

# R&S® SDTR VR5000

## Vehicular Tactical Radio

### Tactical radio for vehicular and semi-mobile communications



# R&S®SDTR VR5000

## Vehicular Tactical Radio

### At a glance

The R&S®SDTR vehicular tactical radio from Rohde & Schwarz is the first member of the new R&S®SDxR software defined radio family. This new generation of software defined radios marks a revolutionary change in tactical communications – both technically and economically.

The R&S®SDTR has been designed for use in vehicles and for integration into semi-stationary and stationary applications. Its ruggedized hardware meets applicable MIL-STD environmental and EMC requirements, enabling the radio's use under extreme conditions such as in armored wheeled vehicles and tracked vehicles.

The core of the R&S®SDTR is an SCA 2.2.2 radio platform (SCA – software communications architecture). The SCA radio platform supports standardized, legacy and Rohde & Schwarz proprietary waveforms and makes it easy to port waveforms. Plus, it enables the implementation of customized waveforms.

The waveforms of the R&S®HDR waveform suite for the R&S®SDxR radio family are based on state-of-the-art technology and form a viable, future-ready foundation for Rohde & Schwarz radiocommunications systems. Rohde & Schwarz drew on its many years of experience in secure radiocommunications in the VHF/UHF band to develop the R&S®HDR waveform suite.

These waveforms enable reliable communications in an anti-access and area-denial environment. Powerful frequency hopping and highly advanced encryption technologies are used to compensate for the influence of follower jammers and interception. The waveform suite provides the best options for transmitting secure high data rates without satellites in a jammed environment in various ground, air and combined ground-air-ground scenarios. Simultaneous voice and data capability significantly reduces the need for additional radios. The waveforms provide an increased situation awareness through adaptive high bandwidth IP networking. An embedded mobile ad hoc networking concept enables continuously stable communications within agile networks. The R&S®HDR waveform suite ensures interoperability across platforms such as land, sea and air.

The R&S®SDTR features software-based encryption backed by further measures such as tamper protection.

#### Key facts

- Optimized for use in vehicles, meeting stringent requirements on vibration, size, weight and power consumption
- Multiband capability in VHF/UHF frequency range from 30 MHz to 512 MHz
- 50 W output power without external amplifiers
- SCA 2.2.2 based, expandable tactical radio platform and waveform
- With R&S®HDR waveform family:
  - Ad hoc networking to automatically update radio network topologies
  - Simultaneous voice and data transmissions for effective communication with less equipment
  - TCP/IP traffic optimizer to effectively transmit TCP/IP via radio links
  - IP-based waveforms to provide a standard interface to reduce application and infrastructure integration efforts
  - Orthogonal frequency hopping capability to avoid interferences of radiocommunications nets used in parallel



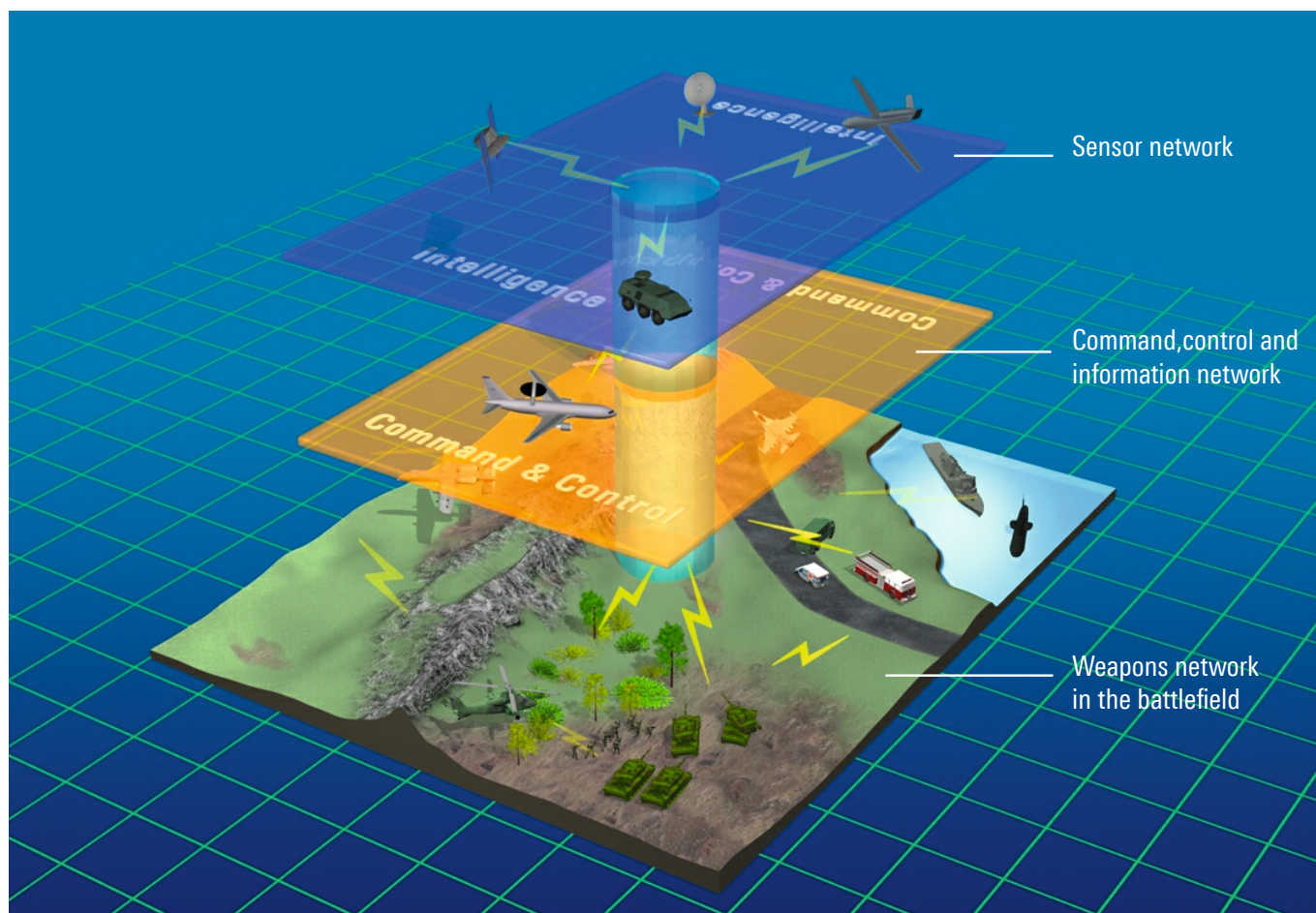
# Key enabler for network centric operations

Networking across all operational levels is the first and foremost condition for efficient, modern warfare. Network centric operations (NCO) require the use of modern software defined radios (SDR) in combination with high data rate waveforms that provide the following capabilities:

- Tap-proof, jam-resistant information transmission (e.g. chat messages, e-mails, situational pictures) in near-realtime at elevated threat levels
- Simultaneous voice and data transmission
- Support of external, IP based applications (e.g. sensors, blue force tracking, battle management systems)
- Interconnection of inhomogeneous information networks over IP

For international, combined missions, waveforms providing interoperability need to be ported to the software defined radios.

Rohde&Schwarz has taken on the challenge by developing a new generation of software defined radios. The R&S®SDxR radio family, in conjunction with the innovative waveforms of the R&S®HDR family, provides the networkability and interoperability that enable network centric operations.



# R&S®SDTR VR5000

## Vehicular Tactical Radio

### Benefits and key features

#### **Radiocommunications using legacy and high data rate waveforms**

- ▮ Network-capable waveforms with advanced encryption concept for international missions
  - ▮ R&S®HDR waveform family
  - ▮ Standardized legacy waveforms in line with STANAGs
  - ▮ Other waveforms
- ▷ page 5

#### **Advanced networking capabilities**

- ▮ Ad hoc networking
  - ▮ Multihop capability
- ▷ page 6

#### **In line with the highest security standards**

- ▮ Strict red/black separation in hardware and software
  - ▮ Crypto ignition key (CIK)
- ▷ page 7

#### **Excellent RF characteristics**

- ▮ Integrated cosite filters for interference-free operation
  - ▮ Integrated MELPe vocoder
  - ▮ Enhanced transmitter and receiver performance
- ▷ page 8

#### **Easy to integrate**

- ▮ Single-line operation for flexible integration
  - ▮ Compact design with integrated amplifier and cosite filters
  - ▮ Installation in inaccessible places
  - ▮ Fully IP based radio for easy system integration
  - ▮ Front panel interfaces, displays and controls
- ▷ page 9

#### **Easy to operate with external control unit**

- ▮ Common control unit for several tactical radios from the R&S®SDTR and R&S®M3TR families
  - ▮ Modern, ergonomic GUI for simple, intuitive operation
  - ▮ Mechanical design optimized for use in a moving vehicle
- ▷ page 11

#### **A worthwhile investment**

- ▮ State-of-the-art, open platform based on advanced international standard
  - ▮ Easy porting of waveforms
  - ▮ Support of customized waveform developments
- ▷ page 12



# Radio-communications using legacy and high data rate waveforms

## Network-capable waveforms with advanced encryption concept for international missions

Secure, effective radiocommunications are essential for mission success in military organizations and state agencies. There is a rapidly growing demand for network-capable and reliable waveforms that are suitable for a wide range of simultaneous voice and data transmissions. In addition to using commercial IP data interfaces, it is crucially important to flexibly network various organizational units. R&S®HDR waveforms take the possible hierarchical structures of communications users into consideration and reflect them in the radio network.

In addition to multiple simultaneous voice transmissions, R&S®HDR waveforms also offer a strong encryption concept for exchanging voice and data messages. The waveforms are adapted to environmental conditions at all times and help ensure continuously stable communications. The waveforms provide high data rate transmissions within self-administered ad hoc networks.

## R&S®HDR waveform family

The R&S®HDR waveform suite includes three waveforms:

- R&S®HDR-AJ-NB (high data rate anti-jam narrowband)
- R&S®HDR-AJ-WB (high data rate anti-jam wideband)
- R&S®HDR-WB (high data rate wideband)

These network-capable waveforms permit users to transmit voice and data simultaneously. The waveforms are fully IP-based, providing user-transparent IP communications. Such an interface substantially simplifies the use of external applications. The waveforms include mobile ad hoc networking functionality and adaptive data rate adjustment. This ensures that the best network-based communications performance is achieved, independent of the environment.

The R&S®HDR-AJ-NB waveform provides a VHF/UHF frequency hopping functionality for mobile units and high-speed airborne platforms. The waveform covers wide transmission ranges and is highly robust against follower jammers and deception. The R&S®HDR-AJ-NB waveform uses a TDMA-based transmission concept.

The R&S®HDR-AJ-WB waveform provides a UHF frequency hopping functionality used primarily by mobile forces that require high data volumes. The waveform covers wide transmission ranges and is highly robust against follower jammers and deception. The TDMA waveform allows users to transmit large amounts of data without sacrificing anti-jam performance.

The R&S®HDR-WB waveform is a UHF fixed frequency waveform featuring a CSMA/CA channel access method. This waveform is designed for networks with high data volumes and wide ranges. The waveform supports a versatile range of applications such as videoconferencing.

The waveforms of the R&S®HDR suite are compatible with SCA 2.2.2.

## Standardized legacy waveforms in line with STANAGs

The R&S®SDTR can store up to ten different waveforms. The radio's basic software includes standardized waveforms such as for analog fixed frequency mode (e.g. from 30 MHz to 88 MHz in line with STANAG 4204 and from 225 MHz to 400 MHz in line with STANAG 4205). The waveforms can be activated on the radio's front panel even in an emergency. Backward compatibility with legacy waveforms makes it possible to set up communications links in joint operations (e.g. with airborne forces) and combined operations (e.g. with allied tactical units).

## Other waveforms

The R&S®SECOM-P waveform provides interoperability with the R&S®M3TR family of software defined tactical radios, including the lightweight handheld version. The R&S®SECOS and HAVE QUICK II ground-air waveforms are available on request. Using suitable tools and the Rohde&Schwarz development environment, users can integrate waveforms from other suppliers into the radio for interoperability with existing radios.

Modern, high data rate tactical network waveforms help to gain and maintain information superiority during missions by supporting IP based applications such as sensors. They let military leaders securely communicate in realtime even at elevated threat levels.

# Advanced networking capabilities

The state-of-the-art, network-capable R&S®HDR waveforms offer a number of special functions for operating versatile radio networks. Users can establish and optimize radio networks that meet the requirements of any mission scenario.

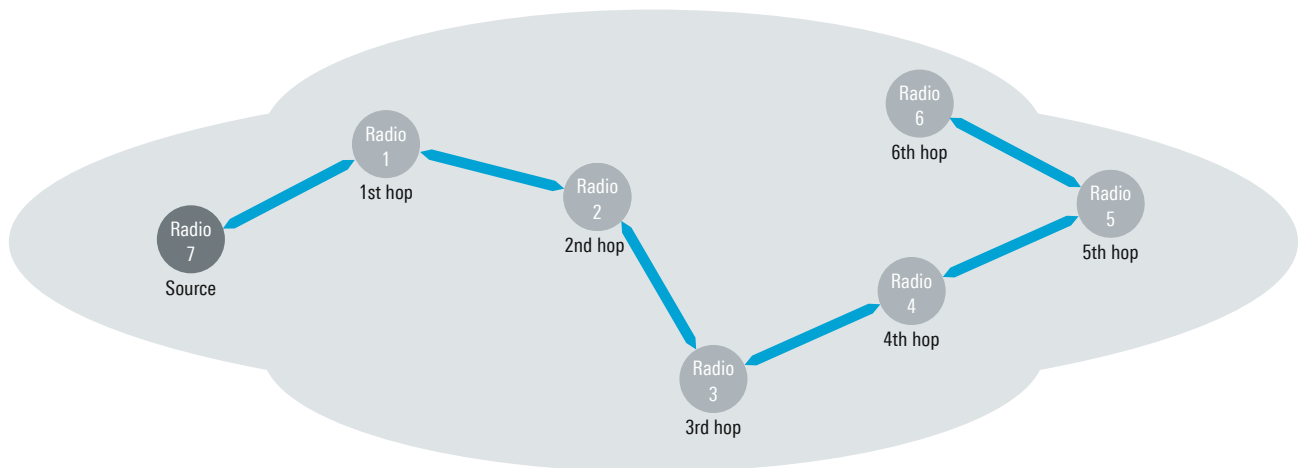
## Ad hoc networking

R&S®HDR waveforms feature a very powerful integrated self-forming and self-healing mobile ad hoc networking (MANET) functionality. MANET enables users to independently set up and automatically update radio network topologies. Voice and data communications routing is decentralized, which allows effective data distribution within a network. There is no need for a central data routing hub.

## Multihop capability

The R&S®HDR multihop capability is based on the MANET functionality and supports the automatic exchange and distribution of voice and data transmissions within the entire network. Multiple radios will forward the messages directly. The multihop network topology allows the use of several radios organized in a communications row. This sort of multihop communications increases the effective range of a network, and results in an extended coverage range that can be several times greater than its standard line of sight (LOS).

### Multihop MANET topology



R&S®HDR waveforms support multihop MANET topologies with several hops in a row.

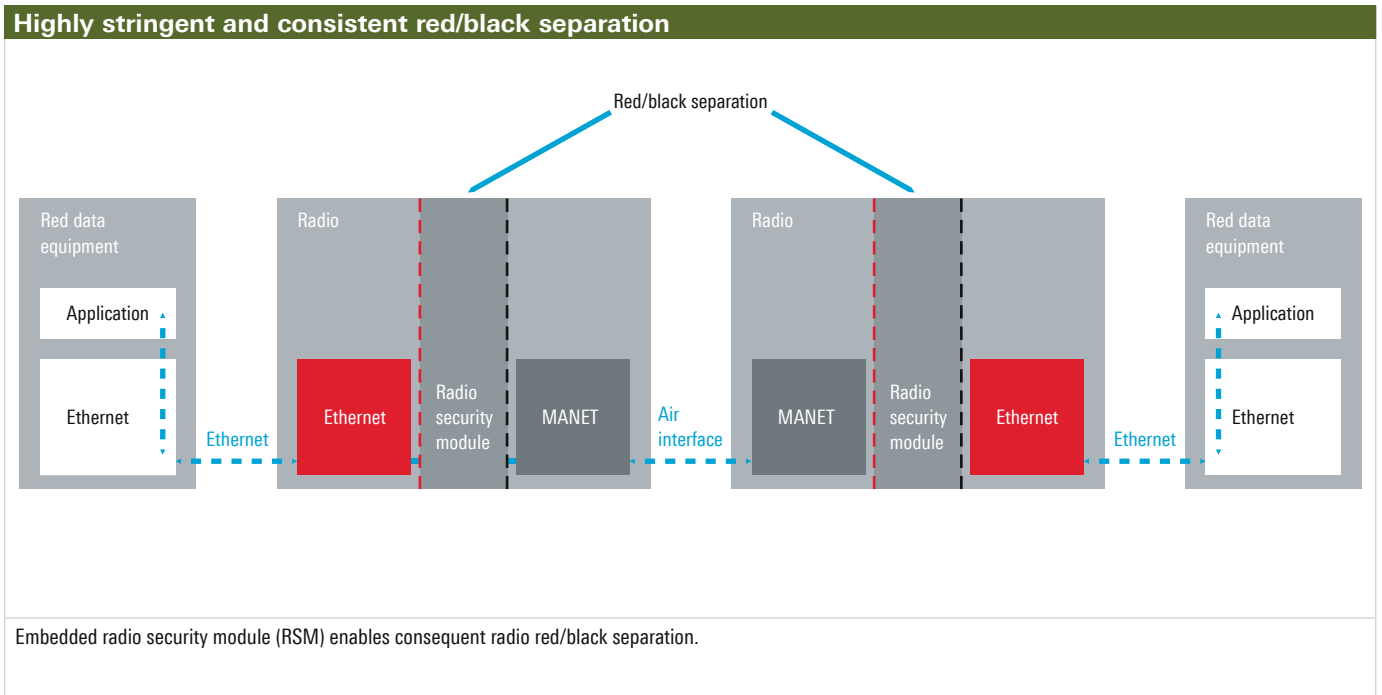
# In line with the highest security standards

## Strict red/black separation in hardware and software

The radio's and waveforms' hardware and software architecture features strict red/black separation to satisfy customers' security requirements. Moreover, a separate module is used to encrypt payload data (voice and data). The R&S®SDTR is tamper resistant.

## Crypto ignition key (CIK)

The CIK is an external security device (available as an option) for the classification and declassification of R&S®SDTR radios. Only when the CIK is connected to the R&S®SDTR, the crypto mechanism is activated and the radio is classified according to the security level of the internal cryptographic data.



# Excellent RF characteristics

Unlike most latest-generation radios available on the market, the R&S®SDTR was developed with a special focus on the RF parameters defining the VHF and UHF ranges. No compromises were made here. As a result, for example, the radio's output power can be kept relatively constant in adverse environments even with a VSWR as poor as 3:1.

## Integrated cosite filters for interference-free operation

The R&S®SDTR comes with the amplifier and a cosite filter built in as standard. This compact solution allows the parallel operation of multiple radio lines in one vehicle (multiline configuration) even under extreme conditions. Interference is largely suppressed in both directions, i.e. transmission and reception. This makes it possible to install multiple, closely spaced antennas on small vehicles. When the antennas are spaced wider apart, multiple radio lines can be operated with very close frequency spacing.

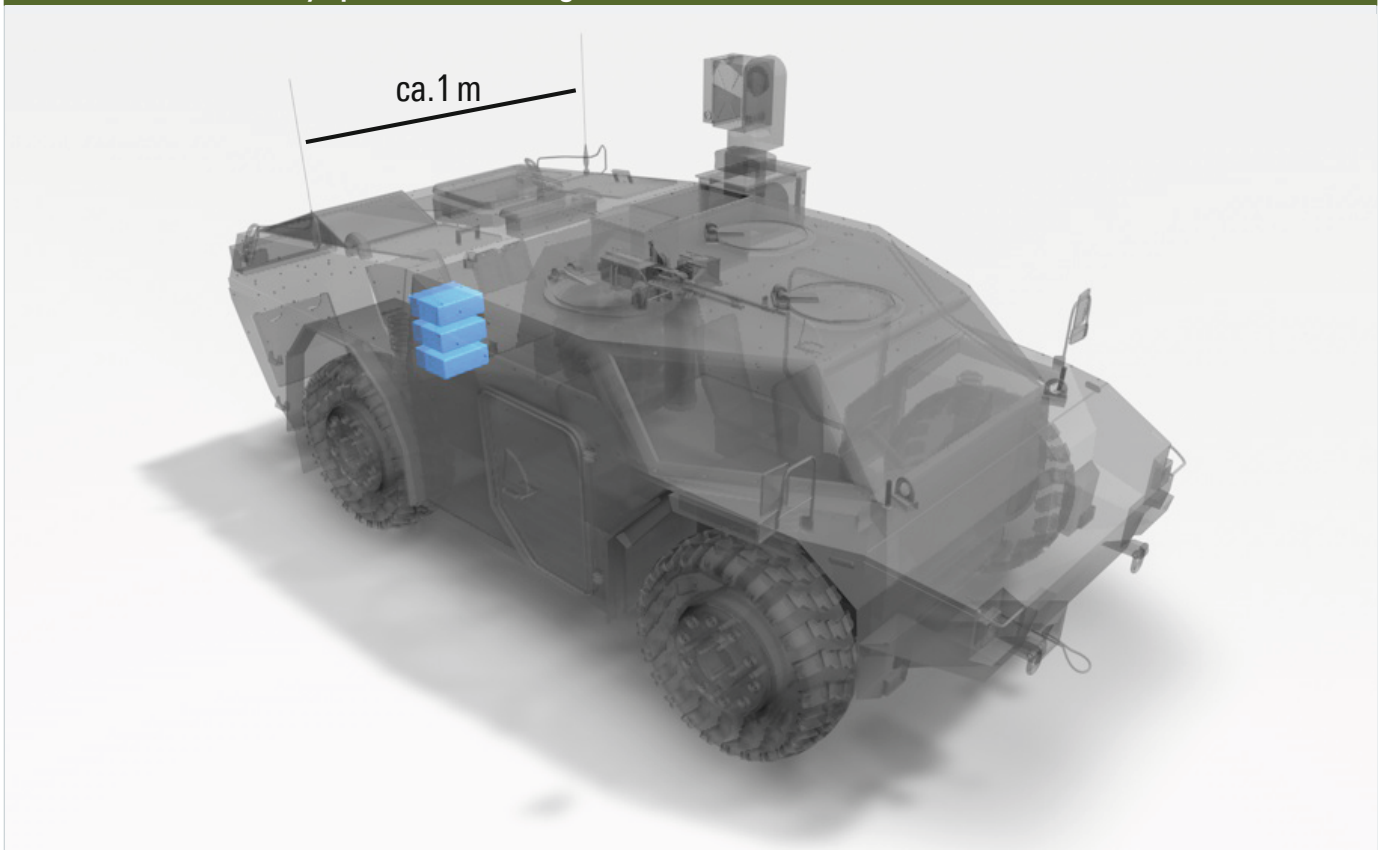
## Integrated MELPe vocoder

The radio's integrated MELPe vocoder is particularly robust and provides reliable voice transmission even in noisy environments.

## Enhanced transmitter and receiver performance

- ▮ Compact multiband solution for the frequency range from 30 MHz to 512 MHz
- ▮ Integrated cosite filters for interference-free operation even under difficult conditions
- ▮ Highly linear, extremely sensitive receiver
- ▮ Transmit path with extremely low phase noise
- ▮ Very high frequency hopping rates
- ▮ Operation of wideband and high data rate waveforms

Antennas can be closely spaced due to integrated cosite filters





# Easy to integrate

## Single-line operation for flexible integration

Military vehicles have only limited space available for communications equipment. The R&S®SDTR is a compact single-line radio and can be mounted more flexibly than large multiline radios. At the same time, the R&S®SDTR offers multi-service functionality when used with an R&S®HDR waveform.

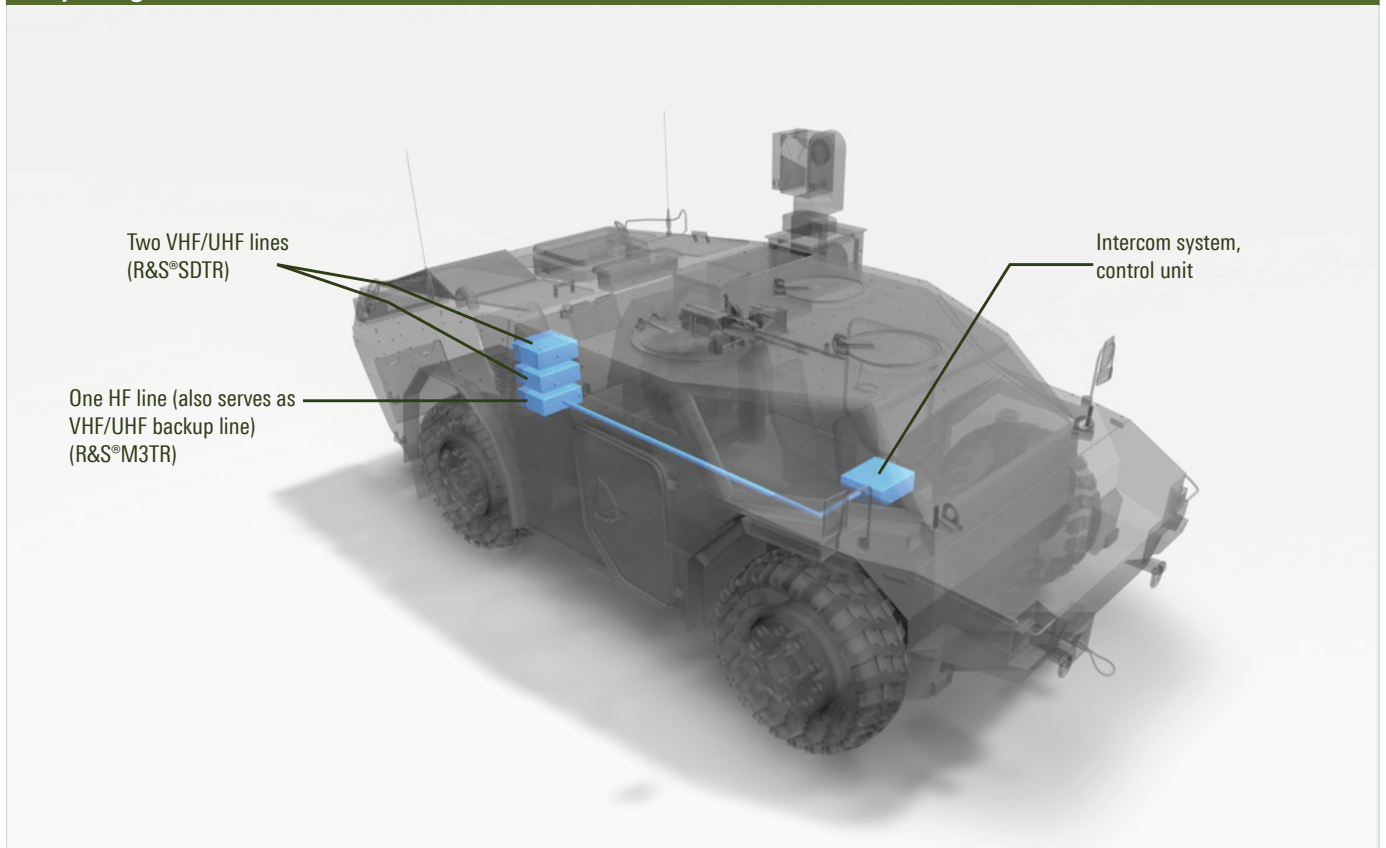
## Compact design with integrated amplifier and cosite filters

The amplifier and cosite filters are built into the R&S®SDTR. No separate fan or shockmounts are required. This allows space-optimized integration of the radio.

## Installation in inaccessible places

The R&S®SDTR can also be installed in inaccessible places in the vehicle, since it is remotely operated from an on-board control unit or battle management system (BMS). In case of emergency, the radio can be operated via its front panel.

### Easy integration of radiocommunications devices in a vehicle



### Fully IP based radio for easy system integration

In addition to mechanical aspects, the software integration of the radio into the overall vehicle system plays a significant role. The R&S®SDTR is fully IP based, which means that it supports radio control as well as voice and data communications based on the standardized IP protocol. This simplifies system integration, since standardized IP applications and components can be used. For example, IP based battle management systems can be integrated via the radio's feedback message interface. Via this interface, the BMS adapts to the radio's optimized flow control mechanisms, yielding maximum data throughput.

### Front panel interfaces, displays and controls

The R&S®SDTR comes with all interfaces and main control elements on the front panel, which simplifies the radio's installation and integration into existing carrier platforms.

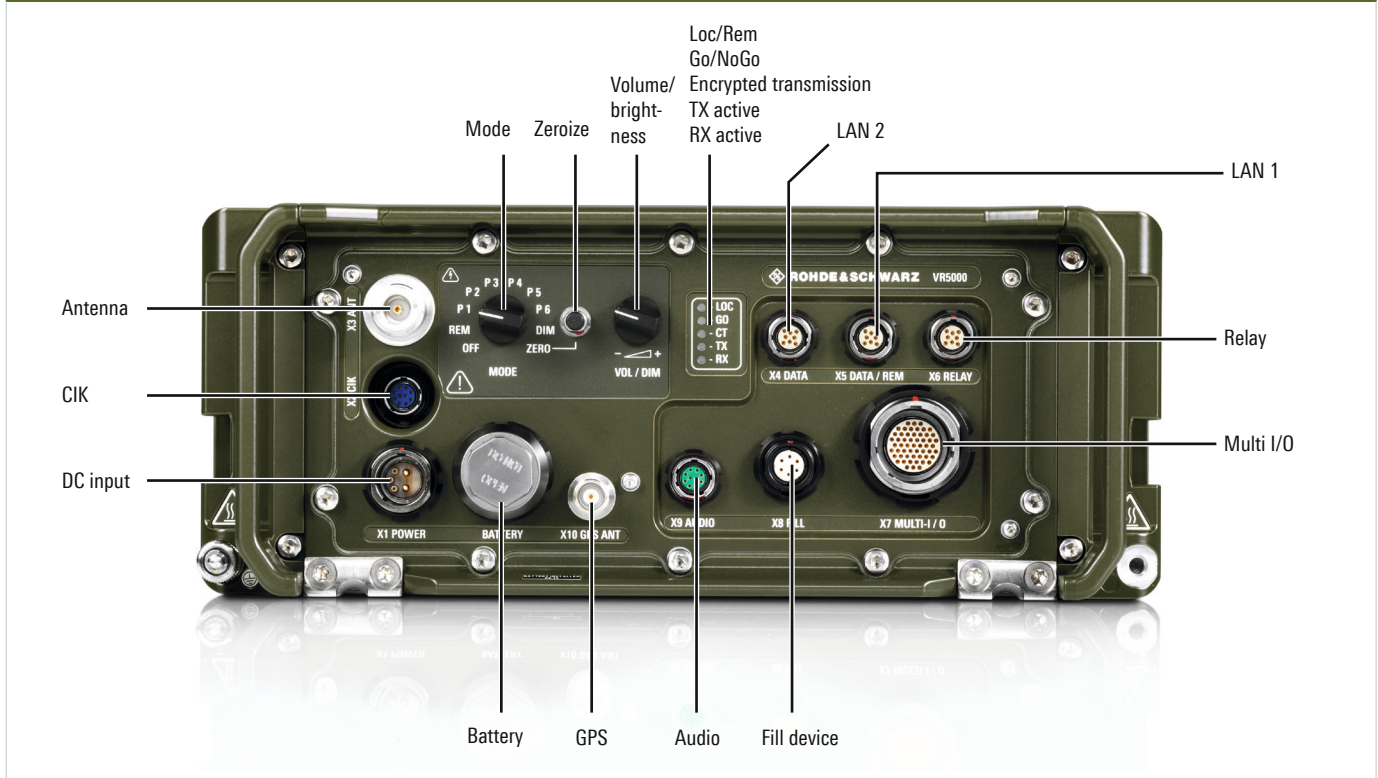
Interfaces and ports on the R&S®SDTR front panel:

- Three Ethernet LAN interfaces: two for separating payload data and control data and one for relay operation
- Multi I/O interface providing all important interfaces such as audiolines and data interface
- Connector for loading configuration data from a fill device into the radio
- Audio interface for connecting audio accessories
- Interface for connecting a GPS antenna
- DC power supply connector
- N-type connector for VHF/UHF antenna

The front panel also contains a port for connecting the optional crypto ignition key (CIK) plus a compartment for the radio's backup battery.

The R&S®SDTR VR5000 has a rotary switch for volume and LED brightness control and another one for selecting pre-set modes. The ZERO button allows critical data to be deleted in case of an emergency. LEDs indicate the operating mode and status (e.g. TX, RX, encrypted, remote).

Interfaces, control elements and status LEDs on R&S®SDTR VR5000 front panel



# Easy to operate with external control unit

## Common control unit for several tactical radios from the R&S®SDTR and R&S®M3TR families

In developing the new generation of tactical radios, a major consideration was to make the radios easy to configure and operate. This led to the development of the Rohde&Schwarz control unit, which can be used to operate several tactical radios from the R&S®SDTR and R&S®M3TR families.

## Modern, ergonomic GUI for simple, intuitive operation

The control unit has a modern, ergonomic and intuitive GUI, which makes operation very easy and significantly reduces training time.

## Mechanical design optimized for use in a moving vehicle

The control unit has been designed to allow operation even under challenging conditions, for example while riding in a tracked vehicle.

Control unit.



# A worthwhile investment

## State-of-the-art, open platform based on advanced international standard

The R&S®SDTR is a future-ready, powerful radio platform that has sufficient hardware resources to host even future waveforms with several megabits data throughput and several thousand frequency hops per second. Rohde&Schwarz selected the radio components with a view to high reliability and availability.

Conventional radios support only a single channel. The R&S®SDTR, in conjunction with the new R&S®HDR waveforms, supports simultaneous data and up to two voice channels in one radio line, which cuts the purchasing costs for multiline configurations.

## Easy porting of waveforms

The R&S®SDTR has been designed as an open platform and allows the porting of waveforms based on the software communications architecture (SCA) standard. SCA defines the rules that regulate the interplay of hardware and software elements in software defined radios (SDR). SCA defines the software structure and interfaces within an SDR, specifies programmable radio elements for variable transmitters and receivers and enables waveform portability.

The R&S®SDxR family of software defined radios has a uniform hardware and software architecture which ensures that ported waveforms do not interfere with one another or with the radio platform. In addition, the radios' security architecture prevents waveforms being compromised by enemy attacks. The Rohde&Schwarz solution protects the copyrights of external waveform suppliers. Plus, it supports the development of customized waveforms on the red and black side.

## Support of customized waveform developments

Rohde&Schwarz provides customers and partners on request with a comprehensive, harmonized tool suite, covering all aspects relevant to waveform development such as requirement analysis, waveform modeling, implementation, porting and testing.

Icing test.



Sand and dust test.





# System configuration

The following options and accessories are available for an R&S®SDTR radio system:

## Cosite filter

An optional cosite filter can be added to the radio's standard, integrated cosite filter. The second filter makes it possible to operate multiple radio lines in parallel, even if antennas have to be closely spaced. The second filter is often mandatory, especially for small vehicles. Like the standard filter, the optional cosite filter is built into the radio, significantly simplifying the radio's integration into the vehicle.

R&S®SDTRVR5000 radios in mounting frame.



R&S®SDTRVR5000 with loudspeaker and headset.



## Control unit

The Rohde&Schwarz control unit can be used to remotely control several R&S®SDTR and R&S®M3TR radios. The control unit's ergonomic design and modern, intuitive GUI make radio operation easy. The control unit can be powered via power over Ethernet (PoE) and therefore requires no separate power supply.

## Mounting frame

The mounting frame comes in two versions – a quick release version for easy mounting and dismounting, and a version with an integrated fan. The second version is intended for operation in an extended temperature range (permissible temperature range), in two-line configurations and for continuous transmission.

If none of the above requirements exist and there is no need for quick dismounting, the R&S®SDTR can be built directly into the vehicle.

## Crypto ignition key (CIK)

The crypto ignition key makes it easy to declassify the R&S®SDTR. When the CIK is removed from the radio, R&S®SDTR encryption mechanisms are deactivated and the radio needs no longer be treated as a crypto unit. It is also possible to operate the radio without the CIK.

## Audio accessory

The following audio accessories are available:

- handset
- dual line headset with noise cancellation capabilities
- dual line loudspeaker with through connection for handset/headset

## Antennas

The R&S®HK055L1 and R&S®HK061 antennas from Rohde&Schwarz were designed for the VHF/UHF range. Combined with the R&S®SDTR, they are ideal for mobile or semi-stationary applications.

### R&S®HK055L1 broadband mobile antenna

The R&S®HK055L1 broadband mobile antenna is a compact transmitting and receiving antenna specially designed for use on tracked vehicles. The R&S®HK055L1 covers an extremely wide frequency range from 27.5 MHz to 600 MHz. The antenna attains its outstanding characteristics without the use of any tuning equipment. It is therefore ideally suited for hopping as well as for multichannel operation. The antenna is equipped with a spring at its base. If the antenna hits an obstacle, it will bend and automatically return to its vertical position. The antenna is integrated in a weather-proof radome.

R&S®HK061 vehicular broadband communications antenna.

### R&S®HK061 vehicular broadband communications antenna

The R&S®HK061 vehicular broadband communications antenna is a compact transmitting and receiving antenna specially designed for use on armored wheeled vehicles. The R&S®HK061 covers an extremely wide frequency range from 30 MHz to 600 MHz. The antenna attains its outstanding characteristics without the use of any tuning equipment. It is therefore ideally suited for hopping as well as for multichannel operation. The antenna is equipped with a spring at its base. If the antenna hits an obstacle, it will bend and automatically return to its vertical position. The antenna is integrated in a weather-proof radome.

A number of whip antennas are supported in addition:

- R&S®HV3012 50 W VHF low-profile antenna
- R&S®HV3013 50 W UHF vehicular antenna
- R&S®HV3015 50 W VHF vehicular antenna
- R&S®HV3019 50 W VHF/UHF vehicular broadband antenna

Each antenna is available with or without a GPS antenna integrated in its base.

R&S®HK055L1 broadband mobile antenna.

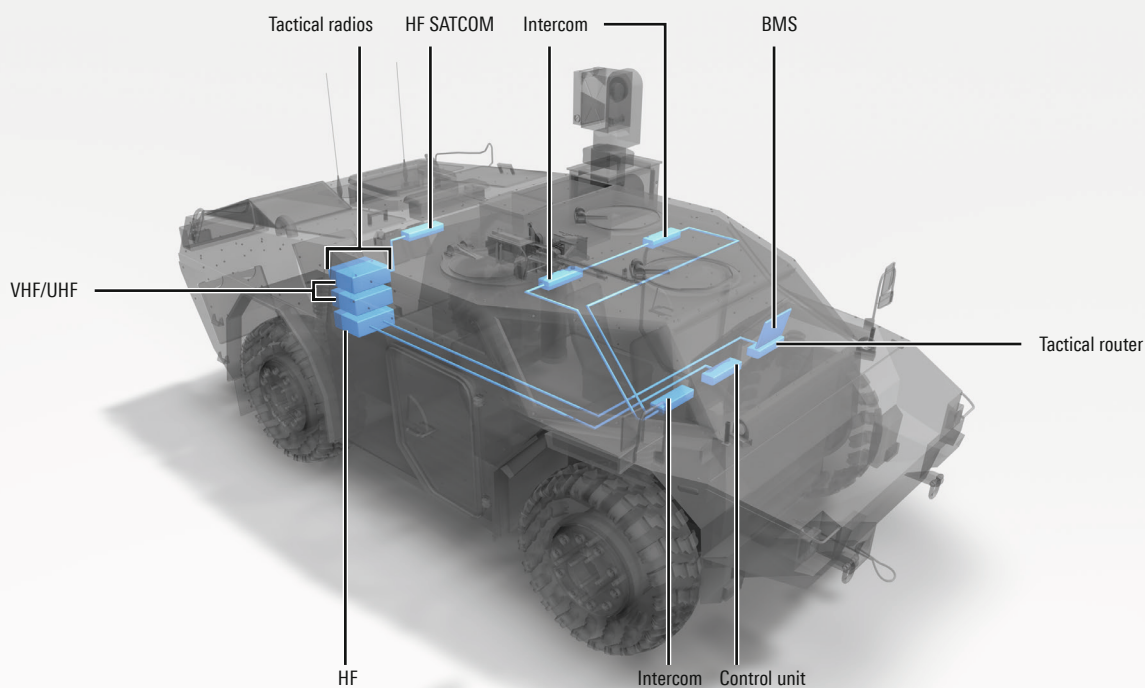


# Typical vehicular application

Rohde&Schwarz radios installed in a vehicle are powered from the on-board power supply system. An R&S®M3TR radio covers the HF range, an R&S®SDTR radio the VHF/UHF range. Each radio is connected to a separate antenna and provided with GPS information. The antennas can be very closely spaced without any degradation of radio system performance. This leaves sufficient space for sensors, weaponry and other equipment.

The compact radios require very little space. The vehicle has an on-board intercom system for communications between passengers and to the outside world via the various radio nodes. The intercom system is connected to the radios via an analog or IP interface. It supports voice transmission to the connected radios and features active noise cancellation to provide good voice quality even if there is high ambient noise. An IP based battle management system (BMS) running on a ruggedized on-board computer provides blue force tracking and messaging applications. A tactical router sets up the communications links and serves as a gateway. The radios can be remotely controlled from a Rohde&Schwarz control unit located in a readily accessible place in the vehicle. Alternatively, the radios can be controlled from the BMS. Ideally, all radios, communications equipment and sensors used are interconnected in a LAN via TCP/IP.

## Equipment within a vehicular installation



## Service that adds value

- ▮ Worldwide
- ▮ Local and personalized
- ▮ Customized and flexible
- ▮ Uncompromising quality
- ▮ Long-term dependability

## Rohde & Schwarz

The Rohde & Schwarz electronics group offers innovative solutions in the following business fields: test and measurement, broadcast and media, secure communications, cybersecurity, monitoring and network testing. Founded more than 80 years ago, the independent company which is headquartered in Munich, Germany, has an extensive sales and service network with locations in more than 70 countries.

## Sustainable product design

- ▮ Environmental compatibility and eco-footprint
- ▮ Energy efficiency and low emissions
- ▮ Longevity and optimized total cost of ownership

Certified Quality Management

**ISO 9001**

Certified Environmental Management

**ISO 14001**

Certified Quality Management

**AQAP-2110**

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