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Брянск (4832)59-03-52
Владивосток (423)249-28-31
Волгоград (844)278-03-48
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Воронеж (473)204-51-73
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Калуга (4842)92-23-67
Кемерово (3842)65-04-62
Киров (8332)68-02-04
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Сочи (862)225-72-31
Ставрополь (8652)20-65-13
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AT A GLANCE

The R&S®TMU9evo UHF transmitter represents the next step toward minimizing operating costs in the medium power class. The transmitter's superior efficiency of up to 40 % for COFDM and 43 % for ATSC, combined with its long-life design, results in an exceptional operating experience. Network operators benefit greatly from low operating costs throughout the product's lifecycle.

The air-cooled R&S®TMU9evo UHF medium-power transmitter delivers output power from 400 W to 3.0 kW for COFDM as well as for ATSC TV standards (including ATSC 3.0). The R&S®TMU9evo is an ideal choice for network operators who demand both excellent quality of service and want to be perfectly prepared to handle channel clearance programs.

As a member of the successful R&S®Tx9 transmitter generation, the R&S®TMU9evo minimizes total cost of ownership (TCO) with its unrivaled long-lived transmitter design, minimal space requirements and efficiency of up to 40 % for COFDM. The new adaptive efficiency optimization feature ensures maximum energy cost savings even after channel changes or output power adjustments.

The transmitter is based on the established R&S®TMU9 platform with all of its proven strengths, including the MultiTX concept, outstanding system flexibility and ease of use. Thousands of installed R&S®TMU9 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
- Maximum on-air time
- Built on the strengths of the established R&S®TMU9 platform
- Intelligent efficiency optimization for minimized energy costs for all types of applications
- Future-ready ATSC 3.0 support

Front view of the R&S®TMU9evo.

BENEFITS AND KEY FEATURES

E^5 – efficiency to the power of five

The R&S®Tx9 transmitter generation scores with efficiency in five different aspects:

- **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

Most mature UHF amplifier design

- Superior efficiency thanks to R&S®PMU905 amplifier with enhanced Doherty technology
- Wideband amplifier design
- Optimum efficiency even after channel changes
- page 4

Operational efficiency in every aspect

- Consistent focus on long-lived transmitter design
- Continuous control of transmitter key performance indicators
- Innovative redundancy concepts at all levels
- page 6

Compact design and easy operation

- Compact, expandable exciter
- MultiTX configurations
- Easy and efficient operation
- page 8

Future-ready ATSC 3.0 support

- page 9

MODEL OVERVIEW

R&S®TMU9evo UHF transmitter family

Number of amplifiers	Output power (AVG) for digital TV standards with Doherty and normal operation [1]	Rack included	Dimensions (W × H × D)	Possible MultiTX configurations
	(DVB-T2, DVB-T, ISDB-T_B, DTMB, ATSC, ATSC 3.0)			
1	400 W	optional	483 mm × 132 mm (3 RU) × 550 mm; 19 in × 5.2 in × 21.6 in	up to 6 transmitters per rack
2	750 W	optional	483 mm × 352 mm (8 RU) × 550 mm; 19 in × 13.9 in × 21.6 in	up to 4 transmitters per rack
3	1.15 kW	optional	483 mm × 440 mm (10 RU) × 550 mm; 19 in × 17.3 in × 21.6 in	up to 3 transmitters per rack
4	1.5 kW	optional	483 mm × 528 mm (12 RU) × 550 mm; 19 in × 20.8 in × 21.6 in	2 transmitters per rack
6	2.3 kW	1 rack	600 mm × 2000 mm (42 RU) × 800 mm; 23.62 in × 78.74 in × 31.49 in	no MultiTX configuration
8	3.0 kW	1 rack		
12	4.5 kW	2 racks	1200 mm × 2000 mm (42 RU) × 800 mm; 47.24 in × 78.74 in × 31.49 in	no MultiTX configuration
16	6.0 kW	2 racks		

[1] Before bandpass filter.

MOST MATURE UHF AMPLIFIER DESIGN

Superior efficiency thanks to R&S®PMU905 amplifier with 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®TMU9 are proof of how well the R&S®TMU9 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®TMU9evo incorporates all of the proven and valued strengths of the R&S®TMU9 platform, while taking key features such as efficiency and compact-ness to the next level. Built on years of pioneering achieve-ments with Doherty technology, the R&S®TMU9evo offers even greater efficiency.

The introduction of the Doherty tech-nology in the R&S®Tx9 transmitter generation has revo-lutionized the broadcast transmitter market. With the R&S®TMU9evo, this amplifier technology is now available for the first time in the medium power class, allowing the R&S®TMU9evo to reach the next level of efficiency. The transmitter sets the benchmark with an efficiency of up to 40 %. It reduces energy costs by up to 50 % compared to the energy cost savings achieved on average by the installed base of transmitters in this power class.

Years of experience and continuous 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®Tx9 transmitter gen-eration in 2012. This amplifier technology has since become synonymous with energy cost savings for many network operators. Thousands of amplifier modules employing multiband Doherty technol-ogy are now in use around the world. Each and every day, technology saves in excess of 1 000 000 kWh compared to conventional amplifier tech-nology. This corresponds to the daily power consumption of a medium-sized European town.

Wideband amplifier design

Thanks to the multiband Doherty tech-nology, the R&S®PMU905 amplifier can be operated over the entire frequency range without hardware modifica-tions. Efficiency optimization for the various frequency bands is even easier with the R&S®PMU905 than with the predecessor model. With the R&S®TMU9evo, network operators need not worry about channel changes.

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

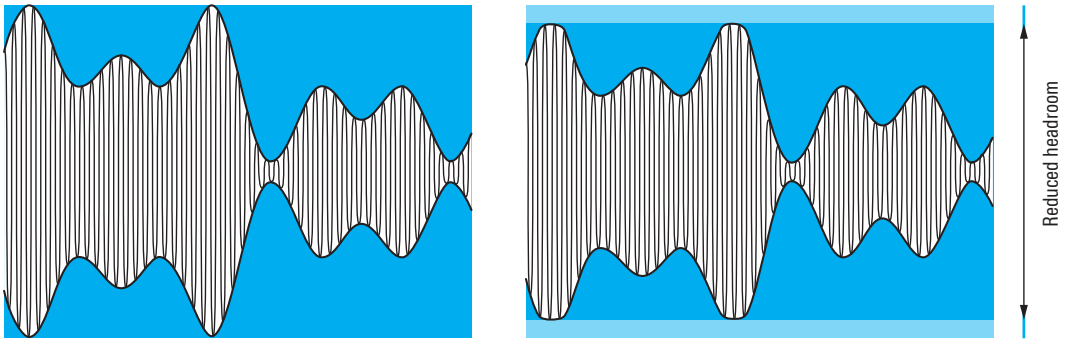
Optimum efficiency even after channel changes

Normally, transmitters are not operated at their full nominal power. Conventional transmitters experience a significant reduction in efficiency at reduced power. This is where another intelligent R&S®TMU9evo technology comes into play. The R&S®TMU9evo transmitter family features power agile efficiency, with the result that transmitter efficiency remains optimal even at reduced power. This is made possible through complete control of the Doherty amplifier circuits, intelligent control of amplifier parameters, and highly advanced precorrection.

To allow network operators to exploit this technology to maximize energy economy, the R&S®TMU9evo offers a new feature: efficiency optimization. This intelligent algorithm, deployed either at the press of a button or adaptively, optimizes amplifier parameters while maintaining the required signal quality. Whether changing channels or adjusting the transmitter output power, efficiency optimization ensures that the system delivers maximum efficiency at all times.

The R&S®TMU9evo also offers improved adaptive precorrection (ADE). This technology has consistently been optimized for Doherty amplifiers, making it the most effective and fastest precorrection technology on the market. With these advanced R&S®Tx9evo technologies, network operators are optimally prepared for channel changes and output power adjustments.

Adaptive efficiency optimization minimizes energy costs in all operating scenarios



Without efficiency optimization
- ► No adjustment of power amplifier parameters
- ► Low efficiency

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

OPERATIONAL EFFICIENCY IN EVERY ASPECT

Consistent focus on long-lived transmitter design

Like all other R&S®Tx9 transmitters, the R&S®TMU9evo offers excellent quality. Based on decades of experience in transmitter design and built with high-quality components, it offers unmatched reliability and outstanding signal quality. For example, the R&S®TCE901 exciter uses direct digital RF generation to deliver TV signals.

The R&S®TMU9evo is based on the R&S®TMU9 medium-power transmitter, which has been a market success since 2012. Thousands of R&S®TMx9 transmitters are in operation around the world. This exceptional success is a clear statement of how the R&S®TMx9 transmitter platform meets the needs of network operators, both in terms of minimal operating costs and maximum availability. Transmitter development at has always been focusing on the challenges faced by net-work operators. Key features such as frequency agility

across the entire IV and V bands and built-in performance analysis capabilities were targeted for improvement in the R&S®TMU9evo, while all of the field-proven strengths of the R&S®TMx9 platform were maintained, including MultiTX and highly optimized, low-attenuation RF power components.

The broad base of installed R&S®TMx9 systems exhibits extremely low failure rates. Based on this established platform, the R&S®TMU9evo demonstrates the same level of proven reliability, keeping off-the-air time to a minimum.

Continuous control of transmitter key performance indicators

The R&S®TMU9evo is able to track its performance with built-in analysis capabilities such as efficiency measurement and integrated signal analysis. These features provide instant feedback about operational parameters through self-monitoring to ensure a consistently high quality of service combined with lowest operational costs.

The integrated signal analysis function continuously measures and outputs shoulder distance and MER values. Operators benefit from this feature because they have full control of the signal quality without having to invest in additional measuring equipment. Furthermore, the R&S®TMU9evo offers broadcast network operators maximum operational convenience. The straightforward definition of boundaries for operational parameters allows a superior level of automation and a significant reduction in infrastructure complexity. This means a new level of simplicity and a reduction in costs.

Enhanced ATSC translator features for easier deployment

When deployed as an ATSC translator, the R&S®TMU9evo offers enhanced features to make operators' lives easier.

With the PSIP editing option, the R&S®TMU9evo detects and displays the original TSID and PSIP information in real time. If desired, the translator can modify the contents of the PSIP table, including short name and major and minor channel number of the input stream. It can also forward all dynamic PSIP electronic program guide information without corrupting any data. With this feature integrated in the R&S®TMU9evo, no additional external device is needed for PSIP editing, and deployment is made easier.

Upon loss of all inputs (ASI and/or RF tuner input), a static picture can be displayed instead of a blue screen. The transmitter will continuously loop a standard compliant transport stream. The static picture feature can deliver a

viewer message. This feature provides a fallback, enabling the transmitter to stay on air if no input signal is present and helping operators to keep and inform their viewers.

When operating as a translator, the R&S®TMU9evo supports loopthrough of the ASI signal. This enables the transmitter to demodulate the RF input signal, allowing the operator to monitor the incoming ASI signal at the baseband level. An ASI test system or ASI transport stream reader can analyze the decoded RF input signal via the ASI output port. This helps simplify the system design of translator stations and gain insight into the root cause of any problems that may occur.

Innovative redundancy concepts at all levels

The R&S®TMU9evo 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, preventing a reboot of the transmitter for interruptions of up to 10 seconds. The battery effectively reduces off-the-air time, offering an economic alternative to using an uninterruptible power supply (UPS).

Optional power supply redundancy for the amplifiers also helps increase availability. If one of the power supplies fails, the standby unit delivers the full current. This ensures interruption-free transmission even if a power supply or a phase in the feed network fails. Redundant power supplies are hot-pluggable and can be easily replaced during operation.

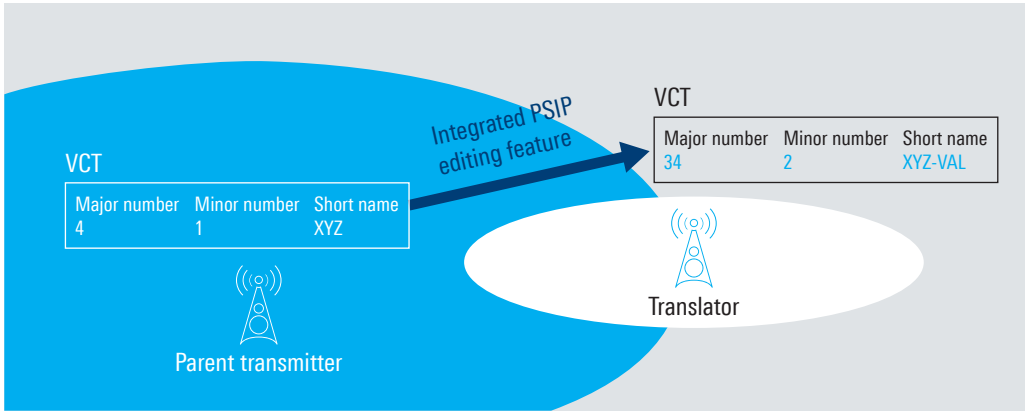
At the transmitter level, the R&S®TMU9evo uses the familiar backup drive redundancy concept deployed by the R&S®TMU9 transmitter family and comprising only two R&S®TCE901 exciters. The passive exciter monitors and controls the active exciter, making a centralized control unit superfluous. The backup drive configuration offers the functionality and convenience of a classic exciter redundancy configuration and increases transmitter availability.

At the system level, the R&S®TMU9evo offers an innovative redundancy configuration: BackupTX.

In a BackupTX system, two R&S®TMU9evo 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®TMU9evo BackupTX system with integrated DVB-S/S2 receivers requires just seven rack units, saving an enormous amount of space compared to conventional 1+1 backup configurations in this power class. This is a major advantage when space is at a premium.

Adjust PSIM information easily without the need for additional devices



COMPACT DESIGN AND EASY OPERATION

Compact, expandable exciter

The R&S®TMU9evo transmitter family comes with the new R&S®TCE901 exciter, which offers an even higher level of integration than the previous R&S®TCE900 model. It integrates signal processing as well as transmitter and system control functionality. The R&S®TCE901 offers numerous functions and options that eliminate the need for equipment such as an integrated satellite receiver or integrated system components for N+1 configurations. This saves space and increases system availability.

The new R&S®TCE901 exciter supports the latest functionality implemented in the R&S®TMU9evo, such as adaptive efficiency optimization and performance analysis capabilities.

The R&S®TCE901 is multifunctional and extremely versatile. It supports the DVB-T, DVB-T2, ISDB-T/ISDB-T_B and ATSC digital TV standards. Together with the R&S®SDE900 software based encoder, it provides a future-ready solution for ATSC 3.0. Multiple standards can be implemented 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.

MultiTX configurations

The MultiTX concept makes it possible to install up to six transmitters in a single rack.

Easy and efficient operation

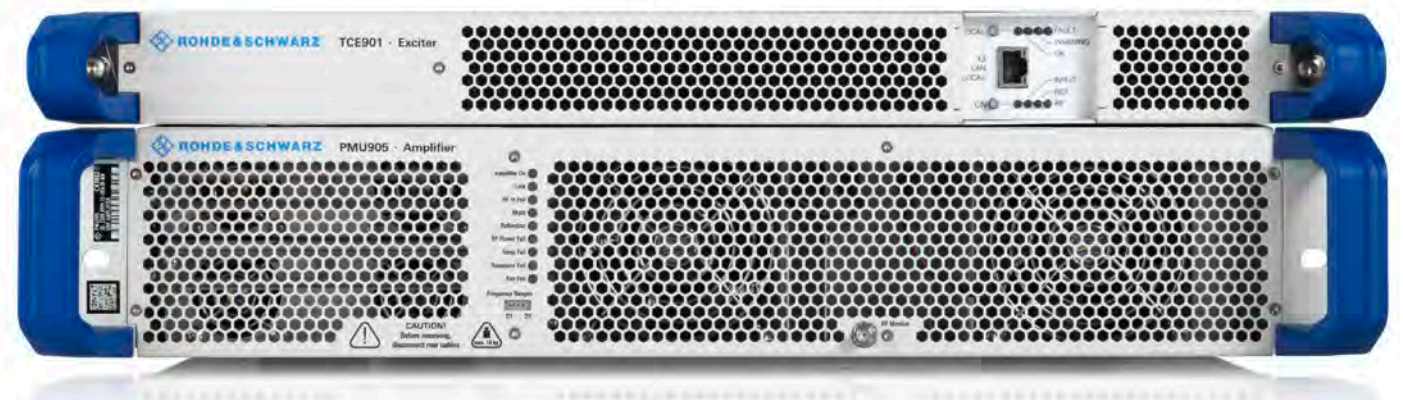
The R&S®TMU9evo graphical user interface (GUI) offers broadcast network operators the convenience they want and need when installing, commissioning and operating transmitters. The transmitter is simple and intuitive to operate. The home screen provides a complete overview of the current operational status of the transmitter and its individual components. The optional R&S®TDU901 transmitter display unit allows fast and convenient 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. If multiple, different transmitters from the R&S®Tx9 generation are installed in a broadcast network, the well-designed, 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.

The R&S®TMU9evo comprising the R&S®TCE901 exciter and the R&S®PMU905 amplifier with 400 W output power.



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. It was designed to evolve together with broadcasters' future requirements. To optimally address network operators' needs for flexibility, took a revolutionary approach to imple-menting this broadcast standard. The R&S®SDE900 is a purely software based solution – ideal for network opera-tors to make optimal use of ATSC 3.0. Based on a high-performance IT server, it enables network operators to fully leverage the capabilities of the standard and flexibly respond to future signal processing requirements.

The exciter solution fully supports ATSC 3.0 features such as multiple physical layer pipes
(PLP), multiple subframes and SFN capabilities for optimal utilization of valuable spectrum. The R&S®SDE900 also supports ATSC 3.0 layered division multiplexing (LDM), helping network operators maximize coverage in different reception scenarios (e.g. fixed and mobile reception).

By design, the R&S®SDE900 can easily accommodate broadcast standard evolutions. Operators benefit from a secure investment and can optimally exploit their valuable spectrum assets since the solution allows flexible adaptation to broadcasters' future opera-tional roadmap.

The R&S®SDE900 is designed as a plug-in rackmount module for R&S®Tx9 generation transmitters, allowing a smooth migration to the ATSC 3.0 standard. The R&S®SDE900 software based encoder delivers the I/Q data. The field-proven R&S®TCE901 exciter uses this data to generate the COFDM waveform and applies the most powerful precorrection on the market, delivering the excel-lent signal quality expected from .

Server based exciter solution

Real-time ATSC 3.0 software based encoder running on a high-performance server

COFDM waveform generation

SPECIFICATIONS

Specifications		
Digital TV		
Standards		DVB-T, DVB-T2, ISDB-T_B, DTMB, ATSC, ATSC 3.0
Channel bandwidth	DVB-T	5/6/7/8 MHz
	DVB-T2	1.7/5/6/7/8 MHz
	ISDB-T/ISDB-T_B, DTMB	6/8 MHz
	ATSC, ATSC 3.0	6 MHz
Inputs	DVB-T, DVB-T2, DTMB	2 × ASI (BNC, 75 Ω), 2 × TSoIP (Gigabit Ethernet)
	ISDB-T/ISDB-T_B	2 × BTS (BNC, 75 Ω), 2 × TSoIP (Gigabit Ethernet)
	ATSC	2 × SMPTE 310M (BNC, 75 Ω)/2 × ASI (BNC, 75 Ω) 2 × TSoIP (Gigabit Ethernet)
	ATSC 3.0	2 × STL or TSoIP (Gigabit Ethernet)
	DVB-S/S2 signal feed (optional)	2 × F (75 Ω)
General data		
Frequency range	UHF bands IV and 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) 208 V ± 10 %, 3 wires + PE (L1/L2/L3/PE) 240 V ± 10 %, 2 wires + PE (L1/L2/PE) 50 Hz to 60 Hz ± 5 %
Maximum 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 [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)
GPS/GLONASS receiver sensitivity	optional	–144 dBm to –5 dBm (SMA)
Integrated OCXO		bridges reference signal interruptions for up to 24 h
Operation		
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

[1] To satisfy more stringent requirements, appropriate measures must be implemented 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.