R&S®THU9 | R&S®THV9 LIQUID-COOLED TRANSMITTER FAMILIES

Efficiency redefined

Product Brochure
Version 06.00

ROHDE&SCHWARZ
Make ideas real

AT A GLANCE

The R&S®THU9/R&S®THV9 UHF/VHF high-power transmitters make terrestrial TV and digital audio broadcasting extremely efficient. They are 42 % more energy efficient for UHF broadcasting and up to 50 % more for VHF. The transmitters have very flexible configurations, are easy to operate and have a very small footprint. Network operators can see cost reductions over the entire life of the system.

R&S®THU9 front

The liquid-cooled transmitters have up to 75 kW output power in the UHF band for digital Doherty standards and up to 58 kW for analog standards. The maximum output power is 30 kW for digital TV and audio broadcasting in the VHF band and 58 kW for analog. Rohde&Schwarz also has the highest power density on the market with as much as 15 kW per rack for COFDM standards.

In Doherty mode, the R&S®THU9/R&S®THV9 transmitter families are up to 42 % efficient for UHF and 50 % for VHF, including the cooling system – maximizing energy and CO2 savings. Energy costs are up to 50 % lower in Doherty mode compared to conventional transmitters.

The transmitters are very flexible and scalable with an extremely compact design. The portfolio ranges from single transmitters with a built-in pump unit and bandpass filter to multitransmitter systems and even N+1 configurations in a single rack. The new operating concept includes ergonomic controls, straightforward, easy-to-use menus and a convenient configuration guide.

Key facts

- Superior efficiency with innovative transmitter design and Doherty technology
- Scalable and flexible system configuration
- Unique MultiTX system with multiple transmitters in a single rack
- Highest power density per transmitter rack
- User-friendly operating terminal and GUI
- Optimized total cost of ownership (TCO)

Outstanding efficiency

		UHF	VHF
COFDM	Doherty mode	38 %	46 %
	Normal mode	28 %	33 %
ATSC	Doherty mode	42 %	50 %
	Normal mode	30 %	43 %

COFDM: DVB-T, DVB-T2, ISDB-$T_{(B)}$, DTMB, DAB, DAB+, T-DMB

BENEFITS AND KEY FEATURES

Brilliant efficiency

- Superior efficiency thanks to unique system design
- Innovative high efficiency amplifier
- Voltage regulation and crest factor reduction
- Efficient liquid cooling system

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Scalable and flexible system configuration

- MultiTX system with multiple transmitters and configurations in a single rack
- R&S®TCE900 – a multitalented transmitter control unit or exciter
- Simple switchover from analog to digital TV
- IP transport stream feed to reduce infrastructure costs
- Integrated satellite receiver for fewer components in rack

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Multifaceted, compact design

- Highest power density available
- MultiTX system with up to four transmitters per rack
- All-in-one transmitter with built-in pump unit and bandpass filter
- Space-saving, flexible liquid cooling system

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Simple operation for fast results

- Ergonomic, user-friendly operating unit
- Simplified navigation with device-oriented views
- Task-oriented menus for fast training of operating personnel

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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®THU9/R&S®THV9 transmitter system																		
Number of amplifiers	**1**	**2**	**3**	**4**	**5**	**6**	**8**	**10**	**12**	**16**	**20**	**24**	**30**	**36**	**40**	**48**	**60**	**72**
UHF																		
Output power (AVG) [1]																		
For COFDM																		
Normal mode	1.3 kW	2.6 kW	3.9 kW	5.2 kW	6.4 kW	7.7 kW	10.0 kW	12.5 kW	15.0 kW	20.0 kW	24.0 kW	29.0 kW						
Doherty mode	1.15 kW	2.3 kW	3.5 kW	4.65 kW	5.8 kW	7.0 kW	9.2 kW	11.3 kW	13.5 kW	18.0 kW	22.0 kW	26.5 kW	32.0 kW	39.0 kW	43.0 kW	50.0 kW	60.0 kW	75.0 kW
For ATSC/ATSC Mobile DTV																		
Normal mode	1.6 kW	3.2 kW	4.8 kW	6.4 kW	8.0 kW	9.5 kW	12.5 kW	15.0 kW	18.5 kW	24.5 kW	30.0 kW	36.0 kW						
Doherty mode	1.15 kW	2.3 kW	3.5 kW	4.65 kW	5.8 kW	7.0 kW	9.2 kW	11.3 kW	13.5 kW	18.0 kW	22.0 kW	26.5 kW	32.0 kW	39.0 kW	43.0 kW	50.0 kW	60.0 kW	75.0 kW
Output power (sync peak) [2]																		
For ATV	2.5 kW	5.0 kW	7.5 kW	10.0 kW	12.5 kW	15.0 kW	20.0 kW	24.5 kW	30.0 kW	39.0 kW	48.0 kW	58.0 kW						
VHF																		
Output power (AVG) [1]																		
For COFDM																		
Normal/Doherty mode	1.3 kW	2.6 kW	3.9 kW	5.2 kW	6.5 kW	7.7 kW	10.0 kW	12.5 kW	15.0 kW	20.0 kW	25.0 kW	30.0 kW						
For ATSC/ATSC Mobile DTV																		
Normal mode	1.6 kW	3.3 kW	4.9 kW	6.5 kW	8.2 kW	9.7 kW	13.0 kW	16.0 kW	19.0 kW	25.0 kW	31.0 kW	38.0 kW						
Doherty mode	1.3 kW	2.6 kW	3.9 kW	5.2 kW	6.5 kW	7.7 kW	10.0 kW	12.5 kW	15.0 kW	20.0 kW	25.0 kW	30.0 kW						
Output power (sync peak) [2, 3]																		
For ATV	2.5 kW	5.0 kW	7.5 kW	10.0 kW	12.0 kW	14.0 kW	19.0 kW	24.0 kW	29.0 kW	39.0 kW	48.0 kW	58.0 kW						
Dimensions in mm (in) (H × W × D)	600 × 2000 × 1100 (23.62 × 78.74 × 43.31)									2000 × 1200 × 1100 (78.74 × 47.24 × 43.31)			2000 × 1800 × 1100 (78.74 × 70.87 × 43.31)		2000 × 2400 × 1100 (78.74 × 94.49 × 43.31)		2000 × 3600 × 1100 (78.74 × 141.74 × 43.31)	
Number of transmitters per rack with MultiTX	up to 4			up to 3	up to 2		1											

[1] Before bandpass filter.
[2] After four-cavity bandpass filter.
[3] Specifications only valid for dual sound. The output power for single sound is slightly lower.

BRILLIANT EFFICIENCY

Superior efficiency due to unique system design

Rohde & Schwarz solid-state TV transmitters are the market leaders with up to 42 % efficiency in the UHF range and 50 % in the VHF range, including the cooling system. The performance results from constant innovation at Rohde&Schwarz and years of experience in developing solid-state, liquid-cooled transmitters and Doherty technology.

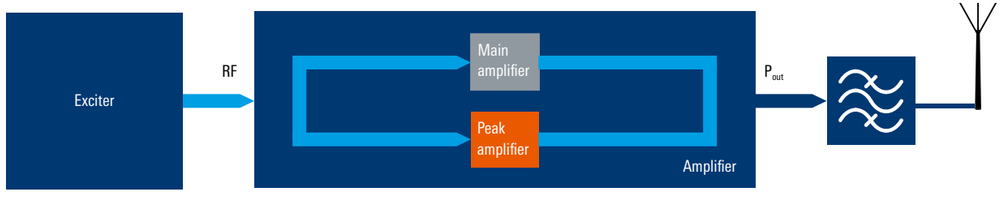
The R&S®THU9/R&S®THV9 transmitter families were designed with efficiency in mind. The power combiner, harmonics filter and RF rigid line minimize attenuation. Together with the other components, they help make the entire transmitter system much more efficient.

Innovative amplifier with high efficiency

The new Doherty amplifier technology makes R&S®THU9/R&S®THV9 transmitters even more efficient. The transmitters set new standards in their class with 42 % UHF efficiency and 50% for VHF. Other transmitters on the market average approximately 20 % efficiency. The R&S®THU9/R&S®THV9 can cut energy costs nearly in half.

Even in normal mode, R&S®THU9/R&S®THV9 transmitters have outstanding 30 % energy efficiency for UHF and 33 % for VHF, including the cooling system. In normal mode, each UHF amplifier delivers 1.35 kW of output power for COFDM standards (1.7 kW for ATSC and 2.8 kW for ATV). UHF amplifiers in Doherty mode have 1.2 kW of output power for DTV. VHF amplifiers have 1.35 kW of output power for digital standards both in Doherty and normal modes. VHF amplifiers have 2.7 kW of output power for ATV in normal mode.

Transmitter system with Doherty amplifier



Liquid-cooled R&S®PHU902 Doherty amplifier

The Doherty concept divides signal amplification into two paths. The main amplifier only boosts the average signal, eliminating the need for peak signal power reserves in the path. The peak amplifier only needs to operate when signal power surges, helping save energy. The intelligent multiband Doherty technology from Rohde&Schwarz lets amplifiers be used over the entire frequency band with few modifications.

The power transistors use sophisticated 50 V technology from LDMOS. The semiconductor manufacturer has worked closely with Rohde&Schwarz to best match the transistors for excellent amplifier board efficiency and long-term stability.

The improved design of the aluminum heat sink in the amplifier keeps all transistors operating at the same temperature and eliminates the need for separate fans.

Three efficient, integrated power supplies feed the transistors. Integrated power supply redundancy means the Doherty amplifiers remain in operation at full output power even if a power source fails.

Voltage regulation and crest factor reduction

Along with optimizing system design, Rohde&Schwarz has two other innovative technological approaches to significantly improve efficiency. The resulting power efficiency is better than that of conventional solid-state technologies.

The unique voltage regulation circuit from Rohde&Schwarz represents a major increase in efficiency. The regulation mechanism in the transmitter control unit optimizes transmitter efficiency for all digital standards. The directional coupler takes a decoupled signal at the transmitter output and routes it back to the R&S®TCE900 exciter and analyzes it. At the same time, the power supplies in the amplifiers iteratively adjust the supply voltage for the power transistors. The voltage regulation circuit significantly improves efficiency, especially when a transmitter is operated at reduced output power.

The R&S®TCE900 exciter from Rohde&Schwarz is the first to reduce the crest factor for all COFDM standards. The crest factor is lowered to 8 dB without any negative impact on MER, improving total transmitter efficiency. The tone reservation method defined in the DVB-T2 standard can also help reduce the crest factor.

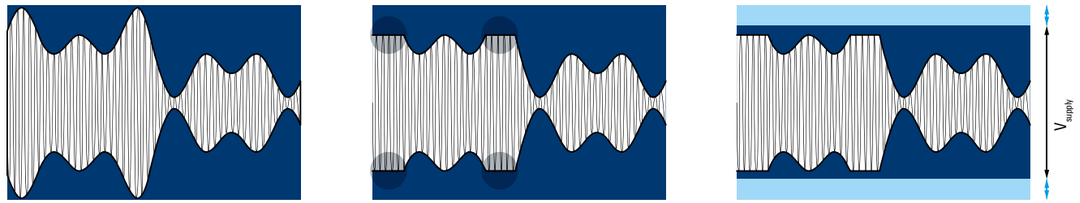
Efficient liquid cooling system

The cooling system is important for overall system efficiency and has been optimized throughout.

The R&S®THU9/R&S®THV9 cooling system comes with efficient field-proven components. The pump rack contains two pump modules in active standby to ensure high system availability. The necessary coolant flow is calculated based on the system configuration and the number of amplifiers. The rotational speed of the pumps is adapted to the coolant flow to save energy and extend transmitter life.

The heat exchangers have two ultramodern fans with extremely low-noise blades, which are highly efficient thanks to the electronically commutated (EC) technology in the motors. The R&S®TCE900 transmitter control unit adjusts the fan speed based on the temperature measured at the transmitter rack input to save even more energy.

Crest factor reduction



Without crest factor reduction

With crest factor reduction

Reduced voltage supply – higher efficiency

Liquid cooling system

SCALABLE AND FLEXIBLE SYSTEM CONFIGURATION

MultiTX system with multiple transmitters and configurations in a single rack

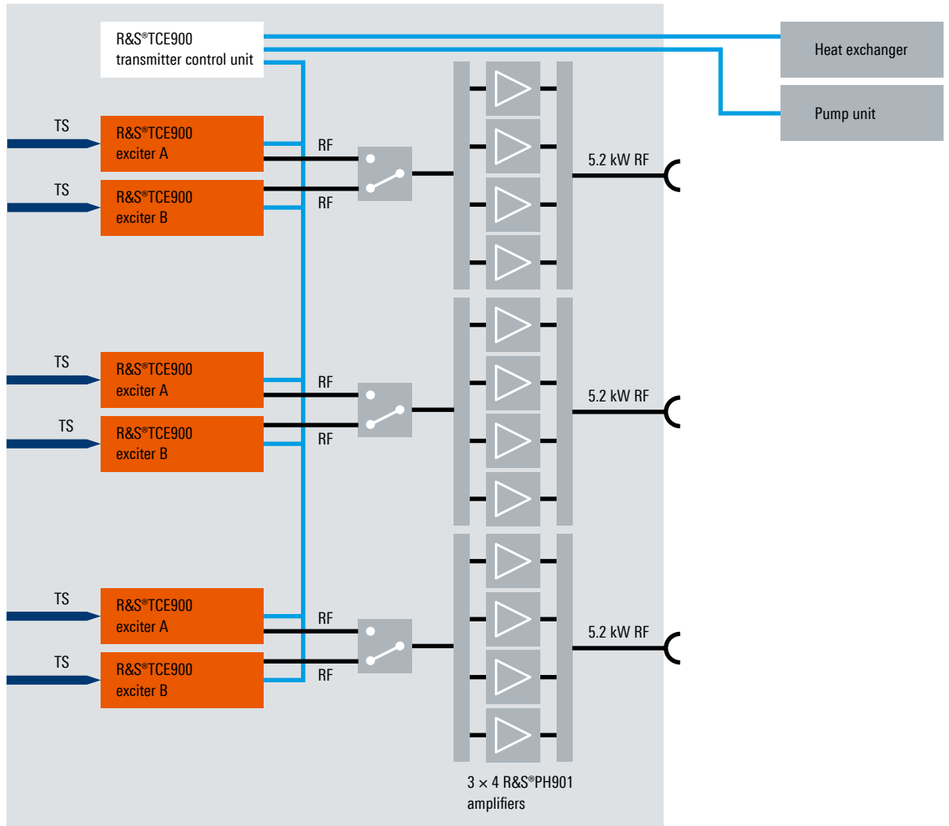
Up to now, only air-cooled transmitters were available for single-rack multi-transmitter systems. Rohde&Schwarz now has a MultiTX system concept for R&S®THU9/ R&S®THV9 liquid-cooled high-power transmitters.

The approach saves operators real money since up to four transmitters can be installed in one rack. An R&S®TCE900 system control unit monitors transmitters and establishes a connection to the monitoring room via a web or SNMP interface. The system also controls the pump unit and heat exchanger in the central cooling system. The transmitters can be configured with a single drive or a dual drive as required.

N+1 configurations are also possible in a single rack. Multitransmitter systems are available for all transmission standards and various output power ratings in transmitter configurations with up to six amplifiers.

MultiTX opens up totally new dimensions in flexibility and scalability at a moderate price. If an expansion is planned for the transmitter site, the rack can include additional RF components such as splitters and combiners. Just add exciters and amplifiers to the transmitter multiplex. System expansion is no problem since the amplifiers have proven, self-engaging connectors while the exciters and system components on the top of the rack are easy to access.

Example of a MultiTX system with three 5.2 kW DVB-T transmitters in a single rack



The new design lets the high-power multitransmitter system meet high availability requirements. Separate AC supply inlets help make transmitter power autonomous.

The robust cooling system can handle environmental influences such as overvoltage. Separate data and AC supply lines for each pump module and fan on the heat exchanger as well as multistage lightning and overvoltage protection circuits help protect the system.

R&S®TCE900 – multitalented transmitter control unit or exciter

R&S®THU9/R&S®THV9 transmitters are based on the new R&S®TCE900 platform. By inserting specific plug-in boards, the base unit can be configured as a transmitter control unit or as an exciter for greater network flexibility. To reconfigure the R&S®TCE900 on site for another application, users simply need to switch out modules. The platform also has free option slots for expanded functions – such as additional satellite receivers. The system modularity helps both DAB and TV network operators save money by reducing the need for spare parts.

When configured as a transmitter or system control unit, the R&S®TCE900 helps transmitters operate smoothly. The R&S®TCE900 connects to the different system components via two plug-in boards: The cooling interface connects the pump unit, the heat exchanger and various sensors. The transmitter interface connects the power distribution and the exciters. The control unit uses the connected exciters to communicate via a CAN bus with the amplifiers, the directional coupler and other system modules.

In the exciter configuration, a coder board for baseband processing and an RF board for high-frequency modulation are added to the R&S®TCE900 base unit. The exciter is extremely versatile and can handle the DVB-T, DVB-T2, ISDB-T/ISDB-TB, DTMB and ATSC digital TV standards as well as the DVB-H and ATSC Mobile DTV standards for mobile TV. With the appropriate coder board, the exciter is ideal for the DAB/DAB+ digital audio broadcast standards and T-DMB Mobile TV applications.
All transmission standards are available as software options for easy retrofitting, so installing multiple standards in one exciter (e.g. DVB-T and DVB-T2) is no problem. In addition to DTV standards, the R&S®TCE900 also supports analog standards. System modularity means just one interface board with analog input interfaces is needed. A GPS receiver comes integrated and can be activated with an option key.

Simple switchover from analog to digital TV

Many operators have switched from analog to digital TV. R&S®THU9/R&S®THV9 transmitters aid this transition. When the exciter is fed with both analog and digital input signals, the switchover can be done locally (pressing a key), remotely or even timed. The IP transport stream reduces infrastructure costs. Cost-effective IP technology is also gaining ground with broadcast networks. The R&S®TCE900 exciter has the option of redundantly feeding two transport streams via Gigabit Ethernet interfaces. External IP-to-ASI gateways are no longer required. System integration saves money and space and simplifies feed monitoring.

Integrated satellite receiver, fewer components in the rack

A module with two satellite receivers can obtain two DVB-S/DVB-S2 satellite streams with no external equipment, saving rack space and eliminating the need to invest in additional instruments. Encoded streams can be decoded via the two integrated common interface slots. Streams can also be processed outside the transmitter by feeding them to third-party instruments via the integrated IP or ASI output and returning them via the IP or ASI input.

VERSATILE, COMPACT DESIGN

Highest power density on the market

Apart from energy, infrastructure is reponsible for most of the costs over the life of a transmitter system. R&S®THU9/ R&S®THV9 have the highest power density on the solid-state transmitter market. Up to twelve amplifiers can be accommodated in a single transmitter rack for up to 15 kW per rack for COFDM standards, up to 18.5 kW for ATSC and up to 30 kW for analog TV.

Integrating further functions into the exciter saves even more space. The R&S®TCE900 has a GPS receiver and IP interfaces as software options, eliminating the need for external equipment.

MultiTX system with up to four transmitters per rack

The MultiTX concept uses the high power density of the amplifiers to integrate multiple transmitters into one rack. Depending on the number of amplifiers per transmitter, a rack can hold up to four transmitters. All other transmitters require much more floor space for a similar configuration. The much smaller footprint of Rohde&Schwarz solutions helps significantly reduce site rental costs.

Compared with conventional couplers, the horizontal arrangement of the power combiner with built-in coolant distribution saves so much space that four RF rigid lines can be installed. A rack can accommodate four transmitters with 3.9 kW output power or three transmitters with 5.2 kW output power.

The transmitter control unit and exciters also take up very little space. Up to seven R&S®TCE900 units can be installed in the mounting frame above the transmitter. The vertical arrangement of the equipment places all interfaces on the top of the transmitter for easy installation and access.

The innovative MultiTX design can even make entire N+1 transmitter systems more compact. One rack can accommodate a maximum 3+1 configuration. To save space, RF coaxial switches are installed directly on the top of the transmitter.

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

High power density is also good for all-in-one configurations. Both the pump unit and a six-cavity bandpass filter can be integrated into the rack for UHF transmitters with up to four amplifiers. The approach also reduces the space required for a single transmitter. The hydraulic components of the pump are installed in the back of the transmitter rack and can easily be accessed via the rear door.

Space-saving, flexible liquid cooling system

The external cooling system also takes up less space. The pump unit fits into tight spaces with a compact hydraulic block. The smart frame design makes installation flexible. The pump can be installed on a floor (standard solution) or wall. Two pumps can also be stacked on top of one another.

Improvements were also made to proven heat exchangers. Rearranging the robust stainless-steel registers made the heat exchangers even more compact. The heat exchangers can be installed vertically or horizontally. The high transmitter efficiency keeps power dissipation low to further reduce the size of the heat exchangers.

Highest power density per transmitter rack

COFDM TV	15.0 kW
ATV	30.0 kW
ATSC	18.5 kW
DAB	15.0 kW

MultiTX sytem with four 3.9 kW transmitters in a single rack

All-in-one system in a single rack

2+1 system, 5.2 kW each, in a single rack

SIMPLE OPERATION FOR FAST RESULTS

Ergonomic design, user-friendly operating unit

The R&S®TDU900 was designed for easy access, operating convenience and ergonomics. The retractable display is installed above the amplifiers and automatically slides out when the user gives it a slight push. The user can then conveniently turn the display to the desired position and operate the transmitter while either standing or seated. The seven-inch display unit has a touchscreen and LEDs that indicate the system status. An Ethernet port is used to exchange configuration data.

R&S®TDU900 transmitter display unit

Simplified navigation with device-oriented views

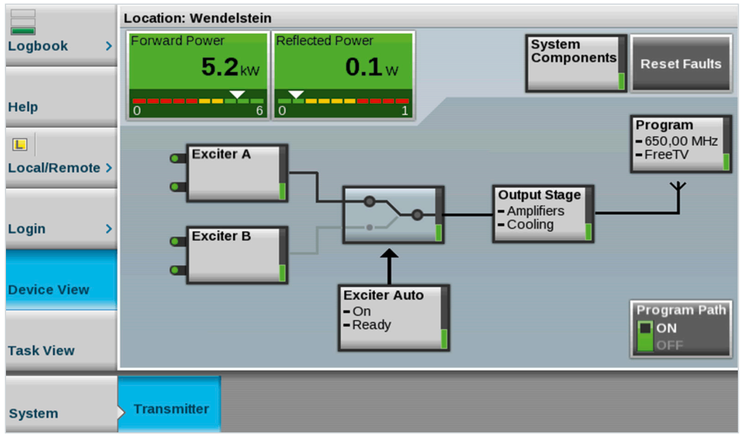
The GUI is straightforward and lets you check the system at a glance. The transmitter system structure is displayed graphically. Tapping a component on the touchscreen opens the related parameters.

The left side of the screen permanently displays important key functions. The softkeys let you check the logbook and switch between local and remote control. The help function gives you additional information about specific components.

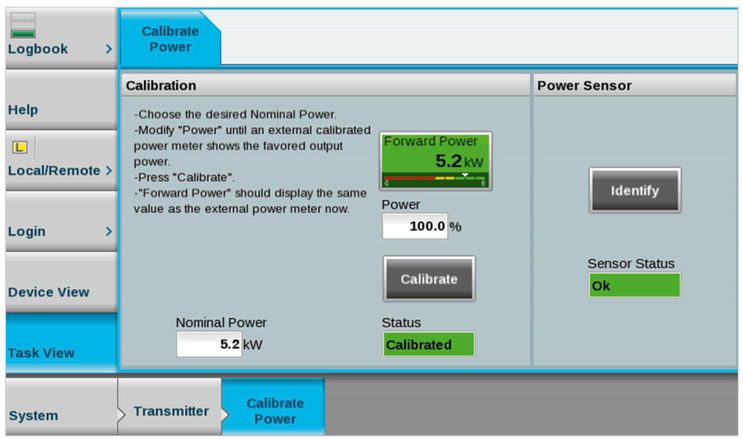
You can switch between different user profiles and between device and task-oriented views. The screen content on the right changes with the component. The system navigation path at the bottom of the screen lets users quickly change from one parameter to another. When accessing the transmitter via the web interface, the same user interface will appear in the web browser.

Task-oriented menus help train personnel

Depending on the system status, operators can have tasks ranging from simple monitoring to complex commissioning. The task-oriented menu helps users adjust to their tasks. Individual steps are clearly displayed on the GUI so that they can be done as quickly as possible. When commissioning the transmitter, the operator is guided through the configuration of the different devices and receives help entering parameters and adjusting settings.



Device-oriented view



Task-oriented view

SPECIFICATIONS

Specifications		
Digital TV		
Standards		DVB-T, DVB-T2, DVB-H, ISDB-T, ISDB-T_B, ATSC, ATSC Mobile DTV, DTMB
Channel bandwidth	DVB-T, DVB-H	5/6/7/8 MHz
	DVB-T2	1.7/5/6/7/8 MHz
	ISDB-T, ISDB-T_B	6 MHz
	ATSC	6 MHz
	DTMB	6/8 MHz
Inputs	DVB-T, DVB-H	2 × ASI (HP/LP), 75 Ω BNC, 2 × RJ-45
	DVB-T2	2 × ASI (HP/LP), 75 Ω BNC, 2 × RJ-45
	ISDB-T, ISDB-T_B	2 × BTS, 75 Ω BNC, 2 × RJ-45
	ATSC	2 × SMPTE310M or 2 × ASI, 75 Ω BNC, 2 × RJ-45
	DTMB	2 × ASI (HP/LP), 75 Ω BNC, 2 × RJ-45
Digital audio broadcasting/Mobile TV in the VHF range		
Standards		DAB, DAB+, T-DMB
Channel bandwidth		1.5 MHz
Inputs		2 × ETI, 75 Ω BNC/high impedance, 2 × EDI, RJ-45
Analog TV		
Standards		B/G, D/K, M [1], N [1], I, I1
Color transmission		PAL, NTSC, SECAM
Sound transmission		IRT dual-sound coding, FM single sound and NICAM728 (–13 dB/–20 dB), FM single sound (–10 dB)
Inputs		1 × video (75 Ω BNC), 2 × audio (XLR)
General data		
Frequency range	UHF band IV/V	470 MHz to 862 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%
EU legislation	EU: in line with Data Act – Regulation (EU) 2023/2854	for details, see user documentation
Maximum 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 [2]	to fast transients and burst 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)
Synchronization		
Reference frequency		10 MHz, 0.1 V to 5 V (V_{pp}) or TTL, BNC
Reference pulse		1 Hz, TTL, BNC
Operation		
Display unit with touchscreen and LEDs		local operation and display
Ethernet interface, RJ-45		local, remote, standard web browser
	optional	network management interface via SNMP
Parallel remote interface	optional	floating contacts for messages and commands

To comply with the applicable standards and limit values for the suppression of out-of-band emissions (and in the case of digital standards, also for maintaining the required shoulder distance), the transmitter may only be operated with suitable filters at the RF output.

1 Only single sound.
2 With built-in AC supply overvoltage protection; more stringent requirements must be satisfied by implementing appropriate measures in the station.

ORDERING INFORMATION

Your local Rohde&Schwarz expert will help you determine the optimum solution for your requirements.
To find your nearest Rohde&Schwarz representative, visit www.sales.rohde-schwarz.com.

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Sustainable product design

- Environmental compatibility and eco-footprint
- Energy efficiency and low emissions
- Longevity and optimized total cost of ownership

Certified Quality Management
ISO 9001

Certified Environmental Management
ISO 14001

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PD 5214.5990.12 | Version 06.00 | November 2025 (st)
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