Top efficiency and top performance

A new high-power transmitter family conquers the market

Efficiency redefined: the R&S®THU9

Efficiency* was the top-priority goal when developing the new R&S®THU9 high-power transmitter family, the first member of the new R&S®Tx9 transmitter generation. The transmitters' unique level of efficiency saves lots of money over the entire life cycle. Their space-optimized design delivers more power per square foot of floor space. Operation via touchscreen makes work easy even for infrequent users. The future-ready system concept safeguards investments and allows practical transmitter configurations for all requirements.

* The development of the ninth transmitter generation from Rohde&Schwarz yields a variety of different technological capacities. Under the heading of "efficiency to the power of five" (E^5), all transmitters of the new generation – including the R&S®THU9 – redefine transmitter efficiency:

- Maximum energy efficiency
- Space efficiency
- Time efficiency in terms of operation
- Service efficiency
- Investment efficiency

FIG 1 In a single rack, the R&S®THU9 transmitter family delivers up to 15 kW output power for COFDM standards at an efficiency of up to 28 %.

UHF high-power transmitters

Reduced power consumption saves money over the entire life cycle

Every transmitter network operator keeps a close eye on energy costs because they account for the majority of costs incurred during the operation of high-power transmitters. For this reason, the main focus was on efficiency when developing the new R&S®THU9 transmitter family (FIG 1). The results of this effort are superior values that save network operators plenty: The transmitters achieve efficiency levels of up to 28 % for COFDM standards and up to 30 % for ATSC – the cooling system included – due to various innovations in the system design.

The core of the transmitter – the R&S®PHU901 amplifiers (FIG 2) – is equipped with state-of-the-art LDMOS power transistors with 50 V supply voltage. A clever matching circuit ensures stable and efficient semiconductor operation. The RF coupling network after the transistors is of discrete design and features minimal attenuation, also contributing to an increase in efficiency. The power combiners and harmonics filters were also developed with the focus on reducing attenuation.

In addition to careful hardware optimization, new signal processing and system control concepts further increase efficiency. Specially developed power supplies enable the transmitter control unit to adapt the transistor supply voltage to requirements. This capability and the built-in, automatic, adaptive precorrection serve to boost transmitter efficiency. This becomes obvious in particular with reduced output power, where many other transmitters must do with clearly poorer efficiency because of missing control mechanisms.

Rohde&Schwarz is the first manufacturer to offer an exciter – the new R&S®TCE900 – that allows the crest factor to be reduced for all COFDM standards. This crest factor reduction is due to a sophisticated algorithm that does not deteriorate modulation quality. It additionally improves transmitter efficiency by approx. 2 %. For DVB-T2, the tone reservation method defined in the standard can alternatively be used to reduce the crest factor.

Space-saving miracle: concentrated power, integrated functionality

Such high power per rack has never been available before. By using power transistors with 50 V supply voltage, it was possible to significantly increase the output power per amplifier. Thanks to optimization, each rack can now accommodate up to 12 amplifiers. The maximum output power per rack is 15 kW for COFDM standards, 18.5 kW for ATSC and 30 kW for analog TV. This market-leading power density significantly reduces the required floor space and cuts down on site rental costs.

Integrating additional functionalities into the rack saves additional space. For example, the R&S®TCE900 exciter offers the option to integrate an internal GPS receiver as the time reference and to feed the transport stream via an IP link. Due to its cost-effectiveness, IP technology is also gaining ground in broadcast feed networks. The exciter can be equipped with optional interfaces for all digital standards to redundantly feed two transport streams via Gigabit Ethernet. External IP-to-ASI gateways are no longer required. This saves money and space and simplifies feed monitoring.

FIG 2 At the core of the transmitter are the R&S®PHU901 amplifiers.

The cooling system normally takes up a lot of space, which is why it was redesigned for the R&S®THU9 transmitters to make it as small as possible. The compact pump unit (FIG 3) can be installed on the floor or on the wall or stacked on another pump unit. In some transmitter configurations, the pump unit can also be integrated into the rack. The pumps operate in active standby, increasing transmitter availability. 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, saving energy and extending transmitter life. As the R&S®THU9 transmitters dissipate less heat due to their high efficiency, the heat exchangers are smaller than usual.

FIG 3 The exceptionally compact and user-configurable R&S®TH9-C1 pump unit has a low power consumption, which contributes to transmitter efficiency.

Requirement-specific system configurations that are fit for the future

Different network operators make different demands on transmitter systems. For this reason, Rohde&Schwarz enhanced the system modularity of the R&S®THU9 transmitters to offer every customer a tailor-made solution. This flexibility begins in the exciter and in the transmitter control unit, for both of which the R&S®TCE900 base unit is used. By inserting the appropriate plug-in boards, the base unit can be configured as a transmitter control unit or as an exciter without having to open it. Multiple transmission standards can be installed on one exciter. Since the base unit is always the same, network operators can change the functionality directly at the transmitter site.

The exciter is extremely versatile. It can handle the DVB-T, DVB-T2, ISDB-T / ISDB-T_B and ATSC digital TV standard as well as the DVB-H and ATSC Mobile DTV standards for mobile TV. All standards are available as software options. For ATV, an additional plug-in board with the input interfaces is inserted into the exciter.

In the years to come, many operators will switch over from analog transmission to digital TV. The R&S®THU9 facilitates this transition. When the exciter is fed with both analog and digital input signals, switchover can take place locally (by pressing a key), remotely or even timed.

In addition to single transmitters with different redundancy concepts, system configurations are now available that are scalable and flexible and save space at the transmitter site, such as MultiTX® and all-in-one systems.

MultiTX® systems consist of up to four liquid-cooled transmitters in a single rack (FIG 4). Depending on the number of transmitters, it is possible to configure systems with single drive, dual drive or backup exciter. To meet higher redundancy requirements, multiple transmitters installed in one rack are combined into an N+1 system. The R&S®TCE900 transmitter control unit acts as the interface to the outside world. It also monitors the cooling system. MultiTX® systems are available for all offered transmission standards and with different power ratings. For example, a single rack can be equipped with three DVB-T2 transmitters with an output power of 5.2 kW each in backup exciter redundancy. FIG 5 provides an overview of the available MultiTX® configurations.

All-in-one systems include everything that is necessary for operation. Due to the high power density in the amplifiers, system racks in typical power classes often provide a lot of space that can be used to integrate the bandpass filters and pump unit. This space-saving configuration is available for transmitters with up to four amplifiers (5.2 kW for COFDM, 6.4 kW for ATSC and 10 kW for ATV). In addition,

Example of a MultiTX® system

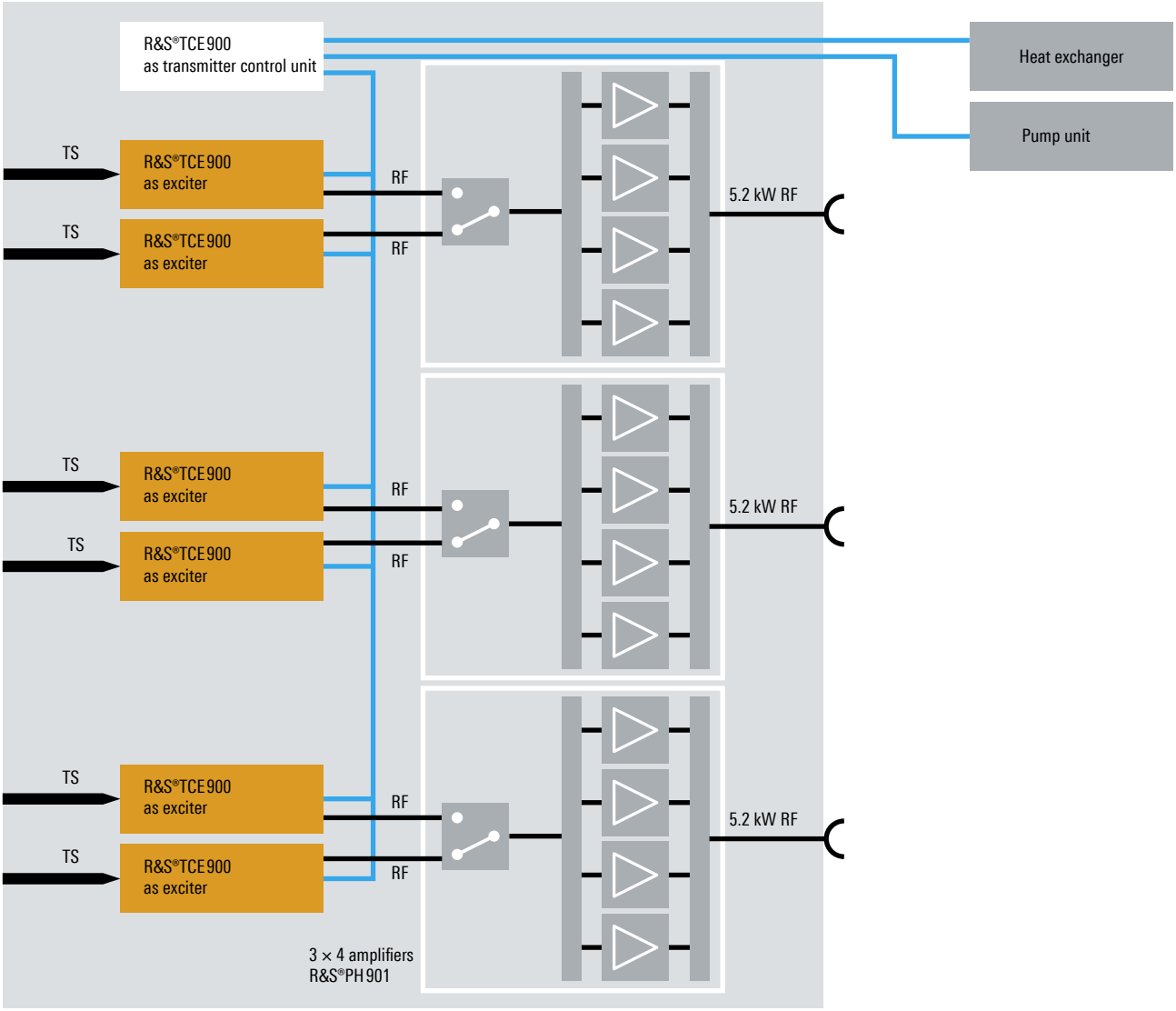

FIG 4 Example of a MultiTX® system with three transmitters in one rack. Depending on the number of transmitters, it is possible to configure systems with single drive, dual drive or backup exciter.

Number of amplifiers	1	2	3	4	5	6	8	10	12	16	20	24
Output power (RMS) for COFDM standards [1]	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
Output power (RMS) for ATSC / ATSC Mobile DTV [1]	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
Output power for ATV (sync peak) [2]	2.6 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
Number of transmitters per rack	up to 4			up to 3	up to 2							
Dimensions (H × W × D)	2000 mm × 600 mm × 1100 mm									2000 mm × 1200 mm × 1100 mm		

1) Before bandpass filter.
2) After four-cavity bandpass filter.

FIG 5 The MultiTX® system allows various multitransmitter configurations.

it is possible to implement configurations only with built-in bandpass filter or only with integrated pump.

Simple operation for fast results

The straightforward, intuitive operating concept helps to accomplish everyday tasks faster and error-free. This is why Rohde&Schwarz has incorporated field experience from numerous sources into the development of the operating concept for the new transmitter generation. As a result, the system and its status are displayed in a clear manner, and operation is easy to learn.

The retractable R&S®TDU900 transmitter display unit (FIG 6), which is installed in the R&S®TCE900 transmitter control exciter, serves as the user interface. The 7" touchscreen slides out when the user gives it a slight push and can then be tilted to the desired position. Another benefit: The user interfaces for local and remote operation via web browser are identical so that users can always work in a familiar environment. A LAN port and a USB interface are provided for exchanging configuration data.

The clear-cut user interface (FIG 7) allows the user to check the system status at a glance. The transmitter system's structure is displayed graphically. Touching the transmitter components on the touchscreen provides direct access to the related parameters. The left-hand side of the screen permanently displays frequently required central functions such as log book, local / remote switchover and context-based help functions. The system navigation path at the bottom of the screen allows the user to rapidly change from one parameter to another.

An absolute innovation is the task-oriented view, which is provided in addition to the device-oriented view (FIG 8). Tasks ranging from simple monitoring to complex commissioning procedures are displayed on the graphical user interface in clear steps so that they can be accomplished in a minimum of time. Before putting the transmitter into operation, for example, the operator is guided through the configuration of the different devices and given help when entering parameters and adapting settings.

FIG 6 The R&S®TDU900 transmitter display unit can be tilted as required and its 7" touchscreen provides high operating convenience.

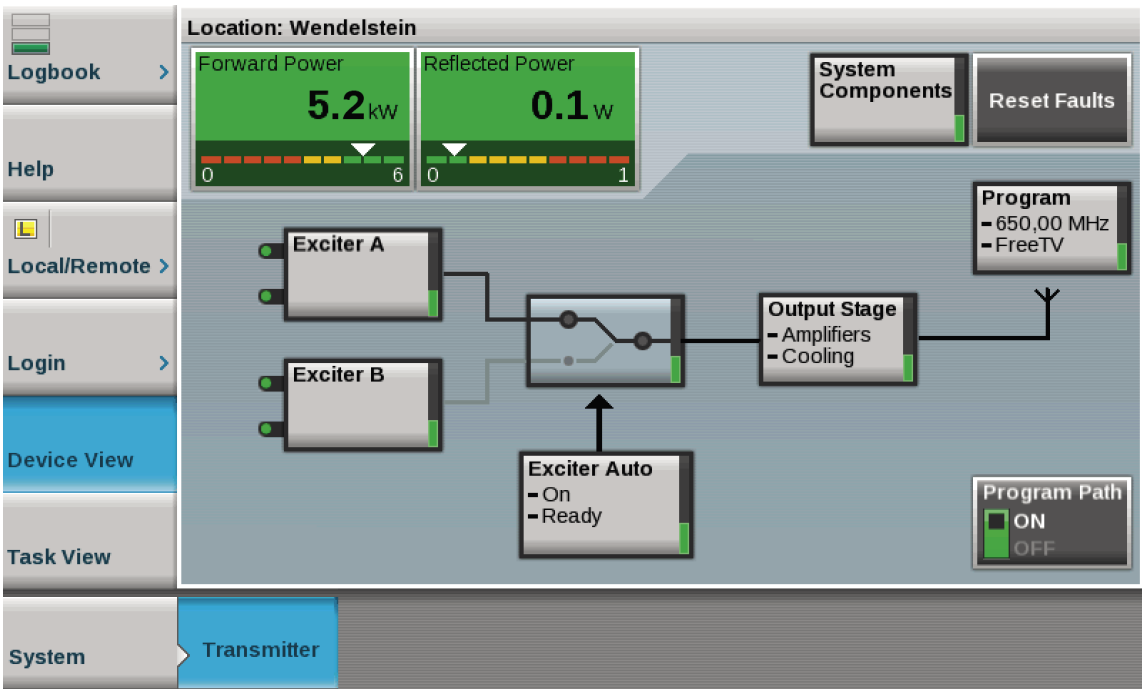

FIG 7 The device-oriented view presents all important system information in a straightforward manner.

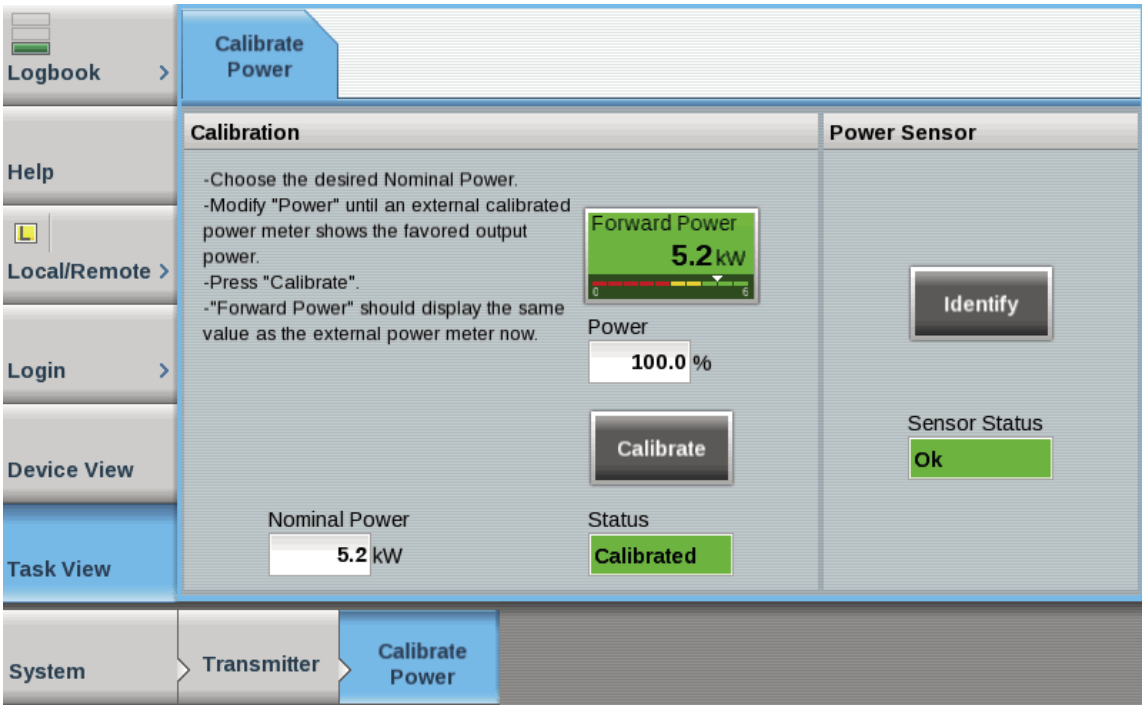

FIG 8 The task-oriented view.

A typical Rohde&Schwarz product: reliable and virtually maintenance-free

Users can rely on the R&S®THU9 transmitter family. Its design has been optimized for high availability and all system components have outstanding Rohde&Schwarz product quality. To keep maintenance costs as low as possible, the transmitters were strictly designed for long life. For example, there are no fans in the amplifiers, which are exclusively liquid-cooled. The R&S®TCE900 is equipped with special fans that have a service life of significantly more than ten years.

Summary

With the R&S®THU9 transmitter family, Rohde&Schwarz has launched a system that perfectly combines diverse efficiency aspects: Featuring unique efficiency, excellent flexibility and future-readiness, coupled with exceptional power density and a user-tailored operating concept, this transmitter family redefines efficiency. The new transmitters will help network operators to clearly reduce the total cost of ownership of their networks.

Axel Menke

Key features at a glance

Brilliant efficiency
- Top efficiency thanks to innovative system design
- Innovative amplifier with high efficiency
- Voltage regulation and crest factor reduction
- Efficient liquid cooling system

Scalable and flexible system configuration
- MultiTX® system with multiple transmitters and configurations in a single rack
- R&S®TCE900 base unit – a multitalent that can be used as a transmitter control unit or as an exciter
- Simple switchover from analog to digital TV
- IP transport stream feed reduces infrastructure costs

Multifaceted, compact design
- Highest power density on the market
- MultiTX® system with up to four single transmitters per rack
- All-in-one transmitter with built-in pump unit and band-pass filter
- Space-saving, flexible liquid cooling system

Simple operation for fast results
- User-friendly, ergonomic operating unit
- Simplified navigation with device-oriented views
- Task-oriented menus for fast training of operating personnel