SIPROTEC Compact 7RW80 Voltage and Frequency Protection

V4.6

Technical Data

Extract from manual C53000-G1140-C233-3, chapter 4

Energy Automation

SIEMENS

NOTE

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

Document version V04.02.00

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Preface

Purpose of this Manual

This manual describes the functions, operation, installation, and commissioning of devices 7RW80. In particular, one will find:

- Information regarding the configuration of the scope of the device and a description of the device functions and settings → Chapter 2;
- Instructions for Installation and Commissioning → Chapter 3;
- Compilation of the Technical Data → Chapter 4;
- As well as a compilation of the most significant data for advanced users → Appendix A.

General information with regard to design, configuration, and operation of SIPROTEC 4 devices are set out in the SIPROTEC 4 System Description */1/ SIPROTEC 4 System Description*.

Target Audience

Protection-system engineers, commissioning engineers, persons entrusted with the setting, testing and maintenance of selective protection, automation and control equipment, and operating personnel in electrical installations and power plants.

Gültigkeitsbereich des Handbuchs

Dieses Handbuch ist gültig für: SIPROTEC 4 Voltage and Frequency Protection 7RW80; Firmware-Version V4.6.

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 is proved by tests conducted by Siemens AG in accordance with the Council Directive in agreement with the generic standards EN 61000-6-2 and EN 61000-6-4 for EMC directive, and with the standard EN 60255-27 for the low-voltage directive. The device has been designed and produced for industrial use. The product conforms with the international standards of the series IEC 60255 and the German standard VDE 0435.

Additional Standards IEEE Std C37.90 (see Chapter 4 "Technical Data")
This product is UL-certified according to the Technical Data:
file E194016

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Additional Support

For questions about the SIPROTEC 4 system, please contact your Siemens sales partner.
Our Customer Support Center provides a 24-hour service.
Phone: +49 (180) 524-8437
Fax: +49 (180) 524-2471
e-mail: support.ic@siemens.com

Training Courses

Inquiries regarding individual training courses should be addressed to our Training Center:

Siemens AG
Siemens Power Academy TD

Humboldtstraße 59
90459 Nürnberg
Germany

Phone:	+49 (911) 433-7415
Fax:	+49 (911) 433-7929
E-Mail:	*poweracademy@siemens.com*
Internet:	*www.siemens.com/poweracademy*

Safety Information

This manual does not constitute a complete index of all required safety measures for operation of the equipment (module, device), as special operational conditions may require additional measures. However, it comprises important information that should be noted for purposes of personal safety as well as avoiding material damage. Information that is highlighted by means of a warning triangle and according to the degree of danger, is illustrated as follows.

DANGER

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

✧

WARNING

indicates that death, severe personal injury or substantial property damage may result if proper precautions are not taken.

✧

CAUTION

indicates that minor personal injury or property damage may result if proper precautions are not taken. This particularly applies to damage to or within the device itself and consequential damage thereof.

✧

NOTE

indicates information on the device, handling of the device, or the respective part of the instruction manual which is important to be noted.

WARNING

Qualified Personnel

Commissioning and operation of the equipment (module, device) as set out in this manual may only be carried out by qualified personnel. Qualified personnel in terms of the technical safety information as set out in this manual are persons who are authorized to commission, activate, to ground and to designate devices, systems and electrical circuits in accordance with the safety standards.

Use as prescribed

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

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

When operating an electrical equipment, certain parts of the device are inevitably subject to dangerous voltage. Severe personal injury or property damage may result if the device is not handled properly.

Before any connections are made, the device must be grounded to the ground terminal.

All circuit components connected to the voltage supply may be subject to dangerous voltage.

Dangerous voltage may be present in the device even after the power supply voltage has been removed (capacitors can still be charged).

Operational equipment with open circuited current transformer circuits may not be operated.

The limit values as specified in this manual or in the operating instructions may not be exceeded. This aspect must also be observed during testing and commissioning.

✧

Typographic and Symbol Conventions

The following text formats are used when literal information from the device or to the device appear in the text flow:

`Parameter Names`

Designators of configuration or function parameters which may appear word-for-word in the display of the device or on the screen of a personal computer (with operation software DIGSI), are marked in bold letters in monospace type style. The same applies to titles of menus.

`1234A`

Parameter addresses have the same character style as parameter names. Parameter addresses contain the suffix **`A`** in the overview tables if the parameter can only be set in DIGSI via the option **Display additional settings**.

`Parameter Options`

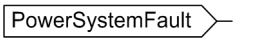
Possible settings of text parameters, which may appear word-for-word in the display of the device or on the screen of a personal computer (with operation software DIGSI), are additionally written in italics. The same applies to the options of the menus.

Indications

Designators for information, which may be output by the relay or required from other devices or from the switch gear, are marked in a monospace type style in quotation marks.

Deviations may be permitted in drawings and tables when the type of designator can be obviously derived from the illustration.

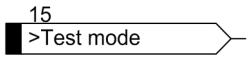
The following symbols are used in drawings:



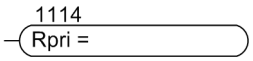
Device-internal logical input signal

Device-internal logical output signal

Internal input signal of an analog quantity

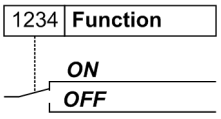


External binary input signal with number (binary input, input indication)



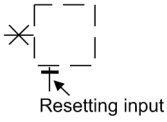
External binary output signal with number (example of a value indication)

External binary output signal with number (device indication) used as input signal

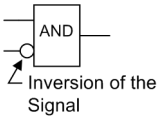


Example of a parameter switch designated **FUNCTION** with address 1234 and the possible settings ***ON*** and ***OFF***

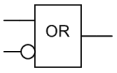
Besides these, graphical symbols are used in accordance with IEC 60617-12 and IEC 60617-13 or similar. Some of the most frequently used are listed below:



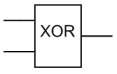
Analog input variable



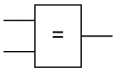
AND-gate operation of input values



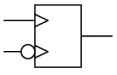
OR-gate operation of input values



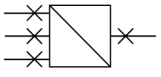
Exclusive OR gate (antivalence): output is active, if only **one** of the inputs is active



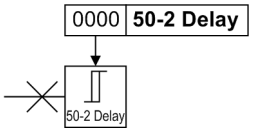
Coincidence gate: output is active, if **both** inputs are active or inactive at the same time



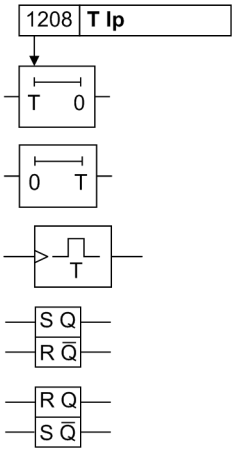
Dynamic inputs (edge-triggered) above with positive, below with negative edge



Formation of one analog output signal from a number of analog input signals



Limit stage with setting address and parameter designator (name)



Timer (pickup delay T, example adjustable) with setting address and parameter designator (name)

Timer (dropout delay T, example non-adjustable)

Dynamic triggered pulse timer T (monoflop)

Static memory (SR flipflop) with setting input (S), resetting input (R), output (Q) and inverted output ($\overline{Q}$), setting input dominant

Static memory (RS-flipflop) with setting input (S), resetting input (R), output (Q) and inverted output ($\overline{Q}$), resetting input dominant

4 Technical Data

4.1 General Device Data

4.1.1 Analog Inputs

Voltage Inputs

Nominal frequency	f_{Nom}	50 Hz or 60 Hz (adjustable)
Operating range frequency (not dependent on the nominal frequency		25 Hz to 70 Hz
Nominal Voltage		34 V – 225 V (adjustable) for connection of phase-to-ground voltages 34 V – 200 V (adjustable) for connection of phase-to-phase voltages
Measuring Range		0 V to 200 V
Burden	at 100 V	approx. 0.005 VA
Overload capacity in the voltage path		
– Thermal (rms)		230 V continuous

4.1.2 Auxiliary voltage

Direct Voltage

Voltage supply via an integrated converter		
Nominal auxiliary DC voltage V_{Aux}	DC 24 V to 48 V	DC 60 V to 250 V
Permissible voltage ranges	DC 19 V to 60 V	DC 48 V to 300 V
Overvoltage category, IEC 60255-27	III	
AC ripple voltage peak to peak, IEC 60255-11	15 % of auxiliary voltage	

Power input	Quiescent	Energized
7RW80	approx. 5 W	approx. 12 W
Bridging time for failure/short-circuit, IEC 60255–11	≥ 50 ms at V ≥ 110 V	
	≥ 10 ms at V < 110 V	

Alternating Voltage

Voltage supply via an integrated converter		
Nominal auxiliary AC voltage V_{Aux}	AC 115 V	AC 230 V
Permissible voltage ranges	AC 92 V to 132 V	AC 184 V to 265 V
Overvoltage category, IEC 60255-27	III	

Power input (at AC 115 V/230 V)	< 15 VA
Bridging time for failure/short-circuit	≥ 10 ms at V = 115 V/230 V

4.1.3 Binary Inputs and Outputs

Binary Inputs

Variant	Quantity
7RW801	3 (configurable)
7RW802	7 (configurable)

DC nominal voltage range	24 V to 250 V	
Current Consumption (independent of the control voltage)	approx. 0.4 mA	
Pickup time Response time of the binary output after trigger signal via binary input	approx. 3 ms approx. 9 ms	
Dropout time Response time of the binary output after trigger signal via binary input	approx. 4 ms approx. 5 ms	
Secured switching thresholds	(adjustable)	
for Nominal Voltages	DC 24 V to 125 V	V high > DC 19 V V low < DC 10 V
for Nominal Voltages	DC 110 V to 250 V	V high > DC 88 V V low < DC 44 V
for Nominal Voltages	DC 220 V and 250 V	V high > DC 176 V V low < DC 88 V
Maximum Permissible Voltage	DC 300 V	
Impulse Filter on Input	220 V coupled above 220nF at a recovery time between two switching operations ≥ 60 ms	

Output Relays

Signal-/Command Relay, Alarm Relay		
Quantity and data	According to the order variant (allocatable)	
Order variant	NO contact	NO/NC selectable
7RW801	3	2 (+ 1 life contact not allocatable)
7RW802	6	2 (+ 1 life contact not allocatable)
Switching capability CLOSE	1000 W / 1000 VA	
Switching capability TRIP	40 W or 30 VA at L/R ≤ 40 ms	
Switching voltage AC and DC	250 V	
adm. current per contact (continuous)	5 A	
adm. current per contact (close and hold)	30 A for 1 s (NO contact)	
Interference suppression capacitor at the relay contacts 2,2 nF, 250 V, Ceramic	Frequency	Impedance
	50 Hz	$1.4 \cdot 10^6\ \Omega \pm 20\ \%$
	60 Hz	$1.2 \cdot 10^6\ \Omega \pm 20\ \%$

4.1.4 Communication Interfaces

User Interface

Terminal	Front side, non-isolated, USB type B socket for connecting a personal computer Operation from DIGSI V4.82 via USB 2.0 full speed (PELV)
Operation	with DIGSI
Transmission speed	up to 12 Mbit/s max.
Bridgeable distance	5 m

Port A

Ethernet electrical for DIGSI or SICAM I/O Unit 7XV5673	
Operation	with DIGSI
Terminal	Front case bottom, mounting location "A", RJ45 socket 100BaseT according to IEEE802.3 LED yellow: 10-/100 MBit/s (on/off) LED green: connection/no connection (on/off)
Test voltage (PELV)	500 V; 50 Hz
Transmission speed	10/100 MBit/s
Bridgeable distance	20 m

Port B

IEC 60870-5-103 single	
RS232/RS485/FO depending on the order variant	Isolated interface for data transfer to a control center
RS232	
Terminal	Back case bottom, mounting location "B", 9- pin DSUB socket
Test voltage (PELV)	500 V; 50 Hz
Transmission speed	min. 1,200 Bd, max. 115,000 Bd; factory setting 9,600 Bd
Bridgeable distance	15 m
RS485	
Terminal	Back case bottom, mounting location "B", 9- pin DSUB socket
Test voltage (PELV)	500 V; 50 Hz
Transmission speed	min. 1,200 Bd, max. 115,000 Bd; factory setting 9,600 Bd
Bridgeable distance	max. 1 km
Fiber optic cable (FO)	
FO connector type	ST connector
Terminal	Back case bottom, mounting location "B"
Optical wavelength	λ = 820 nm
Laser Class 1 according to EN 60825-1/-2	When using glass fiber 50 µm/125 µm or glass fiber 62.5 µm/125 µm
Permissible optical signal attenuation	max. 8 dB, with glass fiber 62.5/125 µm
Bridgeable distance	max. 1.5 km
Character idle state	Configurable; factory setting “Light off”
Profibus RS485 (DP)	
Terminal	Back case bottom, mounting location "B”, 9- pin DSUB socket
Test voltage (PELV)	500 V; 50 Hz
Transmission speed	Up to 1.5 MBd
Bridgeable distance	1 000 m (3 300 ft) at ≤ 93.75 kBd 500 m (1 600 ft) at ≤ 187.5 kBd 200 m (660 ft) at ≤ 1.5 MBd

Profibus FO (DP)	
FO connector type	ST connector Double ring
Terminal	Back case bottom, mounting location "B"
Transmission speed	up to 1.5 MBd
Recommended:	> 500 kBd with normal casing
Optical wavelength	λ = 820 nm
Laser Class 1 according to EN 60825-1/-2	When using glass fiber 50/125 µm or glass fiber 62.5/125 µm
Permissible optical signal attenuation	max. 8 dB, with glass fiber 62.5/125 µm
Bridgeable distance	max. 1.5 km
DNP3.0 /MODBUS RS485	
Terminal	Back case bottom, mounting location "B", 9- pin DSUB socket
Test voltage (PELV)	500 V; 50 Hz
Transmission speed	up to 19,200 Bd
Bridgeable distance	max. 1 km
DNP3.0 /MODBUS FO	
FO connector type	ST connector transmitter/receiver
Terminal	Back case bottom, mounting location "B"
Transmission speed	up to 19,200 Bd
Optical wavelength	λ = 820 nm
Laser Class 1 according to EN 60825-1/-2	When using glass fiber 50 µm/125 µm or glass fiber 62.5/125 µm
Permissible optical signal attenuation	max. 8 dB, with glass fiber 62.5/125 µm
Bridgeable distance	max. 1.5 km
Ethernet electrical (EN 100) for DIGSI and IEC61850	
Terminal	Back case bottom, mounting location "B", 2 x RJ45 socket 100BaseT according to IEEE802.3
Test voltage (with regard to the socket) (PELV)	500 V; 50 Hz
Transmission speed	100 MBit/s
Bridgeable distance	20 m
Ethernet optical (EN 100) for DIGSI and IEC61850	
Terminal	Back case bottom, mounting location "B", Duplex-LC, 100BaseF according to IEEE802.3
Transmission speed	100 MBit/s
Optical wavelength	1300 nm
Bridgeable distance	max. 2 km (1.24 mi)

4.1.5 Electrical Tests

Regulations

Standards:	IEC 60255 IEEE Std C37.90, see individual functions VDE 0435 for more standards see also individual functions

Insulation Test

Standards:	IEC 60255-27 and IEC 60870-2-1
Voltage test (routine test) of all circuits except auxiliary voltage, binary inputs and communication ports	2.5 kV, 50 Hz
Voltage test (routine test) of auxiliary voltage and binary inputs	DC 3.5 kV
Voltage test (routine test) of isolated communication ports only (A and B)	500 V, 50 Hz
Impulse voltage test (type test) of all process circuits (except for communication ports) against the internal electronics	6 kV (peak value); 1.2 µs/50 µs; 0.5 J; 3 positive and 3 negative impulses at intervals of 1 s
Impulse voltage test (type test) of all process circuits against each other (except for communication ports) and against the PE terminal of class III	5 kV (peak value); 1.2 µs/50 µs; 0.5 J; 3 positive and 3 negative impulses at intervals of 1 s

EMC Tests for Immunity (Type Tests)

Standards:		IEC 60255-26, (product standard) IEC/EN 61000-6-2 VDE 0435 For more standards see also individual functions
Immunity to damped oscillatory waves IEC 60255-22-1 IEC 61000-4-18		2.5 kV (Peak); 100 kHz and 1 MHz; τ = 15 ms; 400 Surges per s; Test duration 2 s; R_i = 200 Ω
Electrostatic discharge, Class IV EN 61000-6-2, IEC 60255-22-2		8 kV contact discharge; 15 kV air discharge, both polarities; 150 pF; R_i = 330 Ω, rating criteria B
Radio frequency electromagnetic field, amplitude-modulated, Class III EN 61000-6-2, IEC 60255-22-3		10 V/m; 80 MHz to 2.7 GHz 80 % AM; 1 kHz
Fast transient bursts, Class IV EN 61000-6-2, IEC 60255-22-4		4 kV; 5 ns/50 ns; 5 kHz; 1 min. test length, rating criteria B
High energy surge voltages (SURGE), Installation Class III, EN 61000-6-2, IEC 60255-22-5		Impulse: 1.2 µs/50 µs, rating criteria B
	Auxiliary voltage	common mode: 4 kV; 12 Ω; 9 µF diff. mode: 1 kV; 2 Ω; 18 µF
	Measuring inputs, binary inputs and relay outputs	common mode: 4 kV; 42 Ω; 0.5 µF diff. mode: 1 kV; 42 Ω; 0.5 µF

Immunity to Conducted Disturbance by RF fields, injected Current EN 61000-6-2, IEC 60255-22-6	10 V; 150 kHz to 80 MHz; 80 % AM; 1 kHz; 27 Mhz and 68 MHz spot freq. Dwell time > 10 sec.
Power system frequency magnetic field EN 61000-6-2, IEC 61000-4-8	30 A/m continuous; 300 A/m and 1000 V/m for 3 s;
Radiated Electromagnetic Interference IEEE Std C37.90.2	20 V/m; 80 MHz to 1 GHz; 80 % AM; 1 kHz 35 V/m pulsed, 50% duty cycle 1 Hz rep. rate
Power frequency on binary input ports IEC 60255-26, IEC 61000-4-16	Common mode Zone A and B: 300 Veff (220 Ω, 0.47 µF) Differential Mode Zone B: 100 Veff (100 Ω, 0.047 µF) testet with 3.9 KΩ termination resistor
Ripple on d.c. input power port inmunity test, IEC 61000-4-17	15 % of nominal auxiliary voltage
Gradual shutdown / start-up for d.c. power supply IEC 60255-26	Shut-down ramp: 60 s Power off: 5 min. Start-up ramp: 60 s

EMC Tests for Noise Emission (Type Test)

Standard:	EN 61000-6-4 /01.07 + A1 EN 55011 /11.2009 + A1 class A
Radio noise voltage to lines, only auxiliary voltage IEC/CISPR 16-2-1	150 kHz to 30 MHz Limit Class A
Interference field strength IEC/CISPR 16-2-3	30 MHz bis 1000 MHz Limit Class A 1 GHz to 6 GHz Limit Class A
Harmonic currents on the network lead at AC 230 V IEC 61000-3-2	Device is to be assigned Class D (applies only to devices with > 50 VA power consumption)
Voltage dips, interruptions and fluctuations IEC 60255-11, IEC 61000-4-29	Tolerate Voltage interruptions < 60 ms for the nominal auxiliary voltage.

4.1.6 Mechanical Tests

Vibration and Shock Stress during Steady-State Operation

Standards:	IEC 60255-21 and IEC 60068
Oscillation IEC 60255-21-1, Class 2; IEC 60068-2-6	Sinusoidal 10 Hz to 60 Hz: ±0,075 mm amplitude; 60 Hz bis 150 Hz: 1g acceleration frequency sweep rate 1 octave/min 20 cycles in 3 orthogonal axes.
Shock IEC 60255-21-2, Class 1; IEC 60068-2-27	Semi-sinusoidal acceleration, duration 11 ms, each 3 shocks in both directions of the 3 axes
Seismic Vibration IEC 60255-21-3, Class 2; IEC 60068-3-3	Sinusoidal 1 Hz to 8 Hz: ±7,5 mm amplitude (horizontal axis) 1 Hz to 8 Hz: ±3,5 mm amplitude (vertical axis) 8 Hz to 35 Hz: 2 g acceleration (horizontal axis) 8 Hz to 35 Hz: 1 g acceleration (vertical axis) Frequency sweep 1 octave/min 1 cycle in 3 orthogonal axes

Vibration and Shock Stress during Transport

Standards:	IEC 60255-21 and IEC 60068
Oscillation IEC 60255-21-1, Class 2; IEC 60068-2-6	Sinusoidal 5 Hz to 8 Hz: ±7.5 mm amplitude; 8 Hz to 150 Hz: 2 g acceleration frequency sweep 1 octave/min 20 cycles in 3 orthogonal axes
Shock IEC 60255-21-2, Class 1; IEC 60068-2-27	Semi-sinusoidal 15 g acceleration, duration 11 ms, each 3 shocks (in both directions of the 3 axes)
Continuous Shock IEC 60255-21-2, Class 1; IEC 60068-2-29	Semi-sinusoidal 10 g acceleration, duration 16 ms, each 1000 shocks (in both directions of the 3 axes)

4.1.7 Climatic Stress Tests

Temperatures

Standards:	IEC 60255-1, IEC 60068-2-1/2, IEC 60068-2-78, IEC 60068-2-30
Type test (in acc. with IEC 60068-2-1 and -2, Test Bd for 16 h)	–25 °C to +85 °C oder –13 °F to +185 °F
Damp heat, steady state - Test Cab IEC 60255-1 and IEC 60068-2-78.	40 °C, 93 % RH, 56 days
Damp heat, cyclic - Test Db IEC 60255-1 and IEC 60068-2-30	25 °C to/down 40 °C in 3 hr., > 93 % RH, dwell time 9 hr. 6 cycles
Permissible temporary operating temperature (tested for 96 h)	–20 °C to +70 °C oder –4 °F to +158 °F (clearness of the display may be impaired from +55 °C or +131 °F)
Recommended for permanent operation (in acc. with IEC 60255-6)	–5 °C to +55 °C or +23 °F to +131 °F
Limit temperatures for storage	–25 °C to +55 °C or –13 °F to +131 °F
Limit temperatures for transport	–25 °C to +70 °C or –13 °F to +158 °F
Storage and transport with factory packaging	

Humidity

Permissible humidity	Mean value per year ≤ 75 % relative humidity; on 56 days of the year up to 93 % relative humidity; condensation must be avoided!
Siemens recommends that all devices be installed such that they are not exposed to direct sunlight, nor subject to large fluctuations in temperature that may cause condensation to occur.	

4.1.8 Service Conditions

The protective device is designed for use in an industrial environment and an electrical utility environment. Proper installation procedures should be followed to ensure electromagnetic compatibility (EMC).

In addition, the following is recommended:

- All contacts and relays that operate in the same cubicle, cabinet, or relay panel as the numerical protective device should, as a rule, be equipped with suitable surge suppression components.
- For substations with operating voltages of 100 kV and above, all external cables should be shielded with a conductive shield grounded at both ends. For substations with lower operating voltages, no special measures are normally required.
- Do not withdraw or insert individual modules or boards while the protective device is energized. In withdrawn condition, some components are electrostatically endangered; during handling the ESD standards (for **E**lectrostatic **S**ensitive **D**evices) must be observed. They are not endangered when inserted into the case.

4.1.9 Constructive Design

Case	7XP20
Dimensions	see dimensional drawings, Section *4.12 Dimensions*

Device	Case	Size	Weight
7RW80**-*B	for panel surface mounting	1/6	4.5 kg (9.9 lb)
7RW80**-*E	for panel flush mounting	1/6	4 kg (8.8 lb)

Protection type acc. to IEC 60529	
For equipment in the surface-mounting case	IP 50
For equipment in flush mounting case	Front IP 51 Rear IP 50
For operator protection	IP 2x for current terminal IP 2x for voltage terminal
Degree of pollution, IEC 60255-27	2

4.1.10 UL certification conditions

The data in the following table apply to the device variants 7RW801 and 7RW802.

Output Relays	DC 24 V	5 A General Purpose
	DC 48 V	0,8 A General Purpose
	DC 240 V	0,1 A General Purpose
	AC 240 V	5 A General Purpose
	AC 120 V	1/3 hp
	AC 250 V	1/2 hp
	B300, R300	
Voltage Inputs	Input voltage range	300 V

Battery	Servicing of the circuitry involving the batteries and replacement of the lithium batteries shall be done by a trained technician. Replace Battery with VARTA or Panasonic Cat. Nos. CR 1/2 AA or BR 1/2 AA only. Use of another Battery may present a risk of fire or explosion. See manual for safety instructions. Caution: The battery used in this device may present a fire or chemical burn hazard if mistreated. Do not recharge, disassemble, heat above 100 °C (212 °F) or incinerate. Dispose of used battery promptly. Keep away from children.	
Climatic Stress Tests	Surrounding air temperature	tsurr: max. 70 °C (158 °F), normal operation
Design	Field Wires of Control Circuits shall be separated from other circuits with respect to the end use requirements!	
	Type 1 if mounted into a door or front cover of an enclosure.	

4.2 Voltage Protection

Setting Ranges / Increments

Undervoltages 27-1, 27-2, 27-Vp<		
Measured quantity used with three-phase connection	- Positive sequence system of voltages - Smallest phase-to-phase voltages - Smallest phase-to-ground voltage	
Measured quantity used with single-phase connection	Single-phase phase-to-ground or phase-to-phase voltage	
Connection of phase-to-ground voltages - Bewertung Leiter-ground voltages - Evaluation of phase-to-phase voltages - Evaluation of positive-sequence system	 10 V to 120 V 10 V to 210 V 10 V to 210 V	 Increment 1 V Increment 1 V Increment 1 V
Connection of phase-to-phase voltages	10 V to 120 V	Increment 1 V
Connection: single-phase	10 V to 120 V	Increment 1 V
Dropout ratio r for 27-1, 27-2[1)]	1.01 to 3.00	Increment 0.01
Dropout threshold for (r · 27-1) or (r · 27-2) or (r · 27-Vp<)	max.130 V for phase-to-phase voltage max. 225 V for phase-to-ground voltage Minimum hysteresis 0.6 V	
Time delays 27-1 DELAY, 27-2 DELAY, 27 T Vp<	0.00 s to 100.00 s oder ∞ (disabled)	Increment 0.01 s
Overvoltages 59-1, 59-2, 59-Vp>		
Measured quantity used with three-phase connection	- Positive sequence system of the voltages - Negative sequence system of the voltages - Largest phase-to-phase voltage - Largest phase-to-ground voltage	
Measured quantity used with single-phase connection	Connected single-phase phase-togroundvoltage or phase-to-phase voltage	
Connection of phase-to-ground voltages - Evaluation of phase-to-ground voltages - Evaluation of phase-to-phase voltages - Evaluation of positive-sequence system - Evaluation of negative-sequence system	 20 V to 150 V 20 V to 260 V 20 V to 150 V 2 V to 150 V	 Increment 1 V Increment 1 V Increment 1 V Increment 1 V
Connection of phase-to-phase voltages - Evaluation of phase-to-phase voltages - Evaluation of positive-sequence system - Evaluation of negative-sequence system	 20 V to 150 V 20 V to 150 V 2 V to 150 V	 Increment 1 V Increment 1 V Increment 1 V
Connection: single-phase	20 V to 150 V	Increment 1 V
Dropout ratio r for 59-1, 59-2[1)]	0.90 to 0.99	Increment 0.01 V
Dropout threshold for (r · 59-1) or (r · 59-2) or (r · 59-Vp>)	max. 150 V for phase-to-phase voltage max. 260 V for phase-to-ground voltage Minimum hysteresis 0.6 V	
Time delays 59-1 DELAY, 59-2 DELAY, 59 T Vp>	0.00 s to 100.00 s or ∞ (disabled)	Increment 0.01 s
[1)] $r = V_{dropout}/V_{pickup}$		

Times

Pickup Times	
Undervoltage 27-1, 27-2, 27-1 V_1, 27-2 V_1, 27-Vp< - Overvoltage 59-1, 59-2, 59-Vp> - Overvoltage 59-1 V_1, 59-2 V_1, 59-1 V_2 , 59-2 V_2, 59-Vp> V_1, 59-Vp> V_2	approx. 50 ms approx. 50 ms approx. 60 ms
Dropout Times	
- Undervoltage 27-1, 27-2, 27-1 V_1, 27-2 V_1, 27-Vp> - Overvoltage 59-1, 59-2, 59-Vp> - Overvoltage 59-1 V_1, 59-2 V_1, 59-1 V_2 , 59-2 V_2, 59-Vp> V_1, 59-Vp> V_2	approx. 50 ms approx. 50 ms approx. 60 ms

Tolerances

Pickup Voltage Limits	3 % of setting value or 1 V
Delay times T	1 % of setting value or. 10 ms

Influencing Variables

Auxiliary DC voltage in range $0.8 \leq V_{Aux}/V_{AuxNom} \leq 1{,}15$	1 %
Temperature in range –5 °C (23 °F) ≤ Θ_{amb} ≤ 55 °C (131 °F)	0.5 %/10 K
Frequency in the range of 25 Hz to 70 Hz	
Frequency in the range of $0.95 \leq f/f_{Nom} \leq 1.05$ (f_{Nom} = 50 Hz or 60 Hz)	1 %
Frequency outside range $0.95 \leq f/f_{Nom} \leq 1.05$	Increased tolerances
Harmonics - up to 10 % 3rd harmonic - up to 10 % 5th harmonic	 1 % 1 %

4.3 Frequency Protection 81 O/U

Setting Ranges / Increments

Setting Ranges / Increments	4; each can be set to f> or f<	
Pickup values f> or f< for f_{Nom} = 50 Hz	40.00 Hz to 60.00 Hz	Increments 0.01 Hz
Pickup values f> or f< for f_{Nom} = 60 Hz	50.00 Hz to 70.00 Hz	Increments 0.01 Hz
Dropout threshold = |pickup threshold - dropout threshold|	0.02 Hz to 1.00 Hz	Increments 0.01 Hz
Time delays T	0.00 s to 100.00 s or ∞ (disabled)	Increments 0.01 s
Undervoltage blocking with three-phase connection: Positive sequence component V_1 with single-phase connection ("Vphn, Vsyn"): single-phase Phase-to-ground voltage	10 V to 150 V	Increments 1 V

Times

Pickup times f>, f<	approx. 100 ms at f_{Nom} = 50 Hz approx. 80 ms at f_{Nom} = 60 Hz
Dropout times f>, f<	approx. 100 ms at f_{Nom} = 50 Hz approx. 80 ms at f_{Nom} = 60 Hz

Dropout Difference

Δf = I pickup value - dropout value I	0.02 Hz to 1 Hz

Dropout Ratio

Dropout Ratio for Undervoltage Blocking	approx. 1.05

Tolerances

Pickup frequencies 81/O or 81U	≤ 5 mHz Tolerance (at V = V_{Nom}, f_{Nom} - 0.5 Hz < f < f_{Nom} + 0.5 Hz) < 15 mHz Tolerance (at V = V_{Nom}, f_{Nom} - 5 Hz < f < f_N - 0.5 Hz) < 15 mHz Tolerance (at V = V_{Nom}, f_{Nom} + 0.5 Hz < f < f_{Nom} + 5 Hz)
Undervoltage blocking	3 % of setting value or 1 V
Time delays 81/O or 81/U	1 % of setting value or 10 ms

Influencing Variables

Power supply direct voltage in range 0.8 ≤ V_{PS}/V_{PSNom} ≤ 1.15	1 %
Temperature in range 23 °F (-5 °C) ≤ Θ_{amb} ≤ 131 °F (55 °C)	0,5 %/10 K
Harmonics - up to 10 % 3rd harmonic - up to 10 % 5th harmonic	 1 % 1 %

4.4 Load Restoration

Setting Ranges / Increments

Setting Ranges / Increments	4	
Start threshold with f_{Nom} = 50 Hz	40.00 Hz to 60.00 Hz	Increments 0.01 Hz
Start threshold with f_{Nom} = 60 Hz	50.00 Hz to 70.00 Hz	Increments 0.01 Hz
Pickup Threshold = |Start threshold – Pickup threshold|	0.02 Hz to 2.00 Hz	Increments 0.01 Hz
Dropout Threshold = |Start threshold – Dropout threshold|	0.00 Hz to 2.00 Hz	Increments 0.01 Hz
Delay times T Pickup and Dropout	0 s to 10800 s	Increments 1 s
Delay times T CB-Close command	0.01 s to 32.00 s	

Times

Pickup times	approx. 100 ms at f_{Nom} = 50 Hz approx. 80 ms at f_{Nom} = 60 Hz
Dropout Times	approx. 100 ms at f_{Nom} = 50 Hz approx. 80 ms at f_{Nom} = 60 Hz

Tolerances

Pickup frequencies	15 mHz (with $U = U_{Nom}$, $f = f_{Nom} \pm 5$ Hz)
Undervoltage blocking	3 % of setting value or 1 V
Time delays	1 % of setting value or 10 ms

Influencing Variables

Power supply direct voltage in range $0.8 \leq V_{Aux}/V_{AuxNom} \leq 1.15$	1 %
Temperature in the Range 23.00 °F (–5 °C) $\leq \Theta_{amb} \leq$ 131.00 °F (55 °C)	0.5 %/10 K
Oberschwingungen - up to 10 % 3rd harmonic - up to 10 % 5th harmonic	 1 % 1 %

4.5 Flexible Protection Functions

Measured Values / Modes of Operation

Three-phase	V, $3V_0$, V1, V2, dV/dt
Single-phase	V, V_N,V_x
Without fixed phase reference	f, df/dt, binary input
Measurement method for V	Fundamental, r.m.s. value (true RMS), positive sequence system, negative sequence system, zero sequence system
Pickup on	exceeding threshold value or falling below threshold value

Setting Ranges / Increments

Pickup thresholds:			
Voltage V, V_1, V_2, $3V_0$		2.0 V to 260.0 V	Increments 0.1 V
Displacement voltage V_0		2.0 V to 200.0 V	Increments 0.1 V
Frequency	for f_{Nom} = 50 Hz for f_{Nom} = 60 Hz	40.0 Hz to 60.0 Hz 50.0 Hz to 70.0 Hz	Increments 0.01 Hz Increments 0.01 Hz
Frequency change df/dt		0.10 Hz/s to 20.00 Hz/s	Increments 0.01 Hz/s
Voltage change dV/dt		4 V/s to 100 V/s	Increments 1 V/s
Dropout ratio > element		1.01 to 3.00	Increments 0.01
Dropout ratio < element		0.70 to 0.99	Increments 0.01
Dropout difference f		0.02 Hz to 1.00 Hz	Increments 0.01 Hz
Pickup delay (standard)		0.00 s to 60.00 s	Increments 0.01 s
Command delay time		0.00 s to 3,600.00 s	Increments 0.01 s
Dropout delay		0.00 s to 60.00 s	Increments 0.01 s

Fixed Dropout Difference

Dropout difference df/dt	0.1 Hz/s
Dropout difference dV/dt	3 V/s

Times

Pickup times:	
Voltage (phase quantities) for 2 times the setting value for 10 times the setting value	 approx. 30 ms approx. 20 ms
Voltage (symmetrical components) for 2 times the setting value for 10 times the setting value	 approx. 40 ms approx. 30 ms
Frequency	approx. 100 ms
Frequency change for 1.25 times the setting value	approx. 220 ms
Voltage change dV/dt for 2 times the setting value	approx. 220 ms
Binary input	approx. 20 ms

Dropout times:	
Voltage (phase quantities)	< 20 ms
Current, voltage (symmetrical components)	< 30 ms
Frequency	< 100 ms
Frequency change	< 200 ms
Voltage change	< 200 ms
Binary input	< 10 ms

Tolerances

Pickup thresholds:	
Voltage	3% of setting value or 0,2 V
Voltage (symmetrical components)	4% of setting value or 0,2 V
Voltage change dV/dt	5 % of setting value or 2 V/s
Frequency	15 mHz
Frequency change	5% of setting value or 0,05 Hz/s
Times	1% of setting value or 10 ms

Influencing Variables for Pickup Values

Auxiliary DC voltage in range $0.8 \leq V_{Aux}/V_{AuxNom} \leq 1,15$	1 %
Temperature in range –5 °C (23 °F) $\leq \Theta_{amb} \leq$ 55 °C (131 °F)	0.5 %/10 K
Frequency in the range of 25 Hz to 70 Hz	
Frequency in the range of $0.95 \leq f/f_{Nom} \leq 1.05$ (f_{Nom} = 50 Hz or 60 Hz)	1 %
Frequency outside range $0.95 \leq f/f_{Nom} \leq 1.05$	Increased tolerances
Harmonics - up to 10 % 3rd harmonic - up to 10 % 5th harmonic	 1 % 1 %

4.6 Synchrocheck 25

Modes of Operation

- Synchrocheck

Additional Release Conditions

- Live bus / dead line, - Dead bus / live line, - Dead bus and dead line - Bypassing

Voltages

Maximum operating voltage V_{max}	20 V to 140 V (phase-to-phase)	Increments 1 V
Minimum operating voltage V_{min}	20 V to 125 V (phase-to-phase)	Increments 1 V
V< for dead line V> for live line	1 V to 60 V (phase-to-phase) 20 V to 140 V (phase-to-phase)	Increments 1 V Increments 1 V
Primary transformer rated voltage V2N	0.10 kV to 800.00 kV	Increments 0.01 kV
Tolerances	2 % of pickup value or 2 V	
Dropout Ratios	approx. 0.9 (V>) or 1.1 (V<)	

Permissible Difference

Voltages differences V2>V1; V2<V1 Tolerance	0.5 V to 50.0 V (phase-tophase) 1 V	Increments 0.1 V
Frequency Difference f2>f1; f2<f1 Tolerance	0.01 Hz to 2.00 Hz 20 mHz	Increments 0.01 Hz
Angle Difference α2 > α1; α2 < α1	2° to 80°	Increments 1°
Tolerance	2°	
Max. angle error	5° for Δf ≤ 1 Hz 10° for Δf >1 Hz	

Matching

Vector group matching via angle	0° to 360°	Increments 1°
Different voltage transformer V1/V2	0.50 to 2.00	Increments 0.01

Times

Minimum Measuring Time	approx. 80 ms	
Maximum duration $T_{SYN\ DURATION}$	0.01 s to 1200.00 s or ∞ (disabled)	Increments 0.01 s
Monitoring Time $T_{SUP\ VOLTAGE}$	0.00 s to 60.00 s	Increments 0.01 s
Tolerance of all times	1 % of setting value or 10 ms	

Measured Values of the Synchronism and Voltage Check

Reference voltage V1 - Range - Tolerance [1)]	in kV primary, in V secondary or in % V_{Nom} 10 % to 120 % of V_{Nom} ≤ 1 % of measured value, or 0,5 % V_{Nom}

Voltage to be synchronized V2 - Range - Tolerance [1)]	in kV primary, in V secondary or in % V_{Nom} 10 % to 120 % of V_{Nom} ≤ 1 % of measured value, or 0,5 % V_{Nom}
Frequency of the voltage V1 - Range - Tolerance [1)]	f1 in Hz f_{Nom} ± 5 Hz 20 mHz
Frequency of the voltage V2 - Range - Tolerance [1)]	f2 in Hz f_{Nom} ± 5 Hz 20 mHz
Voltage difference V2-V1 - Range - Tolerance [1)]	in kV primary, in V secondary or in % V_N 10 % bis 120 % of V_N ≤ 1 % of measured value, or 0,5 % V_N
Frequency difference f2-f1 - Range - Tolerance [1)]	in mHz f_{Nom} ± 5 Hz 20 mHz
Angle difference λ2-λ1 - Range - Tolerance [1)]	in ° 0 to 180° 0,5°
[1)] at nominal frequency	

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Setting Ranges / Increments

Pickup threshold of the warning stage $\frac{V/V_N}{f/f_N}$	1.00 to 1.20	Increments 0.01
Pickup threshold of the stage characteristic $\frac{V/V_N}{f/f_N}$	1.00 to 1.40	Increments 0.01
Delay times T V/f>, T V/f>> (Alarm and stage characteristic)	0.00 s to 60.00 s or ∞ (inactive)	Increments 0.01 s
Characteristic value pairs V/f	1.05/1,10/1,15/1,20/1.25/1,30/1.35/1.40	
Associated time delay for t (V/f) thermal replica	0 s to 20 000 s	Increments 1 s
Cooling time T_{COOL}	0 s to 20 000 s	Increments 1 s

Times

Alarm and stage characteristic	
Pickup times for 1.1 · Setting value	approx. 90 ms
Dropout Times	approx. 60 ms

Dropout Ratios

Pickup, Tripping	approx. 0.98

Tripping Characteristic

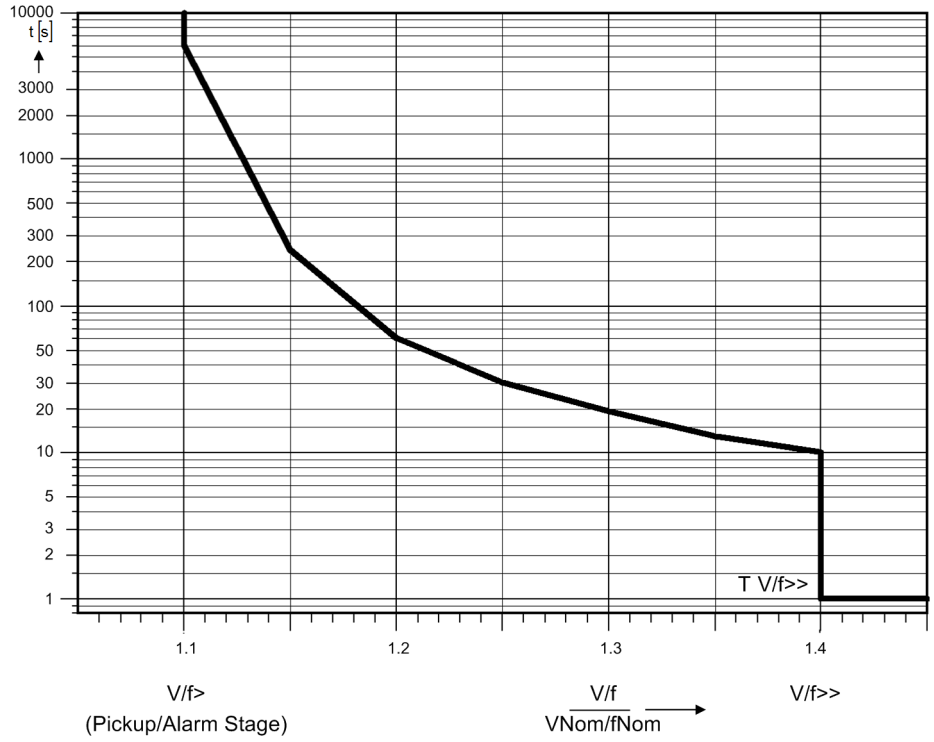
Thermal Replica (Presetting and stage characteristic)	see *Figure 4-1*

Tolerances

Pickup on V/f	3 % of setting value
Delay times T (Alarm and stage characteristic)	1 % of setting value or 10 ms
Thermal replica (time characteristic)	5 %, related to V/f ±600 ms

Influencing Variables

Power supply direct voltage in range $0.8 \le V_{Aux}/V_{AuxNom} \le 1.15$	≤ 1 %
Temperature in the Range 23.00 °F (–5 °C) ≤ Θ_{amb}≤ 131.00 °F (55 °C)	≤ 0.5 %/10 K
Harmonics - up to 10 % 3rd harmonic - up to 10 % 5th harmonic	 ≤ 1 % ≤ 1 %



[resultierende-ausloesekennlinie-aus-therm-020830-ho, 1, en_US]

Figure 4-1 Resulting Tripping Characteristic from Thermal Replica and Stage Characteristic of the Overexcitation Protection (Default Setting)

4.8 Jump of Voltage Vector

Setting Ranges / Increments

Element Δφ	2° to 30°	Increments 1°
Delay times T	0.00 to 60.00 s or ∞ (inactive)	Increments 0.01 s
Reset Time T_{Reset}	0.00 to 60.00 s or ∞ (inactive)	Increments 0.00 s
Undervoltage Blocking	10.0 to 125.0 V	Increments 0.1 V

Times

Pickup Times Δφ	approx. 75 ms
Dropout Times Δφ	approx. 75 ms

Dropout Ratios

–	–

Tolerances

Jump of Phasor	2° at $V > 0.5\ V_N$
Undervoltage Blocking	1 % of setting value or 0.5 V
Delay times T	1 % of setting value or 10 ms

Influencing Variables

Power supply direct voltage in range $0.8 \le V_{Aux}/V_{AuxNom} \le 1.15$	≤ 1 %
Temperature in the Range 23.00 °F (–5 °C) ≤ Θ_{amb}≤ 131.00 °F (55 °C)	≤ 0.5 %/10 K
Frequency in Range $0.95 \le f/f_{Nom} \le 1.05$	≤ 1 %
Harmonics - up to 10 % 3nd harmonic - up to 10 % 5th harmonic	 ≤ 1 % ≤ 1 %

4.9 User-defined Functions (CFC)

Function Blocks and Their Possible Assignments to Task Levels

Function block	Explanation	Task level			
		MW_ BEARB	PLC1_ BEARB	PLC_ BEARB	SFS_ BEARB
ABSVALUE	Magnitude Calculation	X	—	—	—
ADD	Addition	X	X	X	X
ALARM	Alarm	X	X	X	X
AND	AND - Gate	X	X	X	X
BLINK	Blink block	X	X	X	X
BOOL_TO_CO	Boolean to Control (conversion)	—	X	X	—
BOOL_TO_DI	Boolean to Double Point (conversion)	—	X	X	X
BOOL_TO_IC	Bool to Internal SI, Conversion	—	X	X	X
BUILD_DI	Create Double Point Annunciation	—	X	X	X
CMD_CANCEL	Cancel command	X	X	X	X
CMD_CHAIN	Switching Sequence	—	X	X	—
CMD_INF	Command Information	—	—	—	X
COMPARE	Metered value comparison	X	X	X	X
CONNECT	Connection	—	X	X	X
COUNTER	Counter	X	X	X	X
DI_GET_STATUS	Decode status of double-point indication	X	X	X	X
DI_SET_STATUS	Generate double-point indication with status	X	X	X	X
D_FF	D- Flipflop	—	X	X	X
D_FF_MEMO	Status Memory for Restart	X	X	X	X
DI_TO_BOOL	Double Point to Boolean (conversion)	—	X	X	X
DINT_TO_REAL	Adaptor	X	X	X	X
DIST_DECODE	Convert double-point indication with status into four single-point indications with status	X	X	X	X
DIV	Division	X	X	X	X
DM_DECODE	Decode Double Point	X	X	X	X
DYN_OR	Dynamic OR	X	X	X	X
INT_TO_REAL	Conversion	X	X	X	X
IO_UNIT	SICAM I/O Unit		X	X	
LIVE_ZERO	Live-zero, non-linear Curve	X	—	—	—
LONG_TIMER	Timer (max.1193h)	X	X	X	X
LOOP	Feedback Loop	X	X	—	X
LOWER_SETPOINT	Lower Limit	X	—	—	—
MUL	Multiplication	X	X	X	X
MV_GET_STATUS	Decode status of a value	X	X	X	X
MV_SET_STATUS	Set status of a value	X	X	X	X
NAND	NAND - Gate	X	X	X	X
NEG	Negator	X	X	X	X
NOR	NOR - Gate	X	X	X	X

Function block	Explanation	Task level			
		MW_ BEARB	PLC1_ BEARB	PLC_ BEARB	SFS_ BEARB
OR	OR - Gate	X	X	X	X
REAL_TO_DINT	Adaptor	X	X	X	X
REAL_TO_INT	Conversion	X	X	X	X
REAL_TO_UINT	Conversion	X	X	X	X
RISE_DETECT	Edge detector	X	X	X	X
RS_FF	RS- Flipflop	—	X	X	X
RS_FF_MEMO	RS- Flipflop with status memory	—	X	X	X
SQUARE_ROOT	Root Extractor	X	X	X	X
SR_FF	SR- Flipflop	—	X	X	X
SR_FF_MEMO	SR- Flipflop with status memory	—	X	X	X
ST_AND	AND gate with status	X	X	X	X
ST_NOT	Inverter with status	X	X	X	X
ST_OR	OR gate with status	X	X	X	X
SUB	Substraction	X	X	X	X
TIMER	Timer	—	X	X	—
TIMER_SHORT	Simple timer	—	X	X	—
UINT_TO_REAL	Conversion	X	X	X	X
UPPER_SETPOINT	Upper Limit	X	—	—	—
X_OR	XOR - Gate	X	X	X	X
ZERO_POINT	Zero Supression	X	—	—	—

General Limits

Description	Limit	Comment
Maximum number of all CFC charts considering all task levels	32	If the limit is exceeded, the device rejects the parameter set with an error message, restores the last valid parameter set and restarts using that parameter set.
Maximum number of all CFC charts considering one task level	16	When the limit is exceeded, an error message is output by the device. Consequently, the device starts monitoring. The red ERROR-LED lights up.
Maximum number of all CFC inputs considering all charts	400	When the limit is exceeded, an error message is output by the device. Consequently, the device starts monitoring. The red ERROR-LED lights up.
Maximum number of reset-resistant flipflops D_FF_MEMO	350	When the limit is exceeded, an error message is output by the device. Consequently, the device starts monitoring. The red ERROR-LED lights up.

Device-Specific Limits

Description	Limit	Comment
Maximum number of synchronous changes of chart inputs per task level	165	When the limit is exceeded, an error message is output by the device. Consequently, the device starts monitoring. The red ERROR-LED lights up.
Maximum number of chart outputs per task level	150	

Additional Limits

Additional limits [1] for the following CFC blocks:		
Task Level	**Maximum Number of Modules in the Task Levels**	
	TIMER[2] [3]	TIMER_SHORT[2] [3]
MW_BEARB	—	—
PLC1_BEARB	15	30
PLC_BEARB		
SFS_BEARB	—	—

[1] When the limit is exceeded, an error message is iisued by the device. Consequently, the device starts monitoring. The red ERROR-LED lights up.

[2] The following condition applies for the maximum number of timers: (2 · number of TIMER + number of TIMER_SHORT) < 30. TIMER and TIMER_SHORT hence share the available timer resources within the frame of this inequation. The limit does not apply to the LONG_TIMER.

[3] The time values for the blocks TIMER and TIMER_SHORT must not be selected shorter than the time resolution of the device of 10 ms, as then, the blocks will not then start with the starting pulse.

Maximum Number of TICKS in the Task Levels

Task level	Limit in TICKS [1]
MW_BEARB (measured value processing)	10000
PLC1_BEARB (slow PLC processing)	12000
PLC_BEARB (fast PLC processing)	600
SFS_BEARB (interlocking)	10000

[1] When the sum of TICKS of all blocks exceeds the limits mentioned before, an error message is output in the CFC.

Processing Times in TICKS for the Individual Elements

Individual element		Number of TICKS
Block, basic requirement		5
Each input from the 3rd additional input on for generic modules		1
Combination with input signal border		6
Combination with output signal border		7
Additionally for each chart		1
Arithmetic	ABS_VALUE	5
	ADD	26
	SUB	26
	MUL	26
	DIV	54
	SQUARE_ROOT	83
Base logic	AND	5
	CONNECT	4
	DYN_OR	6
	NAND	5
	NEG	4
	NOR	5
	OR	5
	RISE_DETECT	4
	X_OR	5

Individual element		Number of TICKS
Information status	SI_GET_STATUS	5
	CV_GET_STATUS	5
	DI_GET_STATUS	5
	MV_GET_STATUS	5
	SI_SET_STATUS	5
	DI_SET_STATUS	5
	MV_SET_STATUS	5
	ST_AND	5
	ST_OR	5
	ST_NOT	5
Memory	D_FF	5
	D_FF_MEMO	6
	RS_FF	4
	RS_FF_MEMO	4
	SR_FF	4
	SR_FF_MEMO	4
Control commands	BOOL_TO_CO	5
	BOOL_TO_IC	5
	CMD_INF	4
	CMD_INF_EXE	4
	CMD_CHAIN	34
	CMD_CANCEL	3
	LOOP	8
Type converter	BOOL_TO_DI	5
	BUILD_DI	5
	DI_TO_BOOL	5
	DM_DECODE	8
	DINT_TO_REAL	5
	DIST_DECODE	8
	UINT_TO_REAL	5
	REAL_TO_DINT	10
	REAL_TO_UINT	10
Comparison	COMPARE	12
	LOWER_SETPOINT	5
	UPPER_SETPOINT	5
	LIVE_ZERO	5
	ZERO_POINT	5
Metered value (counter)	COUNTER	6
Time and clock pulse	TIMER	5
	TIMER_LONG	5
	TIMER_SHORT	8
	ALARM	21
	BLINK	11
Other	IO_UNIT	17

Routable in Matrix

In addition to the defined preassignments, indications and measured values can be freely routed to buffers, preconfigurations can be removed.

4.10 Auxiliary Functions

Operational Measured Values

Voltages (phase-to-ground) V_{A-N}, V_{B-N}, V_{C-N} Voltages (phase-to-phase) V_{A-B}, V_{B-C}, V_{C-A}, V_{SYN} V_N, V_{ph-N}, V_x or V_0 Positive sequence component V_1 Negative sequence component V_2		in kV primary, in V secondary or in % V_{Nom}
	Range Tolerance [1]	10 % to 120 % V_{Nom} 1,5 % of measured value or 0,5 % V_N
Frequenz f		in Hz
	Range Tolerance [1]	f_{Nom} ± 5 Hz 20 mHz
Synchronization Function		see section (Synchronization Function)
[1] at nominal frequency		

Min / Max Report

Report of Measured Values	with date and time
Reset automatic	Time of day adjustable (in minutes, 0 to 1439 min) Time frame and starting time adjustable (in days, 1 to 365 days, and ∞)
Manual Reset	Using binary input Using keypad Via communication
Min/Max Values for Voltages	V_{A-N}; V_{B-N}; V_{C-N}; V_1 (Positive Sequence Component); V_{A-B}; V_{B-C}; V_{C-A}

Broken-wire Monitoring of Voltage Transformer Circuits

suited for 1- or 2-pole broken-wire detection of voltage transformer circuits; only for connection of phase-ground voltages

Fault Logging

Recording of indications of the last 25 power system faults
Recording of indications of the last 3 power system ground faults

Time Allocation

Resolution for Event Log (Operational Annunciations)	1 ms
Resolution for Trip Log (Fault Annunciations)	1 ms
Maximum Time Deviation (Internal Clock)	0.01 %
Battery	Lithium battery 3 V/1 Ah, Typ CR 1/2 AA Message “Battery Fault” for insufficient battery charge

Local Measured Values Monitoring

Voltage Asymmetry	V_{max}/V_{min} > balance factor, for V > V_{Grenz}
Voltage phase sequence	Clockwise (ABC) / counter-clockwise (ACB)

Fault Recording

maximum of 8 fault records saved; memory maintained by buffer battery in the case of auxiliary voltage failure	
Recording time	5 s per fault record, in total up to 18 s at 50 Hz (max. 15 s at 60 Hz)
Intervals at 50 Hz Intervals at 60 Hz	1 instantaneous value each per 1.0 ms 1 instantaneous value each per 0.83 ms

Statistics

Stored number of trips	Up to 9 digits

Operating Hours Counter

Display Range	Up to 7 digits

Trip Circuit Supervision

With one or two binary inputs

Commissioning Aids

- Phase rotation field check - Operational measured values - Circuit breaker test by means of control function - Creation of a test measurement report - Creation of messages

Clock

Time synchronization		Binary input Communication
Modes of operation for time tracking		
No.	Mode of operation	Explanations
1	Internal	Internal synchronization using RTC (presetting)
2	IEC 60870-5-103	External synchronization using port B (IEC 60870-5-103)
3	Pulse via binary input	External synchronization with pulse via binary input
4	Fieldbus (DNP, Modbus)	External synchronization using field bus
5	SNTP (IEC 61850)	External synchronization using port B (IEC 61850)

Setting Group Change Option of the Functional Settings

Number of Available Setting Groups	4 (parameter group A, B, C and D)
Switchover Performed	using the keypad DIGSI using the front PC port Protocol using port B Binary Input

IEC 61850 GOOSE (inter-relay communication)

The GOOSE communication service of IEC 61850 is qualified for switchgear interlocking The runtime of GOOSE messages with the protection relay picked up depends on the number of connected IEC 61850 clients.

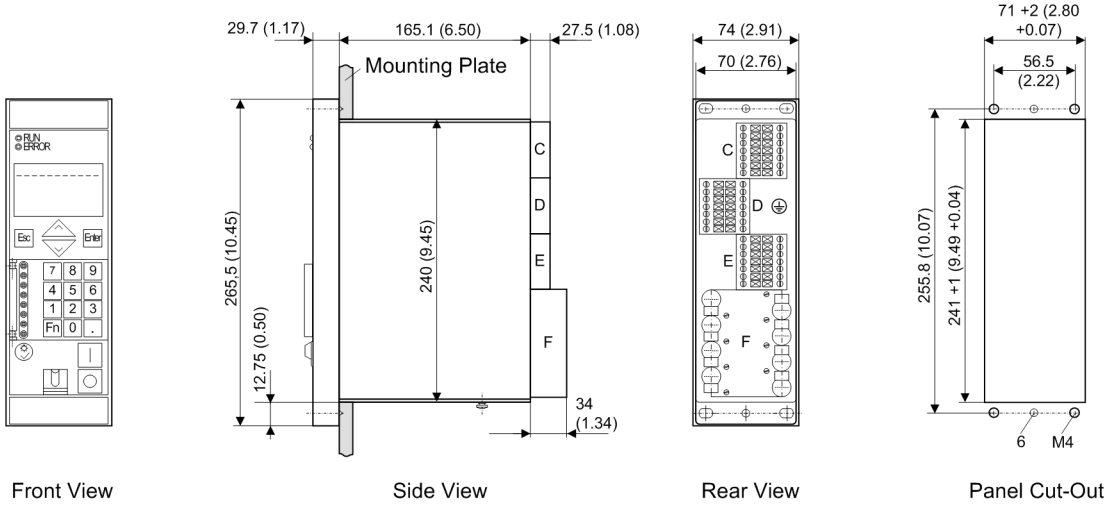
As from version V4.6 of the devices, applications with protective functions have to be checked with regard to their required runtime. In individual cases, the manufacturer has to be consulted with regard to the requirements to ensure that the application functions safely.

4.11 Switching Device Control

Number of Controlled Switching Devices	Depends on the number of binary inputs and outputs available
Interlocking	Freely programmable interlocking
Messages	Single command / double command
Control Commands	Single command / double command
Switching Command to Circuit Breaker	1-, 1½ - and 2-pole
Programmable Logic Controller	PLC logic, graphic input tool
Local Control	Control via menu control assignment of function keys
Remote Control	Using Communication Interfaces Using a substation automation and control system (e.g. SICAM) Using DIGSI (e.g. via Modem)

4.12 Dimensions

4.12.1 Panel Flush and Cubicle Mounting (Housing Size 1/6)



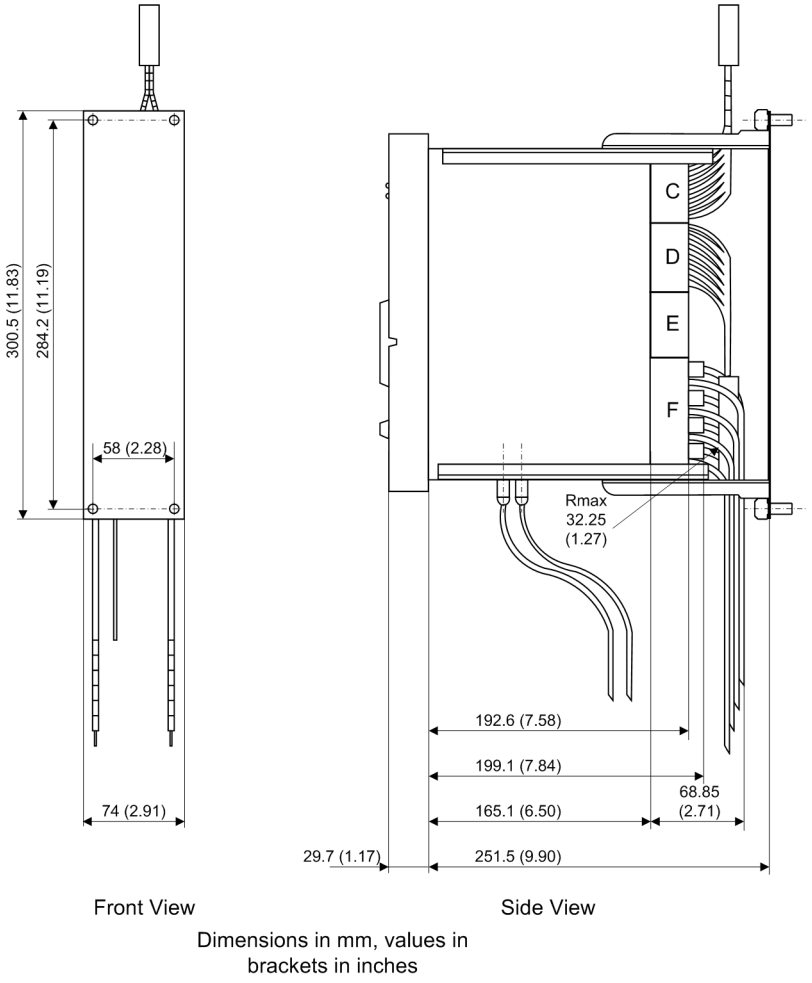
[abmess-sechstel-gehaeuse-7sx80-060606, 1, en_US]

Figure 4-2 Dimensional drawing of a 7RW80 for panel flush or cubicle mounting (housing size $^1/_6$)

Note: A set of mounting brackets (consisting of upper and lower mounting rail) (order no. C73165-A63-D200-1) is required for cubicle mounting. When using the Ethernet interface, it may be necessary to rework the lower mounting rail.

Provide for sufficient space at the device bottom side or below the device to accommodate the cables of the communication modules.

4.12.2 Panel Surface Mounting (Housing Size 1/6)



[abmess-sechstel-gehaeuse-aufbau-7sx80-060606, 1, en_US]

Figure 4-3 Dimensional drawing of a 7RW80 for panel surface mounting (housing size $^1/_6$)

4.12.3 Bottom view

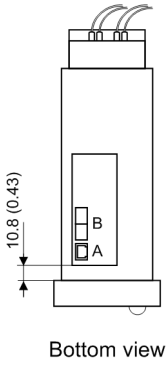


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Figure 4-4 Bottom view of a 7RW80 (housing size $^1/_6$)