

Latest generation of FM transmitters: world champions in compact design and energy efficiency

Despite the Internet and today's omnipresent mobile media devices, FM sound broadcasting remains popular around the globe. The new R&S®THR9 liquid-cooled FM high-power transmitters are the perfect choice for satisfying the requirements of network operators.



The new R&S®THR9 FM transmitters proudly display this logo reflecting their fivefold advance in efficiency:

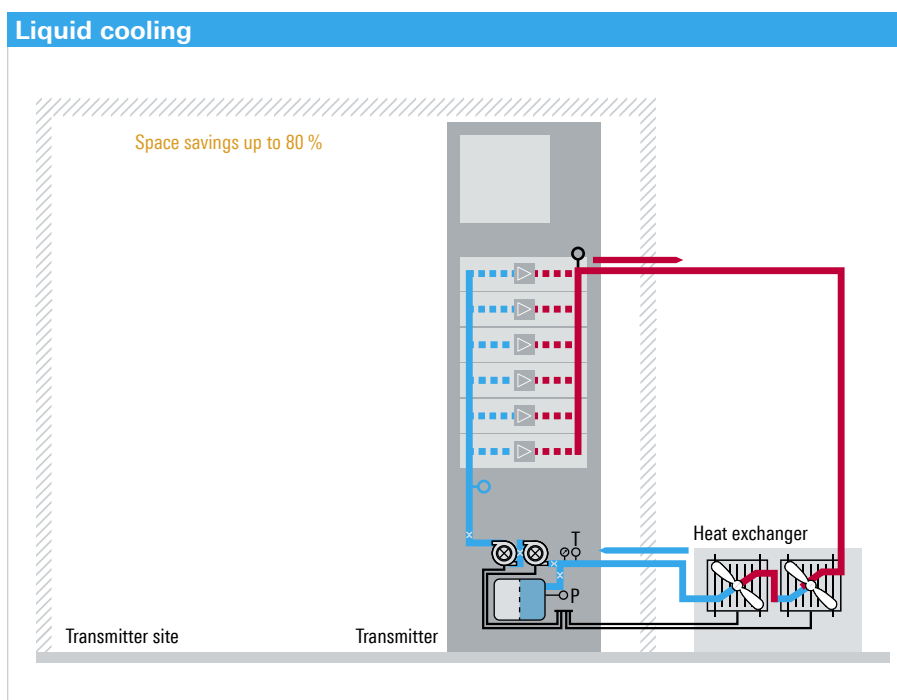
- Energy consumption
- Required space
- Operation
- Configuration
- Total lifecycle

The R&S®THR9 FM transmitter family: top efficiency in the smallest possible space

The R&S®THR9 liquid-cooled FM transmitters (see photo on page 41) are available in power classes from 5 kW to 40 kW for VHF band II (87.5 MHz to 108 MHz). They use various innovative technologies that have already proven their worth in Rohde&Schwarz TV transmitters and are now finding their way into sound broadcasting systems for the first time.

For example, there is the MultiTX system concept to integrate multiple transmitters into a single rack. Like the liquid cooling system, this helps reduce the amount of space required (Fig. 1). In the case of the R&S®THR9, as many as four 10 kW transmitters can be housed in a single rack. Central components such as the transmitter control unit and the liquid cooling system are shared by all transmitters in the rack.

Fig. 1: Liquid-cooled transmitters use up to 80 % less space at transmitter sites. The large air ducting systems required for air-cooled transmitters are eliminated. The heat exchanger also requires minimal space and is installed outside the transmitter site. The pumps are integrated into the transmitter rack.



From pioneer to modern trendsetter

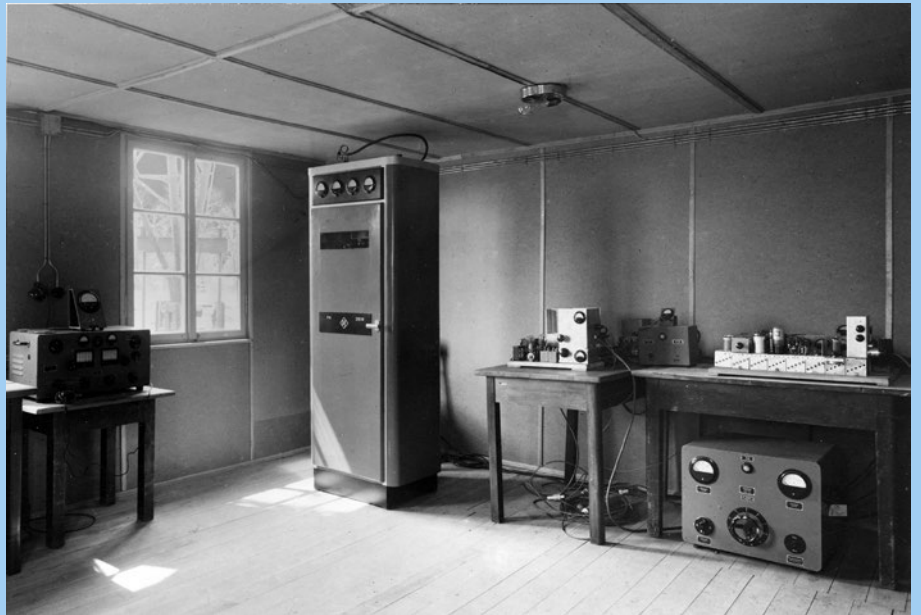
The basic concept of frequency modulation (FM) was developed in the 1920s, but the earliest efforts to use this technology were not very successful. Following extensive development work and testing, the first patent applications for FM technology were filed in the 1930s and the first FM station licenses were issued in the US at the end of the same decade.

In Europe, Rohde&Schwarz played an active role in the spread of FM technology. The company's involvement began shortly after the drafting of the 1948 Copenhagen Frequency Plan when the Bavarian Broadcasting Corporation ordered an FM transmitter from Rohde&Schwarz. It took only six weeks for the company to fill this order, allowing Europe's first VHF FM transmitter to go into operation on February 28, 1949 (see picture on right).

The audio quality of FM radio met with great approval and the transmitter network expanded rapidly. Due to FM radio's good interference immunity, combined with ongoing innovations in hi-fi quality, it became popular across Europe in the VHF band and ultimately worldwide. Of course, the transistor radio boom in the 1950s and 1960s played a significant role.

Further technical advances were triggered by this popularity. By the start of the 1960s, stereo reception was possible. In the 1980s, Rohde&Schwarz played a major role in the development of the radio data system (RDS). RDS was officially launched in 1987 and is still used today primarily in car radios to help provide alternative frequencies.

Despite the popularity of the Internet and widespread use of portable media devices, FM radio remains an important mass medium worldwide. For 65 years now, Rohde&Schwarz has been a part of this development, delivering reliable FM sound broadcasting systems everywhere around the globe. The latest generation represented by the R&S®Tx9 transmitter family introduces a new level of energy efficiency together with a space-saving design.



Europe's first commercial VHF FM transmitter went into operation on February 28, 1949. The supplier was Rohde&Schwarz. This photo was taken in the 16 m² wooden structure operated by the Bavarian Broadcasting Corporation at the foot of the antenna tower in Munich-Freimann.

VHF transmitter from the year 1963 (5 kW in 1 + 1 standby).

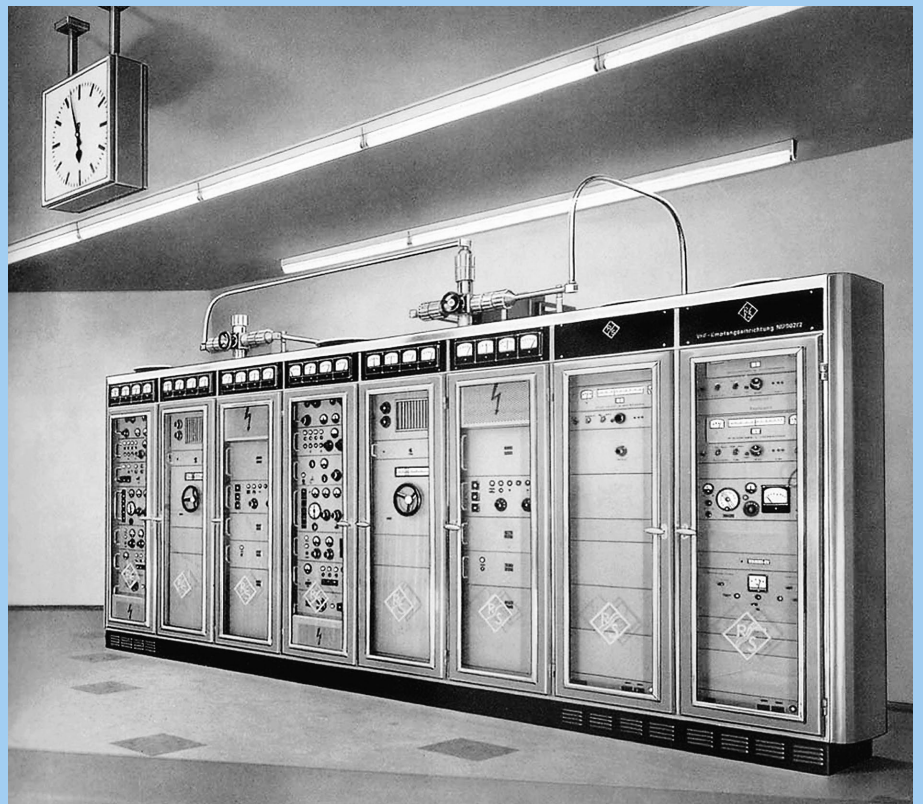




Fig. 2: Redundant, integrated pump modules for cooling single transmitters up to 20 kW.

A central system control unit monitors the transmitters in a MultiTX system and provides a graphical user interface. This concept ensures flexibility and scalability at an affordable cost while meeting the stringent availability requirements that apply to transmitter systems. Moreover, there is enough space left in the R&S®THR9 rack to allow integration of third-party components.

First time ever: liquid cooling for band II transmitters

Liquid cooling has been used in terrestrial TV transmitter systems for several years. Now for the first time, Rohde & Schwarz has implemented this cooling concept in high-power transmitters for band II. At high power levels, liquid cooling has multiple advantages over air-cooled systems, which in some cases require considerable adaptation of buildings and infrastructure.

The amplifiers are integrated into a closed cooling circuit along with the redundant pumps (Fig. 2) and heat exchanger. Compared with air cooling, the main benefit of liquid cooling is that less space is required, since the waste heat is transferred directly from the transmitter room using a heat exchanger installed outside the building – without using any additional infrastructure. Only cooling hoses have to be installed. No costly, high-maintenance systems are needed to remove the hot air. Moreover, the pumps can be integrated into the transmitter rack. Another important aspect is the significant noise reduction at the transmitter site compared with air-cooled systems. The pumps and heat exchanger are easy to service and can be configured to meet practically any requirement. Intelligent algorithms have been implemented to ensure optimized coolant flow.

Leading in energy efficiency and power density

Whereas typical air-cooled transmitter systems achieve energy efficiency between 60 % and 65 %, the R&S®THR9 transmitter stands out with efficiency values of up to 75 %. The transmitters attain such high efficiency due to their state-of-the-art LDMOS transistors, power combiners with minimal loss and well-designed liquid cooling system. This is what makes them the market leaders among transistor-based FM transmitters, enabling a significant reduction in energy costs for the transmitters and the cooling system.

Each amplifier can deliver an output power of up to 5 kW. Since up to eight amplifiers fit into a rack, single transmitters can be set up with up to 40 kW output. Despite the high power levels produced by a single R&S®THR9 rack, there is room for additional equipment that had to be housed elsewhere in the past.

Redundancy at multiple levels

Proven transmitter system redundancy concepts such as exciter standby and n + 1 standby (one standby transmitter for n program transmitters) can be implemented in a wide range of configurations and also combined with the MultiTX system concept. The cooling system has a redundant design with two pumps. Thanks to the clever dimensioning of the amplifier power supplies, transmitter operation can continue without a major loss of output power even if a power supply fails.

Measurements on FM Transmitters for Acceptance, Commissioning and Maintenance Application Note

Product:

R&S®ETL

Despite the advent of advanced digital transmission methods, analog broadcasting remains highly important. Until now, measurements on FM transmitters in connection with acceptance testing, commissioning and maintenance required using a variety of FM instruments.

The R&S®ETL TV analyzer combines these instruments' capabilities in a single unit and can completely replace them. Now, for the first time, acceptance test measurements can be conducted on FM transmitters quickly and easily using just one compact test instrument. The R&S®ETL provides the functionalities of a power meter, spectrum analyzer, audio generator, FM measurement demodulator, stereo decoder, audio analyzer and more in just one box.

Rohde & Schwarz
Application Note
Product Reference
No. 71981011

Rohde & Schwarz

This 89-page application note discusses how to use the R&S®ETL TV analyzer to perform all of the measurements required for acceptance, commissioning and maintenance of FM transmitters (search term: 7BM105).



Fig. 3: R&S®TDU900 transmitter display unit showing a 3 + 1 system with 10 kW output power per transmitter.



Fig. 4: The R&S®TCE900 exciter is configured with plug-ins and can be upgraded for HD Radio™.

Modular design of the exciter and transmitter control unit

The R&S®TCE900 transmitter control exciter is used in all members of the R&S®Tx9 transmitter family (Fig. 4). Using appropriate plug-ins, it can be configured either as an exciter or transmitter control unit, or these two functions can be combined in a single device.

Using an add-on board, the exciter can be upgraded to the latest generation of the HD Radio™ digital standard that is popular in the US. The transmitters are well-prepared for additional digital standards in band II as well as for the future growth of audio over IP.

Easy operation in every configuration

The R&S®TSP900 transmitter status panel allows convenient operation of single transmitters, and a web browser can also be used via the Ethernet interface. A recommended alternative especially for systems with multiple transmitters is the R&S®TDU900 transmitter display unit with a touchscreen (Fig. 3). It can be swiveled into various positions or retracted back into the transmitter rack. Of course, the R&S®THR9 can also be easily integrated into operators' network management systems via remote control using the simple network management protocol (SNMP).

Summary

The R&S®THR9 are the world's most efficient FM high-power transmitters, delivering top efficiency in minimal space. These transmitters allow audio broadcast network operators to cut energy costs as well as to reduce maintenance and rental costs over the entire transmitter lifecycle.

Outstanding power density is achieved using the MultiTX system concept with multiple amplifiers in a single rack combined with liquid cooling. Key aspects include energy efficiency values up to 75 % at the transmitter end as well as diverse concepts for liquid cooling. Finally, the transmitter family is ideally positioned to handle future developments.

Stefan Dzieminski