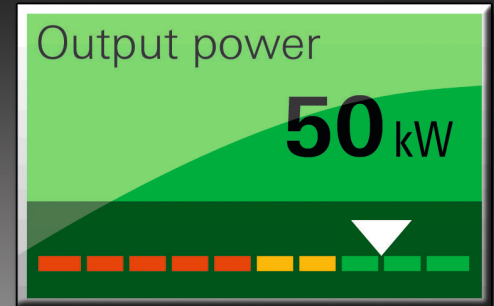


Solid state for highest power levels



General

The best energy efficient technology for broadcast systems today is Doherty amplification. Before now, IOT transmitter systems had to be used for very high output power. Doherty technology has led to the development of very successful, highly efficient digital TV transmitter systems.

This document describes how Rohde & Schwarz has applied Doherty technology to digital TV transmitters. It demonstrates the advantages of a solid state transmitter design over IOT technology for very high output power.

Doherty technology

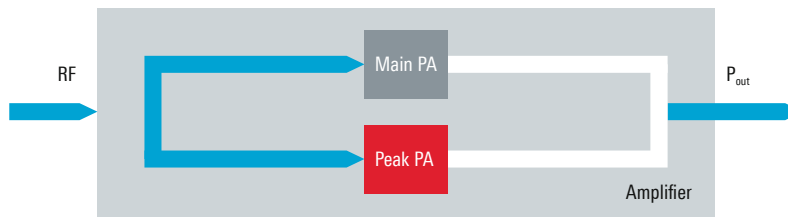
Doherty: efficient technology for high-power transmitters

The amplification of the peak and average power signals is separated by using a main and a peak amplifier path. The main amplifier operates as a normal broadcast amplifier until it backs off. After reaching the back-off point, the amplifier constantly works in saturation, and the peak amplifier joins the main amplifier in amplifying peak signals. Both are operating close to saturation. The main and peak amplifier outputs are then combined to produce the final output power.

The level of efficiency is 10 to 15 percentage points higher than with usual solid state transmitters, resulting in a power efficiency of 42% at the system level for the ATSC standard in the UHF band.

Logically designed Doherty amplifiers are setting new standards in the broadcasting world since this is a very simple and reliable concept. A simple modification is needed to retune the amplifier to cover the entire UHF band with the same hardware. Intelligent amplifier design using Doherty technology is the new method for increasing the efficiency of solid state transmitters, putting them on par with IOT transmitters.

Principle of Doherty amplification



Current portfolio of products with Doherty technology

Rohde&Schwarz provides the widest range of transmitter systems with Doherty technology. All available standards such as ATSC, DVB-T/DVB-T2, ISDB-T/ISDB-T_B and DTMB are supported.

The air-cooled R&S®TMU9/R&S®TMV9 and the liquid-cooled R&S®THU9/R&S®THV9 transmitter families deliver

output powers from 300 W to 50 kW in the UHF and VHF bands. They achieve previously unattained energy efficiency with significantly reduced operational costs.

All R&S®Tx9 transmitters offer the MultiTX configuration that allows multiple transmitters or the cooling system to be integrated into a single rack. With hundreds of different configurations, the product range provides broadcast network operators with the best solution for any application.

Full range of Doherty transmitters



500 W

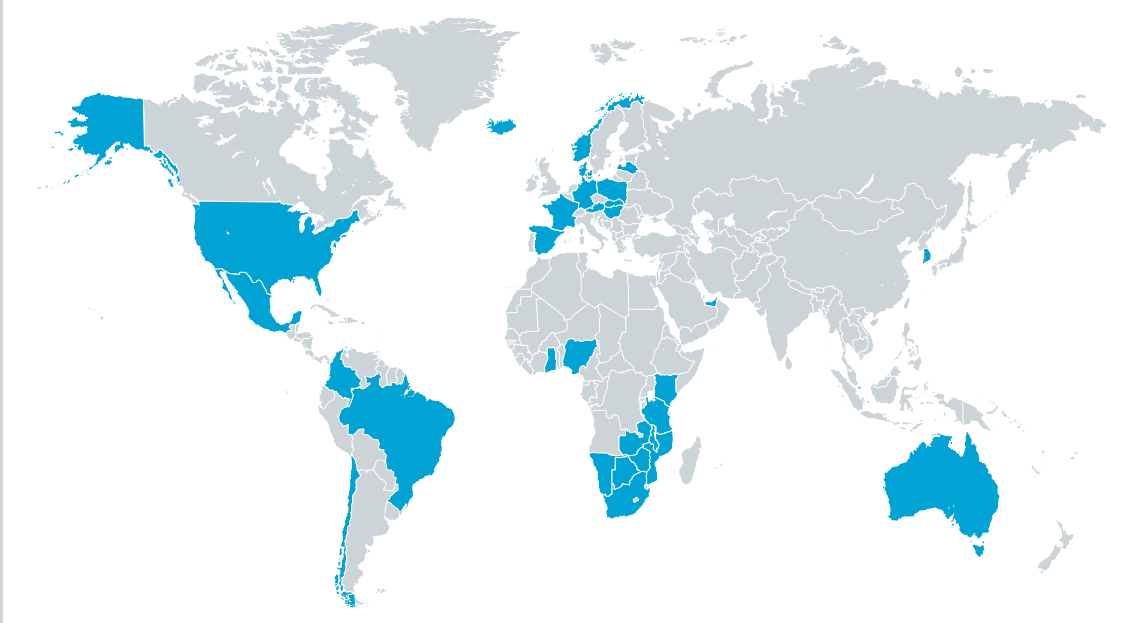
50000 W

Installed Rohde&Schwarz Doherty transmitters

The Doherty technology based Rohde&Schwarz transmitters have already been installed in many countries around the world. Broadcast network providers who have decided in favor of this technology for transmitters broadcasting digital standards appreciate the high

power efficiency and easy maintenance. Doherty technology from Rohde&Schwarz can be found in many different transmitter configurations, power classes for UHF and VHF in many regions all over the world. Over 3000 Doherty technology based amplifiers have been delivered worldwide.

Current references for Doherty transmitter systems

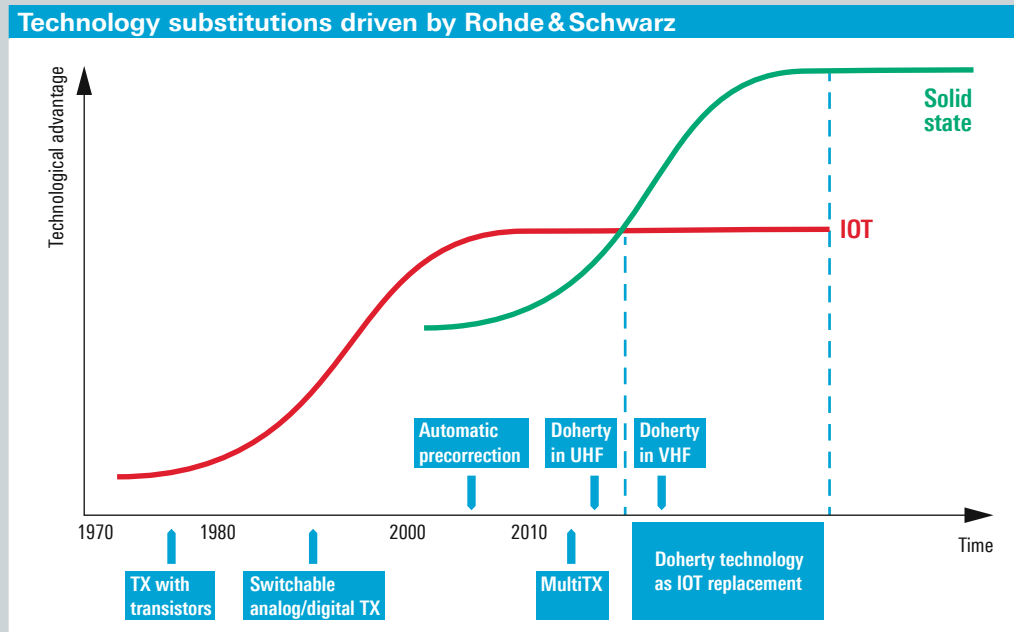


Rohde & Schwarz competence for establishing a new technology

In the history of terrestrial broadcasting, Rohde & Schwarz has proven its role as an innovation leader. The company has introduced several new technologies onto the market, such as the MultiTX feature for incorporating up to six transmitters into one rack.

Rohde & Schwarz has also been the first to successfully introduce Doherty technology for solid state transmitters.

50 kW output power for ATSC in four cabinets at a competitive price makes the solid state transmitter with Doherty technology a serious contender for replacing high-power IOT transmitters.



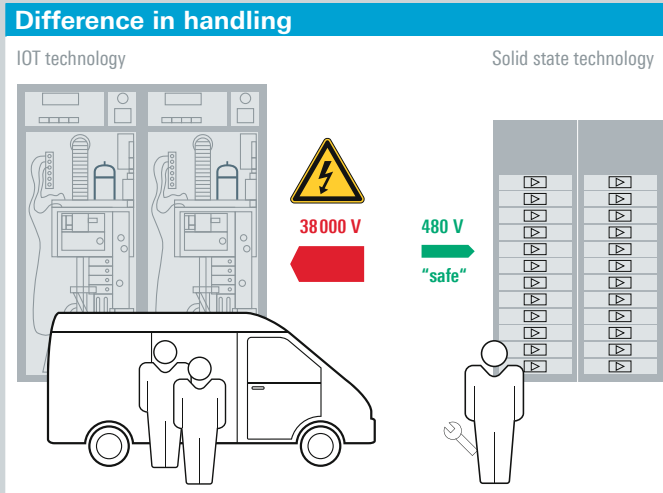
Technological advantages of solid state transmitters

Simplicity and safety

In contrast to IOT transmitter systems, servicing a solid state transmitter system is very simple and does not require constant attention.

Safety is another aspect. An IOT transmitter system requires about 40 000 Volt to operate. For safety reasons, replacing a heavy, inductive output tube requires special equipment and at least two people. Since the R&S®THU9 solid state transmitter system uses the widely available grid voltage, only simple tools are required for servicing and there are no voltage constraints.

Unlike an IOT transmitter system, the R&S®THU9 has a simple servicing concept and no special safety requirements.



Higher redundancy

The R&S®THU9 has built-in redundancy. Even if a transistor or power supply fails, the output power is maintained at nearly full power. The redundancy requirement for the system is that it continues to operate with the highest possible output power even if a component fails.

IOT transmitter systems are mostly operated with two tubes. If one tube fails, the whole system only delivers about 50% of its maximum output power. In a solid state transmitter system for high output powers, the

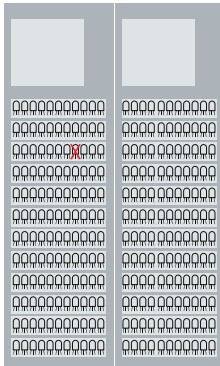
redundancy is outstanding due to several hundred transistors, dozens of power supplies and many power amplifiers.

When a power amplifier in a 25 kW system is down, the drop in output power is less than 10%. The R&S®THU9 transmitter system with Doherty technology even provides full power supply redundancy. A power supply failure does not impact the output power. The high redundancy of the R&S®THU9 is one of several technological advantages over an IOT transmitter.

Redundancy advantage

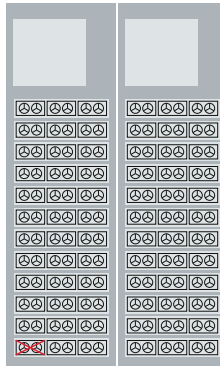
Redundancy elements

Hundreds of transistors



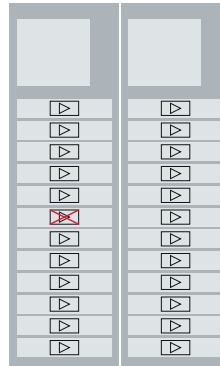
99%

Dozens of power supplies



100%

12 power amplifiers per rack



92%

Remaining output power

Reduced maintenance and reduced service effort

The reliability of a broadcast system and the service intervals generally define the frequency of maintenance tasks. The lower the service frequency and the smaller and simpler the parts, the less overall service effort is required. A solid state transmitter requires less servicing and has fewer maintenance and service costs.

If a solid state transmitter fails, no immediate action is needed since it only has a minor impact on the output. A lot of maintenance aspects can be easily monitored via remote control. Operating staff can diagnose and

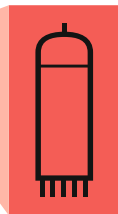
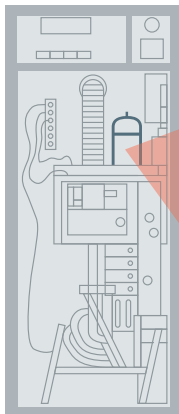
potentially solve problems without immediately sending somebody to the transmitter station.

Spare part handling is also significantly easier since smaller spare parts are needed as compared to a big, heavy and also expensive inductive output tube. Since these components do not age significantly, no system or grid readjustment is needed. Furthermore, the supply of spare tubes has turned out to be critical in recent years.

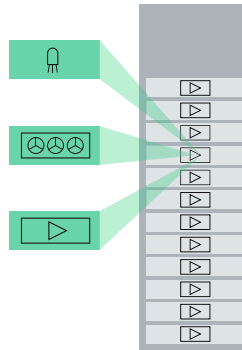
The R&S®THU9 has lower service and maintenance requirements than an IOT transmitter system.

Difference in size and cost of components

IOT technology



Solid state technology



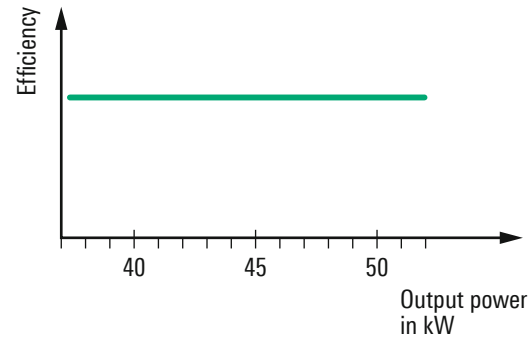
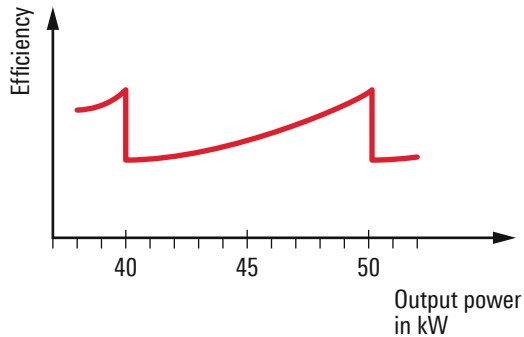
Exact power level and constant efficiency

An IOT transmitter can only achieve high power efficiency when running at its nominal power. For output powers of 20 kW to 50 kW, the number of different nominal power levels is very small since IOTs are only available for a few specific powers. In contrast to an IOT transmitter, a solid state transmitter system is designed for constant efficiency.

Unlike an IOT transmitter system, the R&S®THU9 can provide the exact power a broadcast network provider needs – for all power levels up to 50 kW – at a constant level of power efficiency.

The signal quality of the R&S®THU9 is superior compared with most IOT transmitters. Rohde&Schwarz solid state technology delivers signals with a very stable MER. Fast and accurate adaptive precorrection is available as well.

Difference in efficiency



Summary

Doherty technology in solid state transmitter systems now offers another solution for very high output powers. The comparison between solid state and IOT technology shows that solid state transmitters with Doherty technology in the Rohde&Schwarz system design provide a number of technological advantages.

Rohde&Schwarz technology delivers highly redundant solid state transmitter systems for digital TV. The benefits of high redundancy, constant efficiency, simple and safe operation, and less maintenance and service make solid state the better choice.

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PD 3606.8320.32 | Version 02.00 | July 2014 (ch)
Solid state for highest power levels
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81671 Munich, Germany | Subject to change



3606832032