; 5: L12; 6: L23; 7: L31; 8: SUM; 9 to 14: L1-5 to L1-19; 15 to 20: L2-5 to L2-19; 21 to 26: L3-5 to L3-19 27, 28: A1, A2 (analog input)
	Condition 1: measuring (higher byte)	1: U; 2: I; 3: P; 4: Q; 5: S; 6: COS PHI; 7: PF; 8: PHI; 9: f; 10: SYM U; 11: SYM I; 12: THDU; 13: THDI; 14: HU;15: HI 16: I/O channel Measurands see table in chapter 6.14.4
41002	Condition 1: connection (lower byte)	0: no other connection; 1: AND (*); 2: OR (+)
	Condition 1: comparison (higher byte)	1: less (<) 2: greater (>)
41003 / 41004	Condition 1: value	Setup data see table in chapter 6.14.4; data type *Measured Value*, see chapter 5.2
41005 to 41024	Condition 2 to condition 6	The structure of the registers is always identical to that of registers 41001 to 41004.
41025 / 41026	Filter time	Setup data; filter time 1.0 s to 9.9 s data type *Measured Value*, see chapter 5.2
41027 / 41028	Hysteresis	Setup data; hysteresis 0.1 to10 data type *Measured Value*, see chapter 5.2

Register address	Designation	Comments
41029 [1)]	Activation flag	0: The limit value group parameters were not changed or activated; (read only). 1: The parameters were changed, either in part or completely, however, they were not activated; (read only). 2: The parameters were changed, either in part or completely, and activated; (read and write). 3: Reset; changes that have been entered but not activated yet are deleted, and the initial status of the register is restored. The activation flag is set to 0, as soon as the command from the Modbus master is received; (write only).

[1)] A limit value group can be changed either in part or completely. Writing or reading the **activation flag register 41029** indicates whether the parameter of the limit value group has been changed or activated.

6.14.3 Limit Value Groups No. 2 to No. 7

The register structure of limit value groups no. 2 to no. 7 is identical to that of limit value group no. 1, see chapter 6.14.2. The table below shows the identical registers of the limit value groups:

LVG 1	LVG 2	LVG 3	LVG 4	LVG 5	LVG 6	LVG 7	Comment
41000	41030	41060	41090	41120	41150	41180	Start address for LVG
41001	41031	41061	41091	41121	41151	41181	Condition 1: test point and measuring
41002	41032	41062	41092	41122	41152	41182	Condition 1: connection and comparison
41003 / 41004	41033 / 41034	41063 / 41064	41093 / 41094	41123 / 41124	41153 / 41154	41183 / 41184	Condition 1: value
41005 to 41024	41035 to 41054	41065 to 41084	41095 to 41114	41125 to 41144	41155 to 41174	41185 to 41204	Conditions 2 to 6
41025 / 41026	41055 / 41056	41085 / 41086	41115 / 41116	41145 / 41146	41175 / 41176	41205 / 41206	Filter time
41027 / 41028	41057 / 41058	41087 / 41088	41117 / 41118	41147 / 41148	41177 / 41178	41207 / 41208	Hysteresis
41029	41059	41089	41119	41149	41179	41209	Activation flag

Examples

Output quantities:

Voltage measurement range: AC 480 V

Nominal voltage: AC 230 V ±10 %

Example for limit value group 1: Overvoltage

U_{L1} > AC 253 V OR U_{L2} > AC 253 V OR U_{L3} > AC 253 V; 10 % overvoltage

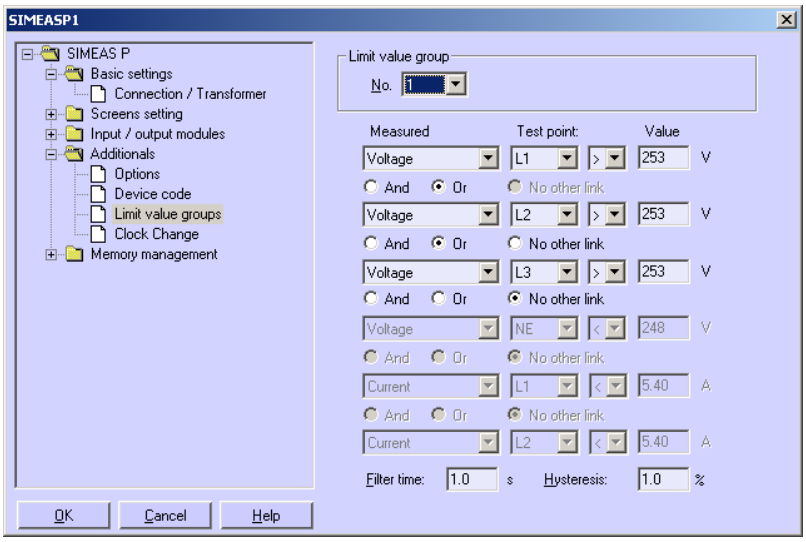

Figure 6-1 Parameter with SICAM P PAR

Parameter via Modbus:

Register address	Register entry	Comment
41000	1	Limit violation group 1
41001	257 = 101H	U L1
41002	514 = 202H	> OR
41003	253 (float) *1)	AC 253 V
41004		
41005	258 = 102H	U L2
41006	514 = 202H	> OR
41007	253 (float) *1)	AC 253 V
41008		
41009	259 = 103H	U L3
41010	512 = 200H	>
41011	253 (float) *1)	AC 253 V
41012		

*1) The value format depends on register 40050 (see chapter 6.2)

to activate: 41029 = 2

Example for limit value group 2: Undervoltage

U_{L1} < AC 207 V OR U_{L2} < AC 207 V OR U_{L3} < AC 207 V; 10 % undervoltage

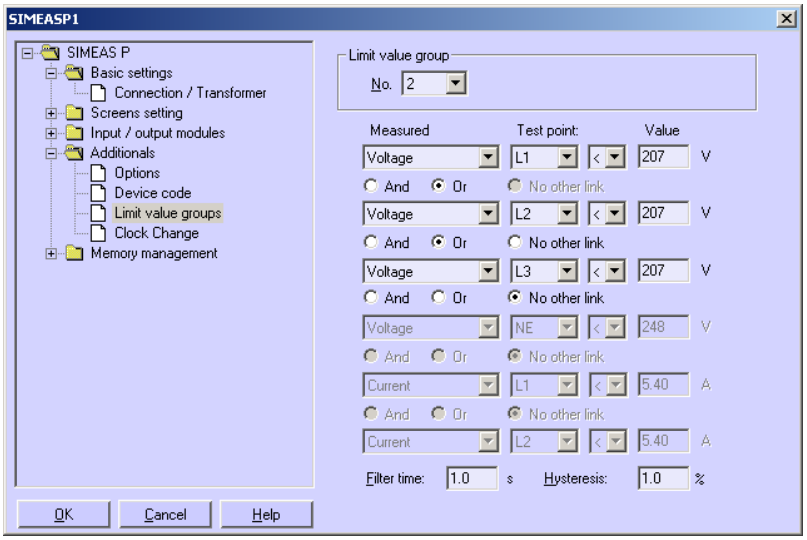

Figure 6-2 Parameter with SICAM P PAR

Parameter via Modbus

Register address	Register entry	Comment
41030	2	Limit violation group 2
41031	257 = 101H	U L1
41032	258 = 102H	< OR
41033	207 (float) *1	AC 207 V
41034		
41035	258 = 102H	U L2
41036	258 = 102H	< OR
41037	207 (float) *1	AC 207 V
41038		
41039	259 = 103H	U L3
41040	256 = 100H	<
41041	207 (float) *1	AC 207 V
41042		

*1) The value format depends on register 40050 (see chapter 6.2)

to activate: 41029 = 2

6.14.4 Valid Range of Values

The table below contains the valid range of values that can be parameterized.

Measureand	Designation	Valid Range of Values
U_{L1-N}	Voltage L1-N	The following applies for the use and parameterization of an external voltage transformer: 0 to 1.2 * $U_{L-N\ (nom)}$ * U_{prim} / U_{sec} The following applies if no external voltage transformer is used / parameterized: U_{prim}= U_{sec}
U_{L2-N}	Voltage L2-N	
U_{L3-N}	Voltage L3-N	
U_{L12}	Voltage L1-L2	0 to 1.2 * $U_{L-L\ (nom)}$ * U_{prim} / U_{sec}
U_{L23}	Voltage L2-L3	
U_{L31}	Voltage L3-L1	
U_{sum}	Voltage sum	0 to 1.2 * $U_{L-N\ (nom)}$ * U_{prim} / U_{sec}
I_{L1}	Current in L1	The following applies for the use and parameterization of an external current transformer: -1.2 * I_{nom} * I_{prim} / I_{sec} to +1.2 * I_{nom} * I_{prim} / I_{sec} The following applies if no external current transformer is used / parameterized: I_{prim}= I_{sec}
I_{L2}	Current in L2	
I_{L3}	Current in L3	
I30	Current in neutral conductor	
P_{L1}	Active power	-1.2 * $U_{L-N(nom)}$ * 1.2 I_{nom} * U_{prim} / U_{sec} * I_{prim} / I_{sec} to +1.2 * $U_{L-N(nom)}$ * 1.2 I_{nom} * U_{prim} / U_{sec} * I_{prim} / I_{sec}
P_{L2}		
P_{L3}		
P	Active power	-1.2 * 3 * $U_{L-N(nom)}$ * 1.2 I_{nom} * U_{prim} / U_{sec} * I_{prim} / I_{sec} to +1.2 * 3 * $U_{L-N(nom)}$ * 1.2 I_{nom} * U_{prim} / U_{sec} * I_{prim} / I_{sec}
Q_{L1}	Reactive power	-1.2 * $U_{L-N(nom)}$ * 1.2 I_{nom} * U_{prim} / U_{sec} * I_{prim} / I_{sec} to +1.2 * $U_{L-N(nom)}$ * 1.2 I_{nom} * U_{prim} / U_{sec} * I_{prim} / I_{sec}
Q_{L2}		
Q_{L3}		
Q	Reactive power	-1.2 * 3 * $U_{L-N(nom)}$ * 1.2 I_{nom} * U_{prim} / U_{sec} * I_{prim} / I_{sec} to +1.2 * 3 * $U_{L-N(nom)}$ * 1.2 I_{nom} * U_{prim} / U_{sec} * I_{prim} / I_{sec}
S_{L1}	Apparent power	-1.2 * $U_{L-N(nom)}$ * 1.2 I_{nom} * U_{prim} / U_{sec} * I_{prim} / I_{sec} to +1.2 * $U_{L-N(nom)}$ * 1.2 I_{nom} * U_{prim} / U_{sec} * I_{prim} / I_{sec}
S_{L2}		
S_{L3}		
S	Apparent power	-1.2 * 3 * $U_{L-N(nom)}$ * 1.2 I_{nom} * U_{prim} / U_{sec} * I_{prim} / I_{sec} to +1.2 * 3 * $U_{L-N(nom)}$ * 1.2 I_{nom} * U_{prim} / U_{sec} * I_{prim} / I_{sec}

Measureand	Designation	Valid Range of Values
COS PHI L1	Active factor cos ϕ	-1.000 to +1.000
COS PHI L2		
COS PHI L3		
COS PHI		
PF L1	Power factor	-1.000 to +1.000
PF L2		
PF L3		
PF		
PHI L1	Phase angle	-180° to +180°
PHI L2		
PHI L3		
PHI SUM		
f	Frequency	45 Hz to 65 Hz
ASYM U	Voltage unbalance	0.000 % to 100.000 %
ASYM I	Current unbalance	
THDU L1-N	THD voltage	0.000 % to 100.000 %
THDU L2-N		
THDU L3-N		
THDI L1	THD current	0.000 % to 100.000 %
THDI L2		
THDI L3		
HU_{L1-N}	Harmonic voltage; 3., 5., 7., 11., 13., 17. and 19. harmonic wave	0.000 % to 100.000 %
HU_{L2-N}		
HU_{L3-N}		
HI_{L1}	Harmonic current; 3., 5., 7., 11., 13., 17. and 19. harmonic wave	0.000 % to 100.000 %
HI_{L2}		
HI_{L3}		
AI1, 2	Analog input 1, 2	-999999.000 to +999999.000

6.15 Register Address 41210: Direction of Current and Power

This register is only available from device version V4.10.

Register address	Designation	Comment
41210 / 2^0	Direction of current[1)]	0: Invers (-), 1: Standard (+)
41210 / 2^1	Direction of power[2)]	0: Generator (-), 1: Load (+)
41210 / 2^2 to 41210 / 2^{15}	reserved	-

Notes:

1) If the polarity was inverted during connection of the current lines, the changeover can be made using the software without having to remove the lines from the device.

2) The parameter defines whether the device functions as a consumer or a generator:

Load (Standard)

- Power positive = power demand
- Power negative = power supply

Generator

- Power negative = power demand
- Power positive = power supply

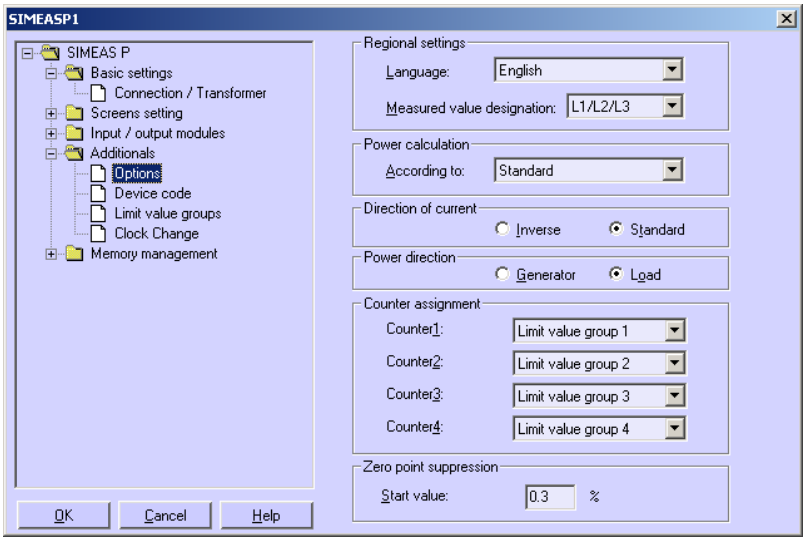

Figure 6-3 Equivalent Settings in SICAM P PAR

Technical Data

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Modbus slave for the SICAM P devices

Modbus slave	
Slave addresses	1 to 247
Modbus modes	RTU, ASCII
Modbus functions	Read holding registers
	Write single register
	Write multiple registers
Data transmission	
Baud rates	300 bit/s, 600 bit/s, 1200 bit/s, 2400 bit/s, 4800 bit/s, 9600 bit/s, 19200 bit/s, 38400 bit/s, 57600 bit/s, 115200 bit/s
Parity bit	RTU mode: NONE, EVEN, ODD
	ASCII mode: EVEN, ODD

Hardware interface - technical data of connector

Connections	9-pin D-SUB socket with signals A, B, RTS, VCC and GND
Protocol	semi-duplex
Max. line length	1000 m / 3300 ft
Isolation level	AC 500 V
Bus termination	terminating resistors:
	221 Ω between A and B
	392 Ω between A and VCC as well as B and GND
	Input resistor without terminating resistor: ≥ 10 kΩ, bus termination using bus connectors with integrated terminating resistors
Transmission level	Low: $-5\ V \leq U_{A-B} \leq -1.5\ V$
	High: $+5\ V \geq U_{A-B} \geq +1.5\ V$
Receive level	Low: $U_{A-B} \leq -0.2\ V$
	High: $U_{A-B} \geq +0.2\ V$
	Transmitter and receiver are surge-proof for voltages between A and GND as well as B and GND in the range of DC -7 V to DC +12 V.
Max. numbers of modules at the bus	32 (if the SICAM P is used on the bus only). Depending on the Modbus master and other bus modules used, this value may be lower. If more than 32 bus modules are required, repeaters with bit retiming must be used.

Hardware interface - Assignment of the bus connection at the device (D-SUB outlet)

Table 7-1 Bus connection at the device (D-SUB outlet)

Pin	RS485 Signal	Remark
1	Shield	Shield / operational ground
2	-	-
3	A	RS485-connection pin A
4	RTS	Directions control RTS (TTL level)
5	GND	Ground to VCC
6	VCC	Supply voltage DC +5 V (max. 100 mA)
7	-	-
8	B	RS485 connection pin B
9	-	-

Bus termination

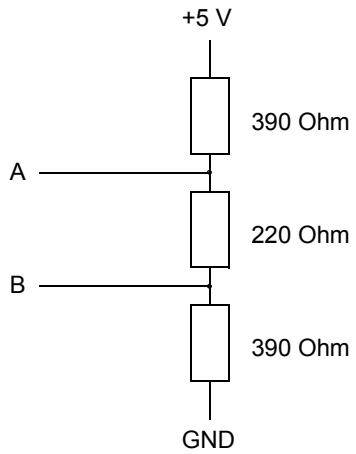

Figure 7-1 Recommended external termination circuit with open-line fail-safe

Glossary

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AI	Analog input
AO	Analog output
BI	Binary input
BO	Binary output
CRC	Cyclic Redundancy Check
Input data / Input direction	Data from Modbus slave to Modbus master
LRC	Longitudinal Redundancy Check
LSB	Least Significant Byte
MSB	Most Significant Byte
Output data / Output direction	Data from Modbus master to Modbus slave
RO	Relay output
RTU	Remote Terminal Unit
SC	Single command
SP	Single-point indication
THD	Total Harmonic Distortion