SIPROTEC Compact 7RW80 Voltage and Frequency Protection

V4.6

Technical Data

Extract from manual C53000-G1140-C233-1, chapter 4

Energy Automation

SIEMENS

Note

For safety purposes, please note instructions and warnings in the Preface.

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Preface

Purpose of this Manual

This manual describes the functions, operation, installation, and commissioning of 7RW80 devices. 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/.

Target Audience

Protection engineers, commissioning engineers, personnel concerned with adjustment, checking, and service of selective protective equipment, automatic and control facilities, and personnel of electrical facilities and power plants.

Applicability of this Manual

This manual applies to: 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 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

Should further information on the System SIPROTEC 4 be desired or should particular problems arise which are not covered sufficiently for the purchaser's purpose, the matter should be referred to the local Siemens representative.

Our Customer Support Center provides a 24-hour service.

Telephone: +49 (180) 524-7000

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e-mail: support.energy@siemens.com

Training Courses

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

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Internet: www.siemens.com/power-academy-td

Technical Data

4

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

DC 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 24 V to 48 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	

AC Voltage

Voltage supply via an integrated converter		
Nominal auxiliary AC voltage V_H	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 115 VAC / 230 VAC)	Quiescent	Energized
7RW80	approx. 5 VA	approx. 12 VA
Bridging time for failure/short-circuit	≥ 10 ms at V= 115/230 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	24 to 125 VDC	V high > 19 VDC V low < 10 VDC
for Nominal Voltages	110 to 250 VDC	V high > 88 VDC V low < 44 VDC
for Nominal Voltages	220 and 250 VDC	V high > 176 VDC V low < 88 VDC
Maximum Permissible Voltage	300 VDC	
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

Operator 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
Operation	With DIGSI
Transmission speed	up to 12 Mbit/s max.
Bridgeable distance	5 m

Port A

Ethernet electrical for DIGSI	Operation	With DIGSI
	Terminal	Front case bottom, mounting location "A", RJ45 socket 100BaseT in acc. with IEEE802.3 LED yellow: 10/100 Mbit/s (on/off) LED green: connection/no connection (on/off)
	Test voltage	500 V; 50 Hz
	Transmission speed	10/100 Mbit/s
	Bridgeable distance	20 m (66 ft)

Port B

IEC 60870-5-103 single		
	RS232/RS485/FO according to the order variant	Isolated interface for data transfer to a control terminal
RS232		
	Connection	Back case bottom, mounting location "B", 9-pin DSUB socket
	Test Voltage	500 V; 50 Hz
	Transmission speed	min. 1 200 Bd, max. 115 000 Bd; Factory setting 9 600 Bd
	Maximum distance of transmission	15 m
RS485		
	Connection	Back case bottom, mounting location "B", 9-pin DSUB socket
	Test Voltage	500 V; 50 Hz
	Transmission Speed	min. 1 200 Bd, max. 115 000 Bd; Factory setting 38 400 Bd
	Maximum distance of transmission	max. 1 km

Fibre Optical Link (FO)		
	FO connector type	ST-Connector
	Connection	Back case bottom, mounting location "B"
	Optical wavelength	λ = 820 nm
	Laser Class 1 according to EN 60825-1/-2	using glass fiber 50 µm/125 µm or using glass fiber 62.5 µm/125 µm
	Permissible optical link signal attenuation	max. 8 dB, with glass fiber 62.5 µm/125 µm
	Maximum distance of transmission	max. 1.5 km
	Character idle state	Configurable; factory setting „Light off“
Profibus RS485 (DP)		
	Connection	Back case bottom, mounting location "B", 9-pin DSUB socket
	Test Voltage	500 V; 50 Hz
	Transmission Speed	up to 1.5 MBd
	Maximum distance of transmission	1.000 m / 3280 feet at ≤ 93.75 kBd 500 m / 1640 feet at ≤ 187.5 kBd 200 m / 660 feet at ≤ 1.5 MBd
Profibus FO (DP)		
	FO connector type	ST-Connector Double ring
	Connection	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	using glass fiber 50 µm/125 µm or using glass fiber 62.5 µm/125 µm
	Permissible optical link signal attenuation	max. 8 dB, with glass fiber 62.5 µm/125 µm
	Maximum distance of transmission	max. 1.5 km
DNP3.0 /MODBUS RS485		
	Connection	Back case bottom, mounting location "B", 9-pin DSUB socket
	Test Voltage	500 V; 50 Hz
	Transmission Speed	up to 19.200 Bd
	Maximum distance of transmission	max. 1 km
DNP3.0 /MODBUS Fibre Optical Link		
	FO connector type	ST connector transmitter/receiver
	Connection	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	using glass fiber 50 µm/125 µm or using glass fiber 62.5 µm/125 µm
	Permissible optical link signal attenuation	max. 8 dB, with glass fiber 62.5 µm/125 µm
	Maximum distance of transmission	max. 1.5 km

Ethernet electrical (EN 100) for IEC61850 and DIGSI		
	Connection	Back case bottom, mounting location "B" 2 x RJ45 socket 100BaseT in acc. with IEEE802.3
	Test voltage (with regard to the socket)	500 V; 50 Hz
	Transmission Speed	100 Mbit/s
	Maximum distance of transmission	20 m
Ethernet electrical (EN 100) for IEC61850 and DIGSI		
	Connection	Back case bottom, mounting location "B" LC connector 100BaseF in acc. with IEEE802.3
	Transmission Speed	100 Mbit/s
	Optical wavelength	1300 nm
	Maximum distance of transmission	max. 2 km

4.1.5 Electrical Tests

Standards

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); 1.2/50 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); 1.2/50 µs; 0.5 J; 3 positive and 3 negative impulses at intervals of 1 s

EMC Tests for Immunity (Type Tests)

Standards:		IEC 60255-6 and -22, (product standards) IEC/EN 61000-6-2 VDE 0435 For more standards see also individual functions
1 MHz test, Class III IEC 60255-22-1, IEC 61000-4-18, IEEE C37.90.1		2.5 kV (Peak); 1 MHz; τ = 15 µs; 400 Surges per s; Test duration 2 s; R_i = 200 Ω
Electrostatic discharge, Class IV IEC 60255-22-2, IEC 61000-4-2		8 kV contact discharge; 15 kV air discharge, both polarities; 150 pF; R_i = 330 Ω
Radio frequency electromagnetic field, amplitude-modulated, Class III IEC 60255-22-3, IEC 61000-4-3		10 V/m; 80 MHz to 2.7 GHz; 80 % AM; 1 kHz
Fast transient bursts, Class IV IEC 60255-22-4, IEC 61000-4-4, IEEE C37.90.1		4 kV; 5/50 ns; 5 kHz; burst length = 15 ms; repetition rate 300 ms; both polarities: R_i = 50 Ω; test duration 1 min
High energy surge voltages (SURGE), Installation Class III IEC 60255-22-5, IEC 61000-4-5		Impulse: 1.2/50 µs
	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
HF on lines, amplitude-modulated, Class III IEC 60255-22-6, IEC 61000-4-6		10 V; 150 kHz to 80 MHz; 80 % AM; 1 kHz
Power system frequency magnetic field IEC 61000-4-8, Class IV;		30 A/m continuous; 300 A/m for 3 s;
Damped oscillations IEC 61000-4-18		2.5 kV (peak value); 100 kHz; 40 pulses per s; Test Duration 2 s; Ri = 200 Ω

EMC Test for Noise Emission (Type Test)

Standard:	IEC/EN 61000-6-4
Radio noise voltage to lines, only auxiliary voltage IEC-CISPR 11	150 kHz to 30 MHz Limit Class A
Interference field strength IEC-CISPR 11	30 MHz to 1000 MHz 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 fluctuations and flicker on the network lead at AC 230 V IEC 61000-3-3	Limit values are kept

4.1.6 Mechanical Stress Tests

Vibration and Shock Stress during Stationary Operation

Standards:	IEC 60255-21 and IEC 60068
Oscillation IEC 60255-21-1, Class II; IEC 60068-2-6	Sinusoidal 10 Hz to 60 Hz: ± 0,075 mm amplitude; 60 Hz to 150 Hz: 1g acceleration frequency sweep rate 1 octave/min 20 cycles in 3 orthogonal axes.
Shock IEC 60255-21-2, Class I; IEC 60068-2-27	Semi-sinusoidal 5 g acceleration, duration 11 ms, each 3 shocks in both directions of the 3 axes
Seismic Vibration IEC 60255-21-3, Class II; 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 60255-6
Type test (in acc. with IEC 60068-2-1 and -2, Test Bd for 16 h)	–25 °C to +85 °C or –13 °F to +185 °F
Permissible temporary operating temperature (tested for 96 h)	–20 °C to +70 °C or –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 Design

Case	7XP20
Dimensions	see dimensional drawings, Section 4.12

Variant	Case	Size	Weight (mass)
7RW80**-*B	in surface mounting housing	1/6	8.8 lb or 4.5 kg
7RW80**-*E	in flush mounting housing	1/6	8.8 lb or 4 kg

International Protection Under IEC 60529	
For surface mounting housing equipment	IP 50
For flush mounted housing equipment	Front IP 51 Rear IP 50
For human safety	IP 1x for terminal voltage block
Degree of pollution IEC 60255-27	2

4.1.10 UL certification conditions

Output Relays	24 VDC	5 A General Purpose
	48 VDC	0.8 A General Purpose
	240 VDC	0.1 A General Purpose
	240 VAC	5 A General Purpose
	120 VAC	1/3 hp
	250 VAC	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 (27, 59)

Setting Ranges / Increments

Undervoltages 27-1, 27-2, 27-Vp< (V<, V<<, Vp<)		
Measured quantity used With three-phase connection:	- Positive sequence system of the voltages - Phase-to-phase voltage - Phase-to-ground-voltage	
Measured quantity used with single-phase connection	Connected single-phase phase-to-ground voltage	
Connection of phase-to-ground voltages: - Evaluation of phase-to-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	 Increments 1 V Increments 1 V Increments 1 V
Connection of phase-to-phase voltages	10 V to 120 V	Increments 1 V
Connection: single-phase	10 V to 120 V	Increments 1 V
Dropout ratio r for 27-1, 27-2 (V<, V<<)[1)]	1.01 to 3.00	Increments 0.01
Dropout Threshold for r · 27-1 (r · V<) or 27-2 (r · V<<) or 27-Vp< (r · Vp<)	max. 150 V for phase-to-phase voltage max. 225 V for phase-to-ground voltage Minimum hysteresis 0.6 V	
Time Delays: 27-1 DELAY (T V<), 27-2 DELAY (T V<<), 27 T Vp<	0.00 s to 100.00 s or ∞ (inactive)	Increments 0.01 s
Overvoltage 59-1, 59-2, 59-Vp>(V>, V>>, Vp>)		
Measured quantity used With three-phase connection	- Positive sequence system of the voltages - Negative sequence system of the voltages - Phase-to-phase voltage - Phase-to-ground-voltage	
Measured quantity used with single-phase connection	Connected single-phase phase-to-ground 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	 Increments 1 V Increments 1 V Increments 1 V Increments 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	 Increments 1 V Increments 1 V Increments 1 V
Connection: Single-phase	20 V to 150 V	Increments 1 V
Dropout ratio r for 27-1, 27-2 (V>, V>>) [1)]	0.90 to 0.99	Increments 0.01
Dropout Threshold for r · 27-1 (r · V>) or r · 27-2 (r · V>>) or r · 27-Vp> (r · Vp>)	max. 150 V for phase-to-phase voltage max. 260 V for phase-to-ground voltage Minimum hysteresis 0.6 V	
Time Delays: 27-1 DELAY (T V>), 27-2 DELAY (T V>>), 27 T Vp>	0.00 s to 100.00 s or ∞ (inactive)	Increments 0.01 s

[1)] $r = V_{dropout}/V_{pickup}$

Times

Pickup times	
- Undervoltage 27-1 (V<), 27-2 (V<<), 27-1 V_1<, 27-2 V_1<<, 27-Vp< - Overvoltage 59-1 (V>), 59-2 (V>>), 59-Vp> - Overvoltage 59-1V_1, 59-2V_1, 59-1V_2, 59-2V_2, 59-1Vp V1, 59-1Vp V2	approx. 50 ms approx. 50 ms approx. 60 ms
Dropout Times	
- Undervoltage 27-1 (V<), 27-2 (V<<), 27-1 V_1, 27-2 V_1, 27-Vp< - Overvoltage 59-1 (V>), 59-2 (V>>), 59-Vp> - Overvoltage 59-1V_1, 59-2V_1, 59-1V_2, 59-2V_2, 59-1Vp V1, 59-1Vp V2	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

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
Frequency in range of 25 Hz – 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 in 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

Number of frequency elements	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 (connection type "Vph-n, 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 Undervoltage blocking Time delays 81/O or 81U	15 mHz (with V = V_{nom}, f = f_{Nom} ± 5 Hz) 3 % of setting value or 1 V 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 23.00 °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 %

4.4 Load Restoration

Setting Ranges / Increments

Number of load restoration stages	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 with f_{Nom} = 50 Hz approx. 80 ms with f_{Nom} = 60 Hz
Dropout Times	approx. 100 ms with f_{Nom} = 50 Hz approx. 80 ms with f_{Nom} = 60 Hz

Tolerances

Pickup frequencies Undervoltage blocking Time delays	15 mHz (with V = V_{nom}, f = f_{Nom} ± 5 Hz) 3 % of setting value or 1 V 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
Harmonics - up to 10 % 3rd harmonic - up to 10 % 5th harmonic	 1 % 1 %

4.5 Flexible Protective Functions

Measured Quantities / Operating Modes

Three-phase	V, $3V_0$, V1, V2, dV/dt, df/dt
Single-phase	V, V_N,V_x,
Without fixed phase reference	f, binary input
Measuring procedure for V	Fundamental wave, True RMS value, Positive Sequence System, Negative sequence system, Zero sequence system
Pickup on	Exceeding threshold or falling below threshold

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_N		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		3 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 3600.00 s	Increments 0.01 s
Dropout delay		0.00 s to 60.00 s	Increments 0.01 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	approx. 220 ms
Binary input	approx. 20 ms
Dropout times:	
Voltage (phase quantities)	< 20 ms
Voltage (symmetrical components)	< 30 ms
Frequency	< 100 ms
Frequency change df/dt	< 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	2 V/s
Frequency	15 mHz
Frequency change df/dt	5 % of setting value or 0.05 Hz/s
Times	1% of setting value or 10 ms

Influencing Variables for Pickup Values

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
Frequency in range 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 in 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

Operating Modes

- 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 Differences

Voltage differences V2>V1; V2<V1 Tolerance	0.5 V to 50.0 V (phase-to-phase) 1 V	Increments 0.1 V
Frequency difference f2>f1; f2<f1 Tolerance	0.01 Hz to 2.00 Hz 15 mHz	Increments 0.01 Hz
Angle differences $\alpha 2 > \alpha 1$; $\alpha 2 < \alpha 1$	2° to 80°	Increments 1°
Tolerance	2°	
Max. angle error	5° for $\Delta f \leq 1$ Hz 10° for $\Delta f \leq 1$ 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 Synchrocheck Function

Reference voltage V1 - Range - Tolerance [1]	in kV primary, in V secondary or in % of V_{Nom} 10 % to 120 % of V_{Nom} ≤ 1 % of measured value, or 0.5 % of V_{Nom}
Voltage to be synchronized V2 - Range - Tolerance [1]	in kV primary, in V secondary or in % of V_{Nom} 10 % to 120 % of V_{Nom} ≤ 1 % of measured value, or 0.5 % of V_{Nom}
Frequency of the voltage V1 - Range - Tolerance [1]	f1 in Hz 25 Hz ≤ f ≤ 70 Hz 20 mHz
Frequency of the voltage V2 - Range - Tolerance [1]	f2 in Hz 25 Hz ≤ f ≤ 70 Hz 20 mHz
Voltage difference V2-V1 - Range - Tolerance [1]	in kV primary, in V secondary or in % of V_{Nom} 10 % to 120 % of V_{Nom} ≤ 1 % of measured value, or 0.5 % of V_{Nom}
Frequency difference f2-f1 - Range - Tolerance [1]	in mHz f_{Nom} ± 3 Hz 20 mHz
Angle difference α2 - α1 - Range - Tolerance [1]	in ° 0 to 180° 1°

[1] at nominal frequency

4.7 Overecxitation Protection 24

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 %

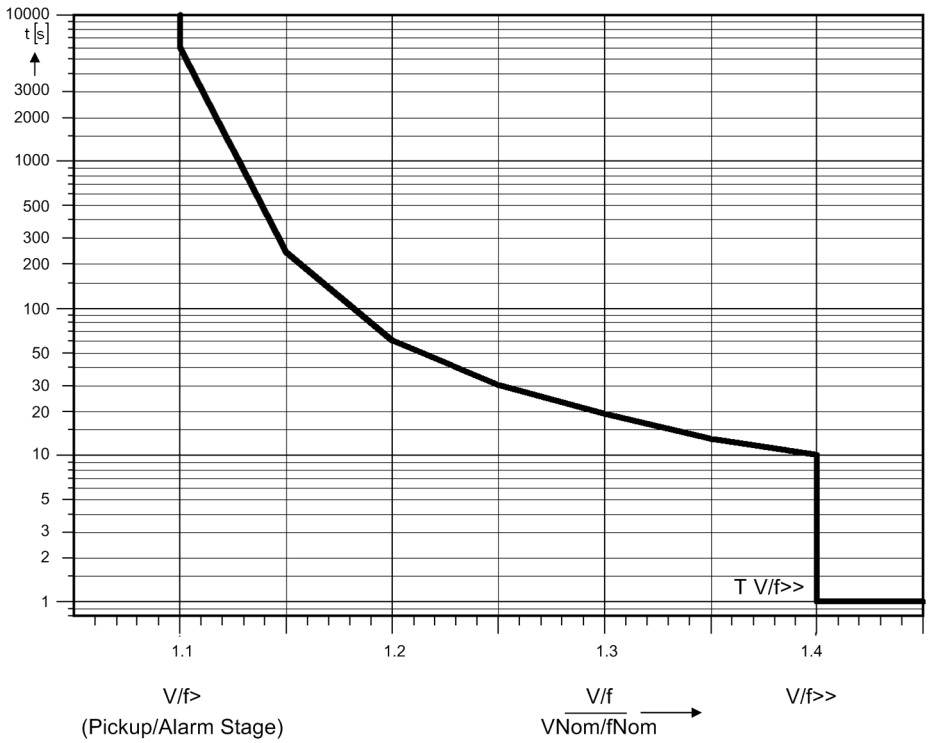

Figure 4-1 Resulting Tripping Characteristic from Thermal Replica and Stage Characteristic of the Overexcitation Protection (Default Setting)

4.8 Jump of Voltage Vector

Setting Ranges / Increments

Stage $\Delta\varphi$	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 $\Delta\varphi$	approx. 75 ms
Dropout Times $\Delta\varphi$	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 % 3rd harmonic - up to 10 % 5th harmonic	 ≤ 1 % ≤ 1 %

4.9 User-defined Functions (CFC)

Function Modules and Possible Assignments to Task Levels

Function Module	Explanation	Task Level			
		MW_ BEARB	PLC1_ BEARB	PLC_ BEARB	SFS_ BEARB
ABSVALUE	Magnitude Calculation	X	—	—	—
ADD	Addition	X	X	X	X
ALARM	Alarm clock	X	X	X	X
AND	AND - Gate	X	X	X	X
FLASH	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	Command cancelled	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 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	Conversion double point indication with status to four single 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
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	—	—	—

Function Module	Explanation	Task Level			
		MW_ BEARB	PLC1_ BEARB	PLC_ BEARB	SFS_ BEARB
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
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	Rise detector	X	X	X	X
RS_FF	RS- Flipflop	—	X	X	X
RS_FF_MEMO	RS- Flipflop with state 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 state 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

Designation	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

Designation	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 output 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 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)	2000
PLC_BEARB (fast PLC processing)	400
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 Required by the Individual Elements

Individual Element		Number of TICKS
Block, basic requirement		5
Each input more than 3 inputs for generic modules		1
Connection to an input signal		6
Connection to an output signal		7
Additional for each chart		1
Arithmetic	ABS_VALUE	5
	ADD	26
	SUB	26
	MUL	26
	DIV	54
	SQUARE_ROOT	83
Basic logic	AND	5
	CONNECT	4
	DYN_OR	6
	NAND	5
	NEG	4
	NOR	5
	OR	5
	RISE_DETECT	4
	X_OR	5
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_CHAIN	34
	CMD_CANCEL	3
	LOOP	8

Individual Element		Number of TICKS
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	6
Time and clock pulse	TIMER	5
	TIMER_LONG	5
	TIMER_SHORT	8
	ALARM	21
	FLASH	11

Configurable in Matrix

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

4.10 Additional 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 % of V_{Nom}
Range Tolerance [1]	10 % bis 120 % von V_N 1,5 % vom Messwert, bzw. 0,5 % V_{Nom}
Frequency 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

suitable for single-, double-pole broken-wire detection of voltage transformer circuits; only for connection of phase-to-ground voltages

Fault Event Recording

Recording of indications of the last 8 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, type 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_{lim}
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 Monitoring

With one or two binary inputs.

Commissioning Aids

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

Clock

Time Synchronization		Binary Input Communication
Operating Modes for Time Tracking		
No.	Operating Mode	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	Field bus (DNP, Modbus)	External synchronization using field bus
5	NTP (IEC 61850)	External synchronization using port B (IEC 61850)

Group Switchover of the Function Parameters

Number of available setting groups	4 (parameter group A, B, C and D)
Switchover can be performed via	the keypad on the device DIGSI using the operator interface protocol using port B binary input

IEC 61850 GOOSE (Inter-Relay Communication)

The GOOSE communication service of IEC 61850 is qualified for switchgear interlocking. Since the transmission time of GOOSE messages depends on both the number of IEC 61850 clients and the relay's pickup condition, GOOSE is not generally qualified for protection-relevant applications. The protective application is to be checked with regard to the required transmission time and cleared with the manufacturer.

4.11 Breaker Control

Number of Controlled Switching Devices	Depends on the number of binary inputs and outputs available
Interlocking	Freely programmable interlocking
Messages	Feedback messages; closed, open, intermediate position
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)

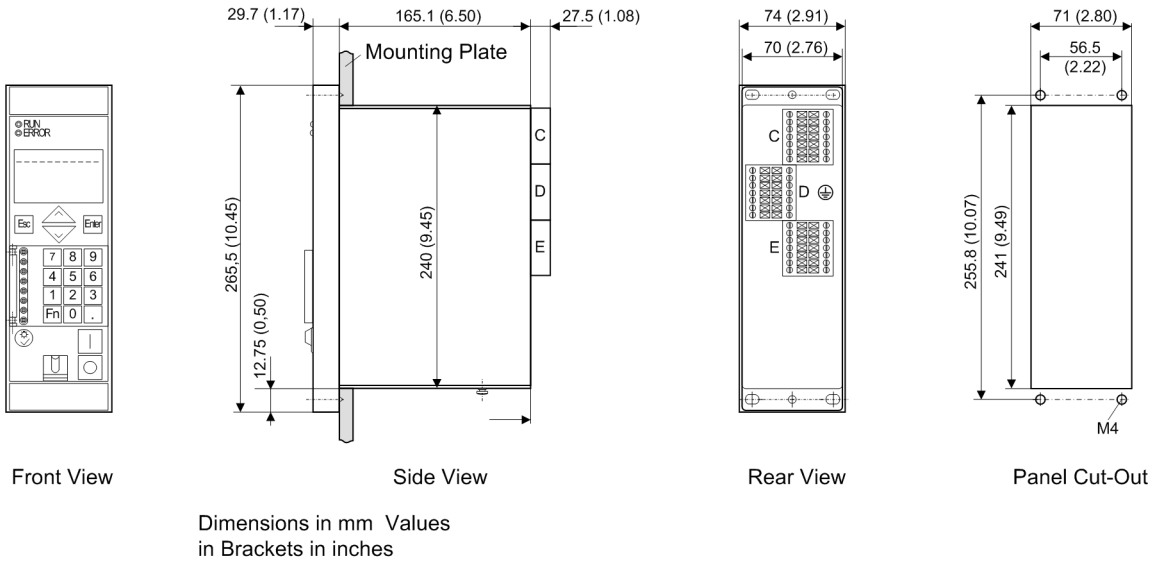

Figure 4-2 Dimensional drawing of a 7RW80 for Panel Fush and Cubicle Mounting (Housing Size $^1/_6$)

Note For cubicle mounting a mounting bracket set (containing upper and lower mounting rails) is needed (Order No. C73165-A63-D200-1). When using the Ethernet interface it may be necessary to work over the lower mounting rail.

Provide enough space for cables of the communications modules at the bottom of or below the device.

4.12.2 Panel Surface Mounting (Housing Size 1/6)

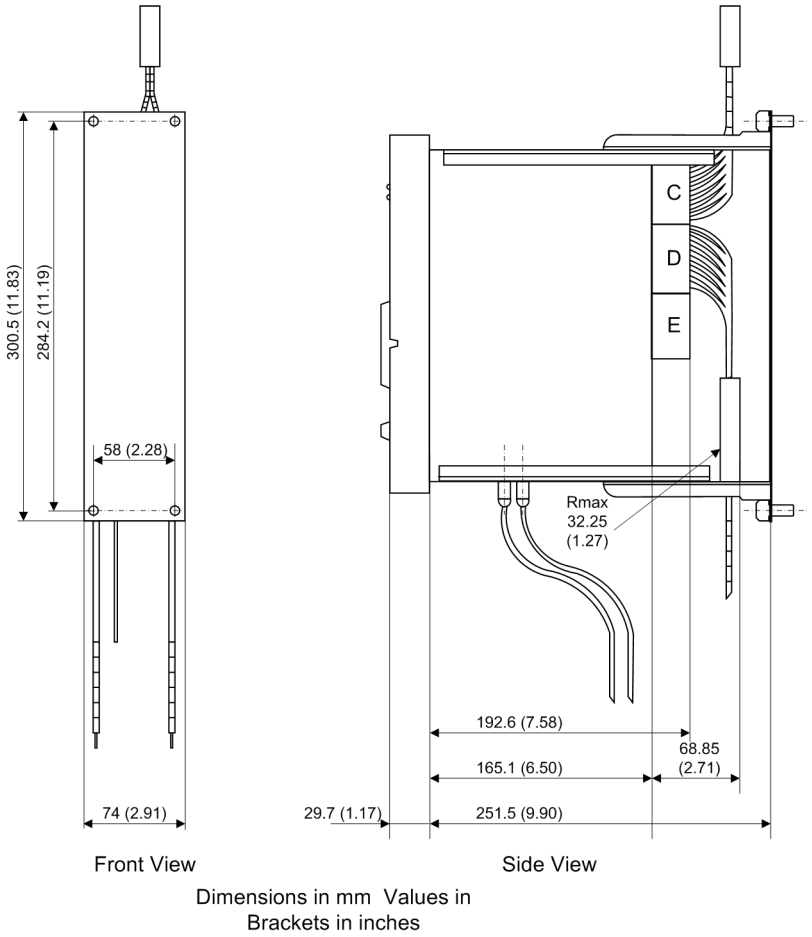

Figure 4-3 Dimensional drawing of a 7RW80 for panel flush mounting (housing size $^1/_6$)

4.12.3 Bottom view

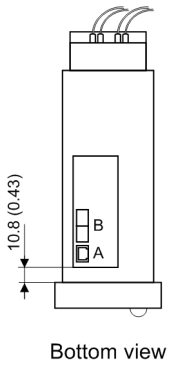

Figure 4-4 Bottom view of a 7RW80 (housing size $^1/_6$)

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