

R & S[®] ESSENTIALS

R&S[®] HMP POWER SUPPLY SERIES

Up to four channels in a single instrument



Data Sheet
Version 02.01

ROHDE & SCHWARZ

Make ideas real



AT A GLANCE

The R&S®HMP power supplies are primarily designed for industrial use. With two, three or four output channels and up to 10 A output current per channel, these rugged instruments are ideal for a wide variety of applications. They offer high efficiency with low residual ripple and many protection functions.

The R&S®HMP power supply series consists of four models. The R&S®HMP2020 two-channel power supply and the R&S®HMP2030 three-channel power supply deliver up to 188 W total output power, the three-channel R&S®HMP4030 and the four-channel R&S®HMP4040 offer a maximum output power of 384 W. The total load can be distributed as desired over the separate channels. Depending on the model, up to 80 W or 160 W of channel power is available – in any voltage/current distribution.

Up to four galvanically isolated, floating output channels with overload and short-circuit protection are available, depending on the instrument type. The channels can be connected in series or parallel to obtain higher voltages or currents. The R&S®HMP4040, for example, offers a maximum voltage of 128 V or a maximum current of 40 A.

All basic functions of the R&S®HMP power supplies are directly accessible on the front panel. The rotary knob plays a key role. It is used to set the voltage, current and limit values for the various protection functions.

The channel keys light up in different colors to indicate the operating conditions of the channels. All channels can be

simultaneously switched on or off with the “Output” key, which lights up white when it is “on”. Active outputs light up green in constant voltage mode and red in constant current mode.

The R&S®HMP power supplies offer a variety of protection functions to prevent damage to the instrument and the DUT. You can separately set the maximum current (electronic fuse, overcurrent protection/OCP) or the maximum voltage (overvoltage protection/OVP) for each channel. The output channels switch off when either of their set limits is reached. Overtemperature protection (OTP) prevents the instrument from overheating.

In industrial applications, power supplies are often installed in 19" racks. The R&S®HZ42 and R&S®HWP91 rack adapters are available for this purpose. Additional connections for all channels (including sense lines) are provided on the rear panel to simplify use in system cabinets.

The R&S®HMP power supplies can be equipped with an optional interface. Available interfaces include a dual USB/LAN (R&S®HO732), a dual RS-232/USB (R&S®HO720) and an IEEE-488 (GPIB) (R&S®HO740) interface.

Model overview

Parameter	R&S®HMP2020	R&S®HMP2030	R&S®HMP4030	R&S®HMP4040
Number of output channels	2	3	3	4
Maximum output current per channel	channel 1: 10 A, channel 2: 5 A	5 A	10 A	10 A
Maximum output power per channel	channel 1: 160 W, channel 2: 80 W	80 W	160 W	160 W
Total output power	max. 188 W	max. 188 W	max. 384 W	max. 384 W
Output voltage per channel	0 V to 32 V	0 V to 32 V	0 V to 32 V	0 V to 32 V

Key facts

- ▶ R&S®HMP2020/R&S®HMP2030 with 2/3 channels and 188 W total output power
- ▶ R&S®HMP4030/R&S®HMP4040 with 3/4 channels and 384 W total output power
- ▶ Maximum output voltage of 32 V per channel; higher voltages possible in serial operation
- ▶ High output currents up to 5 A/10 A (depending on the model); higher currents possible in parallel operation
- ▶ Linear postregulation for low residual ripple
- ▶ Electronic fuse (OCP), adjustable maximum voltage (OVP), overtemperature protection (OTP)
- ▶ Optional USB/LAN, RS-232/USB or IEEE-488 (GPIB) interface
- ▶ Rear panel connections, including sense lines, for all channels

Benefits

More than meets your daily needs

- ▶ page 4

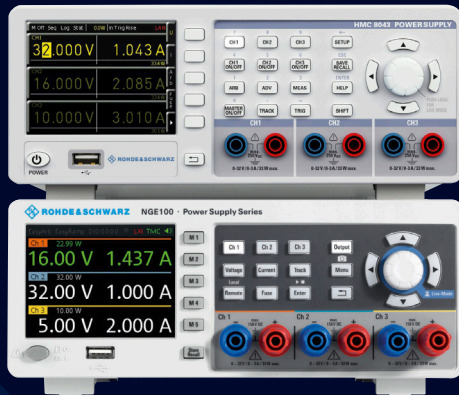
Easy operation

- ▶ page 6

Ideal for labs and test systems

- ▶ page 7

DIFFERENT POWER SUPPLY CLASSES



R&S®HMC8043 and R&S®NGE103B
three-channel power supplies

Basic power supplies

- ▶ Affordable, quiet and stable
- ▶ For manual operation and simple computer-controlled operation
- ▶ Used in education, on the bench and in system racks



R&S®HMP4040 and R&S®NGP814
four-channel power supplies

Performance power supplies

- ▶ When speed, accuracy and advanced programming features are vital to test performance
- ▶ Features such as DUT protection, fast programming times and downloadable time/voltage and time/current sequences
- ▶ Used in labs and ATE applications



R&S®NGU401 single-channel source
measure unit (SMU) and R&S®NGM202
two-channel power supply

Specialty power supplies

- ▶ Tailored for specific applications
- ▶ Unique features such as
 - Emulation of unique battery characteristics
 - Electronic loads to accurately sink current and dissipate power in a controlled manner
- ▶ Used in labs and ATE applications

MORE THAN MEETS YOUR DAILY NEEDS

All channels galvanically isolated and floating

The R&S®HMP power supply series consists of instruments with two, three or four channels. The circuitry of each single channel is completely isolated from the others; there is no connection to chassis ground. This makes it easy to combine the channels to drive balanced circuitries that might need +12 V/-12 V, for example, and avoids any ground problems in complex DUTs.

All channels have the same voltage range

In contrast to other power supplies on the market, the R&S®HMP power supplies offer the same voltage range on all channels. You can select any channel for a specific application. Each channel can be regarded as a separate power supply. Four models in two power classes are available, with two, three or four output channels.

All channels have overload and short-circuit protection

Even the most experienced user is occasionally distracted – so it is good to know that since the outputs are protected against overloads and short circuits, the R&S®HMP power supplies will not be damaged.

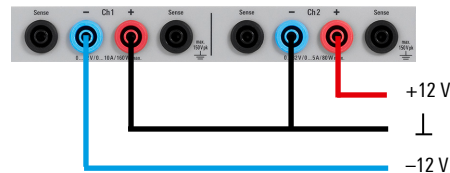
Parallel and serial operation

Because all channels are electrically equivalent, they can be combined in serial mode to achieve higher voltages. Up to 128 V can be achieved with the R&S®HMP4040.

In parallel mode, the channels can be bundled for higher current. Up to 20 A can be achieved when two channels are combined, and up to 40 A when all four channels of the R&S®HMP4040 are combined.

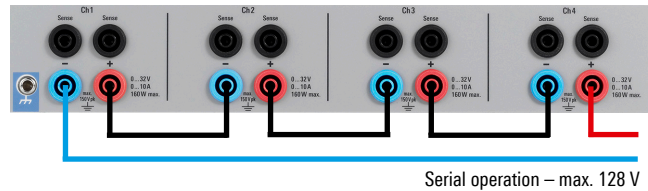
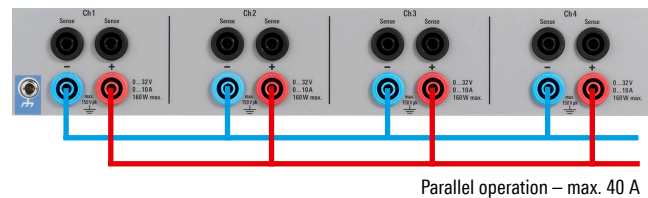
Supplying balanced circuits

Two channels can be connected together to supply balanced circuits with e.g. +12 V/-12 V.



Parallel and serial operation

The output channels can be configured in parallel to achieve higher output current, or in series for higher output voltage.



Constant voltage and constant current modes

Configuring and regulating the output voltage (constant voltage mode) is the standard application for power supplies. However, the R&S®HMP power supplies can also be used in constant current mode, with each channel separately configurable. If the configured current level is exceeded, current limiting ensures that only the configured current can flow. The output voltage is accordingly reduced below the configured value. This prevents damage to the test circuit in the event of a fault.



R&S®HMP2020 two-channel instrument



R&S®HMP2030 three-channel instrument

Tracking and link functions

The separate output channels can be used as independent power sources, but their true versatility becomes evident when combined. The channels can be connected in parallel to achieve higher currents or in series for higher voltages. The convenient tracking function lets you vary the voltage on all channels in parallel. The link function for the electronic fuses makes the instrument even more versatile. The power supply can be configured to switch off all channels when any one of the channels reaches its limit value. It can also be configured so that certain channels remain active, for example to power the fan that cools the DUT. The status of the fuses and all other protection functions are always shown on the display.

Protection functions to safeguard the instrument and DUT

Protection functions are common in performance power supplies with their high output powers. But they are not always implemented as consistently as in the R&S®HMP power supply series. For example, the limit values for all protection functions can be configured separately for each channel.

Maximum voltage (overvoltage protection, OVP)

If the voltage rises above the configured maximum value, the output is switched off and the “OVP” indicator on the display blinks. Depending on the setting, the voltage configured on the instrument or the voltage measured by the instrument is used as the switching threshold for OVP.

Maximum current (electronic fuse, overcurrent protection, OCP)

To provide even better protection for sensitive loads, each channel of the R&S®HMP power supplies is equipped with an electronic fuse that can be separately configured or cleared. If a configured current level is exceeded, the affected output channel will be automatically switched off and a message will be displayed.

The electronic fuse can be linked to other channels (FuseLink function). If a channel exceeds the maximum current level, then this channel and all linked channels will be switched off. Even the delay time of the electronic fuses can be set. With this functionality, you can adjust the behavior of the power supply so that short current spikes that occur when a channel is switched on do not trip the electronic fuse.

Overtemperature protection (OTP)

Of course the R&S®HMP power supplies have internal overtemperature protection that switches off the instrument if there is an imminent risk of thermal overload.

Modern instrument concept: small, compact and quiet

Universal power supplies need to fulfill a variety of requirements. For instance, they must work reliably in countries with unstable power grids. The primary transformer in the R&S®HMP acts as a lowpass filter to maintain stable operation.

Power supplies should be small and compact. The secondary switching regulator makes the R&S®HMP extremely efficient. It reduces weight and size, and the regulated fan usually runs at low speed or shuts off completely, which results in low noise.

Power supplies should provide stable output voltages/ currents with low ripple by using linear control circuitry for stabilization.



R&S®HMP4030 three-channel instrument



R&S®HMP4040 four-channel instrument

EASY OPERATION

Intuitive to use

All basic R&S®HMP power supply functions can be operated directly via keys on the front panel. Accessing menus to configure settings is only necessary for special functions that are needed less frequently.

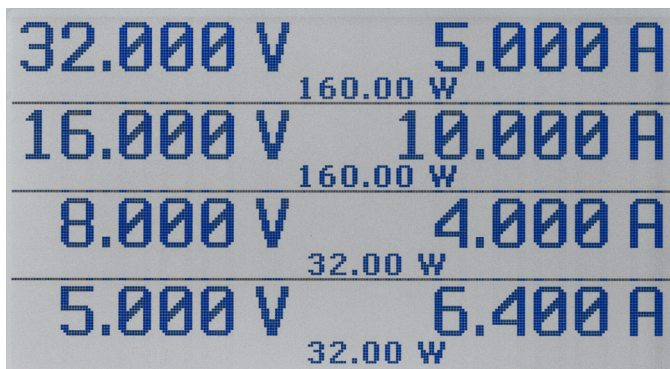
Simply press the “Voltage” key, select an output channel and use the rotary knob or arrow keys to adjust the output voltage in steps as small as 1 mV. You can similarly set a constant output current with a resolution as fine as 0.1 mA, depending on the model and the current range. On the R&S®HMP4030/R&S®HMP4040 instruments, you can also use the numeric keypad to enter values. If you need to set several channels at the same time, for example to increase the output voltage from ± 12 V to ± 15 V, simply press the “Track” key and select the two channels for the positive and negative voltages. Now you can use the rotary knob to symmetrically adjust the two voltages. Activating and deactivating the electronic fuses is just as easy – simply press the “Fuse” key and the channel key.

Color coding of operating states

All settings and operating conditions, including the output power and the status of the protection functions, are shown on the display and indicated by the colors of the illuminated channel keys. The colors of the illuminated keys indicate the different operating conditions:

- ▶ Active channel in constant voltage mode: green
- ▶ Active channel in constant current mode: red
- ▶ Channel in setting mode: blue

The “Output” key lights up white when the selected output channels are connected to the load.



EasyArb function for all channels

Some applications require you to vary the voltage or the current during a test sequence, for example to simulate different charging conditions of a battery. The EasyArb function provides a convenient solution. It lets you program time/voltage or time/current sequences, either manually via the user interface, or via an external interface.

EasyArb can be used for separate channels or for all channels. Up to three complete arbitrary curves with up to 128 points can be saved in the internal memory and retrieved when needed.

Save and recall instrument settings

Frequently used settings can be saved and retrieved using the “Store” and “Recall” keys.

All settings and operating states are clearly visualized. Constant voltage mode is indicated by a green key, constant current mode by a red key. The key color changes to blue in setting mode.

IDEAL FOR LABS AND TEST SYSTEMS

Tailored for use in labs and system racks

Performance power supplies are designed for higher output power than standard instruments. They must be stable and at the same time provide the required accuracy and speed, regardless of whether they are used on the lab bench or integrated into a production test system.

Remote control functions and rack adapters are essential in system applications. Access to rear panel connections, and above all compact design, are key factors for use in test systems.

The R&S®HMP power supplies fulfill all these requirements – in particular the R&S®HMP4040, which uniquely combines four electronically equivalent high-performance channels in a compact package.

Remote sensing for more stringent accuracy requirements

There is often a significant voltage drop over the connection leads, especially in applications with high current consumption. Since power supplies usually maintain a constant output voltage, the voltage on the DUT will be lower than the voltage displayed on the instrument. The sense function compensates for this voltage drop over the supply leads. The voltage actually present at the load is measured by an additional pair of sense lines, and this value is used to regulate the voltage directly at the load. The R&S®HMP power supplies provide separate sense lines for each output channel.

Connections on front and rear panels

The safety sockets on the front panel of the R&S®HMP power supplies are designed for 4 mm banana plugs. Additional connections for all channels (including sense lines) are provided on the rear panel to simplify use in rack systems.



Remote control of instrument functions

All instruments in the R&S®HMP series can be remotely controlled for use in test systems. The standard commands for programmable instruments (SCPI) scripting language is used. The following interfaces are available:

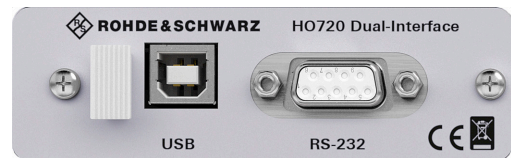
Dual interface USB/LAN

R&S®HO732 dual interface with ports for USB and LAN



Dual interface RS-232/USB

R&S®HO720 dual interface with ports for RS-232 and USB



IEEE-488 (GPIB) interface

R&S®HO740 interface with an IEEE-488 (GPIB) port



You can install the remote control interface yourself, without opening the power supply enclosure.

Connections for all channels – including sense lines – are also provided on the rear panel (example: R&S®HMP4040).

SPECIFICATIONS

Definitions

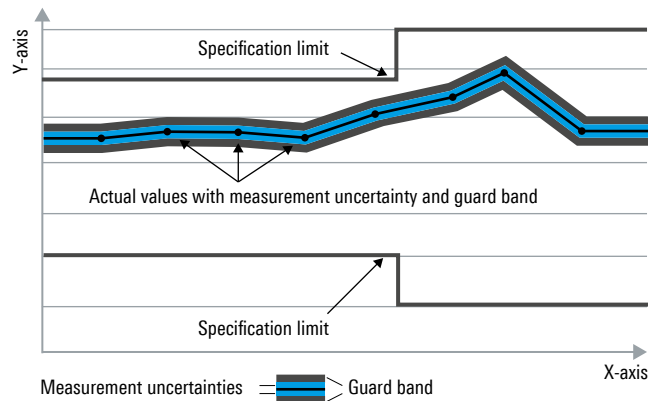
General

Product data applies under the following conditions:

- ▶ Three hours storage at ambient temperature followed by 30 minutes warm-up operation
- ▶ All data is valid at +23°C (−3°C/+7°C) after 30 minutes warm-up time.
- ▶ Specified environmental conditions met
- ▶ Recommended calibration interval adhered to
- ▶ All internal automatic adjustments performed, if applicable

Specifications with limits

Represent warranted product performance by means of a range of values for the specified parameter. These specifications are marked with limiting symbols such as $<$, \leq , $>$, \geq , \pm , or descriptions such as maximum, limit of, minimum. Compliance is ensured by testing or is derived from the design. Test limits are narrowed by guard bands to take into account measurement uncertainties, drift and aging, if applicable.



Specifications without limits

Represent warranted product performance for the specified parameter. These specifications are not specially marked and represent values with no or negligible deviations from the given value (for example, dimensions or resolution of a setting parameter). Compliance is ensured by design.

Typical data (typ.)

Characterizes product performance by means of representative information for the given parameter. When marked with $<$, $>$ or as a range, it represents the performance met by approximately 80% of the instruments at production time. Otherwise, it represents the mean value.

Nominal values (nom.)

Characterize product performance by means of a representative value for the given parameter (for example, nominal impedance). In contrast to typical data, a statistical evaluation does not take place and the parameter is not tested during production.

Measured values (meas.)

Characterize expected product performance by means of measurement results gained from individual samples.

Uncertainties

Represent limits of measurement uncertainty for a given measurand. Uncertainty is defined with a coverage factor of 2 and has been calculated in line with the rules of the Guide to the Expression of Uncertainty in Measurement (GUM), taking into account environmental conditions, aging, wear and tear.

Device settings and GUI parameters are indicated as follows: "parameter: value".

Typical data as well as nominal and measured values are not warranted by Rohde&Schwarz.

In line with the 3GPP/3GPP2 standard, chip rates are specified in million chips per second (Mcps), whereas bit rates and symbol rates are specified in billion bit per second (Gbps), million bit per second (Mbps), thousand bit per second (kbps), million symbols per second (Msps) or thousand symbols per second (ksps), and sample rates are specified in million samples per second (Msample/s). Gbps, Mcps, Mbps, Msps, kbps, ksps and Msample/s are not SI units.

All data is valid at +23°C (-3°C/+7°C) after 30 minutes warm-up time.

Specifications		
Electrical specifications		
Outputs	All channel outputs are galvanically isolated and not connected to ground.	
Number of output channels	R&S®HMP2020	2
	R&S®HMP2030	3
	R&S®HMP4030	3
	R&S®HMP4040	4
Maximum output power	R&S®HMP2020/R&S®HMP2030	188 W
	R&S®HMP4030/R&S®HMP4040	384 W
Maximum output power per channel	R&S®HMP2020	channel 1: 160 W; channel 2: 80 W
	R&S®HMP2030	80 W
	R&S®HMP4030/R&S®HMP4040	160 W
Output voltage per channel	all models	0 V to 32 V
Maximum output current per channel	R&S®HMP2020	channel 1: 10 A; channel 2: 5 A
	R&S®HMP2030	5 A
	R&S®HMP4030/R&S®HMP4040	10 A
Maximum voltage in serial operation	R&S®HMP2020	64 V
	R&S®HMP2030/R&S®HMP4030	96 V
	R&S®HMP4040	128 V
Maximum current in parallel operation	R&S®HMP2020/R&S®HMP2030	15 A
	R&S®HMP4030	30 A
	R&S®HMP4040	40 A
Voltage ripple	20 Hz to 20 MHz	< 1.5 mV (RMS) (meas.)
Current ripple		< 1 mA (RMS) (meas.)
Load regulation	load change from 10% to 90%	
Voltage	±(% of output + offset)	< 0.01 % + 2 mV
Current	±(% of output + offset)	< 0.01 % + 250 µA
Load recovery time	to within ± 10 mV of the set nominal voltage	< 1 ms (meas.)
Line regulation	±10% change in mains voltage	
Voltage	±(% of output + offset)	< 0.01 % + 2 mV
Current	±(% of output + offset)	< 0.01 % + 250 µA
Programming resolution		
Voltage		1 mV
Current	R&S®HMP2020 channel 1 (10 A)	< 1 A: 0.2 mA; ≥ 1 A: 1 mA
	R&S®HMP2020 channel 2 (5 A)	< 1 A: 0.1 mA; ≥ 1 A: 1 mA
	R&S®HMP2030	< 1 A: 0.1 mA; ≥ 1 A: 1 mA
	R&S®HMP4030/R&S®HMP4040	< 1 A: 0.2 mA; ≥ 1 A: 1 mA
Programming accuracy		
Voltage	±(% of output + offset)	< 0.05 % + 5 mV
Current	±(% of output + offset)	< 0.1 % + 5 mA
Output measurements		
Measurement functions	voltage, current	
Readback resolution		
Voltage	1 mV	
Current	R&S®HMP2020 channel 1 (10 A)	< 1 A: 0.2 mA; ≥ 1 A: 1 mA
	R&S®HMP2020 channel 2 (5 A)	< 1 A: 0.1 mA; ≥ 1 A: 1 mA
	R&S®HMP2030	< 1 A: 0.1 mA; ≥ 1 A: 1 mA
	R&S®HMP4030/R&S®HMP4040	< 1 A: 0.2 mA; ≥ 1 A: 1 mA
Readback accuracy		
Voltage	±(% of output + offset)	< 0.05 % + 5 mV
Current	±(% of output + offset)	< 0.1 % + 2 mA
Temperature coefficient (per °C)	+5°C to +20°C and +30°C to +40°C	
Voltage	±(% of output + offset)	0.01 % + 2 mV
Current	±(% of output + offset)	0.02 % + 3 mA
Remote sensing	yes, for each channel	
Maximum sense compensation	1 V	

Specifications		
Ratings		
Maximum voltage to earth		150 V (peak)
Maximum counter voltage	voltage with same polarity connected to the outputs	33 V
Maximum reverse voltage	voltage with opposite polarity connected to the outputs	0.4 V
Maximum reverse current	for 5 minutes max.	5 A
Remote control mode		
Command processing time		< 50 ms (nom.)
Protection functions		
Overvoltage protection		configurable for each channel
Overcurrent protection (electronic fuse)		configurable for each channel
Response time	$(I_{load} > I_{response} \times 2)$	< 10 ms
Fuse linking (FuseLink function)		yes
Fuse delay at output-on	configurable for each channel	0 ms to 250 ms (10 ms increments)
Overtemperature protection		independent for each channel
Special functions		
Arbitrary function (EasyArb)		
Parameters		voltage, current, time
Maximum number of points		128
Dwell time		10 ms to 60 s
Repetition		continuous or burst mode, 1 to 255 repetitions
Data memory		non-volatile memory for 3 arbitrary functions and 10 instrument settings
Display and interfaces		
Display	R&S®HMP2020/R&S®HMP2030 R&S®HMP4030/R&S®HMP4040	240 × 64 pixel LCD 240 × 128 pixel LCD
Front panel connections	channel outputs	4 mm safety sockets
Rear panel connections		connector block with 4 lines per channel
Remote control interfaces	optional	dual interface USB (TMC/CDC)/LAN (R&S®HO732)
	optional	dual interface RS-232/USB (R&S®HO720)
	optional	IEEE-488 (GPIB) (R&S®HO740)
General data		
Environmental conditions		
Temperature	operating temperature range	+5 °C to +40 °C
	storage temperature range	-20 °C to +70 °C
Humidity	noncondensing	5% to 80%
Altitude	operating altitude	max. 2000 m above sea level
Power rating		
Mains nominal voltage		115 V/230 V (±10%); CAT II
Mains frequency		50 Hz to 60 Hz
Maximum power consumption	R&S®HMP2020/R&S®HMP2030 R&S®HMP4030/R&S®HMP4040	300 W 600 W
Mains fuses (115 V power source)	R&S®HMP2020/R&S®HMP2030 R&S®HMP4030/R&S®HMP4040	2 × T6.3H/250 V 2 × T10H/250 V
Mains fuses (230 V power source)	R&S®HMP2020/R&S®HMP2030 R&S®HMP4030/R&S®HMP4040	2 × T3.15H/250 V 2 × T5H/250 V
Product conformity		
Electromagnetic compatibility	EU: in line with EU EMC Directive 2014/30/EU	applied harmonized standards: ▶ EN61326-1 ▶ EN61326-2-1 ▶ EN55011 (Class A) ▶ EN61000-3-2 ▶ EN61000-3-3
	Korea	KC mark
Electrical safety	EU: in line with Low Voltage Directive 2014/35/EU	EN61010-1
	USA, Canada	CSA C22.2 No. 61010-1
RoHS	in line with EU Directive 2011/65/EU	EN IEC63000

Specifications

Mechanical resistance

Vibration	sinusoidal	5 Hz to 55 Hz, 0.15 mm amplitude const., 55 Hz to 155 Hz, 0.5 g const., in line with EN60068-2-6
	random	8 Hz to 500 Hz, 1.2 g (RMS), in all 3 axes, in line with EN60068-2-64

Mechanical data

Dimensions (W × H × D)	R&S®HMP2020/R&S®HMP2030	285 mm × 95 mm × 405 mm (11.22 in × 3.74 in × 15.94 in)
	R&S®HMP4030/R&S®HMP4040	285 mm × 136 mm × 405 mm (11.22 in × 5.35 in × 15.94 in)
Weight	R&S®HMP2020	7.8 kg (17.2 lb)
	R&S®HMP2030	8.0 kg (17.6 lb)
	R&S®HMP4030	12.4 kg (27.3 lb)
	R&S®HMP4040	12.8 kg (28.2 lb)
Rack installation	R&S®HMP2020/R&S®HMP2030	R&S®HZ42 option (19", 2 HU)
	R&S®HMP4030/R&S®HMP4040	R&S®HWP91 option (19", 4 HU)
Recommended calibration interval	operation 40 h/week over entire range of specified environmental conditions	1 year

ORDERING INFORMATION

Designation	Type	Order No.
Base unit		
Two-channel power supply	R&S®HMP2020	3629.6718.02
Three-channel power supply	R&S®HMP2030	3629.6718.03
Three-channel power supply	R&S®HMP4030	3629.6776.03
Four-channel power supply	R&S®HMP4040	3629.6776.04
Included accessories		
Set of power cables, quick start guide		
Interface options		
Dual interface (USB/LAN)	R&S®HO732	5800.3209.02
Dual interface (RS-232/USB)	R&S®HO720	3594.3660.02
IEEE-488 (GPIB) interface	R&S®HO740	3622.3194.02
System components		
19" rack adapter, 2 HU, for R&S®HMP2020/R&S®HMP2030	R&S®HZ42	3622.3207.02
19" rack adapter, 4 HU, for R&S®HMP4030/R&S®HMP4040	R&S®HWP91	5800.0939.02

Warranty

Base unit	3 years
All other items ¹⁾	1 year

Service options

Extended warranty, one year	R&S®WE1	
Extended warranty, two years	R&S®WE2	Please contact your local
Extended warranty with calibration coverage, one year	R&S®CW1	Rohde & Schwarz sales office.
Extended warranty with calibration coverage, two years	R&S®CW2	

¹⁾ For options installed, the remaining base unit warranty applies if longer than 1 year. Exception: all batteries have a 1 year warranty.

Service that adds value

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

Rohde & Schwarz

The Rohde&Schwarz technology group is among the trail-blazers when it comes to paving the way for a safer and connected world with its leading solutions in test & measurement, technology systems and networks&cybersecurity. Founded more than 85 years ago, the group is a reliable partner for industry and government customers around the globe. The independent company is headquartered in Munich, Germany and has an extensive sales and service network with locations in more than 70 countries.

www.rohde-schwarz.com

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

Rohde & Schwarz training

www.training.rohde-schwarz.com

Rohde & Schwarz customer support

www.rohde-schwarz.com/support



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[1513](#) [1514](#) [1550](#) [1651A](#) [1652](#) [1665](#) [1666](#) [1667](#) [1693](#) [1694](#) [1698](#) [MX100TP](#) [1739](#) [1762](#) [1788](#) [TPM-3005](#) [1902B](#) [9174B](#) [GDM-8245](#)
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