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THR9

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Сочи (862)225-72-31
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Сургут (3462)77-98-35
Тверь (4822)63-31-35
Томск (3822)98-41-53
Тула (4872)74-02-29
Тюмень (3452)66-21-18
Ульяновск (8422)24-23-59
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R&S®THR9 Liquid-Cooled FM Transmitter Family

At a glance

The R&S®THR9 high-power FM transmitter family makes terrestrial broadcasting of audio broadcast signals extremely efficient and also saves space. These high-power transmitters feature an energy efficiency of up to 75 %. Liquid cooling and the integration of multiple transmitters in a single rack minimize space requirements. Audio broadcast network operators benefit from extremely low energy costs, maximum robustness and minimum maintenance expenses over the entire system lifetime.

The liquid-cooled transmitters deliver FM output power of up to 40 kW per rack and up to 80 kW in two racks. The integration versatility ranges from single transmitters with built-in pump unit and space for additional system components to multitransmitter systems and even N+1 configurations in a single rack. By making it possible to integrate high output powers as well as multiple transmitters, offers the highest power density per rack.

The R&S®THR9 transmitter family for band II attains efficiency values of up to 75 % in analog FM mode. Unlike air-cooled FM transmitters, the R&S®THR9 incorporates a completely redundant and highly efficient transmitter cooling infrastructure. As a result, the cooling infrastructure and the transmitters are perfectly matched, which offers major advantages in 24/7 operation. The R&S®THR9 high-power transmitter family supports the hybrid HD Radio™ standard (IBOC) as well as purely digital standards in band II.

Key facts

- Energy efficiency of up to 75 %
- Maximum robustness and extremely low service costs thanks to redundant liquid cooling system
- Small footprint through integration of multiple transmitters and highest power density
- FM and HD Radio™ transmitters for band II

R&S®THR9 Liquid-Cooled FM Transmitter Family

Benefits and key features

Minimal footprint: multiple transmitters in a single rack

- MultiTX systems with up to four transmitters per rack
- Integration of an N+1 system in one rack
- Intuitive operation of MultiTX systems

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Field-proven liquid cooling system for low service costs

- Fully redundant liquid cooling system
- Pump and heat exchanger perfectly matched to transmitter
- Easy installation and service

▷ page 7

Superior efficiency for minimal energy costs

- Maximum efficiency due to unique system design
- Innovative amplifier with high efficiency and built-in redundancy
- Efficient liquid cooling system

▷ page 10

Highest power density for reduced footprint

- Integration of multiple transmitters and system components in one 19" rack
- Highest power density for a wide variety of configuration options

▷ page 12

Equipped for the digital future

- Digital audio broadcasting in band II
- HD Radio™ Generation 4

▷ page 13

E5 – efficiency to the power of five
The R&S®Tx9 transmitter generation scores with efficiency at five different levels:

- **Efficiency in energy**
  Economical: minimum power consumption for cost savings over system lifetime
- **Efficiency in space**
  Space-saving: several transmitters and additional components in one rack
- **Efficiency in operation**
  Smooth: installation, operation and maintenance
- **Efficiency in configuration**
  Customer-focused: modular solutions for flexible system configuration
- **Efficiency for a lifetime**
  Future-ready: can be expanded to accommodate new standards and technologies

Model overview

R&S®THR9 transmitter family								
Number of R&S®PHR901 amplifiers	**1**	**2**	**3**	**4**	**6**	**8**	**12**	**16**
Output power for analog standards								
FM audio broadcasting	5 kW	10 kW	15 kW	20 kW	30 kW	40 kW	60 kW	80 kW
Output power (RMS) for digital standards [1]								
HD Radio™ (–20 dB injection level)	4.9 kW	9.7 kW	14 kW	19 kW	29 kW	38 kW	58 kW	76 kW
HD Radio™ (–14 dB injection level)	4.3 kW	8.4 kW	12 kW	17 kW	25 kW	33 kW	50 kW	66 kW
HD Radio™ (–10 dB injection level)	3.0 kW	6.1 kW	9.3 kW	12 kW	18 kW	24 kW	36 kW	48 kW
Dimensions (H × W × D)	2000 mm × 600 mm × 1100 mm (78.74 in × 23.62 in × 43.31 in)						2000 mm × 1200 mm × 1100 mm (78.74 in × 47.24 in × 43.31 in)	
Number of transmitters per rack with MultiTX	up to 4		up to 3	up to 2				
N+1 configuration per rack with MultiTX	3+1		2+1	1+1				

[1] The values correspond to the output power of the analog signal part. The output power of the digital signal part is defined by the injection level.

The integration versatility of the R&S®THR9 transmitter family ranges from single transmitters with built-in pump unit and space for additional system components to multitransmitter systems and even N+1 configurations in a single rack.

Minimal footprint: multiple transmitters in a single rack

MultiTX systems with up to four single transmitters per rack

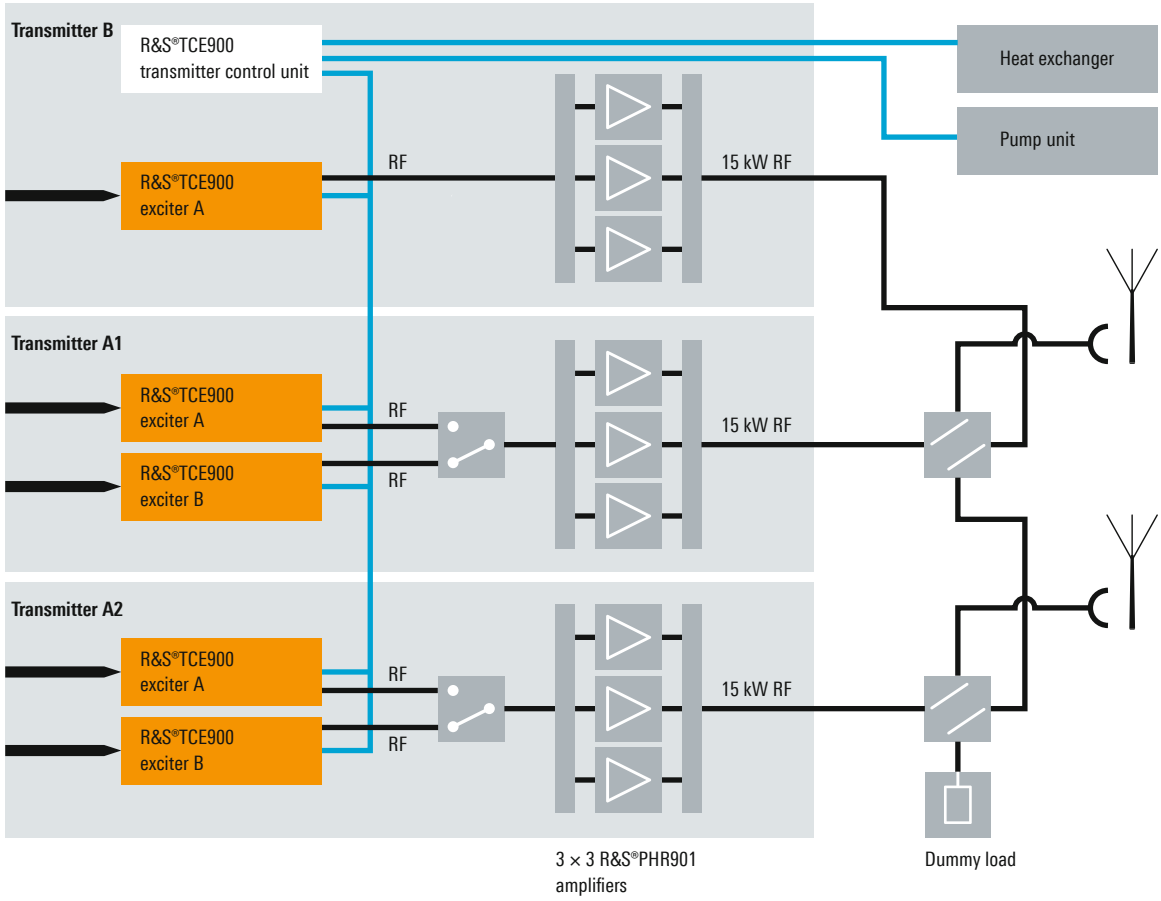
Previously, multitransmitter systems in a single rack were not available for high-power FM transmitters. Now, has implemented the MultiTX system concept in the R&S®THR9 high-power transmitter family for audio broadcasting in band II.

R&S®THR9 multitransmitter systems are available with different output powers for analog and digital mode. This approach saves the operator real money because up to four 10 kW transmitters can be installed in one rack.

MultiTX opens up totally new dimensions in flexibility and scalability at moderate cost. If the transmitter site is to be restructured later, the rack can be ordered with the necessary additional RF components such as splitters and combiners. All that is then needed to put the additional transmitters into operation is to simply install the required exciters and amplifiers. System expansion poses no problem since the amplifiers are hot-pluggable, and exciters and system components are easily accessible at the top of the rack.

The new high-power multitransmitter system offers high availability. Separate AC supply inlets, for example, provide power autonomy for each single transmitter.

Example of a MultiTX system with three 15 kW FM transmitters in 2+1 configuration in a single rack



Integration of an N+1 system in one rack

Depending on the redundancy requirements, the transmitters can be configured with single drive or dual drive. N+1 configurations can also be implemented in a single rack.

The innovative design concept boasts the compactness of entire N+1 transmitter systems. One rack can maximally accommodate a 3+1 configuration. To save space, the RF coaxial switches are installed directly on the top of the rack. A central operating interface provides access to all transmitters of an N+1 system and the highly redundant cooling system.

Example of a MultiTX system with four 10 kW FM transmitters in 3+1 configuration in a single rack

Intuitive operation of MultiTX systems

Each R&S®THR9 is equipped with a status display on the front panel, where the transmitter status can be read off at any time. The buttons on the front panel make it quick and easy to switch from remote to local mode and to switch the transmitter on and off.

The optional R&S®TDU900 transmitter display unit allows fast, intuitive operation of the transmitter system via a 7" touchscreen. The retractable unit automatically slides out of the housing simply by giving it a slight push. It can be conveniently swiveled to the desired position for fast, user-friendly operation.

An Ethernet connector, available with and without an R&S®TDU900, allows the transmitter to be operated locally via LAN interface. The transmitter can be operated remotely via web interface or integrated into a network management system via SNMP.

R&S®TDU900 transmitter display unit.

Field-proven liquid cooling system for low service costs

Fully redundant liquid cooling system is the first to use liquid cooling for band II high-power transmitters. This cooling concept is already used with TV transmitters and has proven to have many advantages over air-cooled transmitter systems that often require significant construction work and infrastruc-ture changes.

The use of liquid cooling for the high output powers of the R&S®THR9 product family simplifies installation, minimizes space requirements and ensures low-noise operation.

The cooling system contains two pump modules that operate in active standby to ensure high system availability. The heat exchangers are equipped with ultramodern fans that are highly efficient and have extremely low-noise blades.

Separate AC supply lines for each pump module and each fan on the heat exchanger as well as lightning and overvoltage protection circuits provide optimal protection for the system.

The powerful heat exchanger is installed on the outside of the transmitter site.

Pump and heat exchanger perfectly matched to transmitter

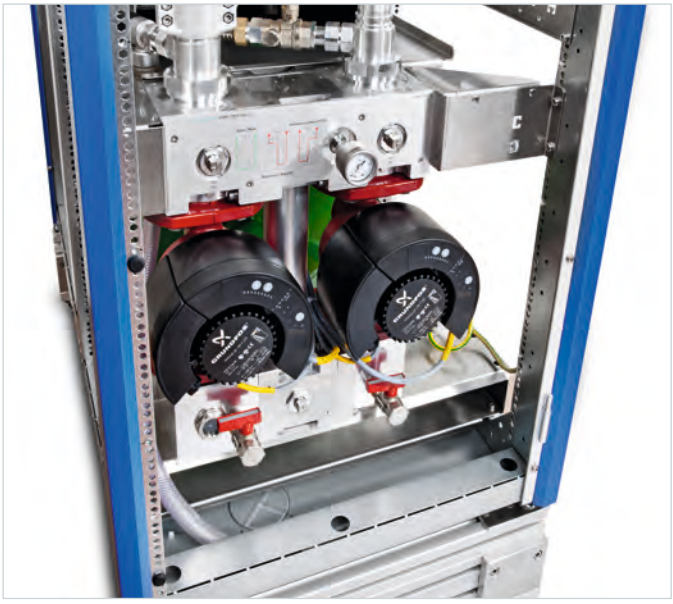
The cooling system of the R&S®THR9 FM transmitter family is equipped with efficient, field-proven components for different output powers. The cooling system is configured according to network operator requirements, the system configuration and the number of amplifiers. The cooling configuration for single transmitters up to 20 kW comprises two pump modules integrated into the rack. For output powers of more than 20 kW and MultiTX systems, a compact pump unit is used that can also be integrated into the rack.

The footprint can also be optimized when the pump unit is installed outside the rack since its compact hydraulic block takes up little space. The cleverly designed supporting frame makes installation flexible. The pump can be installed on the floor (standard solution) or on the wall. Two pumps can also be stacked on one another.

The heat exchangers have a practice-proven design. The arrangement of the robust stainless-steel registers makes the heat exchangers even more compact. The heat exchangers can be installed in different arrangements to accommodate site constraints.

Pump modules in active standby for single transmitters.

Redundant pump system for multiple transmitter systems.



Easy installation and service

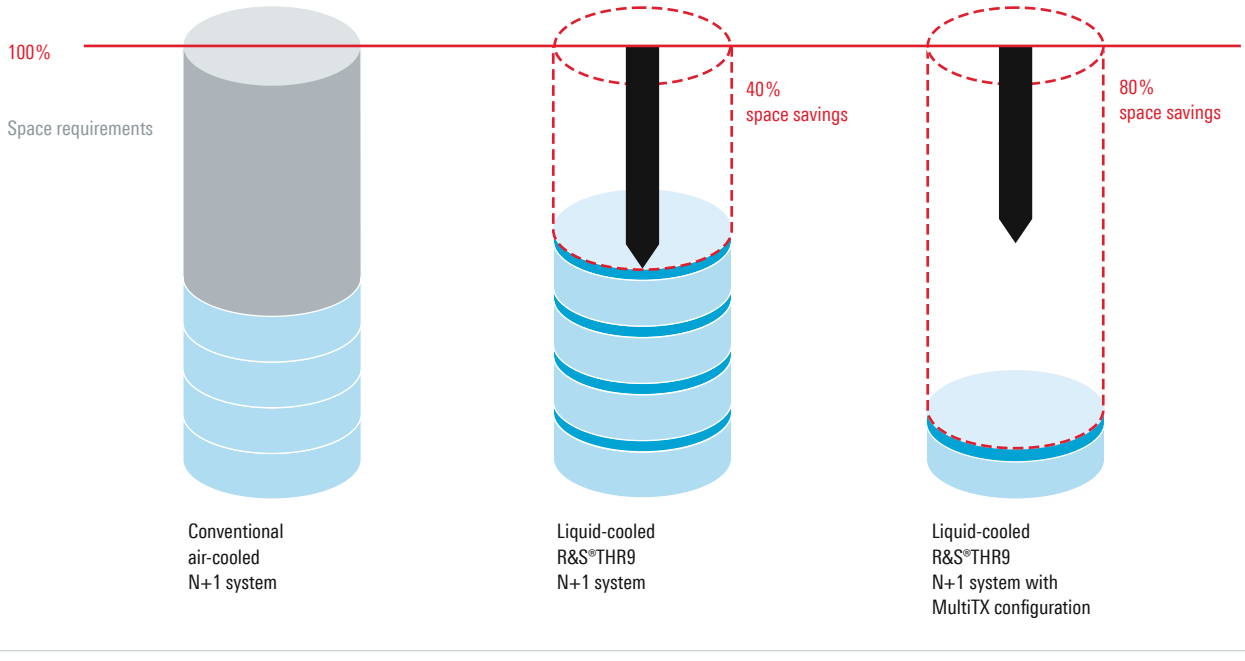
Installing or replacing an air-cooled audio broadcast transmitter often requires substantial construction work. In many cases, it is also necessary to install space-consuming air ducts, additional fans or even a complex air mixing chamber.

The liquid cooling concept makes it possible to achieve space savings of approx. 40 % at the transmitter site because no air cooling installations are needed – only cooling hoses have to be installed. The cooling concept of the R&S®THR9 FM transmitter family saves a considerable amount of space, even for single transmitters.

Thanks to the MultiTX concept and the R&S®THR9 cooling concept, network operators achieve space savings of up to 80 % at the transmitter site. Many air-cooled transmitter systems installed in N+1 configuration are cooled using large, complex air mixing chambers. The R&S®THR9 MultiTX concept makes it possible to integrate four 10 kW transmitters in one rack, using a single liquid cooling system with an internal pump unit and a powerful external heat exchanger. This concept enables users to achieve space savings of up to 80 % and reduces installation and maintenance requirements compared with air-cooled transmitter systems.

The R&S®THR9 liquid cooling system contains only a few moving parts, dramatically reducing maintenance costs. Unlike with air-cooled transmitters, no defective fans need to be replaced nor filter mats cleaned on an annual basis. With the R&S®THR9, all the user has to do is check the coolant once a year and the pumps and heat exchangers every four years. And the best news: even if there is more than one transmitter per rack, this maintenance work need only be performed once. This alone reduces the maintenance costs per transmitter by up to 75 %.

Space-saving N+1 systems through minimized installation space requirements using the R&S®THR9



Superior efficiency for minimal energy costs

Maximum efficiency due to unique system design

The R&S®THR9 transmitter family leads the market for FM transmitters, attaining efficiency values of up to 75 %. This level of performance is the result of constant innovation at in the development of solid-state, liquid-cooled transmitters and the pioneering implementation of the MultiTX concept.

The R&S®THR9 has been designed with superior efficiency and maximum reliability in mind. The power combiner and RF rigid line exhibit minimum attenuation. Together with the other components, they decisively contribute to the high efficiency of the entire transmitter system.

Innovative amplifier with high efficiency and built-in redundancy

Developed for analog and hybrid operation, the amplifier is one of the core components of the audio broadcast transmitter. It has the greatest impact on power consumption. The combination of the mechanical design, cooling concept and state-of-the-art components is the key to the performance and high efficiency of the R&S®PHR901 liquid-cooled amplifier.

Each amplifier delivers an output power of 5.2 kW in analog FM mode and 3.5 kW for HD Radio™ (at –10 dB injection level). The power transistors use sophisticated 50 V LDMOS technology.

The coolant flows through the heat sink so that all transistors operate at the same temperature and no hot spots occur. This optimized design eliminates the need for fans in the amplifier.

Three efficient, integrated and generously dimensioned power supplies provide the power for the transistors. The power supplies have sufficient headroom, ensuring that the amplifier remains on air with > 80 % of its output power even if one of the power supplies fails.

Liquid-cooled R&S®PHR901 amplifier for analog and digital mode.

Efficient liquid cooling system

The introduction of the liquid cooling system for FM is another key factor in the overall efficiency of the system. In particular, large air-cooled systems with multiple transmitters often require very complex cooling systems with air mixing chambers, and the additional cooling units and fans have a significant impact on overall energy consumption. The use of a centralized liquid cooling system considerably reduces the overall energy costs.

The individual components of the liquid cooling system are optimized to save energy. The pumps consume less power since their speed is optimally adjusted based on the calculation of the necessary coolant flow. The R&S®THR9 FM transmitters save even more energy by measuring the temperature in the cooling circuit and adjusting the speed of the highly efficient, state-of-the-art fans accordingly.

Even with all cooling infrastructure components running, the complete transmitter system provides outstanding energy efficiency of up to 74%.

Liquid cooling system

Highest power density for reduced footprint

MultiTX system with three 10 kW transmitters with integrated pump unit in one rack.

Integration of multiple transmitters and system components in one 19" rack

The MultiTX concept utilizes the amplifiers' high power density to integrate multiple transmitters in one rack. Depending on the number of amplifiers per transmitter, a rack can hold up to four single transmitters. All other transmitters on the market require much more floor space for such a configuration. The decisively smaller footprint of the solution allows the operator to sig-nificantly reduce site rental costs.

Compared with conventional coupler solutions, the rack-mounted power combiner with built-in coolant distribution saves so much space that up to four RF rigid lines can be installed. The transmitter control unit and exciters also require very little space. Up to seven R&S®TCE900 units can be installed in the mounting frame at the top of the rack. The vertical arrangement of the equipment, with all necessary interfaces on the top of the rack, makes installation and access easy.

The integration of additional functions saves even more space. Multiple transmitters as well as additional components, such as the liquid cooling pump unit, can be installed in the rack. The R&S®TCE900, for example, offers built-in stereo coding, a GPS receiver and the necessary interfaces for AudioOverIP. If third-party components are needed, these can also be placed in the rack.

Highest power density for a wide variety of configuration options

The R&S®THR9 offers the highest power density on the market for solid-state transmitters. Liquid cooling makes it possible to use very compact 5 kW amplifiers. Due to the achieved power density, a wide variety of different configurations can be implemented.

Up to eight amplifiers for a single transmitter can be accommodated in a single transmitter rack. This configuration allows an output power of up to 40 kW per 19" rack in analog FM mode and, in HD Radio™ mode, up to 24 kW (at –10 dB injection level) per 19" rack. Many systems currently available on the market require two or more racks to achieve comparable output power levels. Beside single transmitters, numerous system configurations are also offered.

Equipped for the digital future

The R&S®THR9 in an HD Radio™ configuration.

THR9 HD Radio™

- Highest energy efficiency of up to 54 % (at –10 dB injection level)
- Hybrid mode with –20 dB to –10 dB injection level
- Extended hybrid mode
- All-digital mode
- Asymmetrical sidebands

Digital audio broadcasting in band II

In the years to come, operators in many regions will have to decide whether to use a digital standard in band II instead of analog FM in their networks. The R&S®THR9 is the ideal solution for an eventual transition, since it supports analog FM as well as the HD Radio™ hybrid standard and is ready to accommodate future hybrid or digital transmission standards in band II.

The amplifier is also prepared for this scenario, since it is optimized both for FM and COFDM waveforms and can be switched from analog to hybrid mode or to purely digital mode.

HD Radio™ Generation 4

The R&S®THR9 with HD Radio™ Generation 4 is state of the art. It achieves substantially better crest factor reduction than 3rd-generation IBOC transmitters, maximizing energy efficiency and increasing HD Radio™ output power.

For customers, this means safety of investment and low cost of ownership, since they can switch from FM to HD Radio™ mode or subsequently increase the injection level using existing hardware.

In addition, the R&S®THR9 is the only HD Radio™ transmitter on the market that features field-tested liquid cooling. It needs no air-conditioned rooms to operate reliably, even in hot regions. This significantly reduces energy costs, completely eliminates a common cause of failure (defective air conditioning system) and minimizes service costs in comparison with air-cooled transmitters, since air conditioning systems require regular and frequent maintenance, which is not necessary for the R&S®THR9.

The IBOC signals are generated through the interaction of importer, exporter, exgine and the R&S®TCE900. The R&S®THR9 system design ensures that the analog signal components are transmitted, even in the event of a failure of the digital signal path.

Specifications

Specifications		
Standards		FM, HD Radio™; other standards on request
Channel bandwidth	FM	200 kHz
	FM, HD Radio™	400 kHz
Inputs	FM	▪ analog audio L ▪ analog audio R ▪ digital AES/EBU ▪ MPx/RDS/SCA1 ▪ MPx/RDS/SCA2 ▪ pilot out
	FM, HD Radio™	▪ digital AES/EBU1 ▪ MPx/RDS/SCA ▪ TS LAN1, RJ-45; E2X/I2E data ▪ TS LAN2, RJ-45; E2X/I2E data
RF output		1 5/8" EIA, 3 1/8" EIA
General data		
Frequency range	VHF band II	87.5 MHz to 108 MHz
VSWR	nominal power	up to 1.5
	reduced power	1.5 to 3.0
	automatic shutdown	> 3.0
Supply voltage		400 V/230 V, 4 wires + PE (L1/L2/L3/N/PE) ±15%; 208 V, 3 wires + PE (L1/L2/L3/PE) ± 15%; 220 V, 3 wires + PE (L1/L2/L3/PE) ± 15%; 240 V, 3 wires + PE (L1/L2/L3/PE) –15%/+10%
Max. installation height		2000 m above sea level > 2000 m on request
Operating temperature range		+1 °C to +45 °C
Relative humidity (max.)		95%, noncondensing
Immunity [1]	to fast transients and bursts in line with IEC 61000-4-4	< 4 kV (AC supply) < 1 kV (signal inputs)
	to surges in line with IEC 61000-4-5	symmetrical < 2 kV (e.g. L1-L2), asymmetrical < 4 kV (e.g. L1-N)
Cooling		liquid-cooled; automatic heat exchanger adjustment as a function of coolant temperature
Coolant		Antifrogen N/water (39%/61%)
Operation		
Status panel with buttons and LEDs		local operation
Display unit with touchscreen and LEDs	optional	local operation and display
Ethernet interface, RJ-45		local, remote, standard web interface
	optional	network management interface via SNMP
Parallel remote interface	optional	floating contacts for messages and commands

[1] With built-in AC overvoltage protection; more stringent requirements must be satisfied by implementing appropriate measures at the transmitter site.