УВЧ Передатчики
THU9evo/THV9evo

Архангельск (8182)63-90-72
Астана (7172)727-132
Астрахань (8512)99-46-04
Барнаул (3852)73-04-60
Белгород (4722)40-23-64
Брянск (4832)59-03-52
Владивосток (423)249-28-31
Волгоград (844)278-03-48
Вологда (8172)26-41-59
Воронеж (473)204-51-73
Екатеринбург (343)384-55-89
Иваново (4932)77-34-06
Ижевск (3412)26-03-58
Иркутск (395)279-98-46
Казань (843)206-01-48
Калининград (4012)72-03-81
Калуга (4842)92-23-67
Кемерово (3842)65-04-62
Киров (8332)68-02-04
Краснодар (861)203-40-90
Красноярск (391)204-63-61
Курск (4712)77-13-04
Липецк (4742)52-20-81
Магнитогорск (3519)55-03-13
Москва (495)268-04-70
Мурманск (8152)59-64-93
Набережные Челны (8552)20-53-41
Нижний Новгород (831)429-08-12
Новокузнецк (3843)20-46-81
Новосибирск (383)227-86-73
Омск (3812)21-46-40
Орел (4862)44-53-42
Оренбург (3532)37-68-04
Пенза (8412)22-31-16
Пермь (342)205-81-47
Ростов-на-Дону (863)308-18-15
Рязань (4912)46-61-64
Самара (846)206-03-16
Санкт-Петербург (812)309-46-40
Саратов (845)249-38-78
Севастополь (8692)22-31-93
Симферополь (3652)67-13-56
Смоленск (4812)29-41-54
Сочи (862)225-72-31
Ставрополь (8652)20-65-13
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
Уфа (347)229-48-12
Хабаровск (4212)92-98-04
Челябинск (351)202-03-61
Череповец (8202)49-02-64
Ярославль (4852)69-52-93

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R&S®THU9evo/ R&S®THV9evo Liquid-Cooled Transmitter Family

At a glance

The R&S®THU9evo/R&S®THV9evo high-power transmitter family heralds the next step toward minimizing operating costs for terrestrial broadcasting. Its overall energy efficiency values of up to 43 % for UHF and 50 % for VHF represent all-time highs. The transmitter family is based on the well-established R&S®THx9 platform and carries forward all of its proven strengths. Network operators benefit from low operating costs throughout the product's lifecycle.

The liquid-cooled high-power transmitters deliver output power levels from 1.5 kW to 106 kW in the UHF band and from 1.3 kW to 30 kW in the VHF band. With the R&S®THx9evo transmitters, offers the highest power density on the market at up to 17.4 kW per rack for COFDM standards and up to 19 kW for ATSC.

 has poured its many years of pioneering experience in Doherty technology into the design of the R&S®THU9evo, achieving efficiency values of up to 43 % for UHF and up to 50 % for VHF, including the cooling system. The new adaptive efficiency optimization feature ensures maximum energy cost savings even after channel changes or output power adjustments.

The transmitters are based on the established R&S®THx9 platform with all of its proven strengths, including the MultiTX concept, outstanding system flexibility and ease of use. Thousands of installed R&S®THU9 and R&S®THV9 transmitters around the globe are proof of how well the platform meets network operators' needs.

Key facts

- Even greater efficiency gains through many years of experience with Doherty technology
- Highest power density on the market
- Built on the strengths of the established R&S®THx9 platform
- Intelligent efficiency optimization for minimized energy costs for all types of applications
- Future-ready ATSC 3.0 support

R&S®THU9evo/ R&S®THV9evo Liquid-Cooled Transmitter Family

Benefits and key features

Minimized operating costs for every application

- Minimized energy costs thanks to enhanced Doherty technology
- Rapid channel change and maximum efficiency combined in a single amplifier
- Minimum energy costs for every operating scenario thanks to intelligent efficiency optimization

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Compact design and easy operation

- Highest power density on the market
- Compact, expandable exciter – the new R&S®TCE901
- Space-saving, scalable cooling system
- Intuitive operation

▷ page 7

Future-ready ATSC 3.0 support

- Server based exciter solution
- Easy upgrade

▷ page 8

R&S®THx9 platform – field-proven thousands of times over

- Built on the known strengths of the R&S®THx9 platform
- MultiTX systems with up to four transmitters per rack
- All-in-one transmitter with built-in pump unit and bandpass filter

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– the partner you can rely on

- Quality transmitters since 1949 – decades of experience in transmitter design and production
- Spare parts available even ten years after product discontinuation

▷ page 14

E^5 – efficiency to the power of five

The R&S®Tx9 transmitter generation scores with efficiency on 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®THU9evo high-power transmitter family

Number of amplifiers per transmitter	Output power (AVG)[1] for COFDM			Output power (AVG)[1] for ATSC		Dimensions (H × W × D)	Number of transmitters per rack with MultiTX configurations
	474 MHz to 680 MHz	680 MHz to 720 MHz	720 MHz to 790 MHz	474 MHz to 720 MHz	720 MHz to 790 MHz		
1	1.5 kW	1.4 kW	1.2 kW	1.65 kW	1.5 kW	2000 mm × 600 mm × 1100 mm (78.74 in × 23.62 in × 43.31 in)	up to 4
2	3.0 kW	2.8 kW	2.4 kW	3.3 kW	3.0 kW		
3	4.5 kW	4.2 kW	3.6 kW	4.9 kW	4.5 kW		
4	6 kW	5.6 kW	4.8 kW	6.5 kW	6.0 kW		up to 3
5	7.5 kW	7.0 kW	6.0 kW	8.2 kW	7.5 kW		up to 2
6	9.0 kW	8.4 kW	7.2 kW	9.8 kW	9.0 kW		
8	11.9 kW	11.0 kW	9.5 kW	13.0 kW	11.9 kW		no MultiTX configuration
10	14.5 kW	13.5 kW	11.5 kW	15.5 kW	14.5 kW		
12	17.4 kW	16.2 kW	14.0 kW	19.0 kW	17.4 kW		
16	23.0 kW	21.5 kW	18.5 kW	25.5 kW	23.0 kW	2000 mm × 1200 mm × 1100 mm (78.74 in × 47.24 in × 43.31 in)	
20	28.0 kW	26.5 kW	22.5 kW	31.0 kW	28.0 kW		
24	34.0 kW	31.5 kW	27.0 kW	37.0 kW	34.0 kW		
30	42.0 kW	39.0 kW	33.5 kW	46.0 kW	42.0 kW	2000 mm × 1800 mm × 1100 mm (78.74 in × 70.87 in × 43.31 in)	
36	50.0 kW	47.0 kW	40.5 kW	55.0 kW	50.0 kW		
40	56.0 kW	52.0 kW	45.0 kW	61.0 kW	56.0 kW	2000 mm × 2400 mm × 1100 mm (78.74 in × 94.49 in × 43.31 in)	
48	67.0 kW	62.5 kW	54.0 kW	73.5 kW	67.0 kW		
60	80.5 kW	75.0 kW	65.0 kW	88.5 kW	80.5 kW	2000 mm × 3600 mm × 1100 mm (78.74 in × 141.73 in × 43.31 in)	
72	96.5 kW	90.0 kW	78.0 kW	106.0 kW	96.5 kW		

R&S®THV9evo high-power transmitter family

Number of amplifiers per transmitter	Output power (AVG)[1]	Dimensions (H × W × D)	Number of transmitters per rack with MultiTX configurations
1	1.3 kW	2000 mm × 600 mm × 1100 mm (78.74 in × 23.62 in × 43.31 in)	up to 4
2	2.6 kW		
3	3.9 kW		
4	5.2 kW		up to 3
5	6.5 kW		up to 2
6	7.7 kW		
8	10.0 kW		no MultiTX configuration
10	12.5 kW		
12	15.0 kW		
16	20.0 kW	2000 mm × 1200 mm × 1100 mm (78.74 in × 47.24 in × 43.31 in)	
20	25.0 kW		
24	30.0 kW		

[1] Before bandpass filter.

Minimized operating costs for every application

Minimized energy costs thanks to enhanced Doherty technology

Focusing on the challenges faced by network operators has always been one of the driving principles behind transmitter development at . Customer satisfaction and the market success experienced with the R&S®THU9 and R&S®THV9 are proof of how well the plat-form satisfies this principle. One of the primary challenges for network operators is and will remain the reduction of operating costs. The R&S®THU9evo/R&S®THV9evo trans-mitters incorporate all of the proven and valued strengths of the R&S®THx9 platform, while taking key features such as energy efficiency and power density to the next level. Built on years of pioneering achievements with Doherty technology, the R&S®THU9evo and R&S®THV9evo offer highest efficiency.

The R&S®THU9evo transmitters achieve energy efficiency of up to 40 % for COFDM standards and up to 43 % for ATSC, including the cooling system, once again setting the benchmark in their class. One UHF amplifier module deliv-ers up to 1.55 kW output power for COFDM standards and up to 1.7 kW for ATSC. The R&S®THV9evo transmitters reach a VHF efficency of up to 46 % for COFDM standards and up to 50 % for ATSC. Years of experience and continu-ous development have given complete mastery over the Doherty technology, which the company has been able to deploy to the greatest advantage.

The multiband Doherty technology was first introduced in the R&S®THx9 generation of transmitters in 2012. Since that time, this amplifier technology has become synonymous with energy cost savings for many network operators. Today, thousands of ampli-fier modules employing multiband Doherty technology are in use in transmitter networks worldwide. Each and every day, technology saves more than 400 000 kWh of energy compared with conventional am-plifier technology.

Liquid-cooled Doherty amplifier

The liquid-cooled amplifiers employ the proven design of the liquid-cooled aluminum heat sink known from previous modules. This design maintains the same operating temperature for all transistors, ensuring maximum service life. Even the power supplies of the amplifiers are liquid-cooled, making separate fans in the amplifiers unnecessary. Three efficient, integrated power supplies deliver power for the transistors. This integrated power supply redundancy allows the Doherty amplifiers to operate at close to maximum power even if one of the power supplies fails.

Rapid channel change and maximum efficiency combined in a single amplifier

Thanks to the multiband Doherty technology, the latest Doherty amplifiers can be operated over the entire frequency range without modifications. Opti-mizations for the various frequency bands are even easier than with predecessor models. With the R&S®THU9evo and R&S®THV9evo transmitters, network operators are optimally equipped for channel changes.

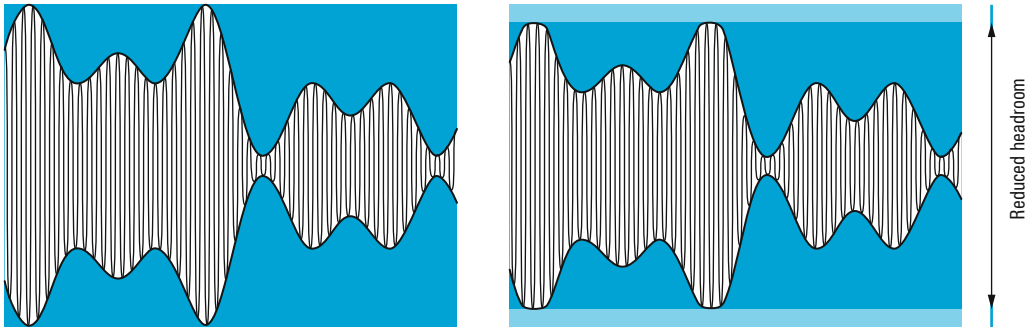
Minimum energy costs for every operating scenario thanks to intelligent efficiency optimization

Normally, transmitters are not operated at their full nominal power. Conventional transmitters experience a significant reduction in efficiency at reduced power. This is where other intelligent R&S®THx9evo technologies come into play. The R&S®THU9evo/R&S®THV9evo transmitter family features power agile efficiency, i.e. transmitter efficiency remains optimal even at reduced power. This is made possible through complete control of the Doherty amplifier circuits along with intelligent control of amplifier parameters, plus advanced precorrection.

To allow network operators to use this potential to maximize energy economy, the R&S®THU9evo/R&S®THV9evo transmitter family offers the newly developed efficiency optimization feature. This intelligent algorithm, deployed at the press of a button or adaptively, optimizes amplifier parameters to meet specific signal quality requirements. Whether changing channels or adjusting the transmitter output power, efficiency optimization ensures that the system delivers maximum efficiency at all times.

The R&S®THU9evo/R&S®THV9evo transmitters also offer improved adaptive precorrection (ADE). This technology has consistently been optimized for the Doherty amplifier characteristics, making it the most effec-tive and fastest precorrection technology on the market. With the advanced R&S®THx9evo technologies, network operators are optimally prepared for channel changes and output power adjustments.

Adaptive efficiency optimization minimizes energy costs for all operating scenarios



Without efficiency optimization
- Unadjusted power amplifier parameters
- Low efficiency

With efficiency optimization
- Adaptively adjusted power amplifier parameters
- High efficiency

Compact design and easy operation

Highest power density on the market

Apart from energy costs, infrastructure costs account for the majority of expenses incurred during the lifecycle of a transmitter system. The R&S®THU9evo/R&S®THV9evo transmitters offer the highest power density on the market for solid-state transmitters. Up to 12 amplifiers can be accommodated in a single transmitter rack. This configuration allows an output power of up to 19 kW.

With this power density, the R&S®THU9evo transmitter family delivers an astonishing maximum output power of 106 kW for ATSC. This means that the state-of-the-art, solid-state transmitters from can now achieve power classes previously attainable only with inductive output tube (IOT) transmitters.

Compact, expandable exciter – the new R&S®TCE901

The R&S®THU9evo/R&S®THV9evo transmitter family comes with the new R&S®TCE901 exciter. The exciter offers an even higher level of integration than the previous model, R&S®TCE900. This saves space and increases the system's availability. It also supports the latest functionality, such as adaptive efficiency optimization. The exciter offers free slots for expanding its functionality (e.g. with optional satellite receivers).

The R&S®TCE901 exciter is multifunctional and extremely versatile. It supports the DVB-T, DVB-T2, ISDB-T/ISDB-T_B, DTMB and ATSC digital TV standards as well as DAB. Together with the R&S®SDE900, it provides a future-ready solution for ATSC 3.0. Multiple standards (e.g. DVB-T and DVB-T2) can be installed in a single exciter. GPS and GLONASS functionality can be activated via option keys.

The R&S®TCE901 comes with an optional, integrated exciter backup battery – a unique feature providing maximum transmitter availability. The battery minimizes the negative effects of mains voltage interruptions. It powers the CPU and the signal processing components during voltage interruptions, ensuring that interruptions of up to 10 seconds do not result in a time-consuming reboot of the transmitter. The battery reduces off-the-air time, without requiring a full-featured UPS.

Compact design and easy operation

Future-ready ATSC 3.0 support

R&S®SDE900 server based exciter solution

The ATSC 3.0 broadcast standard was defined to give broadcast network operators a great degree of flexibility in their service offerings. ATSC 3.0 was designed to evolve together with broadcasters' future requirements. To optimally address network operators' future needs for flexibility, revolutionized how a broadcast standard is implemented. The R&S®SDE900 has a pure software based approach that ideally prepares network operators for ATSC 3.0. Based on a high-performance IT server, it enables network operators to optimally lever-age the full capabilities of the standard and flexibly re-spond to signal processing requirements of the future. The exciter solution fully supports ATSC 3.0 features such as multiple physical layer pipes (PLP), mul-tiple subframes and SFN capabilities for optimal utiliza-tion of valuable spectrum. The R&S®SDE900 also supports ATSC 3.0 layered division multiplexing (LDM), helping net-work operators maximize coverage for different reception scenarios (e.g. fixed and mobile reception).

By design, broadcast standard evolutions can easily be accommodated. Operators benefit from a secure investment and can optimally capitalize on their valuable spectrum assets even in the broadcasting days after tomorrow.

Easy upgrade

The R&S®SDE900 is designed as a plug-in, rackmount module, making it an easy upgrade path to the ATSC 3.0 standard. The R&S®SDE900 software based encoder generates the I/Q modulation data. The field-proven R&S®TCE901 exciter generates the COFDM waveform based on the I/Q data and applies the most powerful precorrection on the market with the high level of signal quality expected from .

Server-based exciter solution

ATSC 3.0

ATSC 3.0 is a digital terrestrial broadcasting standard from the Advanced Television Systems Committee (ATSC) that has been substantially enhanced compared with the ATSC A/53 predecessor standard. ATSC 3.0 is designed to give network operators more flexibility, greater robustness and more efficient operation. It employs state-of-the-art encoding and modulation technologies, enabling a significantly more effective use of the limited spectrum resources. Using minimal resources, it creates capacity to transfer UHD video contents and immersive audio contents to the end user via terrestrial channels. The consistent focus on IP technology in the baseband makes it possible to merge cost-effective terrestrial broadcasting with other IP-based services.

ATSC 3.0 is the first ATSC standard to employ coded orthogonal frequency division multiplexing (COFDM). This modulation method uses a large number of orthogonal carriers, resulting in a signal that is robust against disturbance. COFDM technology also makes it possible to set up spectrum-efficient ATSC 3.0 single-frequency networks (SFN).

Use of the latest low density parity check (LDPC) codes in combination with Bose-Chaudhuri-Hocquenghem (BCH) codes allows the usable channel capacity to approach the theoretical Shannon limit, as does the use of non-uniform constellations (NUC) for modulation. ATSC 3.0 employs multiple PLP technology, enabling flexible use of the channel. With the latest technologies such as LDM, an effective simultaneous crossover can be realized both for mobile reception and for stationary reception.

R&S®SDE900 rackmount module

Space-saving, scalable cooling system

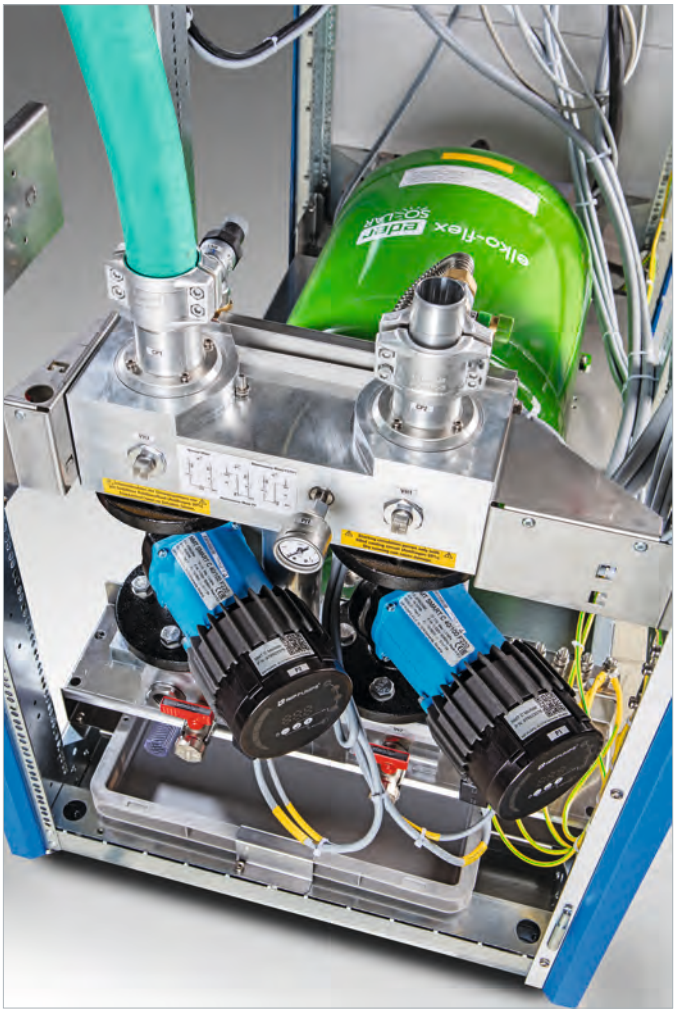
The cooling system of the R&S®THU9evo/R&S®THV9evo transmitters uses efficient, field-proven components for different output powers. It can be scaled according to network operator requirements, the system configuration and the number of amplifiers used in a system. For single transmitters with up to four amplifiers, the new compact cooling system with two redundant pump modules integrated into the rack is the ideal choice. The high-power cooling system is ideal for single transmitters with more than four amplifiers and for MultiTX systems. Depending on the configuration, this high-power system can also be integrated into the rack.

The footprint can also be minimized 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 vertically.

The heat exchangers have a practice-proven design with two redundant, high-efficiency fans. The heat exchangers can be installed in different arrangements to accommodate site constraints.

Compact cooling system with redundant pump modules

High-power cooling system for enhanced requirements



Intuitive operation

The R&S®THU9evo/R&S®THV9evo transmitter family offers the same ease and convenience as the R&S®THU9/R&S®THV9 family. Each transmitter comes with status LEDs on the front panel. 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 touchscreen. In addition, a web interface is available that makes it possible to operate the transmitter either locally or remotely, or to integrate it into a network management system via SNMP.

Whether via touchscreen or web interface – the user benefits from the same convenient GUI used throughout the R&S®Tx9 transmitter generation. This means that if multiple R&S®Tx9 transmitter families are used in a network, the uniform GUI significantly reduces training effort for operating personnel.

The GUI offers network operators the convenience they want and need when installing, commissioning and operating transmitters. The GUI is straightforward and makes it possible to check the system status at a glance. The device based menu provides a graphical view of the transmitter structure. The user simply touches a component to directly access its parameters.

The task-oriented menu shows the different tasks that can be performed with the transmitter. The tasks and their individual steps are presented in a well-structured layout so that they can be accomplished in a minimum of time. For example, when putting the transmitter into operation, the operator is guided through the configuration of the different devices and given help when entering parameters and changing settings.

R&S®TDU900 transmitter display unit

R&S®THx9 platform – field-proven thousands of times over

Built on the known strengths of the R&S®THx9 platform

The R&S®THU9 and R&S®THV9 have been a mainstay of broadcast networks for several years. They have had a last-ing influence on the transmitter market over the past few years, thanks to its unparalleled efficiency made possible by the pioneering efforts of in multi-band Doherty technology combined with unprecedented space savings achieved through MultiTX configurations for liquid-cooled transmitters. Thousands of R&S®THU9 and R&S®THV9 transmitters are in operation around the world. This exceptional success is a clear statement of how the R&S®THx9 transmitter platform meets the needs of network operators, both in terms of minimal operat-ing costs and maximum availability. Transmitter develop-ment at always focuses on the chal-lenges faced by network operators. Key features such as energy efficiency were targeted for improvement while all of the field-proven strengths of the R&S®THx9 plat-form were maintained, including MultiTX and highly opti-mized, low-attenuation RF power components. The broad base of installed R&S®THx9 systems exhibits extremely low failure rates. Based on this established platform, the R&S®THU9evo and R&S®THV9evo transmitters demon-strate the same level of proven reliability.

MultiTX systems with up to four transmitters per rack

The revolutionary MultiTX concept was first introduced for liquid-cooled transmitters in the R&S®THU9 and met with a tremendous response from network operators around the world. The R&S®THU9evo and R&S®THV9evo build on this concept, offering improved power density and allow-ing operators to make even better use of the MultiTX con-cept. Depending on the number of amplifiers per trans-mitter, a rack can hold up to four transmitters. All other transmitters on the market require much more floor space for such a configuration. The significantly smaller footprint of the solution compared with conven-tional transmitters allows operators to substantially reduce site rental costs.

In contrast to conventional couplers, the power combiner is located behind, and directly plugged into the amplifiers, and it comes with integrated coolant distribution. This saves so much space that four RF rigid lines can be in-stalled. This allows a rack to accommodate, for example, four transmitters with up to 4.5 kW output power or three transmitters with up to 6 kW output power.

MultiTX system with four 4.5 kW transmitters in a single rack

The transmitter control unit and exciters also require very little space. Up to seven R&S®TCE900/TCE901 units can be installed in the mounting frame at the transmitter top. The vertical arrangement of the equipment, with all interfaces at the top of the transmitter, makes installation and access easy.

The innovative MultiTX design even makes entire N+1 transmitter systems more compact. 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.

All-in-one transmitter with built-in pump unit and bandpass filter

The high power density also offers advantages for all-in-one configurations. For UHF transmitters with up to four amplifiers, both the pump unit and a six-cavity bandpass filter can be integrated into the rack. This approach considerably reduces the space required for a single transmitter. The hydraulic components of the pump are installed in the rear part of the transmitter rack and can easily be accessed via the rear door.

All-in-one system in a single rack

Specifications in brief

Specifications in brief		
Digital TV		
Standards		DVB-T, DVB-T2, ISDB-T, ISDB-T_B, ATSC, ATSC 3.0, DTMB
Channel bandwidth	DVB-T	5/6/7/8 MHz
	DVB-T2	1.7/5/6/7/8 MHz
	ISDB-T, ISDB-T_B	6 MHz/8 MHz
	ATSC	6 MHz
	ATSC 3.0	6 MHz
	DTMB	6 MHz/8 MHz
Inputs	DVB-T, DVB-T2	2 × ASI (BNC, 75 Ω), 2 × TSoIP (Gigabit Ethernet)
	ISDB-T, ISDB-T_B	2 × ASI (BNC, 75 Ω), 2 × TSoIP (Gigabit Ethernet)
	ATSC	2 × SMPTE 310M or ASI (BNC, 75 Ω), 2 × TSoIP (Gigabit Ethernet)
	ATSC 3.0	2 x STL or TSoIP (Gigabit Ethernet)
	DTMB	2 × ASI (BNC, 75 Ω), 2 × TSoIP (Gigabit Ethernet)
Digital audio broadcasting in the VHF range		
Standards		DAB, DAB+
Channel bandwidth		1.5 MHz
Inputs		2 × ETI (BNC; 75 Ω/high impedance), 2 x EDI (Gigabit Ethernet)
General data		
Frequency range	UHF band IV/V	470 MHz to 790 MHz
	VHF band III	170 MHz to 254 MHz
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
		+1 °C to +40 °C (with R&S®SDE900)
Relative humidity (max.)		95%, noncondensing (indoor)
Immunity[1)]	to fast transients and bursts in line with IEC 61000-4-4	± 2 kV (AC supply) ± 1 kV (signal inputs)
	to surges in line with IEC 61000-4-5	symmetrical: ± 1 kV (e.g. L-N), asymmetrical: ± 2 kV (e.g. L-PE, N-PE)
Synchronization		
Reference frequency		10 MHz, 0.1 V to 5 V (V_{pp}) or TTL, BNC
Reference pulse		1 Hz, TTL, BNC
Operation		
Status panel with buttons and LEDs		local operation
Transmitter display unit with touchscreen and LEDs	optional	local display and operation
Ethernet interface, RJ-45		web interface: local, remote network management interface via SNMP
Parallel remote interface	optional	floating contacts for messages and commands