SIEMENS

SIPROTEC

Coupling Units for Generator Protection

7XR81, 7XR87, 7XR86, 7XR8004

Manual

C53000-H5040-C072-1

NOTE

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

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Version of the product described:

Preface

Purpose of the Manual

This manual contains information about commissioning, operation, and technical data of the SIPROTEC Coupling Units for Generator Protection.

Target Audience

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

Scope

This manual applies to the SIPROTEC Coupling Units for Generator Protection: 7XR81, 7XR87, 7XR86, 7XR8004.

Indication of Conformity

This product complies with the directive of the Council of the European Communities on harmonization of the laws of the Member States relating to electromagnetic compatibility (EMC Directive 2014/30/EU [7XR86, 7XR81, 7XR8004, 7XR87]) and concerning electrical equipment for use within specified voltage limits (Low Voltage Directive 2014/35/EU [7XR86, 7XR81]).

This conformity is based on the compliance with the following harmonized standards: EN 60255-27, EN 60255-26, EN 50581.

RoHS directive 2011/65/EU is met using the standard EN 50581 [7XR86, 7XR81, 7XR8004, 7XR87].

Additional Support

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

Support

Our Customer Support Center provides a 24-hour service.

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Training Courses

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Notes on Safety

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

DANGER

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

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

WARNING

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

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

CAUTION

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

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

NOTICE

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

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

NOTE

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

Qualified Electrical Engineering Personnel

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

Proper Use

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

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

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

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

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

Table of Contents

1 7XR81 – Coupling Device for Rotor Ground-Fault Protection

The 7XR81 coupling unit is the necessary accessory for the rotor ground-fault protection with the 7UM62/7UM85 machine protection relays.

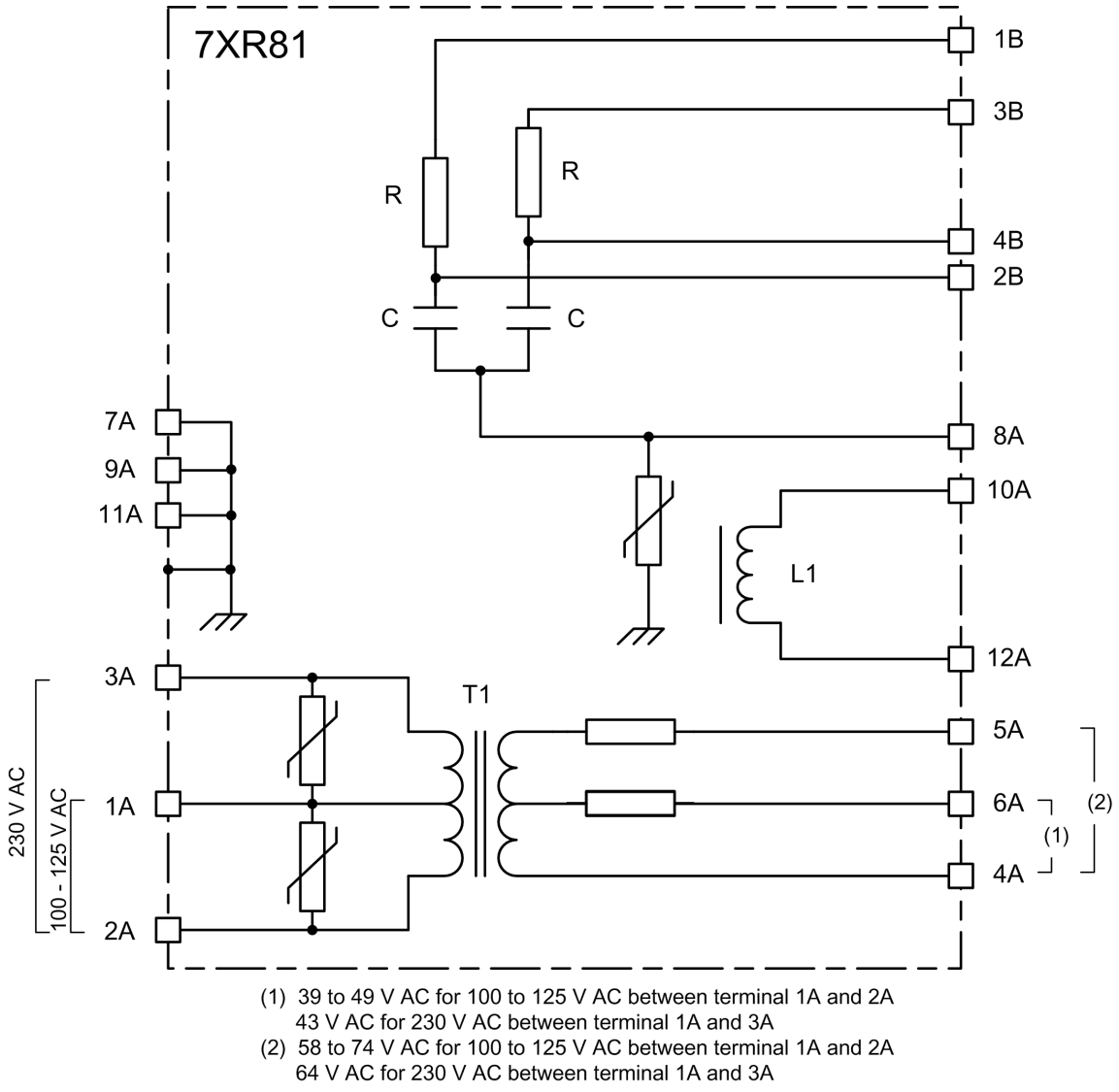
This device replaces the previous 7XR6100-0*A00 coupling unit and the 3PP1336-0DZ series resistor in one device.

Ordering Information

Use the following table for ordering the device:

Order No. / MLFB													
Pos.	1	2	3	4	5	6	7	-	8	9	10	11	12
	7	**X**	**R**	**8**	**1**	**0**	**0**	**-**	**0**		**A**	**0**	**0**
Housing													
Panel **surface** mounting housing with screw terminals →										**B**			
Panel **flush** mounting housing with screw terminals →										**C**			

1.1 Block Diagram



[dw_7xr81 block diagram, 1, en_US]

Figure 1-1 Block Diagram of the 7XR81

1.2 Connection Notes

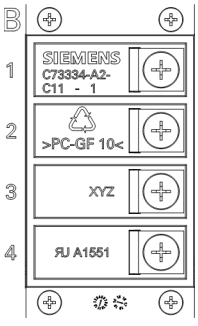
1.2.1 Overview

The device has 2 terminal blocks:
Terminal Block B for connecting the device to the generator's rotor circuit and Terminal Block A for connecting the device to the protection relay and the AC signal source.
Follow these recommendations:

- Ground the device at grounding areas with low resistance and low inductance. Use a conductor of at least 4 mm² (torque 1.2 Nm) to connect the device to protective or functional ground.
- Establish the connections via screwed terminals. Pay attention to the labeling, permitted conductor cross-sections, and bending radius.
- Do not use any PIN-type terminal lugs.
- The field cables have to be selected according to the maximum operating voltage and for a maximal operating temperature of at least 105 °C.

1.2.2 Connection Data for Terminal B

Refer to *Figure 1-1* for a description of the use of each terminal connection.



[dw_7xr81 high voltage terminal B, 1, en_US]

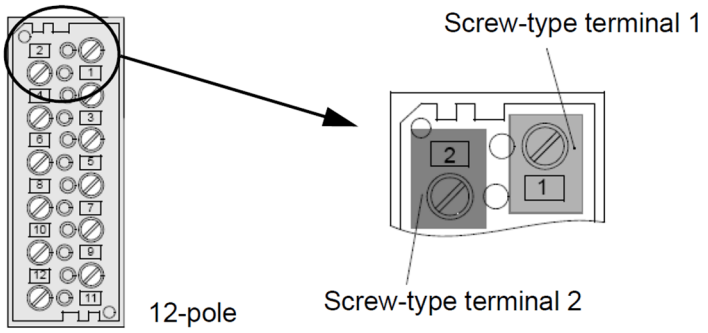
Connection via Ring-Type Lugs (M6)

- Wire cross-section: 1.0 mm² to 2.6 mm² resp. AWG 16 to AWG 14
- Stripping length: L = 9 mm (0.35 in) or L = 10 mm (0.39 in)
- Permissible tightening torque at the terminal screw: 4 Nm (35 lb.in.) to 5 Nm (44 lb.in.)
- Use copper conductors only.

Use the appropriate cable isolation for the application rated voltage (max. 1000 V DC + 250 V AC).

1.2.3 Connection Data for Terminal A

Refer to *Figure 1-1* for a description of the use of each terminal connection.



[dw_7xr81 st 12-pin terminal B, 1, en_US]

Figure 1-2 Screw-type 12-pin Terminal A Block

If you use fork-type cable lugs or connector sleeves, the crimp zone must be insulated to comply with the required insulating clearance. This can also be done using shrink-on sleeves.

Connection via Ring-Type Lugs

For connection via ring-type lugs for bolt diameter 4 mm:

- Max. diameter: 10 mm
- Wire cross-section from 1.0 mm^2 to 2.6 mm^2 resp. AWG 16 to AWG 14
- Use copper conductors only.

Cable lugs series PIDG of Messrs. Tyco Electronics AMP are recommended, e.g. ring-type cable lug PIDG PN 320565-0 and fork-type cable lug PIDG PN 321233-0.

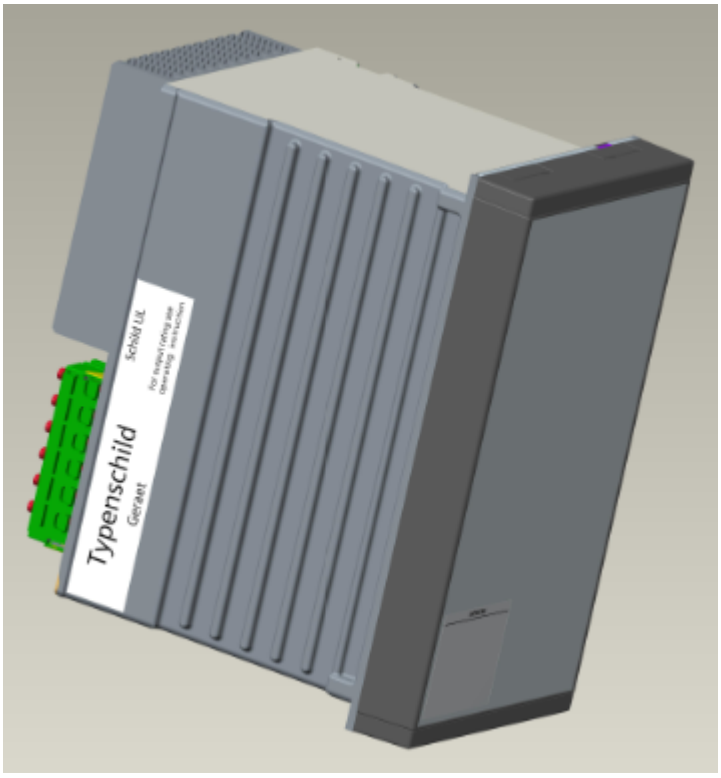
Direct Connection

For direct connection with solid bare wire or flexible wire with end sleeves for cross-section from 0.5 mm^2 to 2.6 mm^2 (AWG 20 to AWG 14) follow these recommendations:

- When using 1 single conductor, the conductor end must be inserted in a way that it will be drawn into the contact cavity while tightening the screw.
- Wire strip length solid bare wire 9 mm to 10 mm (0.354 in to 0.394 in).
- Max. torque value 1.8 Nm (16 in-lb).
- Use copper conductors only.

1.3 Construction Properties

1.3.1 Mechanical Structure

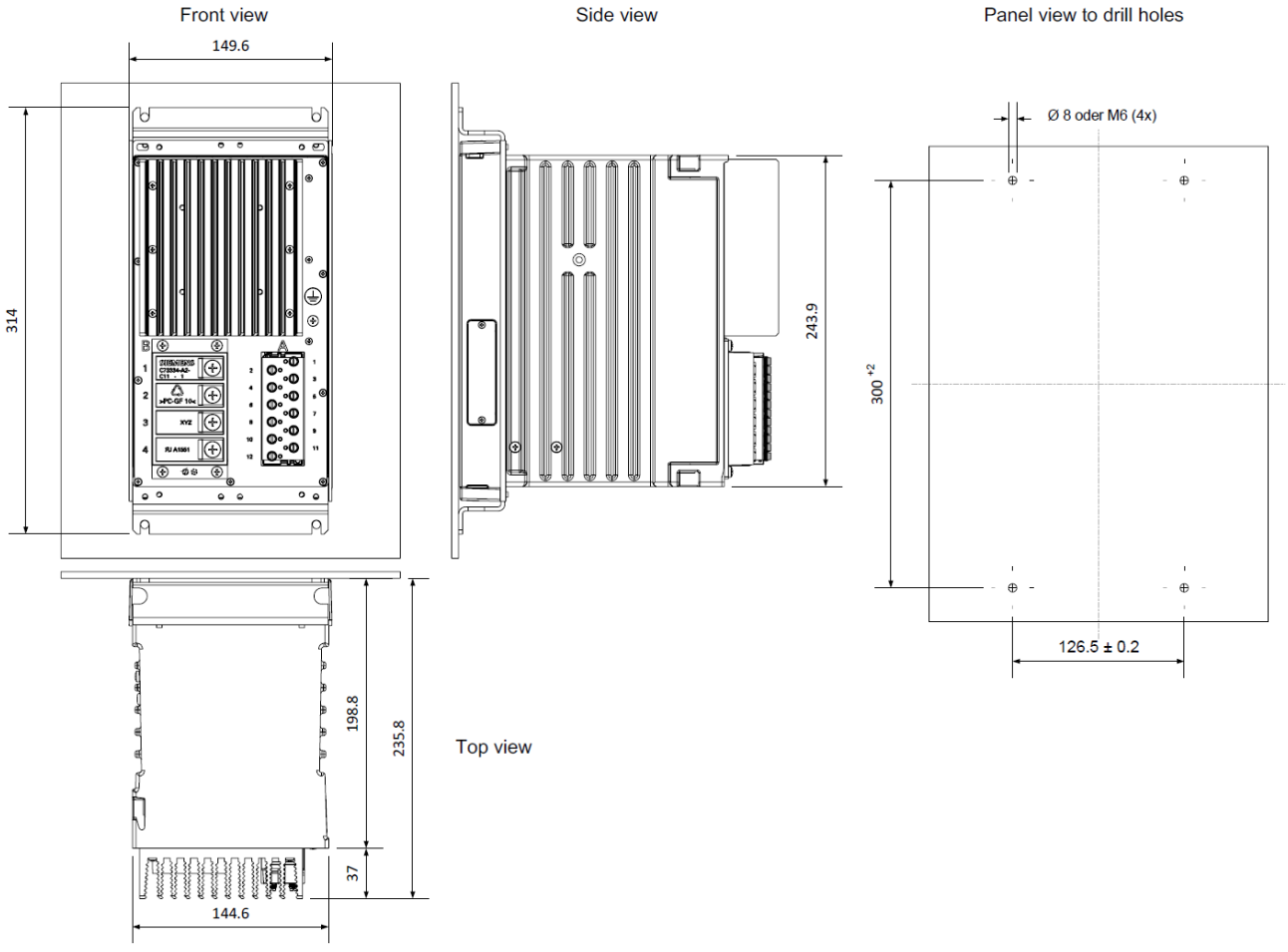


[3d_mechstruct_7xr81, 1, --_--]

Figure 1-3 Mechanical Design of the 7XR81

1.3.2 Dimensions

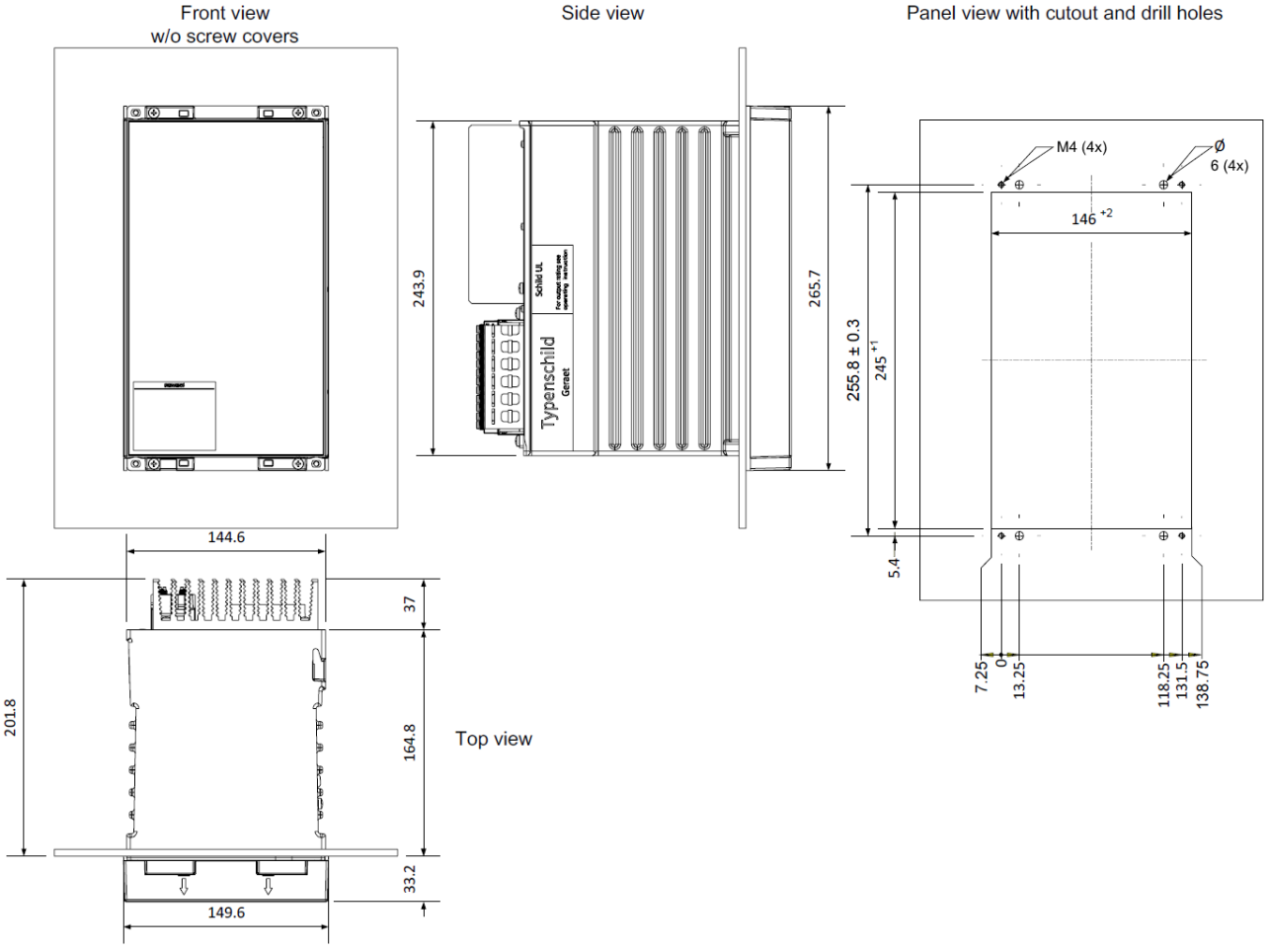
1.3.2.1 Panel Surface Mounting



[dw_7xr81-6, 1, en_US]

Figure 1-4 7XR81 Surface Mounting Dimensions

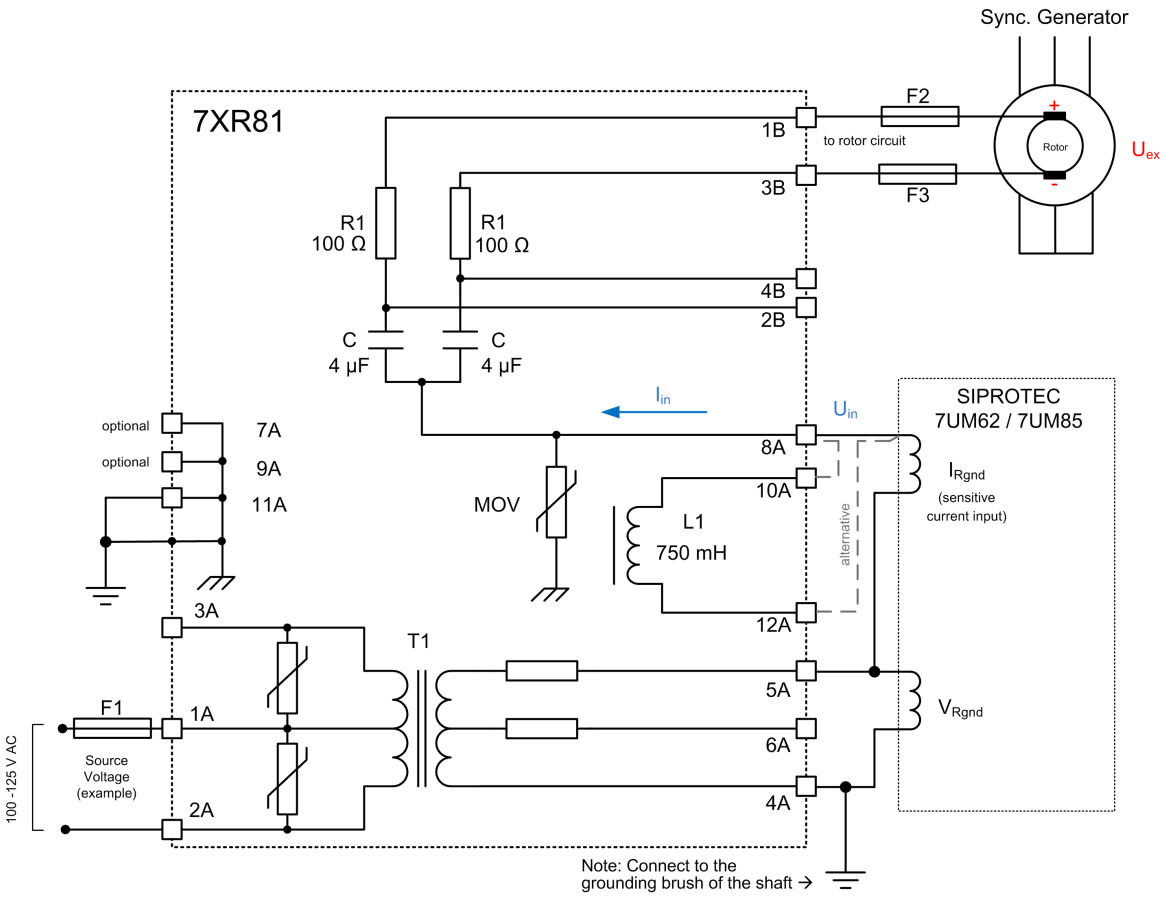
1.3.2.2 Panel Flush Mounting



[dw_7xr81-8, 1, en_US]

Figure 1-5 7XR81 Panel Mounting Dimensions

1.4 Connection Examples



[dw_7xr81 connection examples, 1, en_US]

Figure 1-6 Connection Example for 7XR81

Refer to the user manual of the 7UM62/7UM85 protection relay for details on commissioning the coupling unit.

NOTE

The inductor **L1** can be connected in series between the output **8A** and the input current of the protection relay in order to reduce high ripple noise injected by some excitation regulators.

NOTE

- The fuse **F1** must be rated for 250 V AC, 1 A T (time-lag).
- The fuses **F2**/**F3** must have at least the rated voltage of excitation (e.g. 1000 V DC) and be rated for 0.6 A T (time-lag).

1.5 Technical Data

1.5.1 Auxiliary Voltage and Output Ratings

	Terminals 1A – 2A	**Terminals 2A – 3A**
Rated auxiliary voltage	100 to 125 V AC, 50/60 Hz (1)	230 V AC, 50/60 Hz (2)
Permissible auxiliary voltage	80 to 144 V AC, 45 to 65 Hz	176 to 265 V AC, 45 to 65 Hz
	Terminals 4A – 6A	**Terminals 4A – 5A**
Nominal output voltage	39 to 49 V AC for (1) 43 V AC for (2)	58 to 74 V AC for (1) 64 V AC for (2)
Continuous output current (1B – 3B shorted to ground, without choke L1)	100 mA	
Output current for max. 30 minutes (1B – 3B shorted to ground, with choke L1) Recovery time 60 min Max. power consumption 22 W	175 mA	200 mA

1.5.2 Load Capability of the Capacitive Coupling Circuit

	Terminals 1B – 3B
Max. permissible continuous voltage	1000 V DC + 250 V peak value (max. 300 Hz)[1]
Max. permissible continuous current	500 mA RMS[1]
Max. dissipated power	60 W

1.5.3 Weight

The weight of the device is 5.6 kg (12.4 lb.).

[1] The RMS voltage and current over the resistors R1 (2x 100 Ω) must be measured to avoid exceeding 50 W of power dissipation.

1.6 Electrical Tests

1.6.1 Standards

IEC 60255 (product standard)
Additional standards are listed for the individual tests.

1.6.2 Installation Requirements

Overvoltage category	III
Degree of pollution	2
Protection class	1

1.6.3 Insulation and Safety Tests

Standards	IEC 60255-27
Voltage test (routine test)	AC 3.25 kV, 50 Hz, 1 s (Terminal A)
Voltage test (routine test)	DC 6.2 kV, 1 second (secondary Terminal B)
Surge immunity test (type testing), all circuits	6 kV (peak value) 1.2 µs/50 µs 0.5 J 3 positive and 3 negative impulses at intervals of 1 s
Insulation resistance	> 100 MΩ @ DC 500 V
Resistor of protective equal-potential-bonding	< 0.1 Ω DC 12 V, 30 A after 1 min

1.6.4 EMC Immunity Tests (Type Tests, Test under Mounting Conditions)

Standards	IEC 60255-1 and -26 (product standards) EN 61000-6-2 (generic standard)	
Electrostatic discharge test IEC 61000-4-2	Contact discharge 8 kV, both polarities Air discharge 15 kV, both polarities, 150 pF Ri = 330 Ω	
Electrical fast transient/ burst immunity IEC 61000-4-4	4 kV, 5 ns/50 ns, 5 kHz Burst length 15 ms, Repetition rate 300 ms Both polarities Ri = 50 Ω Test duration ≥ 5 min	
High-energy surge voltages IEC 61000-4-5	Pulse: 1.2 µs/50 µs	
	Measuring inputs, binary inputs, and relay outputs (no differential mode testing)	Common mode: 4 kV, 42 Ω, 0.5 µF Differential mode: 1 kV, 42 Ω, 0.5 µF
Standard for Surge Withstand Capability (SWC) IEEE Std C37.90.1	2.5 kV (peak value) 1 MHz τ = 15 µs, 400 impulses per sec. Test duration ≥ 10 s, Ri = 200 Ω Common mode and differential mode test	
Damped oscillatory wave immunity test IEC 61000-4-18	1 MHz, 2.5 kV (peak value) 3 MHz, 10 MHz, 30 MHz, 2 kV (peak value) Test duration ≥ 60 s	

1.7 Mechanical Tests

1.7.1 Vibration and Shock Stress in Stationary Use

Standards	IEC 60255-21 and IEC 60068
Vibration Test (sinusoidal) IEC 60255-21-1, class 2 and IEC 60068-2-6	Sinusoidal 10 Hz to 60 Hz: ± 0.075 mm Amplitude 60 Hz to 150 Hz; 10 m/s^2 acceleration Frequency sweep 1 octave/min 20 cycles in 3 axes perpendicular to one another
Shock Test IEC 60255-21-2, class 1	Semi-sinusoidal Acceleration 50 m/s2 Duration 11 ms 3 shocks each in both directions of the 3 axes
Seismic Tests IEC 60255-21-3, class 2 and IEC 60068-3-3	Sinusoidal 3 Hz to 35 Hz: Frequency sweep 1 octave/min 1 cycle in 3 axes perpendicular to one another 3 Hz to 8 Hz: ± 7.5 mm amplitude (horizontal axes) 3 Hz to 8 Hz: ± 3.5 mm amplitude (vertical axis) 8 Hz to 35 Hz: 20 m/s2 acceleration (horizontal axes) 8 Hz to 35 Hz: 10 m/s2 acceleration (vertical axis)

1.7.2 Vibration and Shock Stress during Transport

Standards	IEC 60255-21 and IEC 60068
Vibration Test (sinusoidal) IEC 60255-21-1, class 2 and IEC 60068-2-6	Sinusoidal 5 Hz to 8 Hz: ± 7.5 mm Amplitude 8 Hz to 150 Hz: 20 m/s^2 acceleration Frequency sweep 1 octave/min 20 cycles in 3 axes perpendicular to one another
Shock Test IEC 60255-21-2, class 1 and IEC 60068-2-27	Semi-sinusoidal Acceleration 150 m/s^2 Duration 11 ms 3 shocks each in both directions of the 3 axes
Continuous Tests IEC 60255-21-2, class 1 and IEC 60068-2-27	Semi-sinusoidal Acceleration 100 m/s^2 Duration 16 ms 1000 shocks each in both directions of the 3 axes

1.8 Environmental Conditions

1.8.1 Temperatures

Type test, in operation (in compliance with IEC 60068-2-1 and IEC 60068-2-2, test Ad for 16 h and test Bd	-25 °C to +85 °C
Recommended for uninterrupted duty (in compliance with IEC 60255-1)	-10 °C to +55 °C
Temperatures for continuous storage	-25 °C to +55 °C
Type test, transport and storage for 96 h	-40 °C to +70 °C

1.8.2 Humidity

Permissible humidity stress (according to IEC 60068-2-30)	≤ 75 % relative humidity on the annual average Up to 93 % relative humidity
	Devices subjected to condensation are not to be operated! Arrange the devices so that they are not exposed to direct sunlight or extreme temperature changes. This will prevent condensation in the device.
Constant humid heat, 56 days	40 °C, 93 % relative humidity
Humid heat, cyclical	12 h + 12 h cycles 25 °C / 55 °C / 95 % relative humidity

1.8.3 Other Environmental Information

Maximum altitude above sea level	2000 m (6561.68 ft)
Minimum admissible atmospheric pressure	783.8 hPa

1.9 Protection Degree according to IEC 60529

For the equipment	IP20
For personal protection	IP2x[2]

[2] To meet IP2x on Terminal B, additional measures have to be taken. After installation of the cables, the terminal has to be properly covered using an insulating material to avoid direct contact to the screws (e.g. using the self-adhesive tape Terosat 2750 by Henkel); otherwise the device has to be considered IP1x.

2 7XR8004 – Resistor Coupling Unit for 7XT71

The 7XR8004 resistor coupling unit is the necessary accessory for the 1 to 3 Hz rotor ground-fault protection together with the 7XT71 (1 to 3 Hz) generator and the 7UM62/7UM85 machine protection relays.

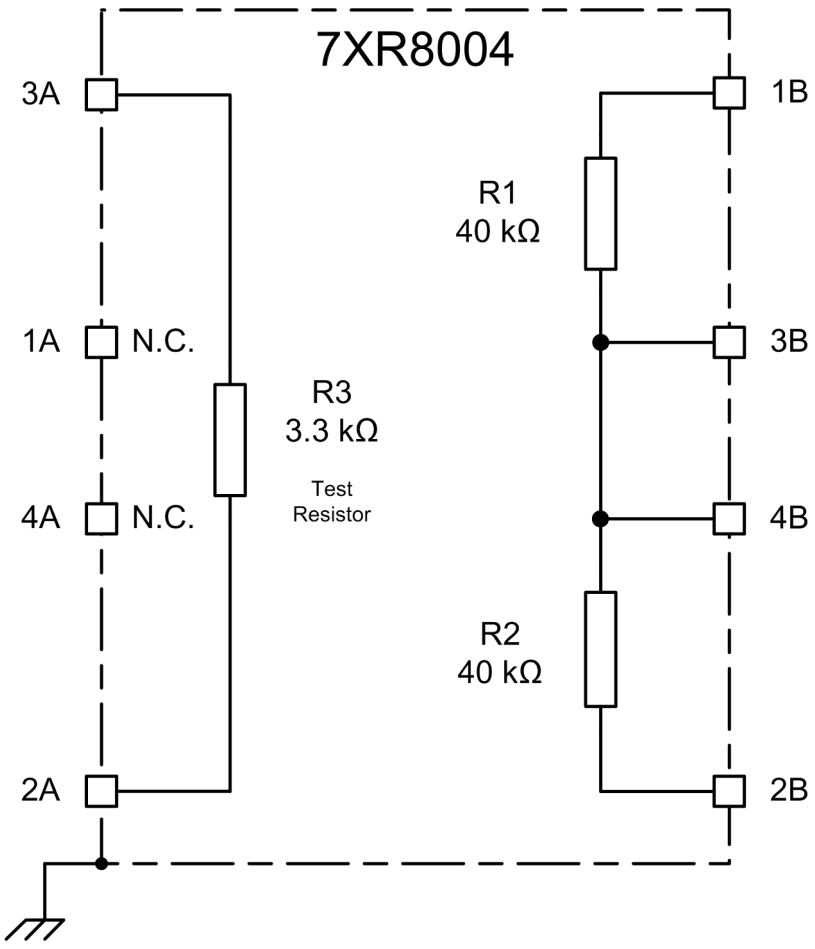
This device replaces the previous 7XR6004-0*A00 resistor unit, allowing higher excitation voltages at a reduced size.

Ordering Information

Use the following table for ordering the device:

Order No. / MLFB													
Pos.	1	2	3	4	5	6	7	-	8	9	10	11	12
	7	**X**	**R**	**8**	**0**	**0**	**4**	**-**	**0**		**A**	**0**	**0**
Housing													
Panel **surface** mounting housing with screw terminals →										**B**			

2.1 Block Diagram (new 7XR8004)



[dw_7xr8004 block diagram, 1, en_US]

Figure 2-1 Block Diagram of the 7XR8004

2.2 Connection Notes

2.2.1 Overview

Follow these recommendations:

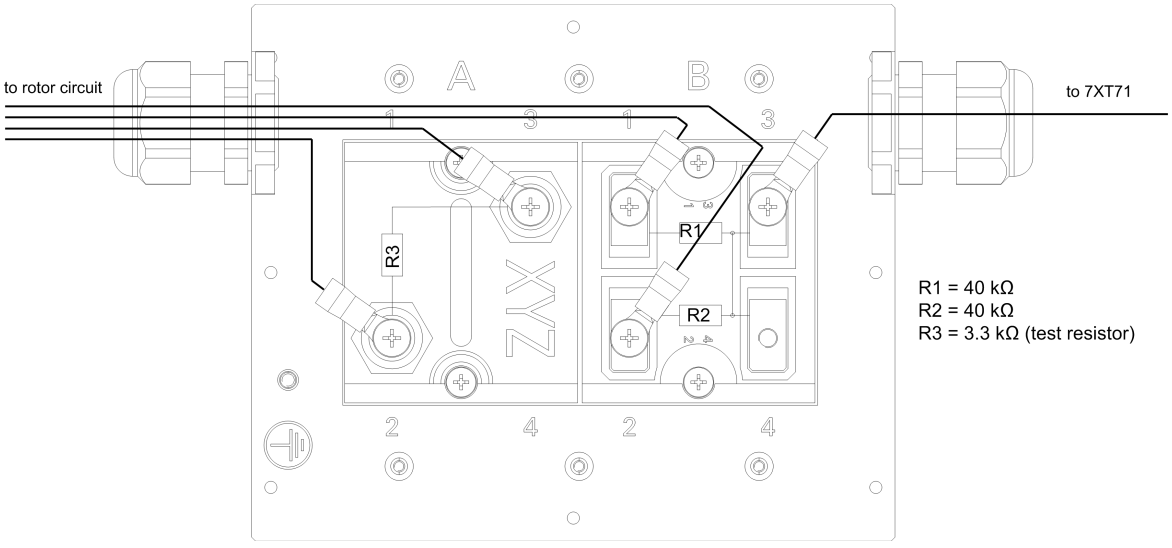
- Ground the device at grounding areas on the top and on the side (M4 screws) on the top and on the side (M4 screws) with low resistance and low inductance connection. Use a conductor of at least 4 mm^2 (torque 1.2 Nm) to connect the device to protective or functional ground.
- Establish the connections via screwed terminals. Pay attention to the labeling, permitted conductor cross-sections, and bending radius.
- Do not use any PIN-type terminal lugs, but only the appropriate M4 ring-type lugs.

2.2.2 Connection Data for the Power Resistors (3.3 kΩ, 2 x 40 kΩ)

Connection via Ring-Type Lugs (M5)

- Wire cross-section: 1.0 mm^2 to 2.6 mm^2 resp. AWG 16 to AWG 14
- Stripping length: L = 9 mm (0.35 in) or L = 10 mm (0.39 in)
- Permissible tightening torque at the terminal screw: 1.3 Nm (11.5 lb.in.) to 1.5 Nm (13.3 lb.in.)
- Use copper conductors only.

Use the appropriate cable isolation for the application rated voltage (max. 2000 V RMS). The cable's permitted continuous operation temperature must be ≥ 105 °C.

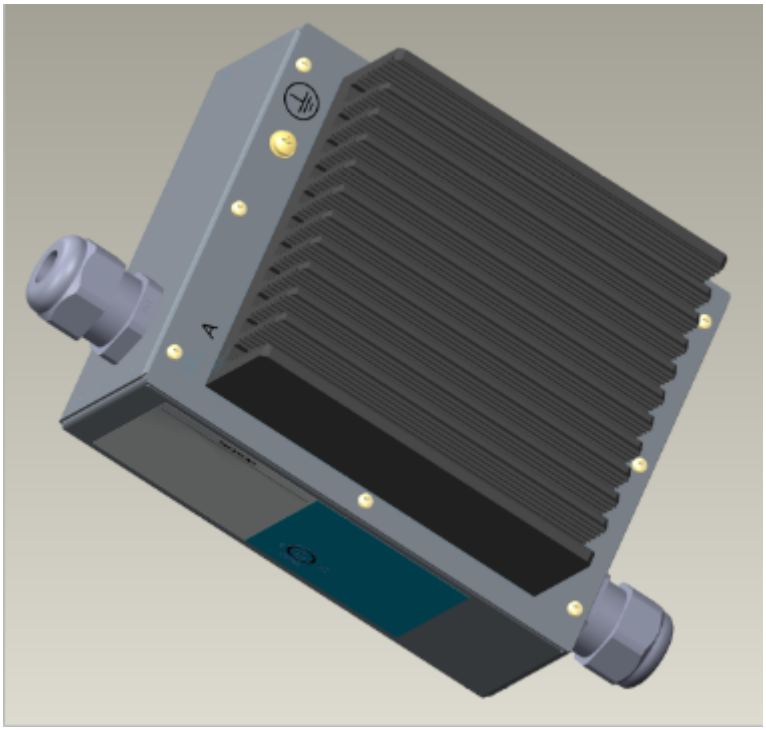


[dw_7xr8004 field cables connection, 1, en_US]

Figure 2-2 7XR8004 Field Cables Connection

2.3 Construction Properties

2.3.1 Mechanical Structure

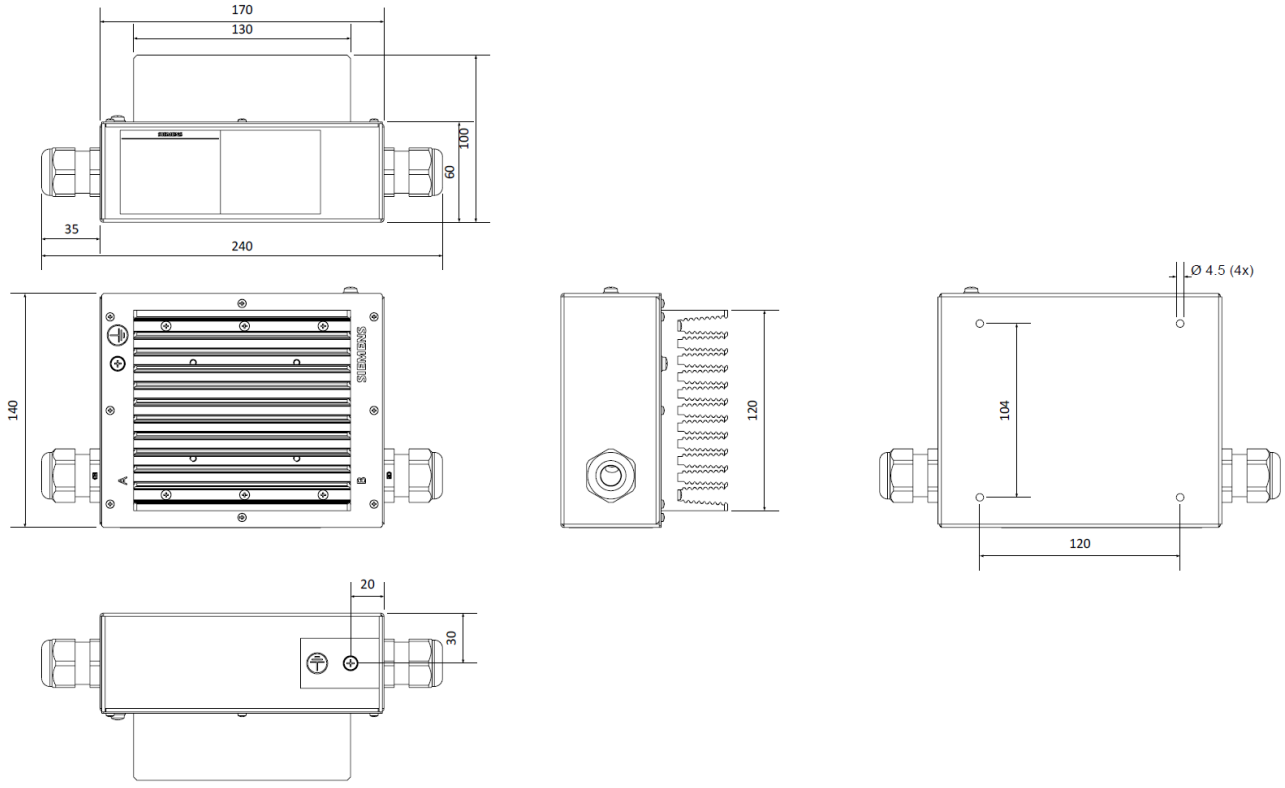


[3d_mechstruct_7xr8004, 1, --_--]

Figure 2-3 Mechanical Design of the 7XR8004

2.3.2 Dimensions

2.3.2.1 Panel Surface Mounting



[dw_7xr8004 dimensions, 1, --_--]

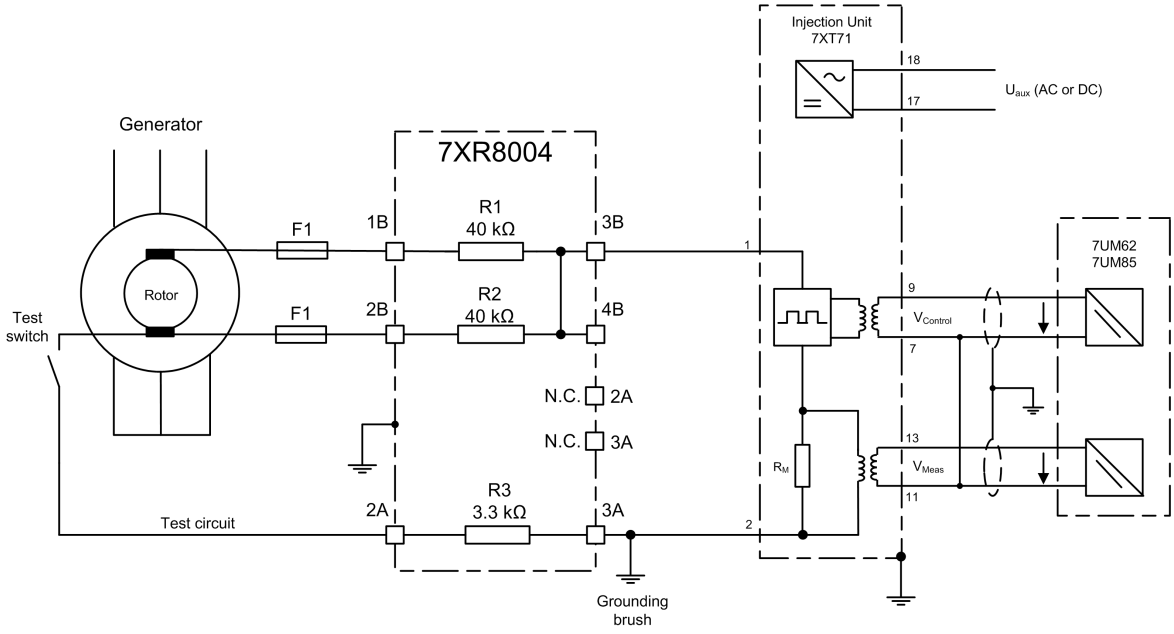
Figure 2-4 7XR8004 Dimensions

2.3.3 Connection Examples

The 7XR8004 replaces the old 7XR6004. The electrical design stayed basically the same, but only one connection option is supported (2 x 40 KΩ). The following points are changed/improved:

- The terminals are designed to support higher excitation voltages, in order to satisfy the safety requirements and future higher excitation voltages.
- The Resistors R1/R2 are dimensioned to allow using the configuration of a maximal excitation voltage (U_{cV}) of 2000 V DC:

  $P_{Rtotal} = U_{cV}^2 / R_{total} = (2000\ V)^2 / 80\ k\Omega = 50\ W$

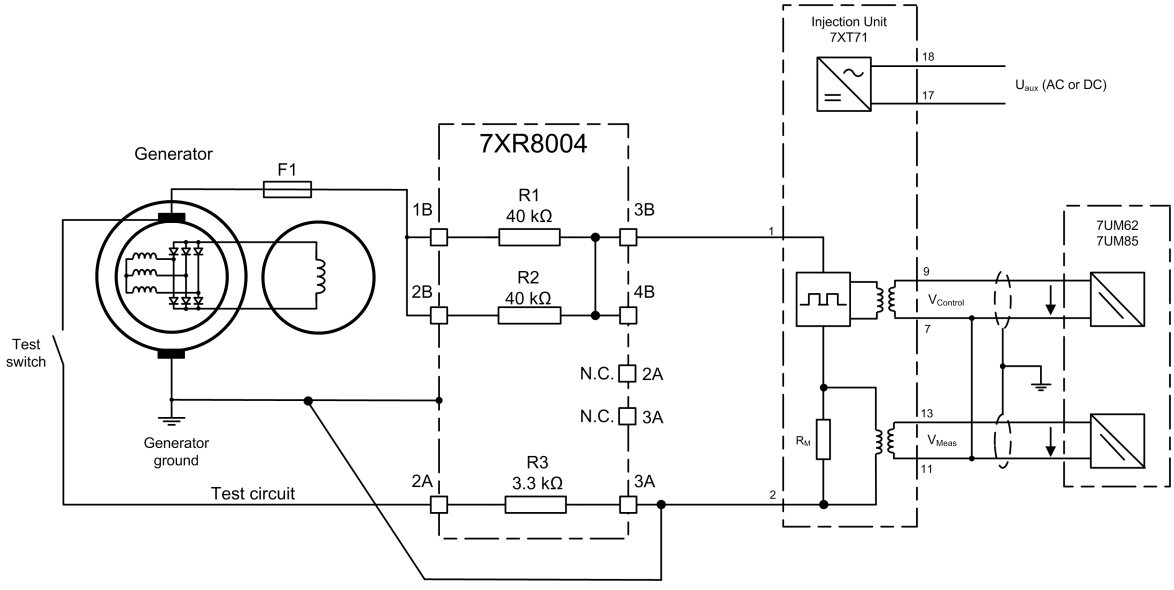


[dw_7xr8004 connex1, 1, en_US]

Figure 2-5 Connection Example for Excitation fed via Slip Rings

NOTE

Test Switch: Refer to the functional description in the 7UM62/7UM85 user manual.
7XT71: For connection of the 7XT71 to the devices, refer to the 7XT71 user manual.
Grounding Brush: Connect to the grounding brush on the shaft.



[dw_7xr8004 connex2, 1, en_US]

Figure 2-6 Connection Example for Excitation via Rotating Rectifiers

NOTE

Test Switch: Refer to the functional description in the 7UM62/7UM85 user manual.
7XT71: For connection of the 7XT71 to the devices, refer to the 7XT71 user manual.

NOTE

The recommended maximum cable length is 20 m (65 ft.).

NOTE

The fuse **F1** must have at least the rated voltage of excitation (e.g. 2000 V DC) and be rated for 0.1 A T (time-lag).

2.4 Technical Data

2.4.1 Load Capability of the Capacitive Coupling Circuit

Description	Value
Max. permissible continuous voltage (2 x 40 kΩ between terminal 1B and 2B)	2000 V RMS (3500 V_{p-p})
Max. continuous dissipated power (R1 + R2)	50 W
Max. permissible continuous voltage (3.3 kΩ between terminal 2A and 3A)	600 V DC
Max. dissipated power (R3) Recovery time 20 min	110 W **(1 min max.)**
Max. total dissipated power **(1 min)** Recovery time 20 min	160 W

2.4.2 Weight

The weight of the device is 1.9 kg (4.2 lb.).

2.5 Electrical Tests

2.5.1 Standards

IEC 60255 (product standard)
Additional standards are listed for the individual tests.

2.5.2 Installation Requirements

Overvoltage category	III
Degree of pollution	2
Protection class	1

2.5.3 Insulation and Safety Tests

Standards	IEC 60255-27
Voltage test (device routine test)	AC 4.2 kV, 50 Hz, 1 s
Voltage test (type test)	AC 6.5 kV, 50 Hz, 1 min (higher values upon special request)
Surge immunity test (type testing), all circuits	8 kV (peak value), 1.2 µs/50 µs, 0.5 J 3 positive and 3 negative impulses at intervals of 1 s
Insulation resistance	> 100 MΩ @ DC 500 V
Resistor of protective equal-potential-bonding	< 0.1 Ω @ DC 12 V, 30 A after 1 min

NOTE

For the insulation tests of the generator according to IEC60034-1 or IEEE421.3, the device has to be disconnected from the generator if the applied voltage is higher than the values shown here.

2.5.4 EMC Immunity Tests (Type Tests, Test under Mounting Conditions)

See *1.6.4 EMC Immunity Tests (Type Tests, Test under Mounting Conditions)* for 7XR81.

2.6 Mechanical Tests

See *1.7 Mechanical Tests* for 7XR81.

2.7 Environmental Conditions

2.7.1 Temperatures

Type test, in operation (in compliance with IEC 60068-2-1 and IEC 60068-2-2, test Ad for 16 h and test Bd	-25 °C to +85 °C
Recommended for uninterrupted duty (in compliance with IEC 60255-1)	-10 °C to +55 °C
Temperatures for continuous storage	-25 °C to +55 °C
Type test, transport and storage for 96 h	-40 °C to +70 °C

2.7.2 Humidity

Permissible humidity stress (according to IEC 60068-2-30)	≤ 75 % relative humidity on the annual average Up to 93 % relative humidity
	Devices subjected to condensation are not to be operated! Arrange the devices so that they are not exposed to direct sunlight or extreme temperature changes. This will prevent condensation in the device.
Constant humid heat, 56 days	40 °C, 93 % relative humidity
Humid heat, cyclical	12 h + 12 h cycles 25 °C / 55 °C / 95 % relative humidity

2.7.3 Other Environmental Information

Maximum altitude above sea level	2000 m (6561.68 ft)
Minimum admissible atmospheric pressure	783.8 hPa

2.8 Protection Degree according to IEC 60529

For the equipment	IP30
For personal protection	IP3x

3 7XR86 Voltage Divider (5:1, 5:2)

The 7XR86 coupling unit is used for the 90%-stator ground-fault protection with the 7UM62/7UM85 machine protection relays.

This device replaces the previous 3PP1336-1CZ-K2Y (5:1, 5:2 voltage divider) resistor unit.

The 7XR86 has the same construction like the 7XR8004. Only the resistors of the 7XR8004 have been replaced.

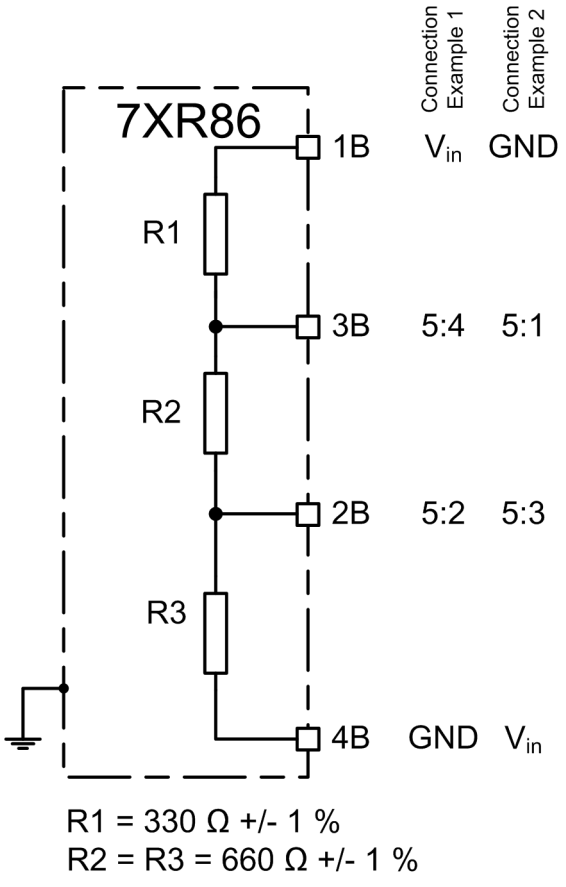
The voltage divider is necessary at grounding or neutral-transformer application with a higher secondary voltage than 200 V (e.g. 500 V) of the protection relay's voltage-inputs maximum voltage (e.g. 100 V).

Ordering Information

Use the following table for ordering the device:

Order No. / MLFB													
Pos.	1	2	3	4	5	6	7	-	8	9	10	11	12
	7	**X**	**R**	**8**	**6**	**0**	**0**	**-**	**0**		**A**	**0**	**0**
Housing													
Panel **surface** mounting housing with screw terminals →										**B**			

3.1 Block Diagram



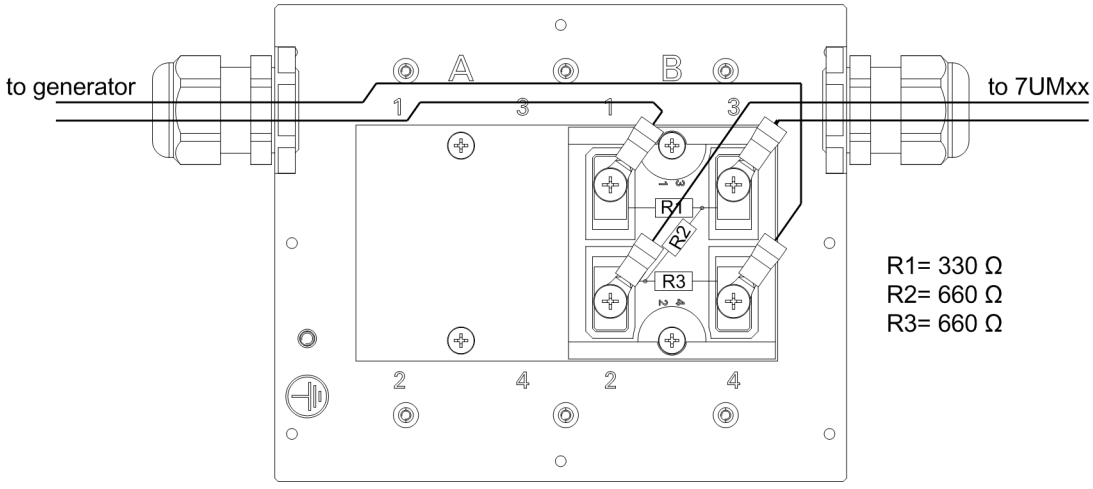
[dw_7xr86 block diagram, 1, en_US]

Figure 3-1 Block Diagram of the new 7XR86

3.2 Connection Notes

Refer to the connection notes of the 7XR8004 (*Connection via Ring-Type Lugs (M5), Page 27*) for details on cables and ring-type lugs.

The following diagram shows a connection example of the voltage divider.



[dw_7xr86 connection examples, 1, en_US]

Figure 3-2 7XR86 Connection Example

NOTE

The connection to the grounding transformer has to be protected using a 600 V 0.5 A T (time-lag) fuse.

NOTE

Refer to 7UM62/7UM85 documents for connection examples.

3.3 Construction Properties

3.3.1 Mechanical Structure

See *2.3.1 Mechanical Structure* of 7XR8004.

3.3.2 Dimensions

3.3.2.1 Panel Surface Mounting

See *2.3.2.1 Panel Surface Mounting* of 7XR8004.

3.4 Technical Data

3.4.1 Load Capability of the Voltage Divider

	Terminals 1B – 4B
Max. permissible continuous voltage	55 V AC Continuous output power 2 W
Max. permissible voltage (60 s)	550 V AC
Max. dissipated power	185 W (max. 60 s, recovery time 600 s)

NOTE

The minimum load of 200 kΩ (protection relay input impedance) is needed to reach the necessary accuracy.

3.4.2 Weight

The weight of the device is 1.9 kg (4.2 lb.).

3.5 Electrical Tests

3.5.1 Standards

IEC 60255 (product standard)
Additional standards are listed for the individual tests.

3.5.2 Installation Requirements

Overvoltage category	III
Degree of pollution	2
Protection class	1

3.5.3 Insulation and Safety Tests

Standards	IEC 60255-27
Voltage test (routine test)	AC 3.5 kV, 50 Hz, 1 min
Surge immunity test (type testing), all circuits	6 kV (peak value), 1.2 µs/50 µs, 0.5 J 3 positive and 3 negative impulses at intervals of 1 s
Insulation resistance	> 100 MΩ @ DC 500 V
Resistor of protective equal-potential-bonding	< 0.1 Ω @ DC 12 V, 30 A after 1 min

3.5.4 EMC Immunity Tests (Type Tests, Test under Mounting Conditions)

See *1.6.4 EMC Immunity Tests (Type Tests, Test under Mounting Conditions)* for 7XR81.

3.6 Mechanical Tests

See *1.7 Mechanical Tests* for 7XR81.

3.7 Environmental Conditions

3.7.1 Temperatures

Type test, in operation (in compliance with IEC 60068-2-1 and IEC 60068-2-2, test Ad for 16 h and test Bd	-25 °C to +85 °C
Recommended for uninterrupted duty (in compliance with IEC 60255-1)	-10 °C to +55 °C
Temperatures for continuous storage	-25 °C to +55 °C
Type test, transport and storage for 96 h	-40 °C to +70 °C

3.7.2 Humidity

Permissible humidity stress (according to IEC 60068-2-30)	≤ 75 % relative humidity on the annual average Up to 93 % relative humidity
	Devices subjected to condensation are not to be operated! Arrange the devices so that they are not exposed to direct sunlight or extreme temperature changes. This will prevent condensation in the device.
Constant humid heat, 56 days	40 °C, 93 % relative humidity
Humid heat, cyclical	12 h + 12 h cycles 25 °C / 55 °C / 95 % relative humidity

3.7.3 Other Environmental Information

Maximum altitude above sea level	2000 m (6561.68 ft)
Minimum admissible atmospheric pressure	783.8 hPa

3.8 Protection Degree according to IEC 60529

For the equipment	IP30
For personal protection	IP3x

4 7XR87 Voltage Divider for Excitation Voltage

The 7XR87 coupling unit is used for interfacing the excitation voltage of a generator to the DC measurement inputs of the 7UM62/7UM85 machine protection relays.

The 7XR87 allows the application of different voltage-divider ratios. Thus, an optimal adaption of the protection on different excitation voltages is possible. Additionally, the coupling unit contains components for reducing harmonics and transients from the excitation circuit.

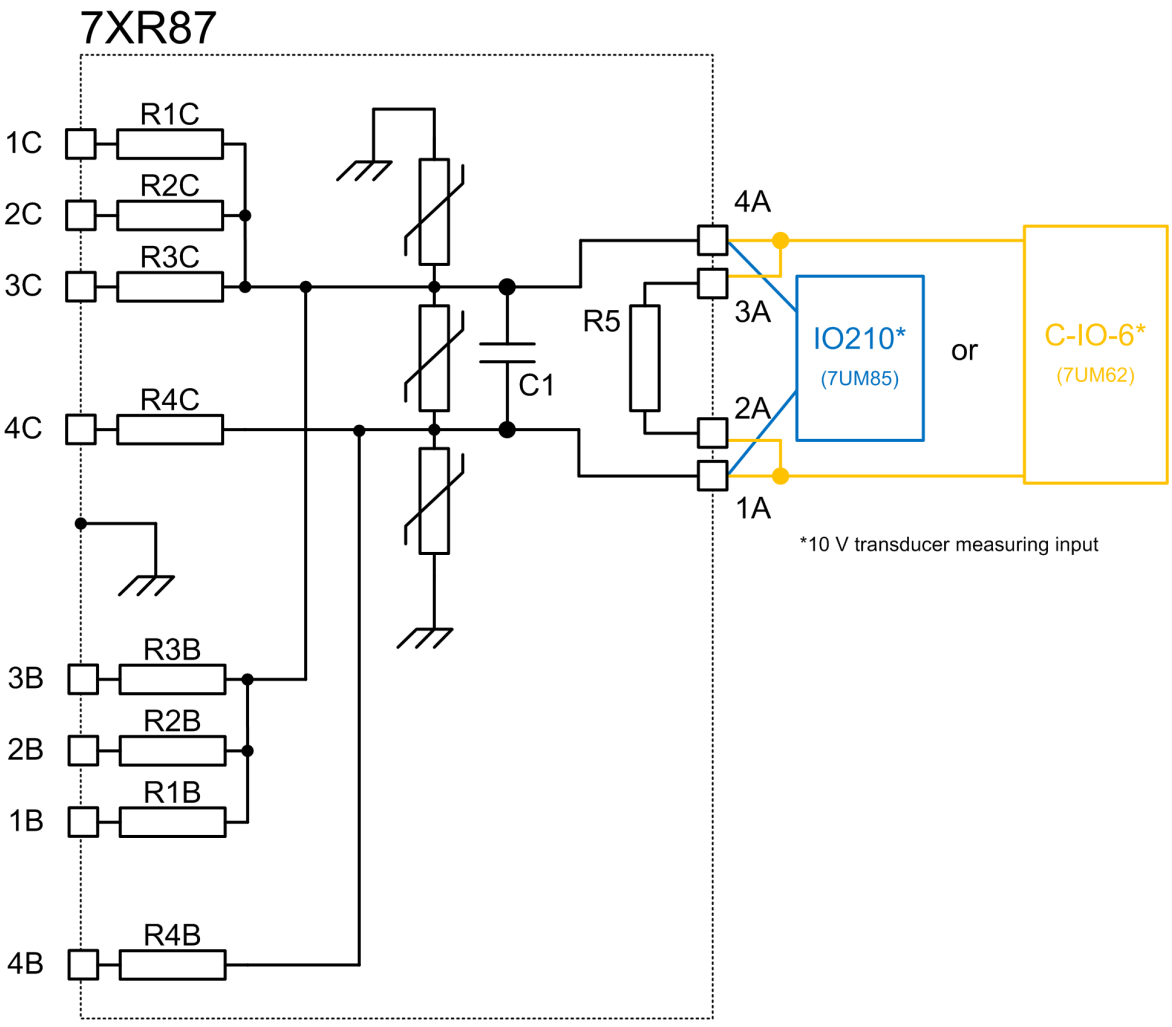
This device replaces the previous 3PP1326-0BZ-K2Y (10:1, 20:1 voltage divider).

Ordering Information

Use the following table for ordering the device:

Order No. / MLFB													
Pos.	1	2	3	4	5	6	7	-	8	9	10	11	12
	7	**X**	**R**	**8**	**7**	**0**	**0**	**-**	**0**		**A**	**0**	**0**
Housing													
Panel **surface** mounting housing with screw terminals →										**B**			
Panel **flush** mounting housing with screw terminals →										**C**			

4.1 Block Diagram



[dw_7xr87 block diagram, 1, en_US]

Figure 4-1 Block Diagram of the 7XR87

4.2 Connection Notes

4.2.1 Overview

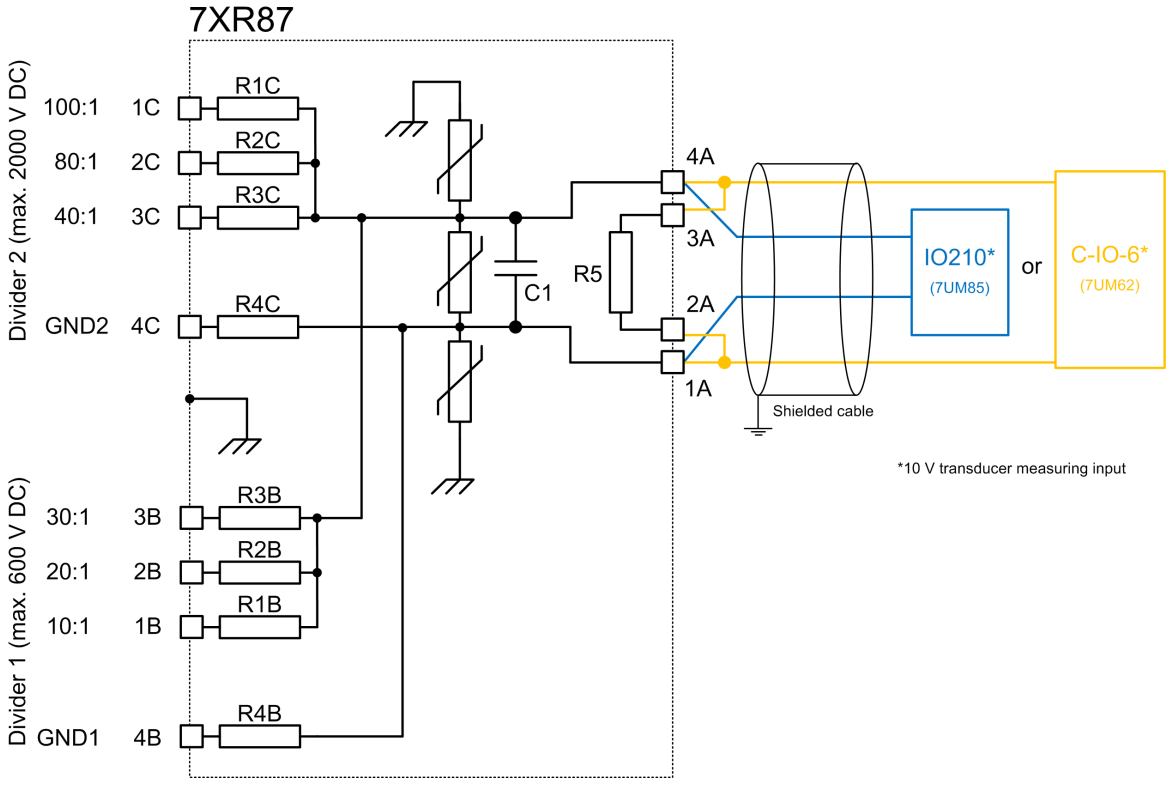
The 7XR87 replaces the 3PP1326 voltage divider. The electrical design was changed compared to the 3PP1326 in order to provide additional divider ratios for higher excitation voltages.

The device provides 6 different voltage dividers ordered in 2 groups with 3 dividers each:

- **Divider 1**: 10:1, 20:1, and 30:1 for a maximum input voltage of 1000 V DC
- **Divider 2**: 40:1, 80:1, and 100:1 for a maximum input voltage of 2000 V DC

A capacitor (C1) provides, in combination with the input resistors, a low pass filter for attenuating the ripple of the excitation voltage.

The resistor R5 provides the necessary impedance adaptation for using the C-IO-6 of the SIPROTEC 4 7UM6x protection relay. For the IO210 of the SIPROTEC 5 7UM85, do not connect the resistor R5 (see connection example below).



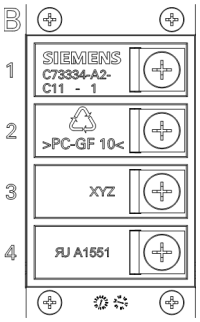
[dw_7xr87 connection examples, 1, en_US]

Figure 4-2 7XR87 Connection Example

The excitation voltage has to be connected between GND1 or GND2 and the required divider ratio. Use only 1 voltage divider at once. Also, connect only 1 protection relay at the output.

4.2.2 Connection Data for Terminal C

Refer to *Figure 4-2* for a description of the use of each terminal connection.



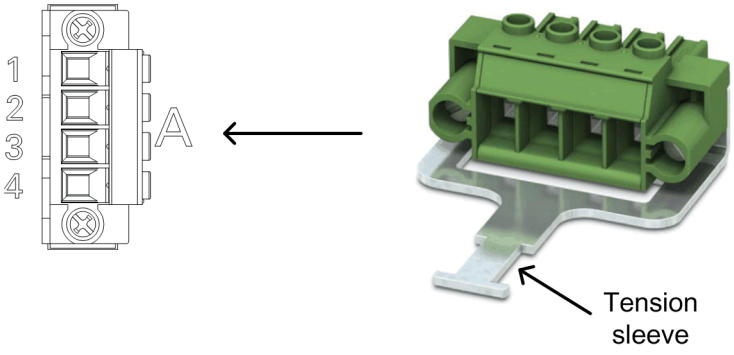
[dw_7xr81 high voltage terminal B, 1, en_US]

Connection via Ring-Type Lugs (M6)

- Wire cross-section: 1.0 mm² to 2.6 mm² resp. AWG 16 to AWG 14
- Stripping length: L = 9 mm (0.35 in) or L = 10 mm (0.39 in)
- Permissible tightening torque at the terminal screw: 4 Nm (35 lb.in.) to 5 Nm (44 lb.in.)
- Use copper conductors only.

Use the appropriate cable isolation for the application rated voltage (max. 2000 V).

4.2.3 Connection Data for Terminal A and B



[dw_7xr87 connection terminal a and b cable sleeve, 1, en_US]

Figure 4-3 Terminal A and B with Cable Sleeve

- The minimum recommended conductor cross-section that can be crimped is 1.5 mm² (AWG 16) with and without bootlace ferrule.
- The maximum conductor cross-section that can be crimped is 4 mm² (AWG 12) with and without bootlace ferrule.
- 2 conductors with same cross-section, stranded, TWIN ferrules with plastic sleeve, max. 2.5 mm² (AWG 14)
- 2 conductors with same cross-section, stranded, ferrules without plastic sleeve, max. 1.5 mm² (AWG 16)

[dw_7xr87 connection terminal a and b stripping, 1, en_US]

Figure 4-4 Stripping Length and Ferrule Length

- The stripping length for use without bootlace ferrule is 10 mm to 12 mm (0.39 inch to 0.47 inch).
- The ferrule length (clamping section) of the bootlace ferrule is minimum 10 mm (0.39 inch) (e.g. DIN 46228-E1,5-10).

NOTE

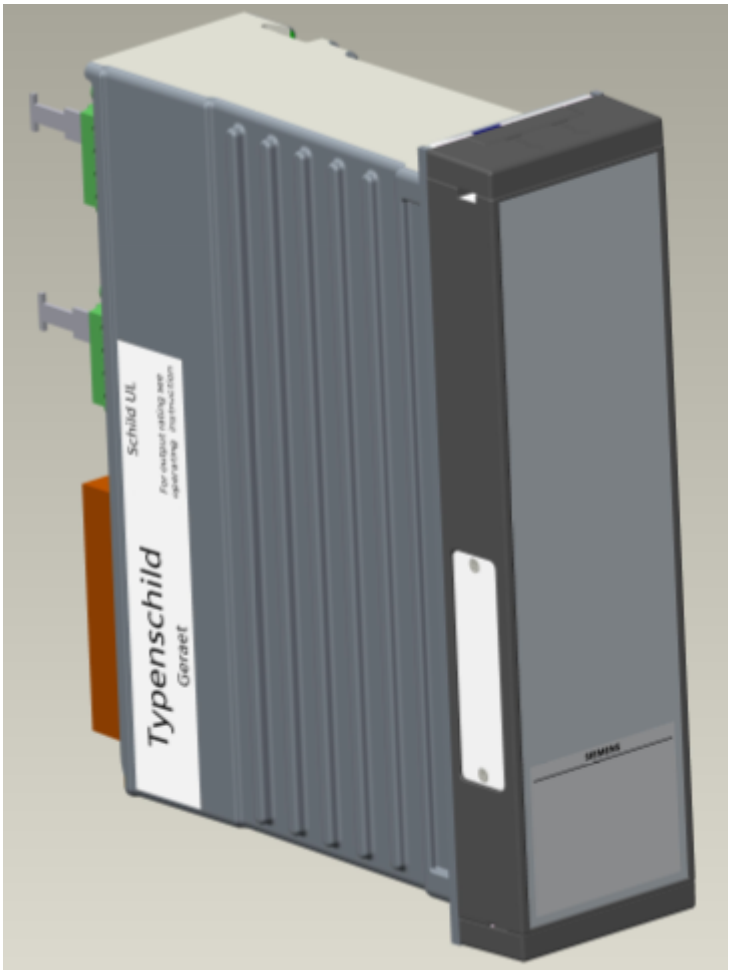
The connection to the rotor circuit has to be protected using a fuse with the proper rated voltage (e.g. 2000 V DC) 0.1 A T (time-lag).

NOTE

Refer to 7UM62/7UM85 documents for connection examples.

4.3 Construction Properties

4.3.1 Mechanical Structure

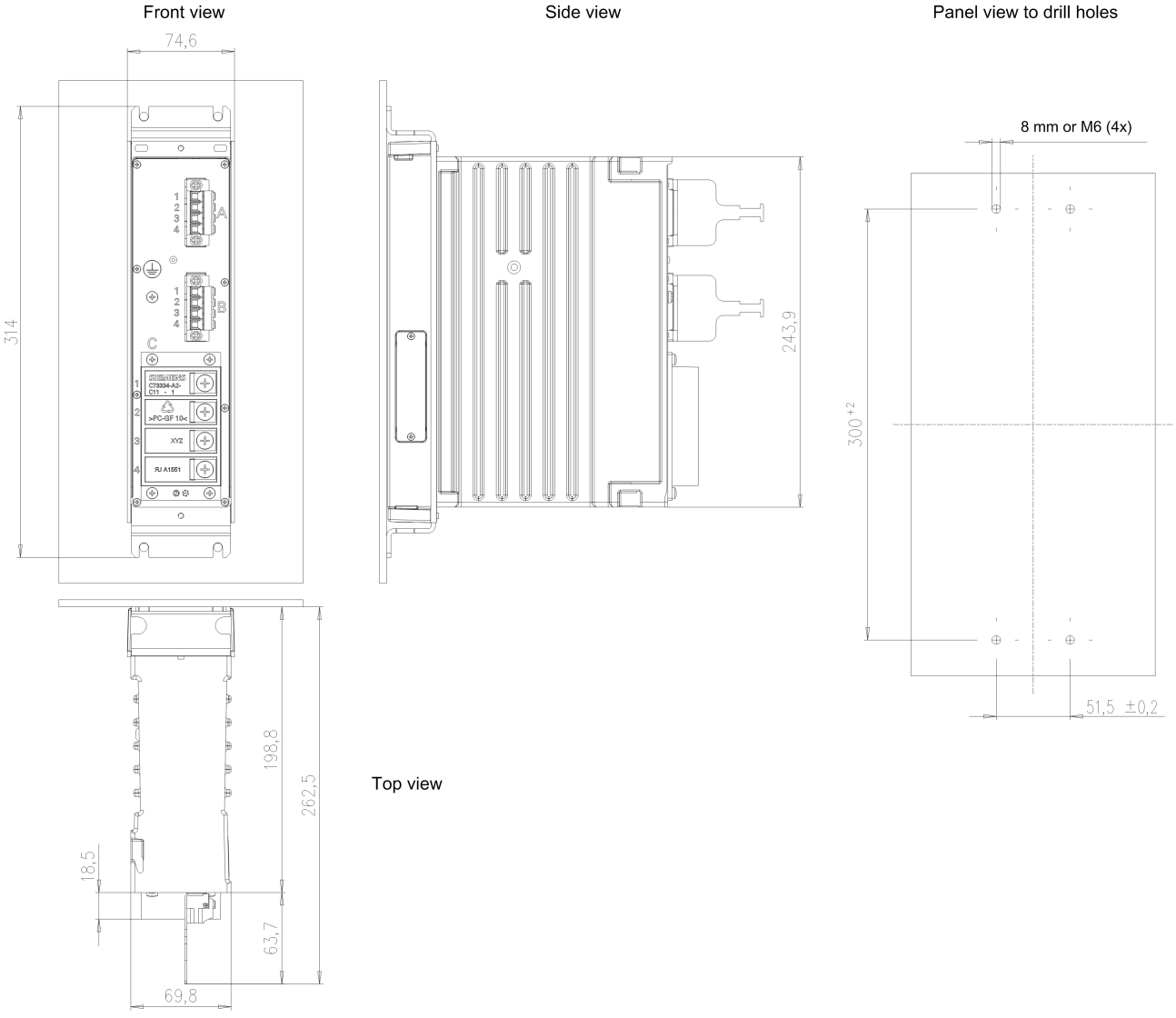


[3d_mechstruct_7xr87, 1, --_--]

Figure 4-5 Mechanical Design of the 7XR87

4.3.2 Dimensions

4.3.2.1 Panel Surface Mounting



[dw_7xr87 dimensions panel, 1, en_US]

Figure 4-6 7XR87 Surface Mounting Dimensions

4.3.2.2 Panel Flush Mounting

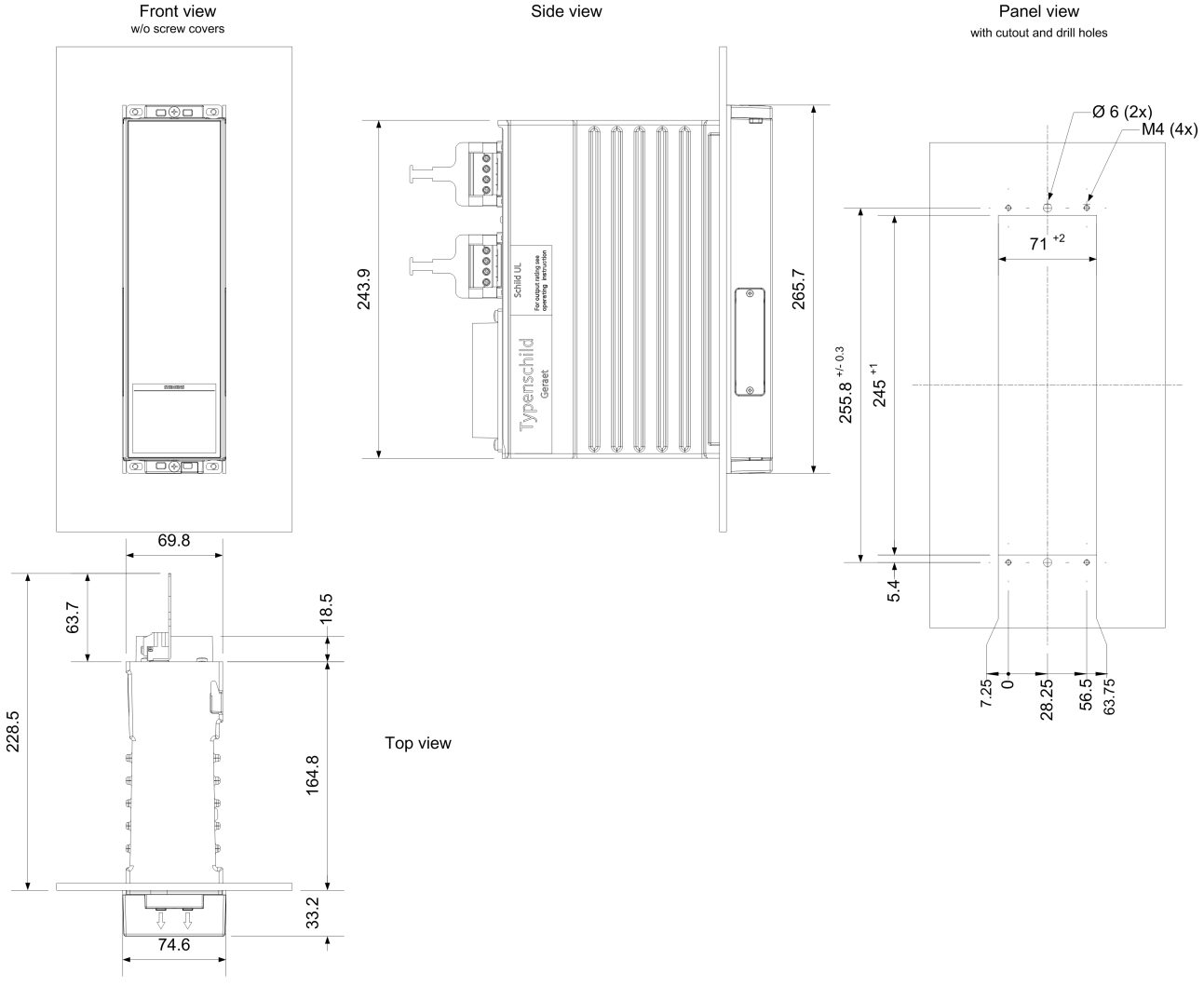


Figure 4-7 7XR87 Flush Mounting Dimensions

4.4 Technical Data

4.4.1 Load Capability of the Voltage Divider

Description	Value
Max. permissible continuous voltage	2000 V DC (Terminal C); 1500 V DC (UL) 600 V DC (Terminal B)
Max. dissipated power	3.5 W

4.4.2 Weight

The weight of the device is 2.2 kg (4.9 lb.).

4.5 Electrical Tests

4.5.1 Standards

IEC 60255 (product standard)
Additional standards are listed for the individual tests.

4.5.2 Installation Requirements

Overvoltage category	III
Degree of pollution	2
Protection class	1

4.5.3 Insulation and Safety Tests

Standards	IEC 60255-27
Voltage test (routine test)	DC 2.8 kV, 1 s (output)
Voltage test (routine test)	DC 4.8 kV, 1 s (input)
Surge immunity test (type testing), all circuits	8 kV (peak value), 1.2 µs/50 µs, 0.5 J 3 positive and 3 negative impulses at intervals of 1 s
Insulation resistance	> 100 MΩ @ DC 500 V
Resistor of protective equal-potential-bonding	< 0.1 Ω @ DC 12 V, 30 A after 1 min

NOTE

For the insulation tests of the generator according to IEC60034-1 or IEEE421.3, the device has to be disconnected from the generator if the applied voltage is higher than the values shown here.

4.5.4 EMC Immunity Tests (Type Tests, Test under Mounting Conditions)

See *1.6.4 EMC Immunity Tests (Type Tests, Test under Mounting Conditions)* for 7XR81.

4.6 Mechanical Tests

See *1.7 Mechanical Tests* for 7XR81.

4.7 Environmental Conditions

4.7.1 Temperatures

Type test, in operation (in compliance with IEC 60068-2-1 and IEC 60068-2-2, test Ad for 16 h and test Bd	-25 °C to +85 °C
Recommended for uninterrupted duty (in compliance with IEC 60255-1)	-10 °C to +55 °C
Temperatures for continuous storage	-25 °C to +55 °C
Type test, transport and storage for 96 h	-40 °C to +70 °C

4.7.2 Humidity

Permissible humidity stress (according to IEC 60068-2-30)	≤ 75 % relative humidity on the annual average Up to 93 % relative humidity
	Devices subjected to condensation are not to be operated! Arrange the devices so that they are not exposed to direct sunlight or extreme temperature changes. This will prevent condensation in the device.
Constant humid heat, 56 days	40 °C, 93 % relative humidity
Humid heat, cyclical	12 h + 12 h cycles 25 °C / 55 °C / 95 % relative humidity

4.7.3 Other Environmental Information

Maximum altitude above sea level	2000 m (6561.68 ft)
Minimum admissible atmospheric pressure	783.8 hPa

4.8 Protection Degree according to IEC 60529

For the equipment	IP20
For personal protection	IP2x[3]

[3] To meet IP2x on Terminal B, additional measures have to be taken. After installation of the cables, the terminal has to be properly covered using an insulating material to avoid direct contact to the screws (e.g. using the self-adhesive tape Terosat 2750 by Henkel); otherwise the device has to be considered IP1x.

A Commissioning and Maintenance

A.1 Unpacking a Device

Devices are tested prior to delivery. Devices are packed on site in a way that meets the requirements of standard ISO 2248.

How to procede

- ✧ Check the packing for external transport damage. Damaged packing may indicate that the devices inside have also sustained damage.
- ✧ Unpack devices carefully; do not use force.
- ✧ Visually check the devices to ensure that they are in perfect mechanical condition.
- ✧ Check the enclosed accessories against the delivery note to make sure that everything is complete.
- ✧ Keep the packing in case the devices must be stored or transported elsewhere.

A.2 Commissioning

How to procede

- ✧ Commissioning and installation have to be executed according to the user manual.
- ✧ During installation of a device, the generator, its accessories and the secondary devices – like the protection relays – must be disconnected and properly grounded.
- ✧ During the insulation tests for the generator or the excitation system according to IEC60034-1/IEEE421.3 the device has to be disconnected.

A.3 Storing a Device

How to procede

- ✧ SIPROTEC devices must be stored in rooms which are clean and dry. Devices or associated replacement modules must be stored at a temperature of –25 °C to +55 °C (-13 °F to 131 °F).
- ✧ The relative humidity must be at a level where condensate and ice is prevented from forming.
- ✧ Siemens recommends that you observe a restricted storage temperature range of +10 °C to +35 °C (50 °F to 95 °F), in order to prevent the capacitors used in the power supply from aging prematurely.

A.4 Repacking a Device

How to procede

- ✧ If you store devices after incoming inspection, pack them in suitable storage packaging.
- ✧ If devices are to be transported, pack them in transport packing.
- ✧ Put the accessories supplied in the packing with the device.
- ✧ If devices are to be shipped elsewhere, you can reuse their transport packaging. If using other packaging, ensure that the transport requirements according to ISO 2248 are met. Storage packaging for individual devices is not adequate for transport purposes.

NOTE

Before energizing with supply voltage, or after storage, the relay shall be situated in the operating area for at least 2 hours in order to ensure temperature equalization and to avoid humidity influences and condensation.

A.5 Returning a Device

NOTE

If the wired terminals of the defective base module are to remain in the system, fit the defective base module with the terminals of the replacement module or order replacement terminals.

How to procede

- ✧ Ensure that the devices are either shipped with the original terminals, or alternatively – if the wired terminals are to remain in the system – with the designated transport safety devices.
- ✧ Pack the defective device (refer to *A.4 Repacking a Device*).
- ✧ Return **all of** the defective device to your Siemens sales partner.

A.6 Environmental Protection Hints

Disposal of Old Equipment and Batteries (Applicable only for European Union and Countries with a Recycling System)

The disposal of our products and possible recycling of their components after decommissioning has to be carried out by an accredited recycling company, or the products/components must be taken to applicable collection points. Such disposal activities must comply with all local laws, guidelines and environmental specifications of the country in which the disposal is done. For the European Union the sustainable disposal of electronic scrap is defined in the respective regulation for "waste electrical and electronic equipment" (WEEE).

The crossed-out wheelie bin on the products, packaging and/or accompanying documents means that used electrical and electronic products and batteries must not be mixed with normal household waste.

According to national legislation, penalties may be charged for incorrect disposal of such waste.

By disposing of these products correctly you will help to save valuable resources and prevent any potential negative effects on human health and the environment.

NOTE

Our products and batteries must not be disposed of as household waste. For disposing batteries it is necessary to observe the local national/international directives.

REACH/RoHS Declaration

You can find our current **REACH/RoHS** declarations at:

https://www.siemens.com/global/en/home/products/energy/ecotransparency/ecotransparency-downloads.html

NOTE

You can find more information about activities and programs to protect the climate at the EcoTransparency website:

https://www.siemens.com/global/en/home/products/energy/ecotransparency.html

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