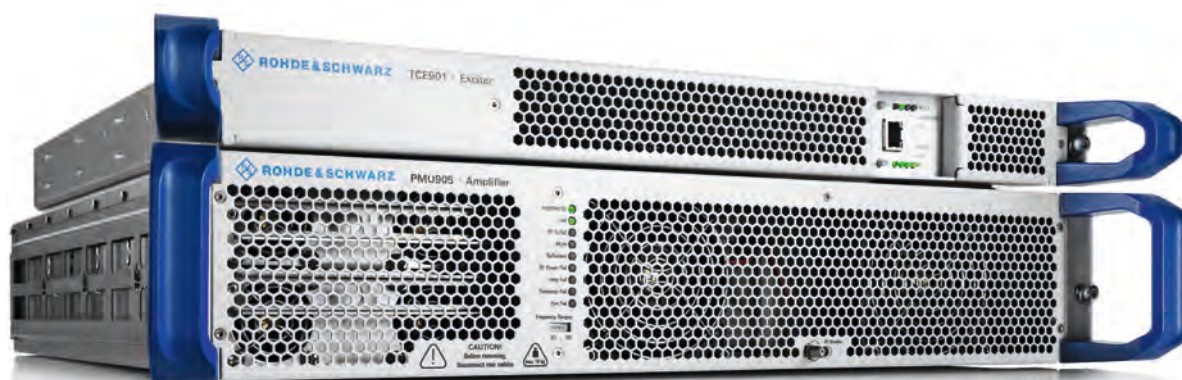


# Компактный УВЧ-передатчик TMU9compact



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# R&S®TMU9compact Air-Cooled UHF Transmitter At a glance

The R&S®TMU9compact UHF transmitter offers a level of compactness unique in its class, combined with excellent energy efficiency for minimal operating costs. Broadcast network operators will appreciate the transmitter's exceptionally high availability achieved through outstanding product quality and innovative redundancy solutions. The easy-to-operate transmitter fits seamlessly into existing infrastructures.

The R&S®TMU9compact UHF transmitter features an exceedingly compact design, delivering an astonishing COFDM output power of 400 W in 3 units and 600 W in 4.5 units. It enhances the established R&S®TMU9 transmitter toward the lower end of the medium-power range. While the R&S®TMU9 shows to its best advantage as a rack-mounted transmitter, the R&S®TMU9compact is an ideal choice both as a desktop transmitter and for rack integration.

As a member of the successful R&S®Tx9 transmitter generation, the R&S®TMU9compact minimizes total cost of ownership (TCO) with an efficiency of up to 43%, minimal space requirements and a design optimized for efficient service. For broadcast network operators, this means a significant reduction in operating expense (OPEX) of up to 50% over the life of the product.

The R&S®TMU9compact offers maximum availability through the recognized quality of products. The transmitter's intelligent redundancy concepts ensure exceptionally high reliability. Intuitive operation based on the tried and tested GUI of the R&S®Tx9 transmitter generation makes the transmitter very easy to use.

## Key facts

- Exceptionally compact in all configurations
- Superior energy efficiency at up to 43%
- Maximum reliability
- Easiest operation and maintenance
- Intelligent redundancy concepts



# R&S®TMU9compact Air-Cooled UHF Transmitter

## Benefits and key features

### Minimal operating costs

- ▮ Superior energy efficiency thanks to R&S®Multiband Doherty technology
  - ▮ Highly compact system design
  - ▮ Cost-optimized service concept
  - ▮ IP transport stream feed to reduce infrastructure costs
- ▷ [page 5](#)

### Maximum availability

- ▮ Field-proven components and robust transmitter design
  - ▮ Built-in redundancies
  - ▮ Innovative redundancy concepts at the device and system level
- ▷ [page 7](#)

### Compact design and easy operation

- ▮ Minimal infrastructure requirements
  - ▮ Compact, expandable exciter
  - ▮ Easy and efficient operation
  - ▮ Maximum efficiency at the push of a button
- ▷ [page 10](#)

### Minimized service effort

- ▮ Servicing at the component level thanks to modular design
  - ▮ Minimal adjustment and test effort
  - ▮ No special knowledge or tools required
- ▷ [page 12](#)

### E<sup>5</sup> – 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

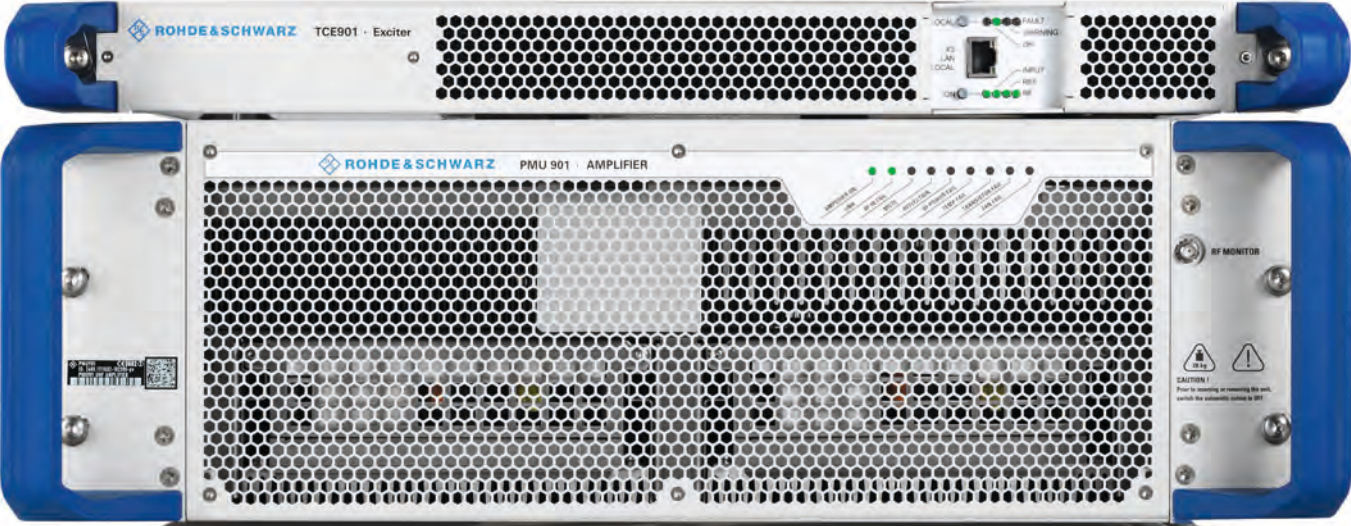


# Model overview

R&S®TMU9compact UHF transmitter system		
Output power (AVG) for digital TV standards in Doherty and normal operation <sup>1)</sup>		
DVB-T2, DVB-T, ISDB-T <sub>B</sub>	400 W	600 W
ATSC/ATSC Mobile DTV	450 W	600 W
<b>Dimensions (W x H x D)</b>	483 mm x 132 mm (3 HU) x 550 mm 19 in x 5.2 in x 21.6 in	483 mm x 198 mm (4.5 HU) x 550 mm 19 in x 7,8 in x 21.6 in

<sup>1)</sup> Before bandpass filter.

The R&S®TMU9compact in a 600 W configuration with the R&S®PMU901 amplifier.



# Minimal operating costs

## Superior energy efficiency thanks to R&S®Multiband Doherty technology

The introduction of the R&S®Multiband Doherty technology in the R&S®Tx9 transmitter generation has revolutionized the broadcast transmitter market. With the R&S®TMU9compact, this amplifier technology is now available for the first time in the compact class, allowing the R&S®TMU9compact to reach the next level of energy efficiency. The transmitter sets the benchmark with an efficiency of up to 43%. It reduces energy costs by up to 50% compared with the average efficiency delivered by other transmitters in this power class.

The R&S®Multiband Doherty technology was first introduced in the R&S®Tx9 generation of transmitters in 2012. Since that time, this amplifier technology has become synonymous with energy cost savings for many network operators. In the meantime, thousands of amplifier modules employing R&S®Multiband Doherty technology are in use around the world. Each and every day, technology saves in excess of 400 000 kWh compared with conventional amplifier technology. This corresponds to the power consumption per day of a medium-sized European town.

The R&S®TMU9compact can be equipped with R&S®PMU901 as well as with R&S®PMU905 amplifiers. Both amplifier models offer R&S®Multiband Doherty technology for maximum efficiency as well as frequency agility across the entire band IV and V. The R&S®PMU901 delivers up to 600 W and the R&S®PMU905 up to 400 W output power (COFDM). The two amplifier models with different output powers can address an extended power range without requiring a coupler. Losses associated with a coupler are avoided, optimizing overall system efficiency. In addition, this design saves space and simplifies commissioning.

## Highly compact system design

Apart from energy and service costs, infrastructure costs account for a large proportion of the expenses incurred during a transmitter's lifecycle. Through numerous innovations and by focusing on what is essential for transmission, the R&S®TMU9compact is able to minimize infrastructure costs and condense transmitter functionality in the smallest of spaces.

At only 3 units for 400 W and 4.5 units for 600 W, the R&S®TMU9compact requires minimal space, whether used as a single transmitter or configured as a multitransmitter (e.g. passive standby) system.

The R&S®PMU905 amplifier (400 W) offers the highest efficiency in its class.



This exceptionally compact size has been achieved by implementing signal generation and system control with a high level of integration, and by superior power density in the amplifier. The new R&S®TCE901 exciter platform integrates signal processing as well as transmitter and system control functionality. In addition, the R&S®TCE901 offers numerous functions and options that make extra equipment superfluous, such as an integrated satellite receiver and integrated system components for N+1 configurations. As a result, the space required for an R&S®TMU9compact system can in some cases be reduced by significantly more than 50% as compared with conventional transmitter systems in this power class.

### Cost-optimized service concept

The R&S®TMU9compact has been designed for minimum maintenance and testing effort in line with customer requirements. Servicing is simple and straightforward, whether on site or at a service center, significantly reducing operating expense for transmitter networks.

### IP transport stream feed to reduce infrastructure costs

Due to its cost-effectiveness, IP technology is also gaining ground in broadcast feed networks. The R&S®TCE901 exciter offers two Gigabit Ethernet interfaces for redundant feed of two transport streams for all digital standards. External IP-to-ASI gateways are no longer needed. The TSoIP functionality is monitored by the exciter, so this solution saves money and space and simplifies program feed monitoring.

The R&S®TMU9compact with optional R&S®TDU901 transmitter display unit, R&S®TCE901 exciter and R&S®PMU905 amplifier with 400 W output power (COFDM).



# Maximum availability

## Field-proven components and robust transmitter design

The R&S®TMU9compact offers the same excellent level of quality as the rack transmitters from the R&S®Tx9 generation. Built with high-quality components and based on a superior architecture, it offers unmatched reliability and excellent signal quality. For example, the R&S®TCE901 exciter delivers TV signals by means of direct digital RF generation.

The R&S®TMU9compact is based on the R&S®TMU9 medium-power transmitter, which has been a market success since 2012. A large number of R&S®TMU9 transmitters are in operation around the world. This broad base of installed R&S®TMU9 systems exhibits extremely low failure rates. The R&S®TMU9compact, which enhances the R&S®TMU9 toward the lower end of the medium-power range, is based on R&S®TMU9 components and demonstrates the same level of proven reliability, keeping off-the-air time to a minimum.

## Built-in redundancies for increased availability

The R&S®TMU9compact comes with an optional, integrated exciter backup battery, a feature that is unique in this power class. 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 thus reduces off-the-air time, without requiring a full-featured uninterruptible power supply (UPS).

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.

In addition to the optional power supply redundancy, the intelligent amplifier design based on multiple output-stage transistors maximizes availability. If one transistor fails, the amplifier can still supply a major portion of the output power.

Built-in reliability based on high-quality components and superior architecture: the field-proven R&S®PMU901 amplifier (600 W).



## Innovative redundancy concepts at the device and system level

At the device level, the R&S®TMU9compact uses the backup drive redundancy concept known from the R&S®TMU9 transmitter family and comprising only two R&S®TCE901 exciters. It operates without a centralized monitoring unit, since the passive exciter monitors the active one. The backup drive configuration offers the functionality and convenience of a classic exciter redundancy configuration and also increases transmitter availability.

At the system level, the R&S®TMU9compact offers two innovative redundancy configurations: BackupTx and Compact N+1.

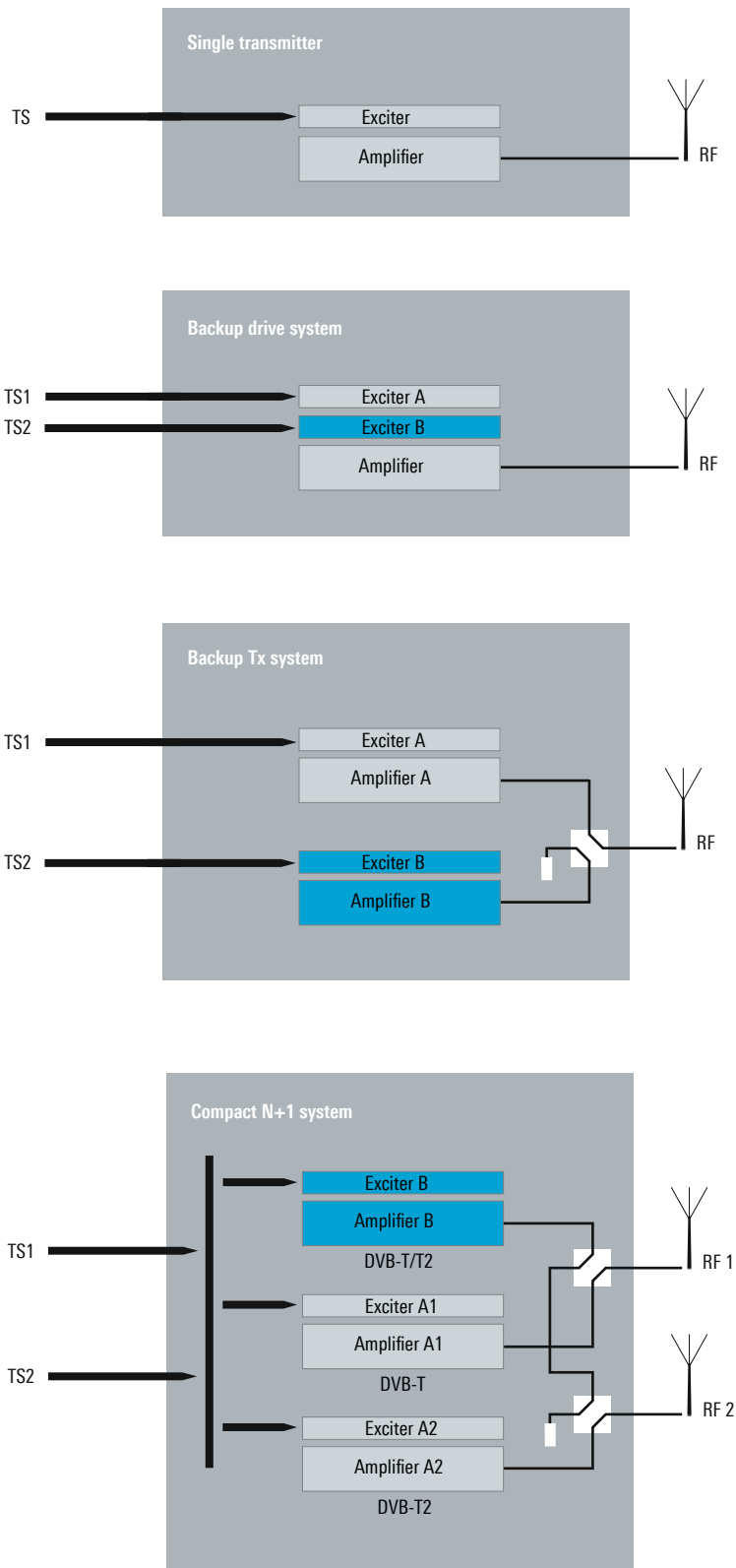
In a BackupTx system, two R&S®TMU9compact transmitters operate in a fully symmetrical 1+1 configuration. The two transmitters monitor each other, making extra hardware for system monitoring and control unnecessary. Doing away with a separate, governing control unit eliminates the risk of a single point of failure. The BackupTx configuration offers the functionality and convenience of a classic passive standby configuration and also increases the availability of transmitter functionality. BackupTx systems require considerably less space than conventional 1+1 systems.

For example, a 400 W R&S®TMU9compact BackupTx system including integrated DVB-S/S2 receivers requires just 7 rack units, saving an enormous amount of space compared with conventional transmitters in this power class. This is a major advantage at locations where space is at a premium.

Compact N+1 is an enhanced version of the well-known N+1 configuration. Same as BackupTx, Compact N+1 requires no extra hardware for system monitoring and control. These functions are performed by the standby transmitter. The standby transmitter in a Compact N+1 configuration, same as the passive transmitter in a BackupTx configuration, is automatically adjusted to the settings of the active transmitters. If an active transmitter fails, the standby transmitter takes over without interruption of transmission. The same applies in the event a standby transmitter needs to be replaced. The new standby transmitter reads the settings from the active transmitters, which continue operating.

The R&S®TMU9compact offers a high degree of flexibility for network operators broadcasting DVB-T and DVB-T2 services in parallel or planning to migrate from DVB-T to DVB-T2. With the R&S®TMU9compact, operators can simultaneously broadcast DVB-T and DVB-T2 services in a Compact N+1 configuration, since the standby transmitter is immediately ready for operation as a DVB-T or DVB-T2 transmitter.





The standby components (blue) additionally perform the functions of system monitoring and control.

# Compact design and easy operation

## Minimal infrastructure requirements

The new R&S®TMU9compact is an excellent solution to close gaps in primary transmitter networks. The transmitter makes little demands on space, cooling and energy supply and is therefore ideal for use in environments that do not provide a typical transmitter site infrastructure. The transmitter's compact design with integrated cooling permits easy installation of the R&S®TMU9compact into existing racks, and costly cooling systems are made superfluous by the transmitter's excellent energy efficiency.

The R&S®TMU9compact can monitor ambient temperature and humidity, making it possible to verify that ambient conditions are within permissible limits to ensure a long service life. No extra equipment is required.

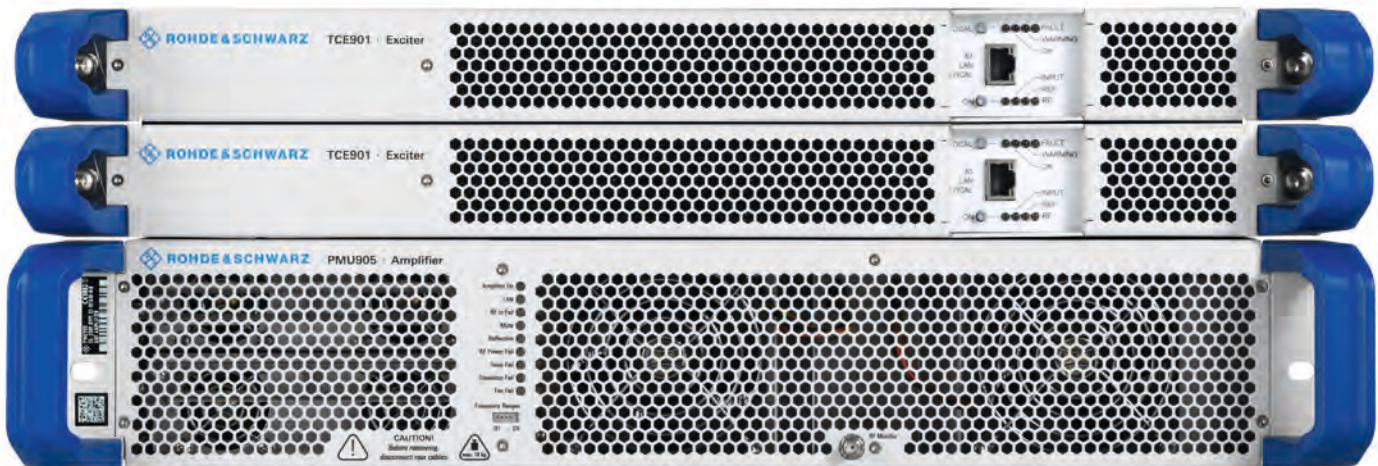
## Compact, expandable exciter

The R&S®TMU9compact transmitter family is the first product in the R&S®Tx9 transmitter generation to use the new R&S®TCE901 exciter platform. Same as the R&S®TCE900, the new platform brings together transmitter control and exciter functionality in a single rack unit. This saves space and increases the system's MTBF. The R&S®TCE901 additionally comes with a smart optioning system, offering free slots to accommodate hardware options to expand transmitter functionality, e.g. transport stream feed via satellite or via DVB-T/T2.

The R&S®TCE901 is multifunctional and extremely versatile. It supports the DVB-T, DVB-T2, ISDB-T/ISDB-T<sub>B</sub> and ATSC digital TV standards. All these standards are available as software options and can be easily retrofitted. Multiple standards can be installed in a single exciter, allowing switchover between transmission standards (e.g. from DVB-T to DVB-T2) at the push of a button, without any hardware modifications. The R&S®TCE901 is also well prepared to handle future transmission standards.

The R&S®TMU9compact has an integrated signal analysis function that continuously measures and outputs shoulder distance and MER values. Operators benefit from this feature as they can monitor signal quality without having to invest in additional measuring equipment.

The R&S®TMU9compact in backup drive configuration with 400 W output power (COFDM).



## Easy and efficient operation

The R&S®TMU9compact graphical user interface (GUI) offers broadcast network operators the convenience they want and need when installing, commissioning and operating transmitters. The home screen provides a complete status overview for the transmitter and its individual components. The optional R&S®TDU901 transmitter display unit allows fast, intuitive operation of the transmitter system via a 7" 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 transmitter families from the R&S®Tx9 generation are installed in a broadcast network, the well-designed and uniform GUI significantly reduces training effort for service personnel.

The task-based 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.

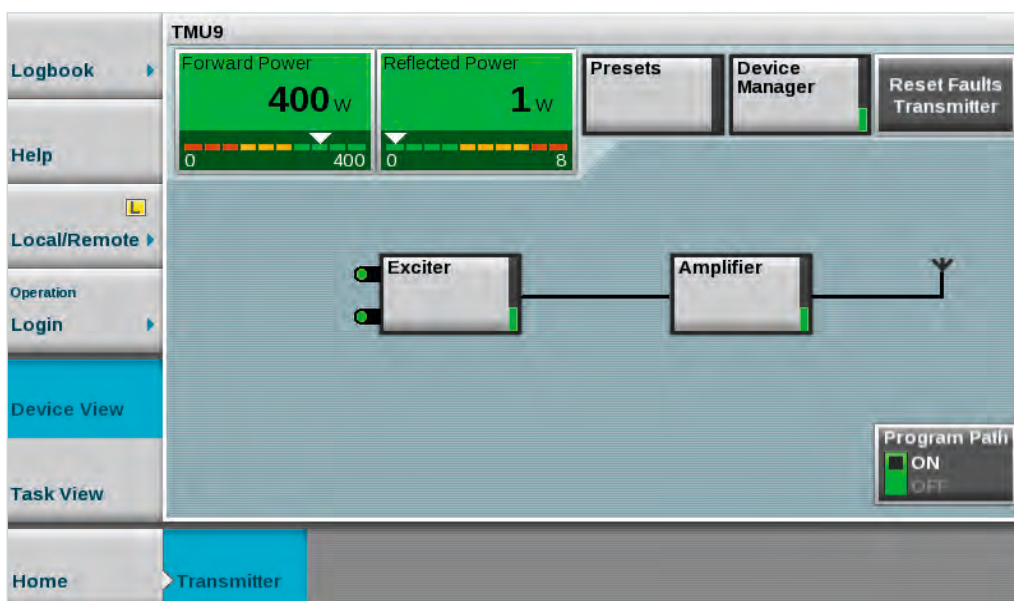
The device-based menu provides a graphical view of the transmitter structure. The user simply touches a component to directly access its parameters.

## Maximum efficiency at the push of a button

The R&S®TMU9compact offers a new feature referred to as R&S®Efficiency Optimization. It allows network operators to maximize energy savings even at reduced output power or when signal quality requirements change. An intelligent algorithm, deployed at the push of a button or adaptively, optimizes amplifier parameters to meet specific signal quality requirements. Whether changing channels or adjusting the transmitter output power, R&S®Efficiency Optimization ensures that the system delivers maximum efficiency at all times.

The R&S®TMU9compact also offers improved adaptive precorrection (ADE). This technology has consistently been optimized for Doherty amplifier characteristics, making it the most effective and fastest precorrection technology on the market.

With these advanced technologies, network operators are optimally prepared for channel changes and output power adjustments.



The user simply touches a transmitter component to directly access its parameters.

# Minimized service effort

## Servicing at the component level thanks to modular design

Broadcast networks often comprise a large number of transmitter stations delivering output powers below 1 kW. These stations usually have only minimal resources in terms of staff and equipment, i.e. no staff and few or no spare parts or replacement transmitters are available on site. In the event of a transmitter failure, this means considerable service effort for each transmitter, an effort that increases enormously with the large number of transmitters in the network. Long service intervals and minimum maintenance effort are thus vital requirements for the efficient and economical operation of a transmitter network.

The R&S®TMU9compact was engineered to provide the best serviceability on the market. With its modular design, the transmitter can be serviced at the component rather than the device level. Most of the transmitter components can be replaced by the customer, so that the transmitter does not have to be returned to or a representative for servicing. In addition, the R&S®TMU9compact shares components with other transmitters from the R&S®Tx9 generation, simplifying spare parts handling and cutting spare parts stocking expenses.

Another important feature that simplifies spare parts management is the fact that the currently set Doherty band is continuously shown on each amplifier, even if the amplifier is without power. The R&S®PMU905 is the world's first amplifier to implement this via an ePaper display. The new feature allows the current Doherty setting of each R&S®PMU905 to be immediately identified in the spare parts warehouse without having to switch on the amplifier or open its housing.

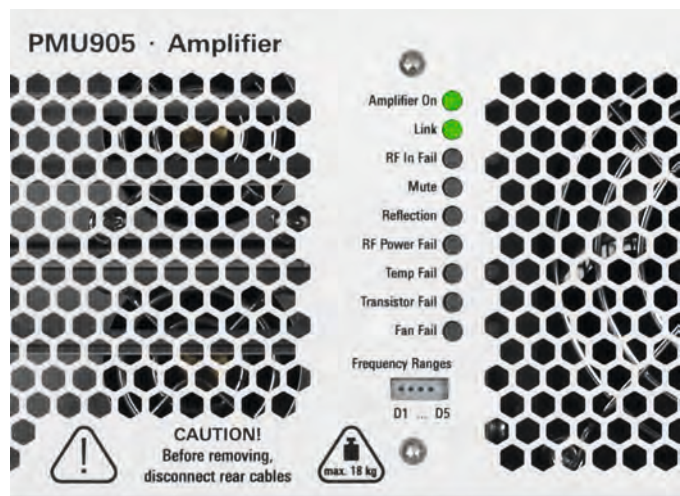
## Minimal adjustment and test effort

To minimize service work at the transmitter site, adjustment and test effort after replacing a defective component must be kept to a minimum. The R&S®TMU9compact fully addresses this need. For example, amplifiers can be replaced without any adjustments, making it quick and easy for service personnel to repair a transmitter on site.

## No special knowledge or tools required

Service expenses can be kept moderate – in terms of both equipment and personnel skills. No special tools are required. Customers can carry out even more challenging repairs using an easy-to-handle test system. The transmitter architecture is straightforward, significantly reducing training requirements for service personnel. This lowers operating expense even before an R&S®TMU9compact medium-power transmitter network is put into operation.

The currently set Doherty band is continuously displayed on the amplifier front panel, simplifying spare parts management.



# Specifications

Specifications		
<b>Digital TV</b>		
Standards		DVB-T, DVB-T2, ISDB-TB, ATSC, DTMB
Channel bandwidth	DVB-T	5/6/7/8 MHz
	DVB-T2	1.7/5/6/7/8 MHz
	ISDB-T/ISDB-TB, DTMB	6/8 MHz
	ATSC	6 MHz
Inputs	DVB-T, DVB-T2, DTMB	2 × ASI (BNC, 75 Ω), 2 × TSoIP (Gigabit Ethernet)
	ISDB-T/ISDB-TB	2 × BTS (BNC, 75 Ω), 2 × TSoIP (Gigabit Ethernet)
	ATSC	2 × SMPTE 310M (BNC, 75 Ω) 2 × TSoIP (Gigabit Ethernet)
	DVB-S/S2 signal feed (optional)	2 × F (75 Ω)
<b>General data</b>		
Frequency range	UHF band IV/V	470 MHz to 790 MHz (790 MHz to 862 MHz on request)
Supply voltage		230 V ± 15%, 2 wires + PE (L1/N/PE), 400 V/230 V ± 15%, 4 wires + PE (L1/L2/L3/N/PE), 50 Hz to 60 Hz ± 5%
Max. installation altitude		3000 m above sea level (> 3000 m on request)
Operating temperature range		+1 °C to +45 °C
Relative humidity (max.)		95%, non-condensing
Immunity <sup>1)</sup>	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)
<b>Synchronization</b>		
Reference frequency		10 MHz, 0.1 V to 5 V (V <sub>pp</sub> ) or TTL, BNC
Reference pulse		1 Hz, TTL, BNC
GPS/Glonass receiver sensitivity	optional	-150 dBm (typ. -164 dBm), SMA
Integrated OCXO		bridges reference signal interruptions for up to 24 h
<b>Operation</b>		
Status panel with buttons and LEDs		local operation
Transmitter display unit with touchscreen	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

<sup>1)</sup> More stringent requirements must be satisfied by implementing appropriate measures at the transmitter site.

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

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