R&S®TMU9
Air-Cooled UHF Transmitter Family
Maximum flexibility, minimum TCO

ROHDE&SCHWARZ

Broadcasting

Product Brochure | 01.00

R&S®TMU9 Air-Cooled UHF Transmitter Family

At a glance

The R&S®TMU9 transmitter family offers unique flexibility by providing more than 50 different standard configurations. Featuring efficiency of up to 38 %, it achieves the highest energy savings on the market. Plus, the simple system configuration allows quick startup. The high availability of the R&S®TMU9 ensures unsurpassed reliable operation. And its compact size saves space at the transmitter site.

The R&S®TMU9 air-cooled transmitters attain output powers from 570 W to 2.85 kW for DVB-H, DVB-T, DVB-T2, ATSC, ATSC Mobile DTV and ISDB-T_B. The transmitters are accommodated in only one rack, saving a great amount of space at the transmitter site.

With efficiency of up to 25 % in normal operation, the transmitters save a great deal of energy and significantly reduce CO_2 emissions. The Doherty architecture for boosting efficiency increases this figure to 38 %. As a result, the R&S®TMU9 transmitters reduce energy costs by more than 40 % compared with conventional transmitters.

The transmitters feature unique system variability. Innovative configurations, such as MultiTX or N+1 systems in a single rack, easy upgrade from standard to increased efficiency mode and built-in bandpass filters, allow short delivery periods even for special transmitter configurations. Excellent efficiency and the integration of multiple transmitters into a single rack reduce the total cost of ownership (TCO) of a transmitter system by more than half over the system's lifetime.

Key facts

- Efficiency of up to 38 %
- Unique variability
- Small footprint
- Quick startup, easy operation and high availability

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

R&S®TMU9 Air-Cooled UHF Transmitter Family

Benefits and key features

Transmitters with exceptional efficiency

- Next level of efficiency thanks to Doherty technology
- Voltage regulation and crest factor reduction
- Adaptive digital equalization
- Efficient amplifier layout

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Unique variability

- Flexible system configuration
- R&S®TCE900 – the multitalent for use as a transmitter control unit and/or exciter
- IP transport stream feed for reducing infrastructure costs

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Small footprint

- Multiple transmitters in a single rack
- 6-in-1 coupler unit integrates different functionalities
- Compact components with integrated cooling

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Easy handling and outstanding reliability

- Simple system configuration for quick startup and expansion
- Easy and efficient operation
- Innovative solutions for increasing availability

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Everything from a single source

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R&S®TMU9 transmitter system					
Number of R&S®PMU901 amplifiers	**1**	**2**	**3**	**4**	**5**
Output power (RMS) for digital standards [1]	600 W (normal operating mode), 570 W (Doherty operating mode)	1140 W	1710 W	2280 W	2850 W
Dimensions in mm (H × W × D)	225 × 483 (19") × 550	2000 × 800 × 600	2000 × 800 × 600	2000 × 800 × 600	2000 × 800 × 600
Number of transmitters per rack (42 RU in a MultiTX system)	up to 6	up to 3	2	1	1
Maximum N+1 configuration per rack	4+1	2+1	1+1	–	–

[1] In Doherty operating mode from 470 MHz to 490 MHz, different output power stages apply: 550/1100/1650/2200/2750 W.

Transmitters with exceptional efficiency

Next level of efficiency thanks to Doherty technology

The R&S®TMU9 achieves excellent efficiency of up to 25 %, even in the standard configuration.

Featuring Doherty amplifier design, the R&S®TMU9 attains the next level of efficiency. The transmitter sets benchmarks, with up to 38 % for COFDM standards. It reduces energy costs by more than 40 % compared with other transmitters on the market.

To attain these values, Doherty technology is the means of choice. This technology is based on an architecture invented in the 1930s by William H. Doherty. It has been used successfully in wireless communications for many years and helps to reduce energy costs.

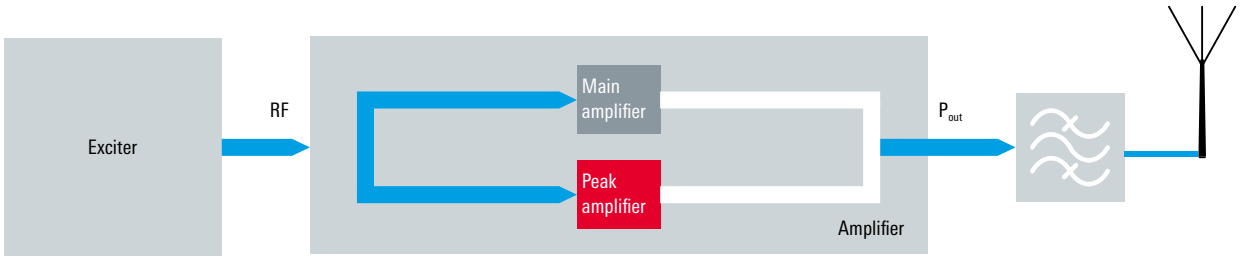
The basic principle involves splitting signal amplification into two paths. In the main amplifier, only the average signal is amplified, and no power margins have to be reserved for peak signals in this path. The peak amplifier is only used when peaks occur in the signal. This architecture saves energy in both the main and the peak amplifier.

Rohde&Schwarz has revolutionized this technology with its R&S®TMU9. For the first time, the amplifier has a broadband design while still making use of the basically narrowband Doherty architecture. Even in large transmitter networks that use many different frequencies, it is now possible to efficiently manage the spare parts inventory. Because no additional modules are required, the mean time between failure (MTBF) of the amplifiers remains unchanged when this technology is used.

Voltage regulation and crest factor reduction

To further increase efficiency, Rohde&Schwarz has incorporated two additional innovative approaches into its mix of technologies, besides the Doherty architecture.

Transmitter system with Doherty amplifier



Voltage regulation considerably boosts efficiency, especially when a transmitter operates at reduced output power. Only Rohde&Schwarz offers this.

The control mechanism in the transmitter control unit allows transmitter efficiency to be optimized for all digital TV standards. The signal is decoupled by the directional coupler at the transmitter output, routed back to the R&S®TCE900 exciter and analyzed. At the same time, the supply voltage for the power transistors is iteratively adjusted via the power supplies in the amplifiers.

With the R&S®TCE900 exciter, Rohde&Schwarz is the first manufacturer to offer a reduction of the crest factor for all COFDM standards. The crest factor is reduced to 8 dB without any negative impact on MER, improving the total transmitter efficiency.

For DVB-T2, the tone reservation method defined in the standard can alternatively be used to reduce the crest factor.

Adaptive digital equalization

All configurations of the R&S®TMU9 feature adaptive digital equalization (ADE) to equalize the transmitter system quickly, easily and at any time. ADE can be used either once when the system is put into operation or adaptively.

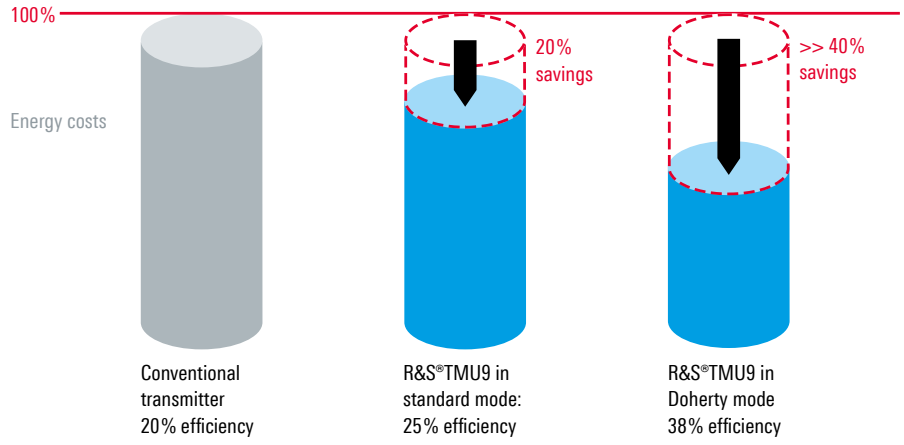
Efficient amplifier layout

The R&S®PMU901 amplifier featuring output power of 570 W for digital standards achieves outstanding power density. The power transistors use sophisticated 50 V LDMOS technology. The close cooperation between Rohde&Schwarz and the semiconductor manufacturer and the optimal matching of the transistors result in excellent efficiency and proven long-term stability of the amplifier section.

The same amplifier can be used both in conventional mode and for systems with increased efficiency. A conventional amplifier can be upgraded to an amplifier with Doherty technology quickly, easily and at any time.

In the R&S®PMU901, passively cooled power supplies are used in an air-cooled transmitter for the first time, contributing to system efficiency and increasing availability.

Energy savings with the R&S®TMU9



Unique variability

Flexible system configuration

The R&S®TMU9 offers unique flexibility. Because the system can be flexibly configured, more than 50 different standard system configurations are available, allowing a short delivery period even when special configuration requirements need to be met.

The new MultiTX concept makes it possible to install up to six transmitters in one rack. Even complete N+1 systems can be accommodated in a single rack.

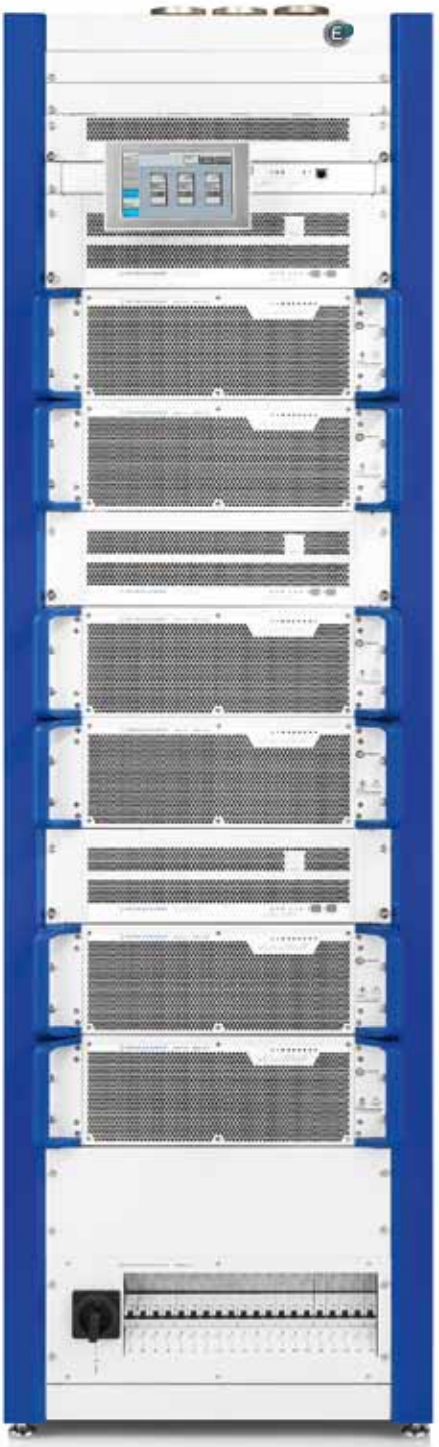
Transmitters with up to two amplifiers can also be ordered without a rack, allowing installation in racks where space is still available or in a rack acquired on-site. Bandpass filters, dummy antennas and other accessories can also be integrated into the transmitter rack, saving additional space at the transmitter site.

Various air ducting configurations can be implemented, allowing the transmitter to operate both with and without ducted exhaust air. If the exhaust air is ducted, the system comes with a kit that has a pressure monitor and ensures constant cooling even if air intake fluctuates.

R&S®TCE900 – the multitalent for use as a transmitter control unit and/or exciter

The R&S®TMU9 transmitter family uses the R&S®TCE900 platform introduced with the R&S®THU9 UHF TV transmitter family. This cross-family platform allows network operators who use both the R&S®THU9 and the R&S®TMU9 to easily and economically manage their spare parts inventories.

By inserting supplementary specific plug-in boards, the base unit can be configured as a transmitter control unit or as an exciter, resulting in unprecedented flexibility for network operators. To reconfigure the R&S®TCE900 on-site for another application, the user simply needs to exchange the modules. The platform also offers free option slots for expanding its functionality (e.g. by adding a satellite receiver).



MultiTX system with three 1.14 kW transmitters in one rack.

When configured as transmitter or system control unit, the R&S®TCE900 ensures smooth operation of the transmitter system. The R&S®TCE900 connects to the different system components via plug-in boards: Depending on the configuration, the cooling-system interface connects the exhaust air duct system, while the transmitter interface connects to the exciters. The control unit uses the connected exciters to communicate with the amplifiers, the directional coupler and other system modules via CAN bus.

In the exciter configuration, a coder board for baseband signal processing and an RF board for RF modulation are added to the R&S®TCE900 base unit. The exciter is extremely versatile. It can be used for all digital TV standards offered by Rohde & Schwarz: DVB-T, DVB-T2, ISDB-T/ ISDB-T_B, ATSC, DVB-H and ATSC Mobile DTV. All these transmission standards are available as software options for easy retrofitting. It is therefore no problem to install multiple standards in one exciter (e.g. DVB-T and DVB-T2). The exciter configuration also includes a GPS receiver that can be easily activated via option key.

In the R&S®TMU9, the R&S®TCE900 can combine the functionalities of a transmitter control unit and an exciter, allowing a complete transmitter rack to operate with a single R&S®TCE900 as control unit and exciter. This saves space and increases the system's MTBF.

IP transport stream feed for reducing infrastructure costs

Due to its cost-effectiveness, IP technology is also gaining ground in broadcast networks. For all digital standards, the R&S®TCE900 exciter optionally offers feeding two transport streams redundantly via Gigabit Ethernet interfaces, eliminating the need for external IP-to-ASI gateways. Because it is integrated in the transmitter control unit, this solution saves money and space, and simplifies feed monitoring.

R&S®TMU9 with 1.14 kW DTV output power in dual drive.

Small footprint

Multiple transmitters in a single rack

The new MultiTX concept makes it possible to accommodate up to six transmitters in a rack of 42 height units. Functioning as a system control unit, the R&S®TCE900 optionally monitors the transmitters and establishes a connection to the monitoring room via web interface or SNMP. If exhaust air is ducted, the R&S®TCE900 also monitors the exhaust air duct. If this is not desired, multiple autonomous transmitters can be integrated in a rack without shared monitoring.

Each transmitter in a multitransmitter group can be operated in dual drive or backup exciter configuration. A MultiTX system can also be quickly and easily expanded by installing an additional transmitter.

6-in-1 coupler unit for coupling two R&S®PMU901 amplifiers.

N+1 configurations can also be implemented in a single rack. For example, a 4+1 system with an output power of 570 W DTV can be configured in just one rack, making it possible to save up to three racks or more than 3 m^2 per backup system (compared with existing systems). As a result, an enormous amount of costs can be saved when leasing site surface.

6-in-1 coupler unit integrates different functionalities

The new 6-in-1 coupler unit includes, besides the coupler unit, an input signal splitter, harmonics filter, lightning protection, power absorber and the measuring systems. Each coupler unit has an optional connector for integrating a customer test point. The module is located directly behind the amplifiers, saving space and reducing the attenuation in the system. The compact design allows fast system startup and makes it possible to add a transmitter to the rack quickly and easily.

Compact components with integrated cooling

The compact R&S®PMU9 amplifier, only 3.5 height units in size, achieves an output power of 570 W. This saves space in the rack for installing other components or additional transmitters. Two integrated fans in the amplifiers can be exchanged during operation and allow the transmitter system to operate without an exhaust air system. Ducted exhaust air can be optionally added to the configuration.

The R&S®TCE900 also significantly contributes to the system's compactness. The entire backup exciter requires only two height units, saving more space. Integrated long-life fans allow reliable operation. They do not need to be replaced.

Easy handling and outstanding reliability

Simple system configuration for quick startup and expansion

The transmitter comes fully cabled; only feed cables, power supply and system monitoring need to be added. Together with the self-engaging connection of the amplifier with the coupler, power supply and signal feed, the R&S®TMU9 can be put into operation fast and easily.

The R&S®TCE900 is accessible from the front, allowing new plug-in boards to be added quickly and easily.

Easy and efficient operation

Each R&S®TMU9 is equipped with a status display on the R&S®TCE900 rackmounts, where the transmitter status can be read off at any time. The buttons on the front panel make it quick and simple to switch from remote to local operation 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 turned to the desired position, allowing fast, user-friendly operation.

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

Innovative solutions for increasing availability

The backup exciter redundancy concept known from the R&S®SCx8000 transmitter family has been enhanced for the R&S®TMU9. All configuring can be done centrally via the control exciter. As a result, a single IP address suffices for configuring and monitoring the system. This concept also makes it possible to directly address the second exciter via a separate IP address, allowing convenient remote diagnosis and eliminating unnecessary visits to the transmitter site.

This redundancy concept not only saves space but also increases the system's availability because it requires only two modules.

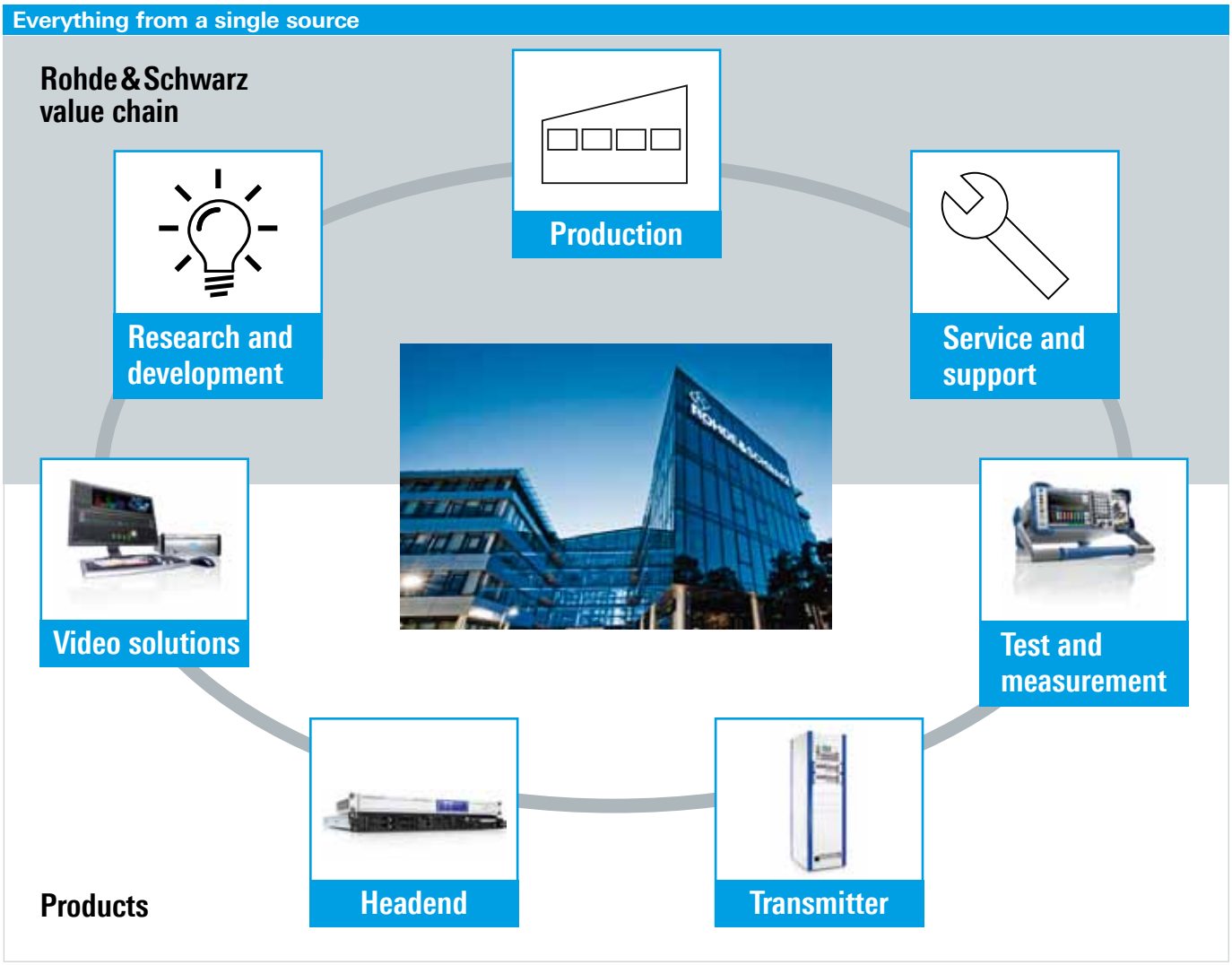
Optional power supply redundancy for the amplifiers also helps to increase availability. Normally, each of the two power supplies delivers half of the necessary current. If one of the power supplies fails, the other delivers the full current. This ensures interruption-free transmission even if a power supply or a phase in the feed network fails. The power supplies can be easily replaced during operation.

Transmitter status display on the front panel via LEDs.

Everything from a single source

Rohde&Schwarz stands for quality, precision and innovation in all fields of wireless communications. As an independent, family-owned company, Rohde&Schwarz generates its growth from its own resources. Since the company is not bound by short-term, quarterly thinking, it can plan for the long term. Customers benefit from this, and purchasing Rohde&Schwarz products is a very safe investment.

At Rohde&Schwarz, the entire value added chain lies in one hand. This is the ideal prerequisite for long-term, trouble-free operation of transmitter systems, since Rohde&Schwarz products meet the most stringent quality requirements. The transmitters were developed with market requirements in mind right from the start. Rohde&Schwarz manufactures its products at its own plants. This ensures short-term, reliable product delivery independently of external suppliers. An extensive T&M product portfolio, film and video post production equipment from Rohde&Schwarz DVS GmbH, as well as worldwide service and support round out the benefits that come with the R&S®TMU9 family of transmitters – true to the motto: "Everything from a single source".



Specifications in brief

Specifications in brief		
Digital TV		
Standards		DVB-T, DVB-T2, DVB-H, ISDB-T, ISDB-T_B, ATSC, ATSC Mobile DTV
Channel bandwidth	DVB-T, DVB-H	5/6/7/8 MHz
	DVB-T2	1.7/5/6/7/8 MHz
	ATSC	6 MHz
	ISDB-T/ISDB-T_B	6/8 MHz
Inputs	DVB-T, DVB-H	2 × ASI (HP/LP), BNC 75 Ω, 2 × RJ-45
	DVB-T2	2 × ASI (HP/LP), BNC 75 Ω, 2 × RJ-45
	ATSC	2 × SMPTE310M or 2 × ASI, BNC 75 Ω, 2 × RJ-45
	ISDB-T/ISDB-T_B	2 × BTS, BNC 75 Ω, 2 × RJ-45
General data		
Frequency range	UHF bands IV/V	470 MHz to 862 MHz
Supply voltage		▮ 230 V; 2 wires + PE (L1/N/PE) ± 15 % ▮ 400/230 V; 4 wires + PE (L1/L2/L3/N/PE); ± 15 %
Max. installation height	> 2000 m on request	2000 m above sea level
Operating temperature range		+1 °C to +45 °C
Relative humidity (max.)		95 %, non-condensing
Immunity [1]	to fast transients and bursts in line with EC 61000-4-4	< 2 kV (AC supply), < 1 kV (signal inputs)
	to surges in line with EC 61000-4-5	symmetrical < 1 kV (e.g. L1-L2), unsymmetrical < 2 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	optional	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

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

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.

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

Service you can rely on

- Worldwide
- Local and personalized
- Customized and flexible
- Uncompromising quality
- Long-term dependability

About Rohde&Schwarz

Rohde&Schwarz is an independent group of companies specializing in electronics. It is a leading supplier of solutions in the fields of test and measurement, broadcasting, radiomonitoring and radiolocation, as well as secure communications. Established more than 75 years ago, Rohde&Schwarz has a global presence and a dedicated service network in over 70 countries. Company headquarters are in Munich, Germany.

Environmental commitment

- Energy-efficient products
- Continuous improvement in environmental sustainability
- ISO 14001-certified environmental management system

Certified Quality System
ISO 9001

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