Data sheet

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R&S®HX002 – 1 kW HF Dipole with integrated tuning unit

Optimum coverage also in the range up to 1000 km

- Single mast
- 1.6/2 MHz to 30 MHz
- Fully automatic operation – no control signals required
- Silent tuning possible
- EMP protection and immunity to interference from adjacent transmitting antennas
- Omnidirectional coverage with high-angle radiation

Although only 10 m long, the self-tuning R&S®HX002 HF dipole with 1 kW input power ensures optimum radio-communications over any distance in the frequency range from 2 MHz to 30 MHz.

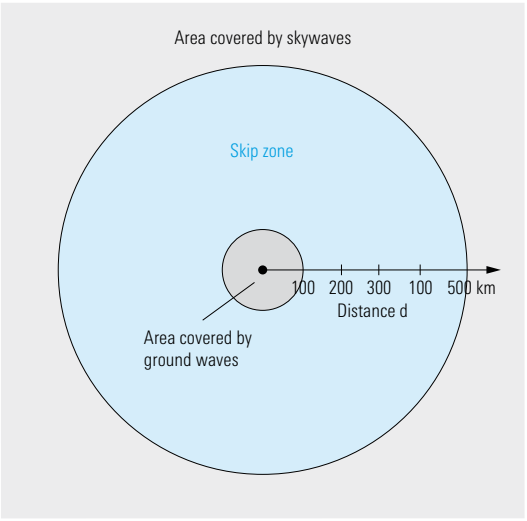
The HF dipole integrates a tuning unit (R&S®FK859) and can be easily equipped with the R&S®HX002F frequency-range extension which allows operation down to 1.6 MHz.

ROHDE&SCHWARZ

Characteristics of the R&S®HX002 HF dipole

The R&S®HX002 HF dipole permits radiocommunications over all distance ranges, in particular the short and medium ranges (up to approx. 1000 km). Rod antennas, for example, do not ensure sufficient transmission reliability over short and medium distances due to the skip zone (right-hand figure) at these distances.

The antenna is specifically designed for operation with Rohde&Schwarz shortwave transmitters. If equipped with the R&S®GX007 junction unit, the dipole can also be used with other transmitters.

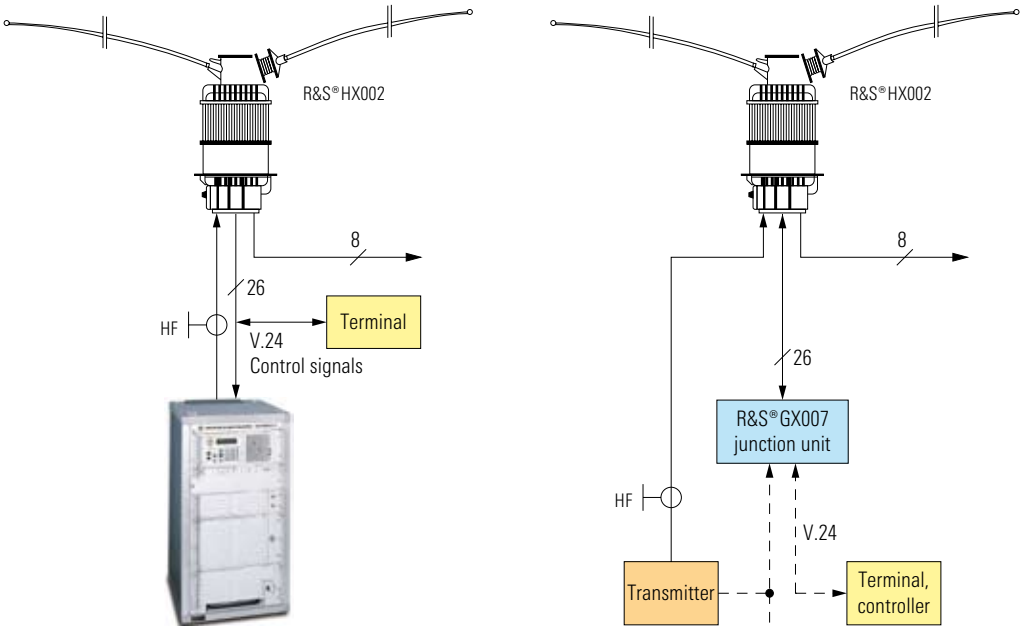


Skip zone at HF produced by vertically polarized antenna

Radiation characteristics

The excellent radiation characteristics of the R&S®HX002 HF dipole are the result of the radiator shape, the integrated lowloss tuning network and the high-quality balun.

Owing to the fully automatic adaptive control of the tuning network, the R&S®HX002 HF dipole meets all demands made on state-of-the-art transmission systems, such as fast frequency change and matching over the complete frequency range, even under varying conditions in the near-field region, for example with changing soil conductivity.



Applications of R&S®HX002 HF dipole; left: with transmitter of R&S®HF850 series; right: with any other type of transmitter and R&S®GX007 junction unit

R&S®HX002 HF dipole (2 MHz to 30 MHz) with integrated tuning unit

Operation and design of the R&S®HX002 HF dipole

Subassemblies

The R&S®HX002 HF dipole consists of the following subassemblies which are accommodated in the antenna housing in a compact form (left-hand figure):

- Radiators
- Tuning network
- Balun
- Fan
- Control unit
- EMP protection circuit

The prerequisite for achieving high antenna gain (diagram on page 4) is met by placing the matching network near the feedpoint of the dipole. The matching network is unbalanced and made up of binary-stepped inductors and capacitors. The balanced current distribution on the radiators is achieved by using a Guanella transformer acting as a balun.

Tuning, operating modes

The nonvolatile tuning memory is updated every time matching correction is performed so that the tuning time is continually minimized.

Since no control signals are required from the transmitter for tuning, the antenna can also be used in systems that are already in operation without the need for any modifications.

The following modes can be selected with a switch provided on the CPU module (figure at bottom of page 2):

- Operation with transmitters of the R&S®HF850 family
- Operation without transmitter control signals; the R&S®GX007 junction unit is available for power supply and status monitoring

In both modes, utility programs can be called up via the V.24 interface of the R&S®HX002 HF dipole and a terminal. These programs check the device status and allow a manual or a single-step tuning routine.

Lightning protection

Lightning and NEMP protection has mainly been provided for the radiator connectors, the balun (spark gaps), the output of the control unit and the control line connector (filter).

Control unit

The control unit is part of a feedback circuit which ensures a frequency- and environment-independent SWR of ≤1.3 (typ. ≤1.1). The control unit includes the following subassemblies:

- Sensing element, which determines signal frequency, reflection coefficient and RF power from the current and voltage on the feeder
- CPU module, which converts the data from the sensing element into switching commands for the matching network by means of a microprocessor and stores the optimum settings in nonvolatile memory
- Tuning attenuator, which prevents overloading of the RF circuit and mismatch of the transmitter during tuning
- Power supply, which generates the required operating voltages from the 28 V supply

The R&S®HX002 HF dipole is of modular design.The plug-ins of the control unit are accessible after opening the front panel.

Tuning memory

The nonvolatile tuning memory (820 channels) covering the complete frequency range from 2 MHz to 30 MHz is updated every time matching correction is performed so that the tuning time of the antenna is continuously and automatically minimized.

The tuning routine is carried out in five steps:

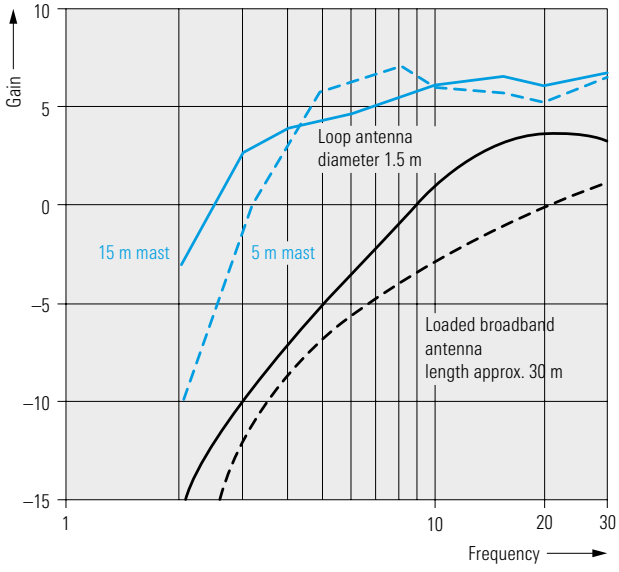
1. Measuring the frequency
2. Calculating the address of the corresponding location in the tuning memory
3. Setting the matching network according to the contents of the tuning memory
4. Measuring the SWR
5. a) If SWR >1.3, a routine for correcting the matching network is carried out
   b) If SWR <1.3, the tuning routine is terminated

Screening, cooling

To ensure electromagnetic compatibility and optimum cooling, the RF section is electrically and mechanically isolated from the control unit. Components, such as inductors and capacitors, and the wiring are accommodated inside a square tubular insulator which also facilitates the flow of cooling air.

The RF contacts, which are actuated via insulating elements, are mounted on the outer surface of the tube. The compact RF contacts ideally fit into the RF lines without causing any parasitic reactances.

The RF section is isolated from the ambient air by a tubular heat exchanger. The RF lead-through insulator to the antenna is in the middle of the ribbed cover.



Gain of R&S®HX002 HF dipole above perfectly conducting plane (15 m mast in terrain or 5 m mast on roof); for comparison: loop antenna and loaded broadband antenna

R&S®HX002F frequency-range extension

Equipped with the R&S®HX002F frequency-range extension, the R&S®HX002 HF dipole can be operated as an antenna with principally vertical polarization in the range from 1.6 MHz to 2 MHz. The R&S®HX002F can easily be retrofitted (no crane required).

Function

Below 2 MHz, the balun of the HF dipole is bypassed by the R&S®HX002F. In conjunction with the mast, the antenna operates as a monopole fed at the top.

Design

The instrument is made up of a high-vacuum relay and an inductance, both accomodated in plastic housing, and controlled and fed by the HF dipole.

R&S®HX002 HF dipole (without rods) with R&S®HX002F frequency-range extension

R&S®GX007 junction unit for R&S®HX002 HF dipole for use in any radiocommunications system, operated without control signals from transmitter

R&S®GX007 junction unit

The R&S®GX007 (figure above) is the control, display and power supply unit for the R&S®HX002 HF dipole (and for the R&S®FK859 antenna tuning unit). It allows the antenna to be operated without control signals from the transmitter and can also be used with shortwave transmitters that do not belong to the R&S®HF850 series. Both the HF dipole and junction unit can easily be integrated in existing HF radio-communications systems.

The R&S®GX007 junction unit performs the following functions:

- Monitoring and indication of antenna status
- Setting of the automatic tuning of the antenna
- Triggering of the selftest and display of results
- Establishing of the connections (via V.24, RS-232-C) for silent tuning and for control via processor as well as remote diagnostics via display terminal
- Generation of the supply voltages from the AC supply

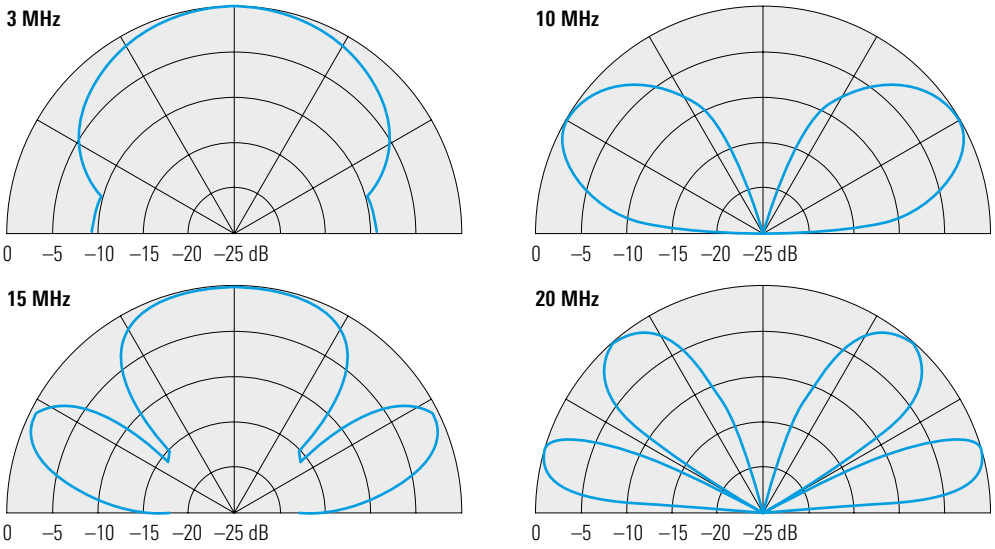
Specifications

R&S®HX002 HF dipole and R&S®HX002F frequency-range extension

Frequency range	2 MHz to 30 MHz
With frequency-range extension	1.6 MHz to 30 MHz
Max. input power	1.15 kW (CW and PEP)
Input impedance	50 Ω
SWR	typ. ≤1.1, max. ≤1.3 (≤1.5)
Polarization	horizontal
With frequency-range extension below 2 MHz	mainly vertical
Vertical patterns	see top of page 7
Tuning	
Tuning time	
Silent tuning (with transmitters of the R&S®HF 850 series or processor control)	≤60 ms, typ. 56 ms
Without retuning (after initial tuning)	70 ms to 500 ms (depending on mode and interface)
Initial tuning (learn phase)	≤15 s in 95 % of all cases ≤50 s in 100 % of all cases
Tuning power	50 W to 300 W
Connectors	
HF dipole	
RF connector	N female
Control and power connector	26-contact circular connector
Lightning protection	using spark gap
NEMP protection	integrated, E < 50 kV/m, t_{rise} > 5 ns, 0.5 × t = 200 ms to 300 ns
Frequency-range extension	
Antenna connectors	screw-connected terminals
Control and power connector	cable with 10-contact circular connector
Electromagnetic compatibility (EMC)	
Immunity to interference from adjacent transmitting antennas	no malfunctioning; if interfering signal exceeds approx. 2 % of input power (at 50 Ω input), automatic tuning is disabled
Susceptibility to external radiation	≤1 kW
Spurious emissions	in line with MIL-STD-461B and MIL-STD-462
General data	
Operating temperature range	–30 °C to +55 °C
Storage temperature range	–40 °C to +85 °C
Relative humidity	95 % at max. +55 °C
Vibration resistance (in transport crate)	0.3 mm amplitude at 10 Hz to 55 Hz, 2 g at 55 Hz to 500 Hz (in line with VG 95332 and MIL-STD-810C)
Shock resistance (in transport crate)	30 g, 11 ms (half sinewave in line with VG 95332 and MIL-STD-810C)
Resistance to salt fog, sand and dust	in line with MIL-STD-810C
Max. installation height	2000 m above mean sea level (permissible input power is reduced at heights exceeding this value)
Required mast height for frequency-range extension	15 m (590.6 in)
Permissible wind speed	
Without ice deposit	188 km/h (in line with DIN 4131)
Wind load (at 188 km/h)	3400 N
With 3 cm radial ice deposit	130 km/h
MTBF (at +25 °C)	
With R&S®XK859 transmitter	10500 h
With other transmitters	6500 h
Power supply	+21 V to +32 V DC, max. 6 A, 2.5 A average at +28 V (max. 165 VA)
Dimensions, weight of HF dipole	510 mm × 1128 mm × 510 mm (20.1 in × 44.4 in × 20.1 in) (dipole length 10300 mm, 405.5 in), 103 kg (227.1 lb)
Dimensions, weight of frequency-range extension	160 mm × 344 mm × 270 mm, 2.5 kg (6.3 in × 13.5 in ×10.6 in , 5.5 lb)

R&S®GX007 junction unit

Connectors (rear panel)	
Power connector	DIN 49457
Connector for R&S®HX002	female, 26-contact
V.24 (RS-232-C) interface	female, 25-contact
Transmitter connector	male, 12-contact
Ground terminal	M5
LEDs	
R&S®GX007 status	+5 V, –5 V, +30 V
R&S®HX002 status	ready (antenna switched on) tuning (tuning switched on) P< (forward power insufficient) SWR< (matching insufficient) T> (temperature too high) V<> (incorrect operating voltage) interference (external transmitter) interlock (transmitter interlock circuit)
Control elements	power on/off test tuning modes (Auto, Hold, Tune) RX modes (Narrowband/Broadband) antenna 1/antenna 2
General data	
Operating temperature range	–25 °C to +55 °C
Storage temperature range	–40 °C to +85 °C
Vibration	
Sinusoidal	5 Hz to 55 Hz/amplitude 0.2 mm
Random	20 Hz to 2000 Hz/6 g to 7 g
Shock resistance	30 g/11 ms (half sinewave in line with MIL-STD-810C)
Electrical safety	VDE 0804
EMC	VDE 0871/0875, MIL-STD-461
MTBF	9000 h
Power supply	100/120/220/240 V, 47 Hz to 63 Hz (max. 225 VA)
Dimensions, weight	484 mm × 90 mm × 390 mm, 6.5 kg (19.1 in × 3.5 in × 15.4 in, 14.3 lb)



Vertical patterns of R&S®HX002 HF dipole above perfectly conducting plane and for 15 m above ground

Ordering information

Designation	Type	Order No.
HF Dipole (with tuning unit), color RAL 7001 silver gray	R&S®HX002	682.3010.24
Frequency-Range Extension, color RAL 7011 iron gray	R&S®HX002F	4017.9053.02
Recommended extras		
Folding Mast, 5 m, for roof mounting, climbable	R&S®KM451B1	4028.3351.02
Mast, 15 m, climbable, with guy ropes	R&S®KM451B2	4028.3400.03
Mast Adapter for R&S®KM451B1 and R&S®KM451B2	R&S®KM451Z4	4032.2904.02
Junction Unit for R&S®HX002 (R&S®FK859), desktop model	R&S®GX007	682.6010.02
Control cable between R&S®GX007 and R&S®HX002		
Length 40 m	R&S®FK859K1	669.8112.40
Length 60 m	R&S®FK859K1	669.8112.60
Length 80 m	R&S®FK859K1	669.8112.80

More information at
www.rohde-schwarz.com
(search term: HX002)

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