Transmitting and Receiving Antennas R&S®HK055 / HE055

Passive or active – new antennas with outstanding characteristics

With its Passive Transmitting and Receiving Antenna R&S®HK055, Rohde&Schwarz introduces a real broadband antenna which has been designed to ideally meet the MMR / JTRS system concept* requirements, especially for mobile applications. The antenna covers the 27.5 MHz to 600 MHz frequency range.

Another innovation, the active R&S®HE055 antenna with similarly outstanding characteristics, covers the frequency range from 1.5 MHz to 600 MHz (optionally up to 1200 MHz); it will also be launched in the near future.

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FIG 1 The R&S®HK055 (black), mounted on a vehicle.

State-of-the-art radio concepts require superb antennas

Networking and interoperability are of vital importance to international operational forces. For this reason, transceivers that support new, future-oriented radio concepts such as MMR and JTRS are acquired or have already been introduced.

These new systems exhibit a very wide frequency range of approx. 1.5 MHz to 600 MHz (or >1200 MHz). The large

* MMR: Multiband multirole radio
JTRS: Joint tactical radio system

bandwidths of the transceivers also place enormous requirements on the antennas to be used. To allow convenient operation of the equipment, an advanced antenna concept without frequency range switching is indispensable. The use of several narrowband antennas with frequency-selective switchover does not provide ideal results.

With its Passive Transmitting and Receiving Antenna R&S®HK055, Rohde&Schwarz introduces a real broadband antenna* that has been specifically designed to match the MMR / JTRS system concepts, especially for mobile applications (FIG 1). It covers the frequency range from 27.5 MHz to 600 MHz.

The term broadband antenna usually refers to an antenna where one or more parameters (e.g. radiation pattern, impedance, gain, etc) are frequency-independent within a defined frequency range, or are at least within a specified tolerance range.

Many years of expertise in the development of extremely broadband antennas at Rohde&Schwarz show that a significant increase in the bandwidth either expands the antenna cross-section or adversely affects efficiency due to attenuating measures. For this reason, the challenge in designing a real broadband antenna lies in ideally combining the individual, mutually dependent antenna parameters.

For example, electrically long antennas exhibit high efficiency (important for transmitting antennas), but at the same time cause irregular radiation patterns (minima in the preferred transmit/receive directions); plus, their mechanical handling is difficult (especially in mobile use).

Electrically short antennas, on the other hand, supply radiation patterns which are optimally suited for the described application. However, they exhibit impedance with considerable reactive components, resulting in poor matching and thus high reflection losses and poor efficiency.

Log-periodic antennas or spiral antennas usually have a direction-dependent radiation pattern, or polarization is circular. Other measures such as wave traps, fractal structures or stacked patch antennas tend to produce multiband rather than true broadband antennas.

The combination of the above positive effects has already been analyzed in diverse antenna concepts. Consequently, Rohde&Schwarz has designed the R&S®HK055 as a combination of a monopole and a dipole antenna. This concept ideally combines the characteristics of both antenna types, thus meeting the high requirements placed on such broadband antennas.

In the lower frequency range (27.5 MHz to approx. 110 MHz) a monopole with the following advantages is used:

- High sensitivity at low frequencies
- Radiation patterns ideally suited for communications purposes
- Compact size, thus optimally suited for mobile use

In the upper frequency range (approx. 110 MHz to 600 MHz) a dipole is effective, exhibiting the following advantages:

- Radiation patterns excellently suited for communications purposes
- Effective use of the generated transmit power due to high efficiency
- Low reflected power due to low VSWR
- Reduced dependence on the antenna platform (because of the symmetrical design) and therefore suitable for use in different environments, e.g. on different types of vehicles
- Well suited for mobile use, owing to compact mechanical (cross) dimensions

Both subrange antennas are internally connected via a diplexer which combines the signals without narrowband gain losses and forwards the resulting signal to a female RF connector. During operation, all the user needs is a connecting cable to the antenna.

A glassfiber-reinforced plastic radome protects the antenna elements and the diplexer. The sturdy mechanical antenna concept was specifically designed to meet the requirements in and on vehicles. The R&S®HK055 is resistant to water and dust and withstands vibrations and mechanical shocks. A spring element at the base enables the antenna to return to an upright position after being bent (e.g. by a collision with a horizontal obstacle) without any damage. Owing to the spring's design, wind up to 80 km/h causes only insignificant deflection.

The R&S®HK055 has nearly omnidirectional horizontal radiation patterns over the entire frequency range. FIGs 2 and 3 show two typical vertical radiation patterns. The VSWR is <3 across the entire useful bandwidth of the antenna. FIG 4 shows a typical VSWR characteristic.

Comparing the receive level of the R&S®HK055 with that of a typical, commercially available antenna shows

* The predecessor of this antenna was defined in a study commissioned by the Federal Office for Defence Technology and Procurement. The technical performance of the R&S®HK055 is based on the results of this study.

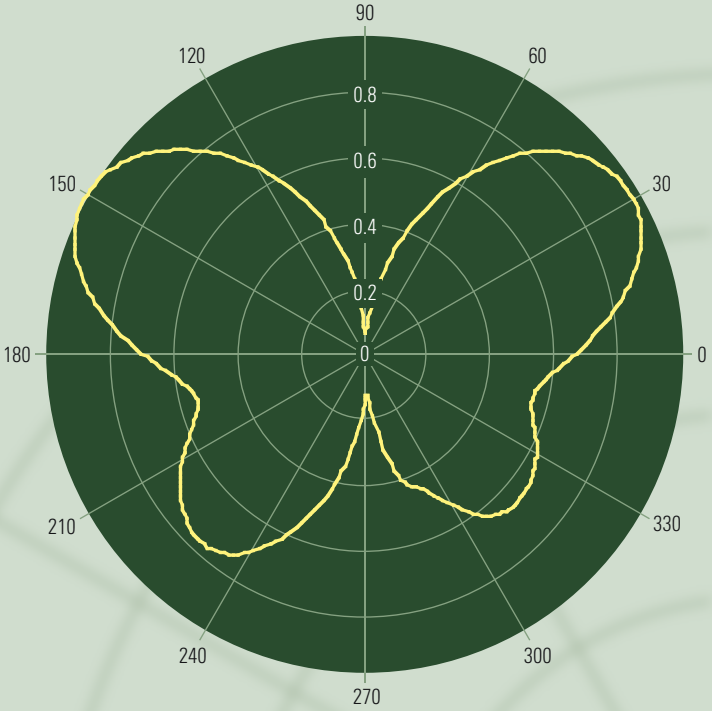

FIG 2 Typical elevation radiation pattern of the R&S®HK055 at 125 MHz.

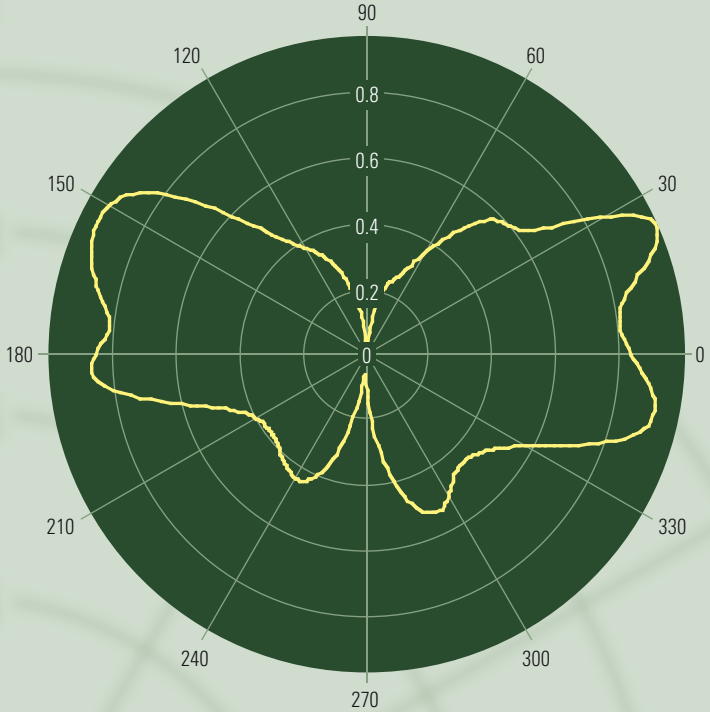

FIG 3 Typical elevation radiation pattern of the R&S®HK055 at 440 MHz.

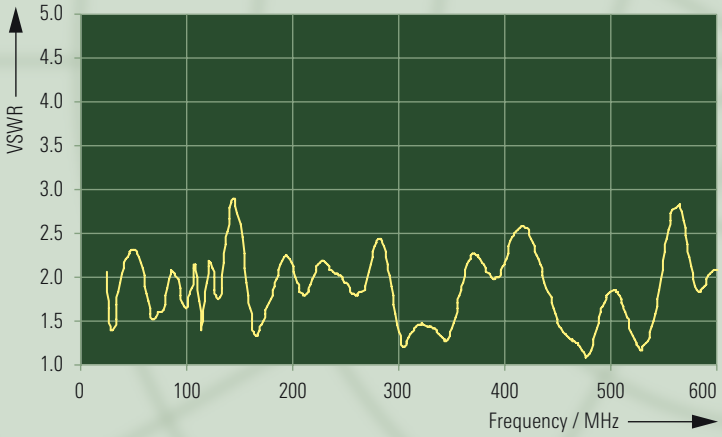

FIG 4 Typical VSWR characteristic of the R&S®HK055.

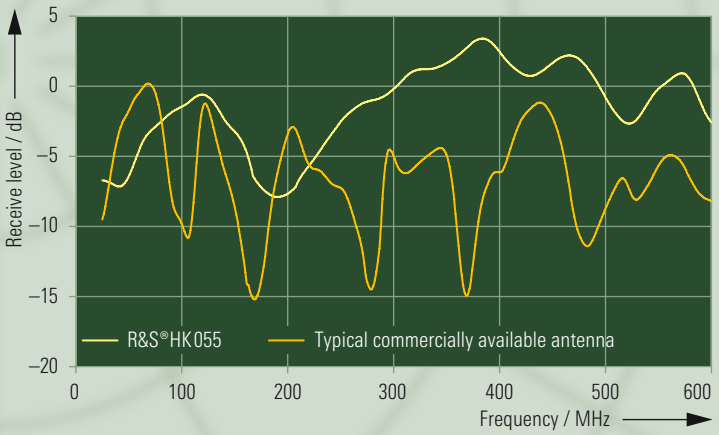

FIG 5 Difference in receive levels between the R&S®HK055 and a comparable antenna that is also commercially available.

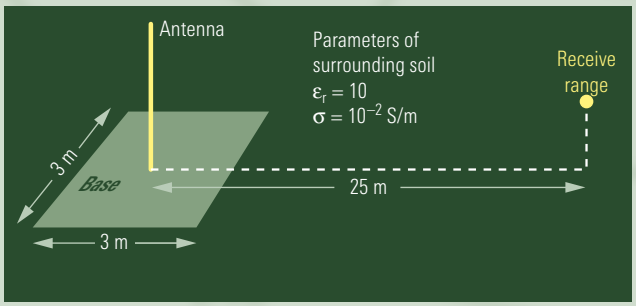

FIG 6 Test setup to determine the receive level difference between the R&S®HK055 and the reference antenna.

Condensed data of the R&S®HK 055

Frequency range	27.5 MHz to 600 MHz
Impedance	50 Ω
VSWR	<3.0
Horizontal radiation pattern	omnidirectional, uncircularity <1 dB
Vertical radiation pattern	see FIGs 2 and 3
Polarization	vertical
Gain	approx. –3 dBi to +2 dBi
Max. input power	100 W CW
Operating temperature range	–40 °C to +85 °C
RF connector	N female
Dimensions (diameter × height)	approx. 100 mm × 1600 mm

that the sophisticated design of the Rohde & Schwarz antenna provides a significant advantage in performance (FIG 5). FIG 6 shows the test setup which helped to determine the receive level difference.

Active Receiving Antenna R&S®HE055

Based on the R&S®HK055 application ranges, Rohde & Schwarz is developing the Active Receiving Antenna R&S®HE055 (FIG 8). The R&S®HE055 features an even wider frequency range from 1.5 MHz to 600 MHz (optionally up to 1200 MHz) and is ideally suited, for example in monitoring applications, to receive signals in the entire MMR / JTRS bandwidth.

Attaining intercept points as high as possible, i.e. high electromagnetic susceptibility, is vital with this application; plus, the antenna must exhibit very high field sensitivity to be able to receive weak signals as well (FIG 7).

The wide dynamic range of the R&S®HE055, which is available over the entire frequency range, is one of the key characteristics of this refined antenna design. Due to its compact size and rugged design, it is also ideal for mobile applications.

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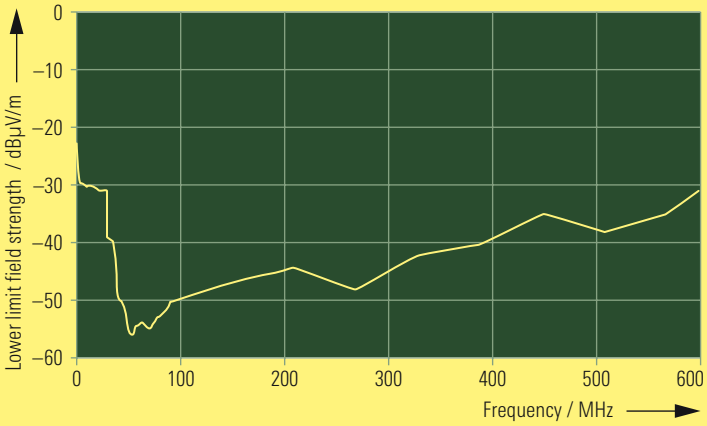
FIG 7 Typical limit field strength of the active R&S®HE055 antenna at 1 Hz measurement bandwidth.



Condensed data of the R&S®HE055

Frequency range	1.5 MHz to 600 MHz
Impedance	50 Ω
VSWR	<2.0 (typ.)
Horizontal radiation pattern	omnidirectional
Polarization	vertical
Actual gain	approx. –50 dB to 0 dB (1.5 MHz to 50 MHz) approx. 2 dB (50 MHz to 600 MHz)
1 dB compression point	>10 dBm (referenced to the output)
Intercept point	IP2 >+70 dBm (referenced to the output) IP3 >+40 dBm (referenced to the output)
Output noise power	approx. –95 dBm to –105 dBm (1.5 MHz to 20 MHz) approx. –103 dBm to –110 dBm (20 MHz to 120 MHz) approx. –110 dBm to –118 dBm (120 MHz to 600 MHz)
Power supply	21 V to 32 V DC
Temperature range	–40 °C to +85 °C
RF connector	N female
Dimensions (diameter × height)	approx. 100 mm × 1400 mm

FIG 8 The Active Receiving Antenna R&S®HE055.