



SIPROTEC 5 Fault Recorder 7KE85

V6.00 and higher

Technical Data

Extract from manual C53000-G5040-C018-3, chapter 11

Energy Automation

SIEMENS

**NOTE**

For your own safety, observe the warnings and safety instructions contained in this document, if available.

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Document version: C53000-G5040-C018-3.00

Edition: 11.2014

Version of the product described: V06.00

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Preface

Purpose of the Manual

This manual describes the functions of the fault recorder 7KE85.

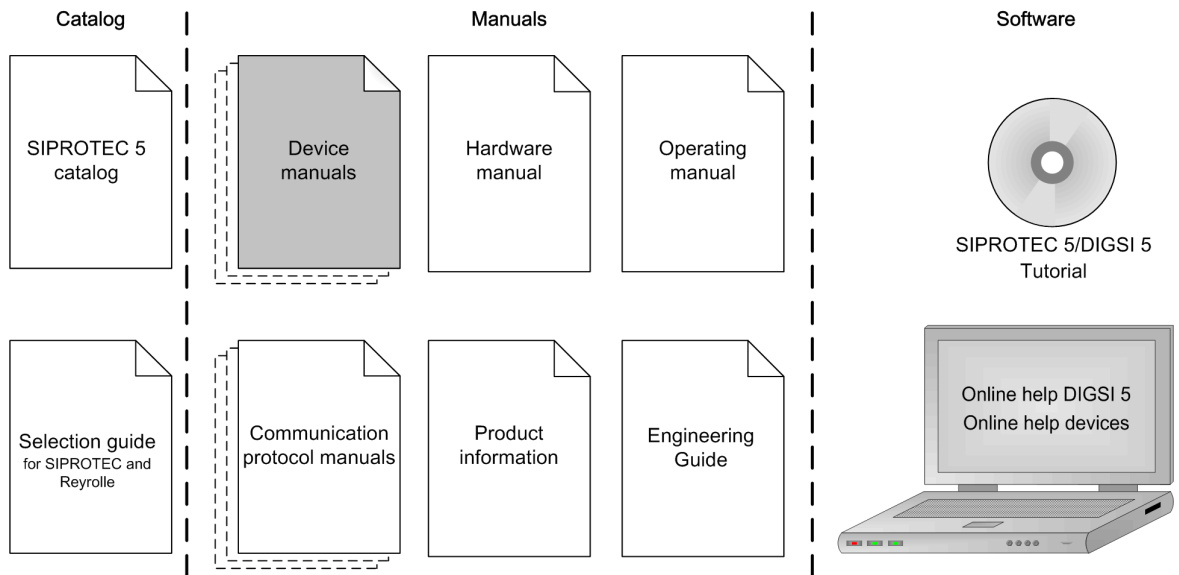
Target Audience

System configurers, commissioning engineers, and persons entrusted with the setting, testing and maintenance of fault recorder equipment, and operational crew in electrical installations and power plants.

Scope

This manual applies to the SIPROTEC 5 device family.

Further Documentation



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- **Device manuals**
Each Device manual describes the functions and applications of a specific SIPROTEC 5 device. The printed manual and the online help for the device have the same informational structure.
- **Hardware manual**
The Hardware manual describes the hardware building blocks and device combinations of the SIPROTEC 5 device family.
- **Operating manual**
The Operating manual describes the basic principles and procedures for operating and assembling the devices of the SIPROTEC 5 range.

- **Communication protocol manuals**
The Communication protocol manuals contain a description of a specific protocol for communication within the SIPROTEC 5 device family and to higher-level network control centers.
- **Product information**
The Product information includes general information about device installation, technical data, limiting values for input and output modules, and conditions when preparing for operation. This document is provided with each SIPROTEC 5 device.
- **Engineering Guide**
The Engineering Guide describes the essential steps when engineering with DIGSI 5. In addition, the Engineering Guide shows you how to load a planned configuration to a SIPROTEC 5 device and update the functionality of the SIPROTEC 5 device.
- **DIGSI 5 online help**
The DIGSI 5 online help contains a help package for DIGSI 5 and CFC.
The help package for DIGSI 5 includes a description of the basic operation of software, the DIGSI principles and editors. The help package for CFC includes an introduction to CFC programming, basic examples of working with CFC, and a reference chapter with all the CFC blocks available for the SIPROTEC 5 range.
- **SIPROTEC 5/DIGSI 5 Tutorial**
The tutorial on the DVD contains brief information about important product features, more detailed information about the individual technical areas, as well as operating sequences with tasks based on practical operation and a brief explanation.
- **SIPROTEC 5 catalog**
The SIPROTEC 5 catalog describes the system features and the devices of SIPROTEC 5.
- **Selection guide for SIPROTEC and Reyrolle**
The selection guide offers an overview of the device series of the Siemens protection devices, and a device selection table.

Indication of Conformity



This product complies with the directive of the Council of the European Communities on harmonization 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 Directive in accordance with the generic standards EN 61000-6-2 and EN 61000-6-4 (for EMC directive) and with the standard EN 60255-27 (for Low Voltage Directive) by Siemens AG.

The device is designed and manufactured for application in an industrial environment.

The product conforms with the international standards of IEC 60255 and the German standard VDE 0435.

Other Standards

IEEE Std C 37.90

The technical data of the product is approved in accordance with UL.

For more information about the UL database, see www.ul.com

Select **Online Certifications Directory** and enter **E194016** as **UL File Number**.



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Additional Support

For questions about the system, please contact your Siemens sales partner.

Support

Our Customer Support Center provides a 24-hour service.

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Notes on Safety

This document is not a complete index of all safety measures required for operation of the equipment (module or device). However, it comprises important information that must be followed for personal safety, as well as to avoid material damage. Information is highlighted and illustrated as follows according to the degree of danger:



DANGER

DANGER means that death or severe injury **will** result if the measures specified are not taken.

- ◇ Comply with all instructions, in order to avoid death or severe injuries.



WARNING

WARNING means that death or severe injury **may** result if the measures specified are not taken.

- ◇ Comply with all instructions, in order to avoid death or severe injuries.



CAUTION

CAUTION means that medium-severe or slight injuries **can** occur if the specified measures are not taken.

- ◇ Comply with all instructions, in order to avoid moderate or minor injuries.
-

NOTICE

NOTICE means that property damage **can** result if the measures specified are not taken.

- ◇ Comply with all instructions, in order to avoid property damage.
-



NOTE

Important information about the product, product handling or a certain section of the documentation which must be given particular attention.

Qualified Electrical Engineering Personnel

Only qualified electrical engineering personnel may commission and operate the equipment (module, device) described in this document. Qualified electrical engineering personnel in the sense of this manual are people who can demonstrate technical qualifications as electrical technicians. These persons may commission, isolate, ground and label devices, systems and circuits according to the standards of safety engineering.

Proper Use

The equipment (device, module) may be used only for such applications as set out in the catalogs and the technical description, and only in combination with third-party equipment recommended and approved by Siemens.

Problem-free and safe operation of the product depends on the following:

- Proper transport
- Proper storage, setup and installation
- Proper operation and maintenance

When electrical equipment is operated, hazardous voltages are inevitably present in certain parts. If proper action is not taken, death, severe injury or property damage can result:

- The equipment must be grounded at the grounding terminal before any connections are made.
- All circuit components connected to the power supply may be subject to dangerous voltage.
- Hazardous voltages may be present in equipment even after the supply voltage has been disconnected (capacitors can still be charged).
- Operation of equipment with exposed current-transformer circuits is prohibited. Before disconnecting the equipment, ensure that the current-transformer circuits are short-circuited.
- The limiting values stated in the document must not be exceeded. This must also be considered during testing and commissioning.

11 Technical Data

| | | |
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11.1 General Device Data

11.1.1 Supply Voltage

| Integrated Power Supply | | | |
|--|--|---|---|
| For modular devices, the following printed circuit-board assemblies have a power supply: PS201 – Power supply of the base module and of the 1st device row PS203 – Voltage supply of 2nd device row CB202 – Plug in module assembly with integrated power supply, for example, to accommodate communication modules | | | |
| Permissible voltage ranges (PS201, PS203, CB202) | DC 19 V to DC 60 V | DC 48 V to DC 300 V AC 80 V to AC 265 V | |
| Auxiliary rated voltage V_H (PS201, PS203, CB202) | DC 24 V/DC 48 V | DC 60 V/DC 110 V/DC 125 V/DC 220 V/ DC 250 V or AC 100 V/AC 115 V/AC 230 V, 50 Hz/60 Hz | |
| Permissible voltage ranges (PS101) | DC 19 V to DC 60 V | DC 48 V to 150 V | DC 88 V to DC 300 V AC 80 V to AC 265 V |
| Auxiliary rated voltage V_H (PS101) | DC 24 V/DC 48 V | DC 60 V/DC 110 V/ DC 125 V | DC 110 V/ DC 125 V/ DC 220 V/DC 250 V or AC 100 V/AC 115 V/ AC 230 V, 50 Hz/60 Hz |
| Superimposed alternating voltage, peak-to-peak, IEC 60255-11 | $\leq 15\%$ of the DC auxiliary rated voltage (applies only to direct voltage) | | |
| Inrush current | ≤ 18 A | | |
| Recommended external protection | Miniature circuit breaker 6 A, characteristic C according to IEC 60898 | | |
| Internal fuse | | | |
| – | DC 24 V to DC 48 V | DC 60 V to DC 125 V | DC 24 V to DC 48 V AC 100 V to AC 230 V |
| PS101 | 4 A inert, AC 250 V, DC 150 V, UL recognized SIBA type 179200 or Schurter type SPT 5x20 | 2 A time-lag, AC 250 V, DC 300 V, UL recognized SIBA type 179200 or Schurter type SPT 5x20 | |
| PS201, PS203, CB202 | 2 A time-lag, AC 250 V, DC 300 V, UL recognized SIBA type 179200 or Schurter type SPT 5x20 | | |
| Power consumption (life relay active) | | | |
| – | DC | AC 230 V/50 Hz | AC 115 V/50 Hz |
| 1/3 base module, non-modular Without plug-in modules | 7.0 W | 16 VA | 12.5 VA |
| 1/3 base module, modular Without plug-in modules | 13 W | 33 VA | 24 VA |
| 1/6 expansion module | 3 W | 6 VA | 6 VA |
| 1/6 plug-in module assembly without plug-in modules (modules CB202) | 3.5 W | 14 VA | 7 VA |

| Integrated Power Supply | | | |
|---|--|--------|--------|
| Plug-in module for base module or plug-in module assembly (for example, communication module) | < 5 W | < 6 VA | < 6 VA |
| Stored-energy time for auxiliary voltage outage or short circuit, modular devices | For V ≥ DC 24 V ≥ 50 ms For V ≥ DC 110 V ≥ 50 ms For V ≥ AC 115 V ≥ 50 ms | | |
| Stored-energy time for auxiliary voltage outage or short circuit, non-modular devices | For V ≥ DC 24 V ≥ 20 ms For V ≥ DC 60 V/DC 110 V ≥ 50 ms For V ≥ AC 115 V ≥ 200 ms | | |

11.1.2 Binary Inputs

| | | | |
|---|--|--|--|
| Rated voltage range | DC 24 V to 250 V (bipolar) | | |
| Current consumption, excited | Approx. DC 0.6 mA to 1.8 mA (independent of the operating voltage) | | |
| Pickup time | Approx. 3 ms | | |
| Dropout time | Approx. 4 ms | | |
| Switching thresholds | Adjustable with DIGSI 5 | | |
| | Range 1 for 24 V, 48 V, and 60 V Operating voltage | $V_{low} \leq DC 10 V$ $V_{high} \geq DC 19 V$ | |
| | Range 2 for 110 V and 125 V Operating voltage | $V_{low} \leq DC 44 V$ $V_{high} \geq DC 88 V$ | |
| | Range 3 for 220 V and 250 V Operating voltage | $V_{low} \leq DC 88 V$ $V_{high} \geq DC 176 V$ | |
| Maximum permitted voltage | DC 300 V | | |
| The binary inputs contain interference suppression capacitors. In order to ensure EMC, use the terminals shown in the terminal diagrams/connection diagrams to connect the binary inputs to the common potential. | | | |

11.1.3 Relay Outputs

Standard Relay (Type S)

| | |
|--|--|
| Switching capacity | On: 1000 W/VA Off: 30 VA; 40 W ohmic; 30 W/VA at L/R ≤ 40 ms |
| AC and DC contact voltage | 250 V |
| Permissible current per contact (continuous) | 5 A |
| Permissible current per contact (switching on and holding) | 30 A for 1 s (make contact) |
| Short-time current across closed contact | 250 A for 30 ms |
| Total permissible current for contacts connected to common potential | 5 A |
| Switching time OOT (Output Operating Time) Additional delay of the output medium used | ≤ 10 ms |

| | |
|--|---|
| Max. rated data of the output contacts in accordance with UL certification | 5 A continuous current AC 250 V, 5 A, General Purpose DC 250 V, 5 A (make), 0.1 A (break) AC 120 V, 1/3 hp AC 250 V, 1/2 hp B300 R300 |
| Interference suppression capacitors across the contacts | 4.7 nF, $\pm 20\%$, AC 250 V |

Fast Relay (Type F)

| | |
|--|--|
| Switching capacity | On: 1000 W/VA Off: 30 VA; 40 W ohmic; 30 W/VA at L/R ≤ 40 ms |
| AC and DC contact voltage | 250 V |
| Permissible current per contact (continuous) | 5 A |
| Permissible current per contact (switching on and holding) | 30 A for 1 s (make contact) |
| Short-time current across closed contact | 250 A for 30 ms |
| Total permissible current for contacts connected to common potential | 5 A |
| Switching time OOT (Output Operating Time) Additional delay of the output medium used | Closing time, typical: 4 ms Opening time, typical: 2 ms Maximum: ≤ 5 ms |
| Rated data of the output contacts in accordance with UL certification | AC 120 V, 8.5 A, General Purpose AC 277 V, 6 A, General Purpose AC 277 V, 0.7 hp AC 347 V, 4.5 A, General Purpose B300 R300 |
| Interference suppression capacitors across the contacts | 4.7 nF, $\pm 20\%$, AC 250 V |
| Supervision | 2-channel activation with cyclic testing (only for make contact) |

High-Speed Relay with Semiconductor Acceleration (Type HS)

| | |
|--|-----------------------------|
| Switching capacity | On/Off: 1000 W/VA |
| Contact voltage | AC 200 V, DC 250 V |
| Permissible current per contact (continuous) | 5 A |
| Permissible current per contact (switching on and holding) | 30 A for 1 s (make contact) |
| Short-time current across closed contact | 250 A for 30 ms |
| Total permissible current for contacts connected to common potential | 5 A |
| Switching time OOT (Output Operating Time) Additional delay of the output medium used | ≤ 1 ms |
| Rated data of the output contacts in accordance with UL certification | B150 Q300 |

Power Relay (for Direct Control of Motor Switches)

| | | |
|--|--------|--|
| Switching capacity for permanent or periodic operation | | |
| 250 V/4.0 A | 1000 W | To avoid damage, an external protection circuit must shut down the motor in case of a blocked rotor. |
| 220 V/4.5 A | 1000 W | |
| 110 V/5.0 A | 550 W | |
| 60 V/5.0 A | 300 W | |
| 48 V/5.0 A | 240 W | |
| 24 V/5.0 A | 120 W | |
| Switching on switching power for 30 s, recovery time until switching on again: 15 minutes. For shorter switching operations, consider a pulse-break ratio of 3 %. | | |
| 110 V/9.0 A | 1000 W | Permanent operation and jogging operation are not allowed! To avoid damage, an external protection circuit must shut down the motor in case of a blocked rotor. |
| 60 V/10.0 A | 600 W | |
| 48 V/10.0 A | 480 W | |
| 24 V/10.0 A | 240 W | |
| AC and DC contact voltage | | 250 V |
| Permissible continuous current per contact | | 5 A |
| Permissible current per contact (switching on and holding) | | 30 A for 1 s |
| Short-time current across closed contact | | 250 A for 30 ms |
| Total permissible current for contacts connected to common potential | | 5 A |
| Switching time OOT (Output Operating Time) Additional delay of the output medium used | | ≤ 16 ms |
| Rated data of the output contacts in accordance with UL certification | | DC 300 V, 10 A, Resistive DC 250 V, 1 hp motor - 30 s ON, 15 min OFF DC 110 V, 3/4 hp motor - 30 s ON, 15 min OFF DC 60 V, 1/2 hp motor - 30 s ON, 15 min OFF DC 48 V, 1/3 hp motor - 30 s ON, 15 min OFF DC 24 V, 1/6 hp motor - 30 s ON, 15 min OFF |
| Interference suppression capacitors across the contacts | | 4.7 nF, ± 20 %, AC 250 V |
| The power relays operate in interlocked mode, that is, only one relay of each switching pair picks up at a time thereby avoiding a power-supply short circuit. | | |

11.1.4 Design Data

Masses

| | Device Size | | | | |
|--|-------------------------------|---------|---------|---------|---------|
| | Weight of the Modular Devices | | | | |
| Type of construction | 1/3 | 1/2 | 2/3 | 5/6 | 1/1 |
| Flush-mounting device | 4.8 kg | 8.1 kg | 11.4 kg | 14.7 kg | 18.0 kg |
| Surface-mounted device with integrated on-site operation panel | 7.8 kg | 12.6 kg | 17.4 kg | 22.2 kg | 27.0 kg |
| Surface-mounted device with detached on-site operation panel | 5.1 kg | 8.7 kg | 12.3 kg | 15.9 kg | 19.5 kg |

| | Size | Weight |
|----------------------------------|------|--------|
| Detached on-site operation panel | 1/3 | 1.9 kg |
| Detached on-site operation panel | 1/6 | 1.1 kg |

| | Device Size Weight of the Non-Modular Devices 7xx82 |
|-----------------------|--|
| Type of construction | 1/3 |
| Flush-mounting device | 3.7 kg |

Dimensions of the Basic and 1/3 Modules

| Type of Construction (Maximum Dimensions) | Width x Height x Depth (in Inches) |
|--|---|
| Flush-mounting device | 145 mm x 268 mm x 228.5 mm (5.71 x 10.55 x 9) |
| Surface-mounted device with integrated on-site operation panel | 145 mm x 314 mm x 337 mm (5.71 x 12.36 x 13.27) |
| Surface-mounted device with detached on-site operation panel | 145 mm x 314 mm x 230 mm (5.71 x 12.36 x 9.06) |

Dimensions of Device Rows

| Type of Construction (Maximum Dimensions) | Width x Height x Depth (in Inches) | | | | |
|--|---|---|--|--|--|
| | 1/3 | 1/2 | 2/3 | 5/6 | 1/1 |
| Type of construction | | | | | |
| Flush-mounting device | 145 mm x 268 mm x 228.5 mm (5.71 x 10.55 x 9) | 220 mm x 268 mm x 228.5 mm (8.66 x 10.55 x 9) | 295 mm x 268 mm x 228.5 mm (11.61 x 10.55 x 9) | 370 mm x 268 mm x 228.5 mm (14.57 x 10.55 x 9) | 445 mm x 268 mm x 228.5 mm (17.52 x 10.55 x 9) |
| Surface-mounted device with integrated on-site operation panel | 145 mm x 314 mm x 337 mm (5.71 x 12.36 x 13.27) | 220 mm x 314 mm x 337 mm (8.66 x 12.36 x 13.27) | 295 mm x 314 mm x 337 mm (11.61 x 12.36 x 13.27) | 370 mm x 314 mm x 337 mm (14.57 x 12.36 x 13.27) | 445 mm x 314 mm x 337 mm (17.52 x 12.36 x 13.27) |
| Surface-mounted device with detached on-site operation panel | 145 mm x 314 mm x 230 mm (5.71 x 12.36 x 9.06) | 220 mm x 314 mm x 230 mm (8.66 x 12.36 x 9.06) | 295 mm x 314 mm x 230 mm (11.61 x 12.36 x 9.06) | 370 mm x 314 mm x 230 mm (14.57 x 12.36 x 9.06) | 445 mm x 314 mm x 230 mm (17.52 x 12.36 x 9.06) |

Expansion Module Dimensions

| Type of Construction (Maximum Dimensions) | Width x Height x Depth (in Inches) |
|--|--|
| Flush-mounting device | 75 mm x 268 mm x 228.5 mm (2.95 x 10.55 x 9) |
| Surface-mounted device with integrated on-site operation panel | 75 mm x 314 mm x 337 mm (2.95 x 12.36 x 13.27) |
| Surface-mounted device with detached on-site operation panel | 75 mm x 314 mm x 230 mm (2.95 x 12.36 x 9.06) |

Plug-In Module Dimensions

| Type of Construction (Maximum Dimensions) | Width x Height x Depth (in Inches) |
|---|--|
| USART-Ax-xEL, ETH-Bx-xEL | 61 mm x 45 mm x 120.5 mm (2.4 x 1.77 x 4.74) |
| USART-Ax-xFO, ETH-Bx-xFO (without protective cover) | 61 mm x 45 mm x 132.5 mm (2.4 x 1.77 x 5.22) |
| ANAI-CA-4EL | 61 mm x 45 mm x 119.5 mm (2.4 x 1.77 x 4.7) |
| ARC-CD-3FO | 61 mm x 45 mm x 120.5 mm (2.4 x 1.77 x 4.74) |

Minimum Bending Radii of the Connecting Cables Between the On-Site Operation Panel and the Base Module

| | |
|-------------------|---|
| Fiber-optic cable | R = 50 mm Pay attention to the length of the cable protection sleeve, which you must also include in calculations. |
| D-Sub cable | R = 50 mm (minimum bending radius) |

Degree of Protection to IEC 60529

| | |
|---|--|
| For equipment in the surface-mounting housing | IP50 |
| For equipment in the flush-mounting housing | Front IP51 Back side of the modular devices IP50 Back side of the non-modular devices IP40 |
| For operator protection | IP2X for current terminals IP1X for voltage terminals |
| Degree of pollution, IEC 60255-27 | 2 |

UL Note

| |
|---|
| Type 1 if mounted into a door or front cover of an enclosure. When expanding the device with the 2nd device row, then they must be mounted completely inside an enclosure. |
|---|

Tightening Torques for Terminal Screws

| Type of Line | Current Terminal | Voltage Terminal with Spring-Loaded Terminals | Voltage Terminal with Screw Connection |
|---|------------------|---|--|
| Litz wire with ring-type lug | 2.7 Nm | No ring-type lug | No ring-type lug |
| Stranded wires with boot-lace ferrules or pin-type lugs | 2.7 Nm | 1.0 Nm | 0.6 Nm |
| Solid conductor, bare (2 mm ²) | 2.0 Nm | 1.0 Nm | – |



NOTE

Use copper cables only.

Torques for Other Screw Types

| Screw Type | Torque |
|-----------------------------|---------|
| M4 x 20 | 1.2 Nm |
| M4 x 8 | 1.2 Nm |
| M2.5 x 6 | 0.39 Nm |
| Countersunk screw, M2.5 x 6 | 0.39 Nm |
| Countersunk screw, M2.5 x 8 | 0.39 Nm |
| Collar screw, M4 x 20 | 0.7 Nm |

11.1.5 Influencing Variables for Measured Values

| | |
|---|--------------------|
| Auxiliary voltage: $0.8 V_{ar}$ to $1.2 V_{ar}$ | $\leq 0.2 \%$ |
| Ambient temperature -10 °C to 55 °C | $\leq 0.5 \%/10 K$ |

| | |
|---|---------------|
| Frequency: 45 Hz to 65 Hz | $\leq 1 \%$ |
| Harmonics | $\leq 1 \%$ |
| • Up to 10 % of 3rd harmonics | $\leq 1 \%$ |
| • Up to 10 % of 5th harmonics | |
| Warmup | $\leq 0.3 \%$ |
| Transient excess pickup in fundamental component measurement method for $\tau > 100$ ms (with complete unbalance) | $\leq 5 \%$ |
| EMC interference | $\leq 1.5 \%$ |

11.2 Date and Time Synchronization

| | |
|--|---------------------------------|
| Date format | DD.MM.YYYY (Europe) |
| | MM/DD/YYYY (USA) |
| | YYYY-MM-DD (China) |
| Time source 1, time source 2 | None |
| | IRIG B |
| | DCF77 |
| | PI |
| | SNTP |
| Time zone 1, time zone 2 | Local |
| | UTC |
| Failure indication after | 0 s to 3600 s |
| Time zone and daylight saving time | Transfer of PC settings |
| | Manually setting the time zones |
| Time zone offset with respect to GMT | -720 min to 840 min |
| Switching over to daylight saving time | Active |
| | Inactive |
| Beginning of daylight saving time | Input: Day and time |
| End of daylight saving time | Input: Day and time |
| Offset daylight saving time | -120 to 120 [steps of 15] |

11.3 Phasor Measurement Unit

Accuracy

As per IEEE Std C37.118.1a-2013

Synchrophasor Standard

| |
|-------------------------|
| IEEE Std C37.118.1-2011 |
|-------------------------|

11.4 Recorder Functions

11.4.1 Fast-Scan Recorder

Setting Values

| Fast-Scan Recorder | Setting Range | Increment |
|-------------------------|-----------------------|------------------------------|
| Memory capacity | 0.200 GB to 15.000 GB | Increments of 1 |
| Maximum record time | 5.0 s to 90.0 s | Increments of 0.1 |
| Pre-trigger time | 0 s to 3.0 s | Increments of 0.1 |
| Post-trigger time | 5.0 s to 90.0 s | Increments of 0.1 |
| Manual record time | 1.0 s to 90.0 s | Increments of 0.1 |
| Sampling frequency | 1 kHz to 16 kHz | Increments of 1, 2, 4, 8, 16 |
| Retrigger blocking time | 0.0 s to 3600 s | Increments of 0.1 |

Number of Recorder Instances

| | |
|--------------------|---------|
| Fast-scan recorder | 1 (fix) |
|--------------------|---------|

Signals to be Recorded

Refer to [Number of Routable Measured Values \(MV\) and Binary Tracks \(SPS\), Page 358](#)

Trigger

| |
|-------------------|
| Frequency trigger |
| Power trigger |
| Voltage trigger |
| Current trigger |

11.4.2 Slow-Scan Recorder

Setting Values

| Slow-Scan Recorder | Setting Range | Increment |
|-------------------------|-----------------------|-----------------|
| Memory capacity | 0.200 GB to 14.800 GB | Increments of 1 |
| Maximum record time | 1 min to 90 min | Increments of 1 |
| Pre-trigger time | 0 s to 90 s | Increments of 1 |
| Post-trigger time | 1 min to 90 min | Increments of 1 |
| Manual record time | 1 min to 90 min | Increments of 1 |
| Averaging time | 1 to 3000 periods | Increments of 1 |
| Retrigger blocking time | 0 min to 240 min | Increments of 1 |

Number of Recorder Instances

| | |
|--------------------|--------|
| Slow-scan recorder | 0 to 2 |
|--------------------|--------|

Signals to be Recorded

Refer to [Number of Routable Measured Values \(MV\) and Binary Tracks \(SPS\), Page 358](#)

Trigger

| |
|-------------------|
| Frequency trigger |
|-------------------|

| |
|-----------------|
| Power trigger |
| Voltage trigger |
| Current trigger |

11.4.3 Continuous Recorder

Setting Values

| Continuous Recorder | Setting Range | Increment |
|---------------------|-----------------------|-----------------|
| Memory capacity | 0.200 GB to 14.800 GB | Increments of 1 |
| Averaging time | 1 s to 900 s | |

Number of Recorder Instances

| | |
|---------------------|--------|
| Continuous recorder | 0 to 5 |
|---------------------|--------|

Signals to be Recorded

Refer to [Number of Routable Measured Values \(MV\) and Binary Tracks \(SPS\), Page 358](#)

11.4.4 Trend Recorder

Setting Values

| Trend recorder | Setting Range | Increment |
|-----------------|-----------------------|-------------|
| Memory capacity | 0.200 GB to 14.800 GB | Increment 1 |

Number of Recorder Instances

| | |
|----------------|--------|
| Trend recorder | 0 to 2 |
|----------------|--------|

Signals to be Recorded

Refer to [Number of Routable Measured Values \(MV\) and Binary Tracks \(SPS\), Page 358](#)

11.4.5 Measured Values and Binary Inputs

Binary Inputs

| | Setting Range | Increment |
|---------------|---------------------|-----------------|
| Sampling | 4 kHz ¹⁸ | Increments of 1 |
| Resolution | 1 ms | Increments of 1 |
| Sampling rate | Event-driven | |

Number of Routable Measured Values (MV) and Binary Tracks (SPS)

| Recorder | Measured Values (MV) | Binary Tracks (SPS) |
|---------------------|----------------------|---------------------|
| Fast-Scan recorder | 30 | 100 |
| Slow-Scan recorder | 30 | 100 |
| Continuous recorder | 30 | – |
| Trend recorder | 50 | 200 |

¹⁸ Toggle rates applied permanently and greater than 10 Hz are not recommended.

Routable Measurands

| |
|-------------------------------------|
| Measurands |
| Frequency |
| Voltage |
| Current |
| Power |
| PQ 10/12 cycles |
| PQ trend |
| Flicker to IEC 61000-4-15, class F3 |

11.5 Supervision Functions

11.5.1 Voltage-Balance Supervision

Setting Values

| | | |
|-------------------------|----------------------|-----------------------|
| Release threshold value | 0.300 V to 100.000 V | Increments of 0.001 V |
| Threshold value min/max | 0.58 to 0.95 | Increments of 0.01 |
| Tripping delay | 0.00 s to 100.00 s | Increments of 0.01 s |

Dropout Ratio

| | |
|----------------------------|--------------|
| Dropout ratio overvoltage | Approx. 0.97 |
| Dropout ratio undervoltage | Approx. 1.05 |

Times

| | |
|---------------|----------------|
| Tripping time | Approx. 500 ms |
| Dropout time | Approx. 500 ms |

11.5.2 Voltage-Sum Supervision

Setting Values

| | | |
|-----------------|----------------------|-----------------------|
| Threshold value | 0.300 V to 170.000 V | Increments of 0.001 V |
| Tripping delay | 0.00 s to 100.00 s | Increments of 0.01 s |

Dropout Ratio

| | |
|---------------|--------------|
| Dropout ratio | Approx. 0.97 |
|---------------|--------------|

Times

| | |
|---------------|----------------|
| Tripping time | Approx. 500 ms |
| Dropout time | Approx. 500 ms |

11.5.3 Voltage Phase-Rotation Reversal

Setting Values

| | | |
|--------------------------|--------------------|----------------------|
| Tripping delay | 0.00 s to 100.00 s | Increments of 0.01 s |
| Phase-rotation direction | A B C A C B | |

Dropout Ratio

| | |
|---------------|--------------|
| Dropout ratio | Approx. 0.97 |
|---------------|--------------|

Times

| | |
|---------------|----------------|
| Tripping time | Approx. 500 ms |
| Dropout time | Approx. 500 ms |

11.5.4 Broken-Wire Detection

Setting Values

| Value | Setting Range | Increment |
|---------------------------|--|-----------|
| Mode of blocking | <i>Blocking</i> <i>Automatic blocking</i> <i>No blocking</i> | - |
| Delta value for autoblock | 0.004 I/I _{rated} to 5.000 I/I _{rated} | 0.001 |

11.5.5 Current-Balance Supervision

Setting Values

| | | | |
|-------------------------|--------------------------|---------------------|-----------------------|
| Release threshold value | I _{rated} = 1 A | 0.030 A to 90.000 A | Increments of 0.001 A |
| | I _{rated} = 5 A | 0.15 A to 450.00 A | Increments of 0.01 A |
| Threshold value min/max | | 0.10 to 0.95 | Increments of 0.01 |
| Tripping delay | | 0.00 s to 100.00 s | Increments of 0.01 s |

Dropout Ratio

| | |
|----------------------------|------------|
| Overcurrent dropout ratio | About 0.97 |
| Undercurrent dropout ratio | About 1.05 |

Times

| | |
|---------------|----------------|
| Tripping time | Approx. 500 ms |
| Dropout time | Approx. 500 ms |

11.5.6 Current-Sum Supervision

Setting Values

| | | | |
|-----------------------------------|-------------------------------------|---------------------|-----------------------|
| Slope of the characteristic curve | | 0.00 to 0.95 | Increments of 0.01 |
| Threshold | 1 A @ 50 and 100 I _{rated} | 0.030 A to 10.000 A | Increments of 0.001 A |
| | 5 A @ 50 and 100 I _{rated} | 0.15 A to 50.00 A | Increments of 0.01 A |
| | 1 A @ 1.6 I _{rated} | 0.001 A to 1.600 A | Increments of 0.001 A |
| | 5 A @ 1.6 I _{rated} | 0.005 A to 8.000 A | Increments of 0.001 A |
| Tripping delay | | 0.00 s to 100.00 s | Increments of 0.01 s |

Dropout Ratio

| | |
|---------------|------------|
| Dropout ratio | About 0.97 |
|---------------|------------|

Times

| | |
|---------------|----------------|
| Tripping time | Approx. 500 ms |
| Dropout time | Approx. 500 ms |

11.5.7 Current Phase-Rotation Supervision

Setting Values

| | | |
|--------------------------|--------------------|----------------------|
| Tripping delay | 0.00 s to 100.00 s | Increments of 0.01 s |
| Phase-rotation direction | A B C A C B | |

Dropout Ratio

| | |
|---------------|--------------|
| Dropout ratio | Approx. 0.97 |
|---------------|--------------|

Times

| | |
|---------------|----------------|
| Tripping time | Approx. 500 ms |
| Dropout time | Approx. 500 ms |

11.5.8 Analog Channel Supervision via Fast Current Sum

Times

| | |
|--------------|--|
| Pickup times | Approx. 2 ms (faster than the fastest protection function) |
| Dropout time | Approx. 100 ms |

11.6 Operational Measured Values and Statistical Values

Voltages

| | |
|---|--|
| V_A, V_B, V_C Voltage range | V secondary < 200 V secondary |
| Secondary rated voltage Measuring range Frequency range | 100 V to 125 V $(1.1 \text{ to } 2) \cdot V_{\text{rated}}$ 49 Hz to 51 Hz at $f_{\text{rated}} = 50 \text{ Hz}$ 59 Hz to 61 Hz at $f_{\text{rated}} = 60 \text{ Hz}$ |
| Tolerance | 0.1 % of the measured value in the above mentioned ranges |
| Frequency range (expanded) | 40 Hz to 60 Hz at $f_{\text{rated}} = 50 \text{ Hz}$ 50 Hz to 70 Hz at $f_{\text{rated}} = 60 \text{ Hz}$ |
| Tolerance | 0.3 % of the measured value in the above mentioned ranges |
| V_{AB}, V_{BC}, V_{CA} Voltage range | V secondary < 200 V |
| Secondary rated voltage Measuring range Frequency range | 100 V to 125 V $(1.1 \text{ to } 2) \cdot V_{\text{rated}}$ 49 Hz to 51 Hz at $f_{\text{rated}} = 50 \text{ Hz}$ 59 Hz to 61 Hz at $f_{\text{rated}} = 60 \text{ Hz}$ |
| Tolerance | 0.1% of the measured value in the above mentioned ranges |
| Frequency range (expanded) | 40 Hz to 60 Hz at $f_{\text{rated}} = 50 \text{ Hz}$ 50 Hz to 70 Hz at $f_{\text{rated}} = 60 \text{ Hz}$ |
| Tolerance | 0.3 % of the measured value in the above mentioned ranges |

Currents, Instrument Transformers

| | |
|--|--|
| $I_A, I_B, I_C, 3I_0$ Current range | A secondary < $1.6 I_{\text{rated}}$ |
| Nominal currents Measuring range Frequency range | 1 A, 5 A $(0.1 \text{ to } 1.6) \cdot I_{\text{rated}}$ 49 Hz to 51 Hz at $f_{\text{rated}} = 50 \text{ Hz}$ 59 Hz to 61 Hz at $f_{\text{rated}} = 60 \text{ Hz}$ |
| Tolerance | 0.1 % of the measured value in the above-mentioned ranges |
| Frequency range (expanded) | 40 Hz to 60 Hz at $f_{\text{rated}} = 50 \text{ Hz}$ 50 Hz to 70 Hz at $f_{\text{rated}} = 60 \text{ Hz}$ |
| Tolerance | 0.3 % of the measured value in the above mentioned ranges |

Currents, Protection-Class Current Transformer

| | |
|--|---|
| $I_A, I_B, I_C, 3I_0$ Current range | A secondary < $100 I_{\text{rated}}$ |
|--|---|

| | |
|----------------------------|--|
| Nominal currents | 1 A, 5 A |
| Measuring range | 0.1 to 25 A |
| Frequency range | 49 Hz to 51 Hz at $f_{rated} = 50$ Hz 59 Hz to 61 Hz at $f_{rated} = 60$ Hz |
| Tolerance | 0.1 % of the measured value in the above mentioned ranges |
| Frequency range (expanded) | 40 Hz to 60 Hz at $f_{rated} = 50$ Hz 50 Hz to 70 Hz at $f_{rated} = 60$ Hz |
| Tolerance | 0.3 % of the measured value in the above mentioned ranges |

Currents, Sensitive Ground-Current Transformer

| | |
|----------------------------|--|
| $3I_0$ | A secondary |
| Current range | $< 1.6 I_{rated}$ |
| Rated currents | 1 A, 5 A |
| Measuring range | $(0.1 \text{ to } 1.6) \cdot I_{rated}$ |
| Frequency range | 49 Hz to 51 Hz at $f_{rated} = 50$ Hz 59 Hz to 61 Hz at $f_{rated} = 60$ Hz |
| Tolerance | 0.1 % of the measured value in the above-mentioned ranges |
| Frequency range (expanded) | 40 Hz to 60 Hz at $f_{rated} = 50$ Hz 50 Hz to 70 Hz at $f_{rated} = 60$ Hz |
| Tolerance | 0.3 % of the measured value in the above-mentioned ranges |

Phase Angle

| | |
|--------------------|--|
| Φ_V | $^\circ$ |
| Frequency range | 47.5 Hz to 52.5 Hz at $f_{rated} = 50$ Hz 57.5 Hz to 62.5 Hz at $f_{rated} = 60$ Hz |
| Tolerance Φ_V | 0.2 $^\circ$ at rated voltage |
| Φ_I | $^\circ$ |
| Frequency range | 47.5 Hz to 52.5 Hz at $f_{rated} = 50$ Hz 57.5 Hz to 62.5 Hz at $f_{rated} = 60$ Hz |
| Tolerance Φ_I | 0.2 $^\circ$ at rated current |

Power Values

| | |
|----------------------------|--|
| Active power P | W secondary |
| Measuring range | $ \cos\phi \geq 0.01$ |
| Voltage range | $(0.8 \text{ to } 1.2) \cdot V_{rated}$ |
| Current range | $(0.1 \text{ to } 2) \cdot I_{rated}$ |
| Frequency range | 49 Hz to 51 Hz at $f_{rated} = 50$ Hz 59 Hz to 61 Hz at $f_{rated} = 60$ Hz |
| Tolerance | 0.3 % of the measured value in the above mentioned ranges |
| Frequency range (expanded) | 40 Hz to 69 Hz at $f_{rated} = 50$ Hz 50 Hz to 70 Hz at $f_{rated} = 60$ Hz |
| Tolerance | 0.5 % of the measured value in the above mentioned ranges |
| Reactive power Q | VAr secondary |

| | |
|--|--|
| Measuring range Voltage range Current range Frequency range | $ \cos\phi \geq 0.984$ $(0.8 \text{ to } 1.2) \cdot V_{\text{rated}}$ $(0.1 \text{ to } 2) \cdot I_{\text{rated}}$ 49 Hz to 51 Hz at $f_{\text{rated}} = 50 \text{ Hz}$ 59 Hz to 61 Hz at $f_{\text{rated}} = 60 \text{ Hz}$ |
| Tolerance | 1.0 % of the measured value in the above mentioned ranges |
| Frequency range (expanded) | 40 Hz to 69 Hz at $f_{\text{rated}} = 50 \text{ Hz}$ 50 Hz to 70 Hz at $f_{\text{rated}} = 60 \text{ Hz}$ |
| Tolerance | 1.5 % of the measured value in the above mentioned ranges |
| Apparent power S | VA |
| Measuring range Voltage range Current range Frequency range | $(0.01 \text{ to } 2) \cdot S_{\text{rated}}$ $(0.8 \text{ to } 1.2) \cdot V_{\text{rated}}$ $(0.01 \text{ to } 2) \cdot I_{\text{rated}}$ 49 Hz to 51 Hz at $f_{\text{rated}} = 50 \text{ Hz}$ 59 Hz to 61 Hz at $f_{\text{rated}} = 60 \text{ Hz}$ |
| Tolerance | 0.3 % of the measured value in the above mentioned ranges |
| Frequency range (expanded) | 40 Hz to 69 Hz at $f_{\text{rated}} = 50 \text{ Hz}$ 50 Hz to 70 Hz at $f_{\text{rated}} = 60 \text{ Hz}$ |
| Tolerance | 0.5 % of the measured value in the above mentioned ranges |

Frequency

| | |
|----------------------------|---|
| Frequency f | Hz |
| Range | $f_{\text{rated}} - 0.20 \text{ Hz} < f_{\text{rated}} + 0.20 \text{ Hz}$ |
| Tolerance | $\pm 5 \text{ mHz}$ in the V_{rated} range |
| Range | $f_{\text{rated}} - 3.00 \text{ Hz} < f_{\text{rated}} + 3.00 \text{ Hz}$ |
| Tolerance | $\pm 10 \text{ mHz}$ in the V_{rated} range |
| Frequency range (expanded) | 10 Hz to 80 Hz |
| Tolerance | 20 mHz in the range $f_{\text{rated}} \pm 10 \%$ for rated values |

11.7 CFC

Typical response times and maximum number of ticks of the CFC process levels:

| Process Level | Time (in ms) | Max. Number of Ticks |
|----------------------|--------------|----------------------|
| Fast event triggered | <1 | 1500 |
| Event triggered | <5 | 10700 |
| Interlocking | <5 | 105 000 in total |
| Measurement | 500 | |

The times describe the lead time of a typical CFC chart at the respective process level. In the maximum number of ticks applies to a typical load for the device. The process level **Measurement** runs in cycles every 500 ms. All other process levels are event-triggered.

Table 11-1 Ticks of the Individual CFC Blocks

| Element | Ticks |
|-------------|-------|
| ABS_D | 0,6 |
| ABS_R | 0,8 |
| ACOS_R | 1,9 |
| ADD_D4 | 2,6 |
| ADD_R4 | 2,7 |
| ADD_XMV | 1,2 |
| ALARM | 0,7 |
| AND_SPS | 1,0 |
| AND10 | 4,9 |
| ASIN_R | 0,7 |
| ATAN_R | 0,8 |
| BLINK | 0,7 |
| BOOL_CNT | 1,4 |
| BOOL_INT | 1,6 |
| BSC_DEF | 0,7 |
| BSC_EXE | 0,7 |
| BUILD_ACD | 1,4 |
| BUILD_ACT | 1,4 |
| BUILD_DPS | 0,8 |
| BUILD_ENS | 3,0 |
| BUILD_Q | 0,9 |
| BUILD_SPS | 0,6 |
| BUILD_XMV | 0,7 |
| BUILDQ_Q | 3,0 |
| CHART_STATE | 3,2 |
| CMP_DPS | 0,6 |
| CON_ACD | 1,0 |
| CON_ACT | 1,0 |
| CONNECT | 0,9 |
| COS_R | 0,8 |
| CTD | 0,9 |
| CTU | 0,9 |
| CTUD | 0,9 |

| Element | Ticks |
|-----------|-------|
| DINT_REAL | 3,0 |
| DINT_UINT | 3,0 |
| DIV_D | 1,7 |
| DIV_R | 1,9 |
| DIV_XMV | 0,9 |
| DPC_DEF | 0,7 |
| DPC_EXE | 0,7 |
| DPC_INFO | 0,5 |
| DPC_OUT | 0,7 |
| DPS_SPS | 0,6 |
| DRAGI_R | 0,9 |
| EQ_D | 0,7 |
| EQ_R | 0,9 |
| EXP_R | 1,0 |
| EXPT_R | 1,5 |
| F_TRGM | 0,5 |
| F_TRIG | 0,5 |
| FF_D | 0,6 |
| FF_D_MEM | 0,6 |
| FF_RS | 0,6 |
| FF_RS_MEM | 0,6 |
| FF_SR | 0,8 |
| FF_SR_MEM | 0,8 |
| GE_D | 0,7 |
| GE_R | 0,8 |
| GT_D | 0,7 |
| GT_R | 0,9 |
| HOLD_D | 0,6 |
| HOLD_R | 0,6 |
| INC_INFO | 0,6 |
| LE_D | 0,7 |
| LE_R | 1,0 |
| LIML_R | 1,0 |
| LIMU_R | 1,6 |
| LN_R | 0,9 |
| LOG_R | 2,4 |
| LOOP | 0,7 |
| LT_D | 1,0 |
| LT_R | 1,0 |
| MAX_D | 0,7 |
| MAX_R | 0,9 |
| MEMORY_D | 0,6 |
| MEMORY_R | 0,7 |
| MIN_D | 0,7 |
| MIN_R | 1,3 |
| MOD_D | 0,7 |
| MUL_D4 | 3,2 |

| Element | Ticks |
|-----------|-------|
| MUL_R4 | 3,0 |
| MUL_XMV | 2,1 |
| MUX_D | 0,6 |
| MUX_R | 0,7 |
| NAND10 | 5,8 |
| NE_D | 0,9 |
| NE_R | 0,9 |
| NEG | 1,9 |
| NEG_SPS | 0,6 |
| NLC_LZ | 2,0 |
| NLC_XMV | 1,9 |
| NLC_ZP | 2,4 |
| NOR10 | 5,8 |
| OR_DYN | 0,9 |
| OR_SPS | 0,9 |
| OR10 | 4,9 |
| R_TRGM | 0,6 |
| R_TRIG | 0,6 |
| REAL_DINT | 3,0 |
| REAL_SXMV | 3,0 |
| SIN_R | 1,0 |
| SPC_DEF | 1,1 |
| SPC_EXE | 1,1 |
| SPC_INFO | 0,6 |
| SPC_OUT | 1,2 |
| SPLIT_ACD | 1,4 |
| SPLIT_ACT | 1,4 |
| SPLIT_BSC | 0,8 |
| SPLIT_DPS | 0,8 |
| SPLIT_Q | 0,5 |
| SPLIT_SPS | 0,6 |
| SPLIT_XMV | 0,8 |
| SQRT_R | 0,9 |
| SUB_D | 1,7 |
| SUB_R | 1,8 |
| SUB_XMV | 1,1 |
| SUBST_B | 1,2 |
| SUBST_BQ | 1,2 |
| SUBST_D | 1,2 |
| SUBST_R | 1,2 |
| SUBST_XQ | 1,2 |
| SXMV_REAL | 3,0 |
| TAN_R | 1,2 |
| TLONG | 1,0 |
| TOF | 0,7 |
| TON | 0,7 |
| TT | 0,7 |

| Element | Ticks |
|-----------|-------|
| TSHORT | 0,9 |
| UINT_DINT | 3,0 |

