

Version
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2004

Test Receiver R&S® ESPI

The precompliance standard up to 7 GHz

Excellent test receiver features

- ◆ Choice of 5 detectors (max. 3 simultaneously)
- ◆ EMI measurement bandwidths 200 Hz, 9 kHz, 120 kHz, 1 MHz
- ◆ Pulse weighting with quasi-peak detector according to CISPR
- ◆ For all commercial EMI standards

Extremely high measurement speed

- ◆ Measurement times from 100 μ s to 100 s
- ◆ **Option:** preselector and 20 dB preamplifier

Spectrum analyzer

- ◆ IF resolution bandwidths from 10 Hz to 10 MHz
- ◆ Test routines for TOI, ACP, OBW, CCDF

Outstanding performance features

- ◆ Total measurement uncertainty
 - Spectrum analyzer mode: 0.5 dB (without preselection)
 - Receiver mode: <1.5 dB
- ◆ Displayed average noise level (DANL): –155 dBm (1 Hz, $f < 1$ GHz)
- ◆ NF = 21.5 dB (12 dB with preamplifier)
- ◆ Programmable scan tables
- ◆ Limit lines
- ◆ Transducer tables and sets
- ◆ Brilliant 21 cm TFT colour display


ROHDE & SCHWARZ

Precompliance Test Receiver/Spectrum Analyzer R&S® ESPI...

- ◆ Optimized operating concept thanks to decades of experience in EMI test receiver development
- ◆ Very high measurement speed
- ◆ High measurement accuracy

With the two R&S® ESPI test receiver models, the well-known advantages of the R&S® ESIB high-end compliance test receivers/analyzers have been systematically implemented for the top of the middle-end.

Thanks to a common platform system, the user has the additional benefits of the R&S® FSP spectrum analyzer family which is already in place. These benefits by far exceed the capabilities and functions of conventional precompliance test equipment.

The R&S® ESPI defines the vital criteria, such as functionality, measurement speed and accuracy for middle-end equipment.

The use of innovative techniques, such as the VLSI front-end and largely digital signal processing, together with ASICs developed by Rohde&Schwarz, has resulted in a product with top-class specifications and high reliability.

Outstanding features

TEST RECEIVER

- ◆ Peak, Quasi-Peak, RMS and AV (max. 3 detectors simultaneously)
- ◆ EMI measurement bandwidths 200 Hz, 9 kHz, 120 kHz, 1 MHz
- ◆ Correct pulse weighting to CISPR 16-1 from PRF of **10 Hz**
- ◆ For all commercial EMI standards such as CISPR, EN, ETS, FCC, ANSI C63.4, VCCI and VDE
- ◆ **Option R&S® ESPI-B2:** Preselector and 20 dB preamplifier

SPECTRUM ANALYZER

- ◆ Resolution bandwidths from 10 Hz to 10 MHz (in 1/3/10 sequence)
- ◆ RMS detector for measurements on digitally modulated signals
- ◆ Test routines for TOI, ACPR, OBW, amplitude statistics

Unprecedented measurement speed

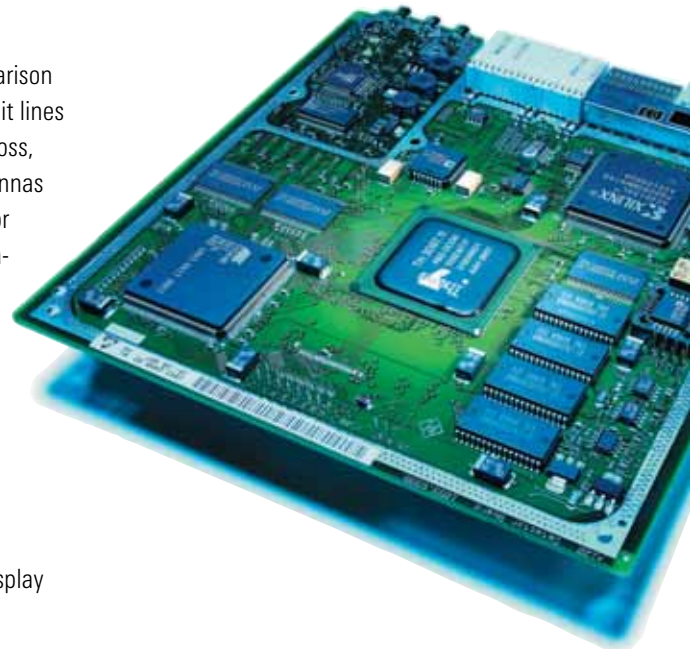
- ◆ Fast detection of critical frequencies through overview measurements:
 - Measurement time 100 μ s to 100 s in receiver mode,
 - up to 16000 s in analyzer mode



...the standard in the EMI precompliance class

EMC-relevant performance features

- ◆ Total measurement uncertainty
 - Spectrum analyzer mode: 0.5 dB (without preselection)
 - Receiver mode: <1.5 dB
- ◆ Displayed average noise level (DANL): **-155 dBm** (1 Hz), $f < 1$ GHz
- ◆ Noise figure 21.5 dB (12 dB with preamplifier option)
- ◆ Overview measurements in spectrum analyzer mode
- ◆ User-programmable scan tables
- ◆ Display of results and comparison with standard-conformal limit lines
- ◆ Correction values for cable loss, coupling networks and antennas included as transducer factor
- ◆ Data reduction and modification of a frequency list for weighted final measurement
- ◆ Bargraph display for different types of detectors
- ◆ Overload indication
- ◆ Built-in AF demodulation
- ◆ EMI bandwidths to CISPR
- ◆ Brilliant 21 cm TFT colour display



Precompliance has a name: R&S® ESPI3 and R&S® ESPI7

Features

The **R&S® ESPI3** and **R&S® ESPI7**, which are suitable for all commercial EMI standards to CISPR, EN, ETS, FCC, ANSI C63.4, VCCI and VDE, have been specially designed for precompliance measurements in development. The aim is to perform EMC diagnostic measurements on the devices under test as quickly as possible and as accurately as necessary and to document the results.

The final compliance test will then be purely a formality. The advantages of test receiver accuracy and selectivity combined with the measurement speed of a spectrum analyzer define the crucial performance features for a new class of test receivers.

R&S® ESPI3: 9 kHz to 3 GHz

R&S® ESPI7: 9 kHz to 7 GHz

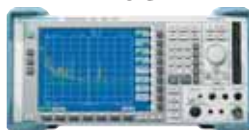
These two models make it possible to take products through the critical stages of development and the EMC test plan and still be on schedule for approval and market launch.

The precompliance measuring instruments from Rohde&Schwarz provide the functions that are required for in-house test sequences:

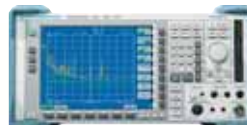
- ◆ Manual measurement of EMI spectra thanks to the receiver-oriented operating concept
- ◆ Semi-automatic measurements with predefined scan and sweep tables allowing interactive interruption
- ◆ Individual evaluation of critical frequencies using markers and additional detectors assigned to the markers which are simultaneously displayed
- ◆ Fully automatic interference measurements in conjunction with external EMI software packages from Rohde&Schwarz, including, for instance, determination of the worst case by automatic switchover of the phase and protective ground settings via the USER port for remote-controlled line impedance stabilization networks

9 kHz ----- 3 GHz ----- 7 GHz

R&S® ESPI 3



R&S® ESPI 7



Accuracy and reproducibility are also key parameters for all applications of the R&S® ESPI test receiver family.

The combination of test receiver and spectrum analyzer provides an optimum concept for precompliance measurements in development environments.

EMI measurements to standard

Fitted with the optional preselector/preamplifier (R&S® ESPI-B2), all R&S® ESPI models feature an excellent dynamic range compared with other precompliance solutions and are, therefore, able to perform precise interference measurements with pulse repetition frequencies (PRF) from **10 Hz** to CISPR 16-1.

Measurements to commercial EMI standards such as CISPR, EN 550xx, ETS, FCC, ANSI C63.4, VCCI or VDE can be carried out directly by comparing the EMI spectrum with the associated limit lines and switching on the appropriate detectors (PK, QP, AV, RMS).

The detectors

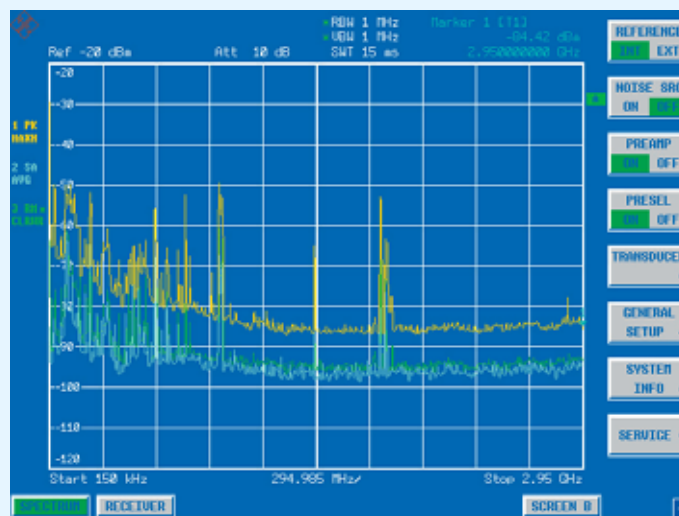
Depending on the operating mode of the R&S® ESPI3 and R&S® ESPI7, i.e. spectrum analyzer or test receiver, the following detectors are available:

- ◆ Analyzer mode: MaxPeak, MinPeak, AutoPeak, Sample, RMS, Average
- ◆ Receiver mode: Peak, Quasi-Peak (CISPR), RMS, Average

PEAK = peak value
 QUASI-PEAK = CISPR weighting
 AV = linear average value
 RMS = RMS value

R&S® ESPI-B2: preamplifier and preselection filters up to 3 GHz

The input stages of precompliance test equipment, which often feature a rather poor overload capability, would be hopelessly overdriven without a preselection unit. This is different with the R&S® ESPI where, in combination with preselection filter units, a low-noise preamplifier comes after the filter module but before the mixer stage. It must be possible to switch the preamplifier on/off as required, since in the case of high signal levels, the dynamic range would be reduced by an amount numerically equal to the gain. Where low signal levels are to be expected, it is best to switch in the preamplifier. Since the Test Receivers R&S® ESPI operate both in the spectrum analyzer mode and in the test receiver mode, both modes offer the choice of switching the preamplifier on or off. In the receiver mode, the preselection filter setting is fixed, whereas in the analyzer mode it can be selected.



Spectrum analyzer mode with selectable preselection filters and preamplifier switched on

Up to 3 detectors can be activated simultaneously and the results displayed.

The bargraph display, with current detector value and MaxHold display, clearly shows the results of manual circuit adjustment when the DUT cabling is arranged for maximum emissions and when the antenna is aligned relative to the DUT for a maximum reading.

In the receiver mode, the QP detector is coupled with the time constants, prescribed by the standard, as a function of the frequency range. This ensures that the correct time constants and IF bandwidth are used for signal weighting in the CISPR bands. This means much greater ease of operation for the user.

The measurement bandwidths

The measurement bandwidths of the R&S® ESPI are designed for a large variety of applications:

The analyzer mode provides all –3 dB bandwidths from 10 Hz to 10 MHz (in 1/3/10 sequence). In the receiver mode, the –6 dB bandwidths can also be selected by softkey: 200 Hz, 9 kHz, 120 kHz plus 1 MHz bandwidth.

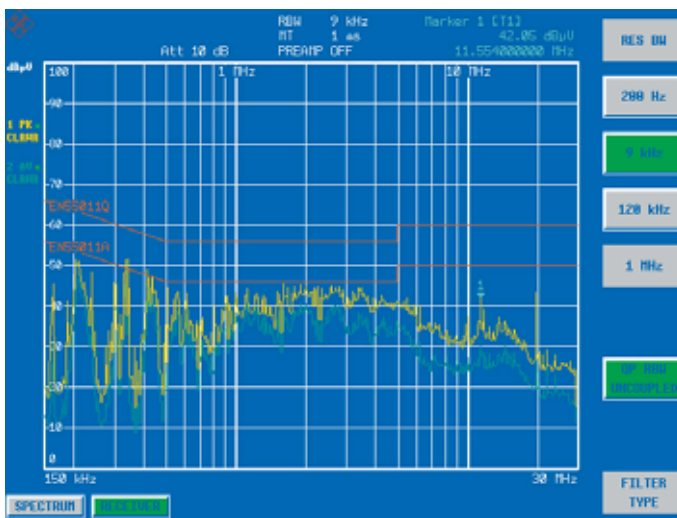
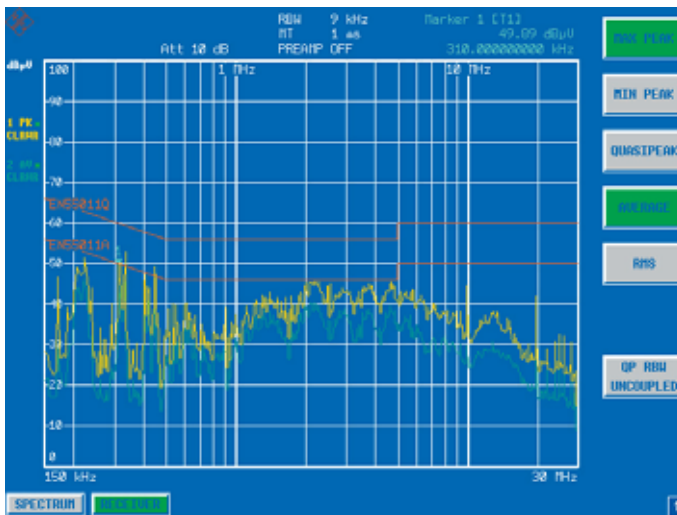
Moreover, approx. 40 digital channel filters are available.

Like the detectors, the standard-conformal CISPR bandwidths can be coupled as a function of the frequency range. If necessary, the coupling can be disabled.

The preselector/preamplifier option (R&S® ESPI-B2) is available as a protection against overloading by pulsed, high-power signals and for ensuring the validity of signal evaluation in the linear operating range of the measuring instrument. The advantage of this option is that, in the analyzer mode, the preselection filters or the preamplifier can be switched on or off as required.

User-selectable parameters in up to 10 subranges

The basis for all reproducible measurements is a scan table with up to ten subranges and user-programmable frequency parameters such as START, STOP, STEP SIZE, resolution bandwidth, measurement time per frequency as well as RF attenuation setting at a constant value or coupled to AUTO RANGE overload monitoring. For sensitive measurements (if low signal levels are expected), the preamplifier can be switched on or off as a function of the subrange.



| SCAN TABLE | | | | | |
|--------------|---------|---------|---------|---------|---------|
| Scan Start | 30 MHz | | | | |
| Scan Stop | 3 GHz | | | | |
| Step Mode | AUTO | | | | |
| | RANGE 1 | RANGE 2 | RANGE 3 | RANGE 4 | RANGE 5 |
| Start | 30 MHz | 1 GHz | | | |
| Stop | 1 GHz | 3 GHz | | | |
| Step Size(A) | 40 kHz | 400 kHz | | | |
| Res BW | 120 kHz | 1 MHz | | | |
| Meas Time | 100 µs | 100 µs | | | |
| Auto Ranging | ON | ON | | | |
| RF Attn | 10 dB | 10 dB | | | |
| Preamp | ON | ON | | | |
| Auto Preamp | OFF | OFF | | | |

SCAN table

Diagram and graphics display can most easily be defined via ADJUST AXIS.

Marker functions and split-screen display

In addition to normal FULL SCREEN display, a second window is opened in the SPLIT SCREEN mode for bargraph display with current detector values and MaxHold display. By activating "Tune to Marker" the receive frequency and the amplitude of the detectors coupled to the marker are displayed as a bargraph and numerically. This makes things considerably easier for the user.

The split-screen display in the analyzer mode makes it possible to resolve fine spectrum detail. By coupling the marker frequency (in screen B) to the center frequency of screen A, the parameters such as bandwidth, span, RF attenuation can be selected separately to detect spurious which are close to the signal and cannot be seen in the overview spectrum.



R&S®ESPI – the optimal balance of price and performance

- ◆ The large 21 cm display with brilliant colours makes it easy to read parameters and displays results clearly
- ◆ 5 different detectors including quasi-peak detector, up to three of them can be selected simultaneously
- ◆ EMI bandwidths 200 Hz, 9 kHz, 120 kHz and 1 MHz
- ◆ Resolution bandwidths from 10 Hz to 10 MHz
- ◆ Editable limit lines
- ◆ Correction tables for transducers, coupling networks, accessories, antennas
- ◆ Convenient documentation of results as a hardcopy or file in PC-compatible formats
- ◆ Interfaces: GPIB, Centronics, RS-232-C, LAN (option)
- ◆ Automatic test routines for measurement of TOI, OBW, phase noise, ACP(R)



Overview of limit lines

- ◆ Split-screen display with independent settings and up to 3 traces per screen
- ◆ Fast measurements in the time domain: minimum sweep time 1 μ s
- ◆ Gated sweep for measurements on TDMA signals
- ◆ Minimum sweep time of 2.5 ms supports daily efforts in the lab to cut development times

Additional applications – extra performance

Modern communication systems are required to achieve optimum spectral efficiency at high data rates. For the 3rd generation CDMA mobile radio systems currently under development, this is achieved by a number of measures, for example high-precision power control.

The R&S®ESPI is the ideal measurement tool for diagnostic measurements, development, precertification and post-certification thanks to its excellent RF characteristics:

- ◆ Total measurement uncertainty
 - Spectrum analyzer mode: 0.5 dB (without preselection)
 - Receiver mode: <1.5 dB
- ◆ Displayed average noise level of -155 dBm (1 Hz) typ. without preamplifier
- ◆ Phase noise of -145 dBc (1 Hz) typ. at an offset of 10 MHz provides optimum conditions for ACPR measurements on WCDMA systems

The resolution bandwidths of up to 100 kHz are fully digital and provide – in addition to high selectivity – an ideal basis for accurate (adjacent-)channel power measurements thanks to a maximum bandwidth deviation of 3%.



R&S® ESPI comes as standard with a large variety of functions

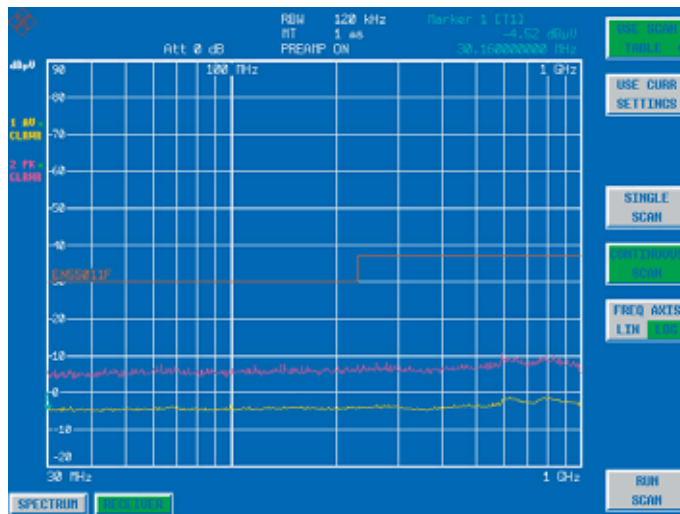
Fit for the future

Thanks to its modular design, the R&S® ESPI is optimally equipped to handle today's measurements and the measurements of the future. The design already takes into account both hardware and firmware extensions so that the R&S® ESPI will meet all requirements in the years to come as well. A safe investment for the future.

Ergonomics & design

The R&S® ESPI sets the new standard in the precompliance class. The 21 cm (8.4") colour display makes it easy for the user to read results and provides an overview of the parameters which have been selected.

Vertical and horizontal rows of softkeys make it easy to handle even complex measurements. Parameters like frequency and amplitude are entered by means of dedicated hardkeys and unit keys.



Displayed average noise level in receiver mode with preselector/preamplifier switched on

Wide dynamic range

Featuring the lowest displayed average noise level in its class (DANL -145 dBm typ. at 10 Hz RBW), the R&S® ESPI measures even small signals precisely, when using the optional Preselector/Preamplifier R&S® ESPI-B2 from 9 kHz to 3 GHz even down to -153 dBm (10 Hz RBW). Together with the high intercept point, this yields an intermodulation-free range of 100 dB typ. – an excellent value even for instruments at the higher end of the market.

Phase noise

The R&S® ESPI's minimal phase noise makes it suitable for demanding measurements both close to the carrier (-113 dBc (1 Hz) typ. at 10 kHz) and far from the carrier (-125 dBc (1 Hz) typ. at 1 MHz). The R&S® ESPI is therefore optimally equipped for performing spectral analysis and ACPR measurements on narrowband systems like IS-136 or PDC as well as on wideband systems like IS-95 or WCDMA.



Interior view: modular design of test receiver

Spectrum analyzer application, ACPR measurements

Measurement of the adjacent-channel power ratio (ACPR), which many mobile radio standards stipulate for components and units, is performed in the R&S®ESPI analyzer mode by automatic test routines. All settings, measurements and filters required for a selected standard are activated at a keystroke.

In addition to a large number of preprogrammed standards, the channel width and channel spacing can be selected individually.

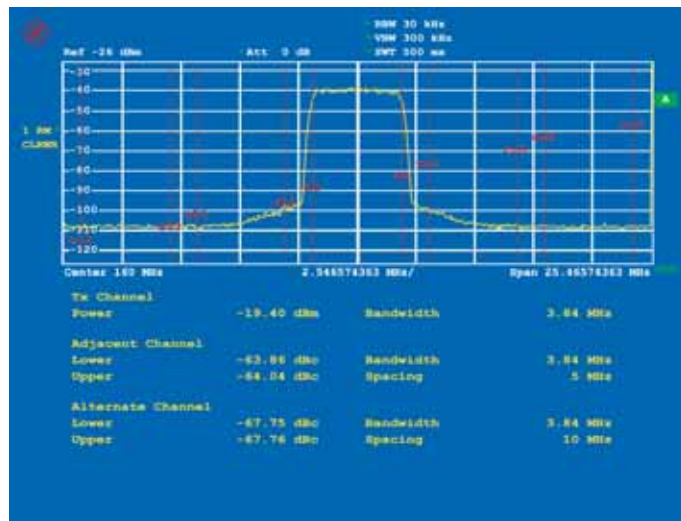
Thanks to its excellent dynamic range, the lowest phase noise in its class and its RMS detector, the R&S®ESPI sets the new standard for the top of the mid-range – even for ACPR measurements.

Test routines for TOI, OBW, etc are standard

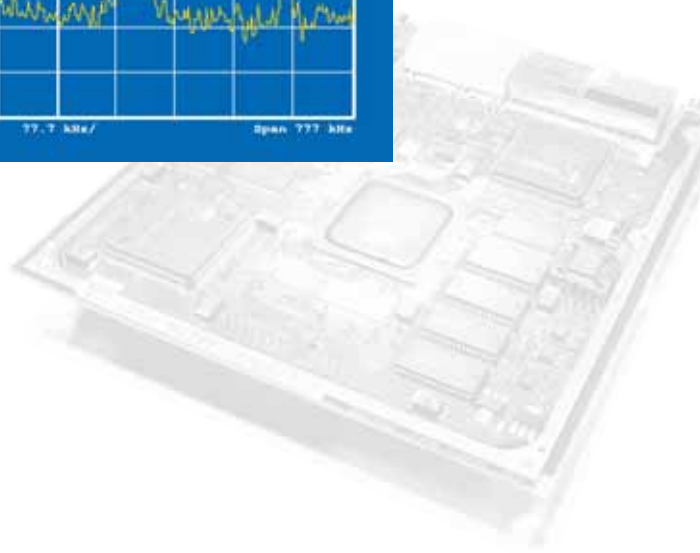
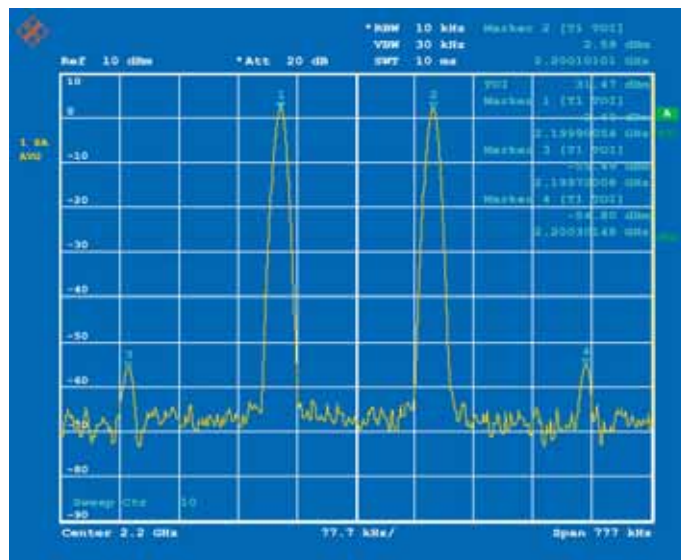
The R&S®ESPI offers fast test routines for a multitude of typical laboratory measurements. The routines make postprocessing superfluous and supply results directly:

- ◆ Determination of TOI
- ◆ Occupied bandwidth (OBW)
- ◆ Burst power with peak, average and RMS indication as well as standard deviation
- ◆ Modulation depth of AM signals
- ◆ Phase noise
- ◆ Bandwidth marker

Of course, these functions can also be used via the fast GPIB interface.



TOI measurement



Optional tracking generator 9 kHz to 3 GHz

The optional Internal Tracking Generator R&S®FSP-B9 up to 3 GHz and External Generator Control R&S®FSP-B10 enhance the two R&S®ESPI test receiver models to give scalar network analyzer functionality. Gain, frequency response, insertion and return loss are measured using a selective method with a wide dynamic range without being affected by harmonics or spurious from the generator. The Internal Tracking Generator R&S®FSP-B9 can be used in both R&S®ESPI models and covers the frequency range from 9 kHz to 3 GHz. A frequency offset of ± 150 MHz can be set for measurements on frequency-converting modules. The tracking generator can be broadband-modulated by an external I/Q baseband signal.

Optional LAN interface

With the aid of the optional LAN Interface R&S® FSP-B16, the R&S®ESPI models can be connected to common networks such as 100Base-T so that functions like file logging on network drives or documentation of measurement results via network printer are available. The R&S®ESPI can also be remote-controlled via the LAN interface. Control is via a softpanel that behaves exactly as if it were part of a real instrument. The LAN interface has a clear speed advantage over the IEC/IEEE bus – in particular when large blocks of data are transmitted.

Easy generation of reports thanks to PC compatibility

- ◆ PC-compatible screenshots, no conversion software needed
- ◆ Windows printer support
- ◆ LabWindows driver
- ◆ LabView driver
- ◆ SCPI-compatible
- ◆ R&S®FSE/ESIB-compatible GPIB command set
- ◆ Customized training



Rear view with interfaces for tracking generator with I/O, LAN and user port

R&S®ESPI-K50 – external trigger for measuring field-strength profiles

To measure the coverage fieldstrength of a communication or broadcast network, continuous level measurements have to be performed at a high measurement rate and the results must be forwarded to an evaluation unit.

When a displacement sensor/GPS system is used, the external trigger input of the R&S®ESPI can be used to start the single measurements. The level values can thus be accurately assigned to the measurement site.

The coverage measurement function is only available in the receive mode and in the case of remote control. The R&S®ESPI performs the coverage measurement in two different ways:

- ◆ All measurements are performed on a discrete frequency (sample rate >100 ks/s)
- ◆ A channel list with up to 1000 channels is cyclically processed, i.e. a new frequency is set for each measurement

Additional channel filters

In addition to the channel filters included as standard in the R&S®ESPI, the option provides filters with bandwidths of 5.6 MHz to 8 MHz for DVB-T signals as listed below.

- ◆ 5.6 MHz: ISDB-T (Japan)
- ◆ 6.0 MHz: ATSC (USA, Korea)
- ◆ 6.4 MHz
- ◆ 7.0 MHz: DVB-T (Europe, Australia)
- ◆ 8.0 MHz: DVB-T (Europe)

Lab model or robust portable unit

Whether as a desktop model for the lab, in a 19" rack, or as a robust unit with edge protectors and carrying handle for portable use – the R&S®ESPI always looks good.



Environmental compatibility

- ◆ Fast and easy disassembly
- ◆ Small number of materials
- ◆ Mutual compatibility of materials
- ◆ Easy identification of substances through appropriate marking (plastics)

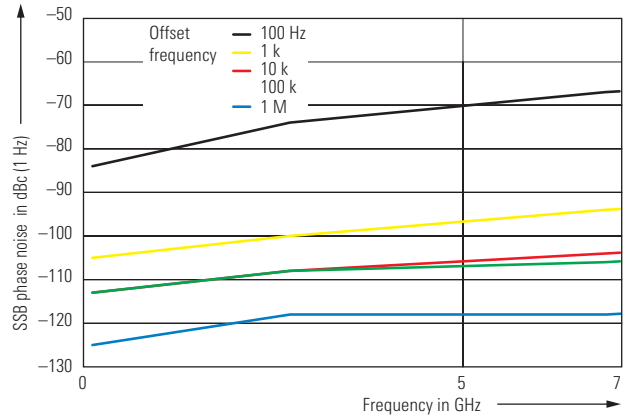
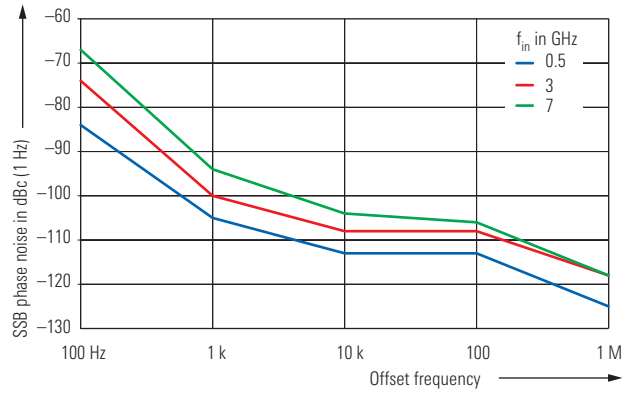
Specifications

Specifications apply under the following conditions: 15 minutes warmup time at ambient temperature, specified environmental conditions met, calibration cycle adhered to and total calibration performed. Data designated "nominal" apply to design parameters and are not tested. Data designated " $\sigma = xx \text{ dB}$ " indicate the standard deviation.

| | R&S® ESPI3 | R&S® ESPI7 |
|--|---|----------------------|
| Frequency | | |
| Frequency range | 9 kHz to 3 GHz | 9 kHz to 7 GHz |
| Frequency resolution | 0.01 Hz | |
| Internal reference frequency (nominal) | | |
| Aging per year ¹⁾ | 1×10^{-6} | |
| Temperature drift (+5°C to +45°C) | 1×10^{-6} | |
| with option R&S® FSP-B4 (OCXO) | | |
| Aging per year ¹⁾ | 1×10^{-7} | |
| Temperature drift (+5°C to +45°C) | 1×10^{-8} | |
| External reference frequency | 10 MHz | |
| Frequency display (receiver mode) | | |
| Display | numerical display | |
| Resolution | 0.1 Hz | |
| Frequency display (analyzer mode) | | |
| Display | with marker or frequency counter | |
| Resolution | span/500 | |
| Accuracy (sweep time >3 × auto sweep time) | ± (frequency × reference error + 0.5% × span + 10% × resolution bandwidth + ½ (last digit)) | |
| Frequency counter | | |
| Resolution | 0.1 Hz to 10 kHz (selectable) | |
| Count accuracy (S/N >25 dB) | ± (frequency × reference error + ½ (last digit)) | |
| Display range for frequency axis | | |
| | 0 Hz, 10 Hz to 3 GHz | 0 Hz, 10 Hz to 7 GHz |
| Resolution/accuracy of display range | 0.1% | |
| Spectral purity (dBc (1 Hz)) | | |
| SSB phase noise, $f = 500 \text{ MHz}$, for frequencies > 500 MHz see diagram | | |
| Carrier offset | | |
| 100 Hz | <-84, -90 typ. | |
| 1 kHz | <-100, -108 typ. | |
| 10 kHz | <-106, -113 typ. | |
| 100 kHz ²⁾ | <-110, -113 typ. | |
| 1 MHz ²⁾ | <-120, -125 typ. | |
| 10 MHz | -145 typ. | |
| Residual FM, $f = 500 \text{ MHz}$, RBW 1 kHz, sweep time 100 ms | 3 Hz typ. | |
| Frequency scan (receiver mode) | | |
| Scan | scan with max. 10 subranges with different settings | |
| Measurement time per frequency | 100 μs to 100 s, selectable | |
| Sweep (analyzer mode) | | |
| Span 0 Hz (zero span) | 1 μs to 16000 s | |
| Resolution | 125 ns | |
| Span $\geq 10 \text{ Hz}$ | 2.5 ms to 16000 s | |
| Max. deviation | 1% | |
| IF bandwidths (receiver mode) | | |
| Bandwidths (-3 dB) | | |
| | 10 Hz to 10 MHz; in 1, 3, 10 sequence | |
| Bandwidth error | | |
| $\leq 100 \text{ kHz}$ | <3% | |
| 300 kHz to 3 MHz | <10% | |
| 10 MHz | +10%, -30% | |
| Shape factor $BW_{60 \text{ dB}} : BW_{3 \text{ dB}}$ | | |
| $\leq 100 \text{ kHz}$ | <5:1 (Gaussian filter) | |
| 300 kHz to 3 MHz | <15:1 (4-circuit synchronously tuned filters) | |
| 10 MHz | <7:1 | |

¹⁾ After 30 days of operation.

²⁾ Valid for span >100 kHz.



Typical values for SSB phase noise (referred to 1 Hz bandwidth)

| Carrier offset | $f_{in} = 3 \text{ GHz}$ | $f_{in} = 7 \text{ GHz}$ |
|----------------|--------------------------|--------------------------|
| 100 Hz | -74 dBc | -67 dBc |
| 1 kHz | -100 dBc | -94 dBc |
| 10 kHz | -108 dBc | -104 dBc |
| 100 kHz | -108 dBc | -106 dBc |
| 1 MHz | -118 dBc | -118 dBc |

Preselector (option R&S® ESPI-B2), can be switched off in analyzer mode

| Filter | Frequency range | Bandwidth (-6 dB) | |
|-------------------------------|---|-------------------|----------|
| 1 | <150 kHz | 230 kHz | fixed |
| 2 | 150 kHz to 2 MHz | 2.6 MHz | fixed |
| 3 | 2 MHz to 8 MHz | 2 MHz | tracking |
| 4 | 8 MHz to 30 MHz | 6 MHz | tracking |
| 5 | 30 MHz to 70 MHz | 15 MHz | tracking |
| 6 | 70 MHz to 150 MHz | 30 MHz | tracking |
| 7 | 150 MHz to 300 MHz | 60 MHz | tracking |
| 8 | 300 MHz to 600 MHz | 80 MHz | tracking |
| 9 | 600 MHz to 1000 MHz | 100 MHz | tracking |
| 10 | 1 GHz to 2 GHz | highpass filter | tracking |
| 11 | 2 GHz to 3 GHz | highpass filter | fixed |
| Preamplifier (9 kHz to 3 GHz) | can be switched between preselector and 1st mixer, gain 20 dB | | |

| | R&S® ESPI 3 | R&S® ESPI 7 |
|--|--|--|
| EMI bandwidths | 200 Hz, 9 kHz, 120 kHz (–6 dB) 1 MHz (pulse bandwidth) | |
| Bandwidth error ≤120 kHz 1 MHz | <3% 10%, nominal | |
| Shape factor BW _{60 dB} : BW _{6 dB} ≤120 kHz 1 MHz | <5:1 (Gaussian filter) <15:1 (4-circuit synchronously tuned filters) | |
| Resolution bandwidths (analyzer mode) | | |
| Bandwidths (–3 dB) | 10 Hz to 10 MHz; in 1, 3, 10 sequence | |
| Bandwidth error ≤100 kHz 300 kHz to 3 MHz 10 MHz | <3% <10% +10%, –30% | |
| Shape factor BW _{60 dB} : BW _{3 dB} ≤100 kHz 300 kHz to 3 MHz 10 MHz | <5:1 (Gaussian filter) <15:1 (4-circuit synchronously tuned filters) <7 | |
| EMI bandwidths | 200 Hz, 9 kHz, 120 kHz (–6 dB) 1 MHz (pulse bandwidth) | |
| Bandwidth error ≤120 kHz 1 MHz | <3% 10%, nominal | |
| Shape factor BW _{60 dB} : BW _{6 dB} ≤120 kHz 1 MHz | <5:1 (Gaussian filter) <15:1 (4-circuit synchronously tuned filters) | |
| Video bandwidths | 1 Hz to 10 MHz; in 1, 3, 10 sequence | |
| FFT filter | | |
| Bandwidths (–3 dB) | 1 Hz to 30 kHz (–3 dB); in 1, 3, 10 sequence | |
| Bandwidth error, nominal | 5% | |
| Shape factor BW _{60 dB} : BW _{3 dB} , nominal | 2.5 | |
| Level | | |
| Display range | displayed average noise level to 137 dBμV | |
| Maximum input level | | |
| DC voltage | 50 V | |
| RF attenuation 0 dB | | |
| CW RF power | 127 dBμV (= 0.3 W) | |
| Pulse spectral density | 97 dB(μV/MHz) | |
| RF attenuation ≥10 dB | | |
| CW RF power | 137 dBμV (= 1 W) | |
| Max. pulse voltage | 150 V | |
| Max. pulse energy (10 μs) | 1 mWs | |
| 1 dB compression of input mixer | | |
| 0 dB RF attenuation, f >200 MHz, without preselector | 0 dBm nominal | |
| Intermodulation | | |
| 3rd-order intermodulation (TOI) | | |
| Intermodulation-free dynamic range, level 2 × –30 dBm, Δf >5 × RBW or 10 kHz, whichever the greater value | | |
| 20 MHz to 200 MHz | >70 dBc, TOI >5 dBm | |
| 200 MHz to 3 GHz | >74 dBc, TOI >7 dBm (10 dBm typ.) | |
| 3 GHz to 7 GHz | – | >80 dBc, TOI >10 dBm (15 dBm typ.) |
| with option R&S® ESPI-B2, preselector switched on, preamplifier switched off | | |
| 20 MHz to 200 MHz | >65 dBc, TOI >0 dBm | |
| 200 MHz to 3 GHz | >69 dBc, TOI >2 dBm (5 dBm typ.) | |

| | R&S® ESPI 3 | R&S® ESPI 7 |
|--|---|-----------------------------|
| with option R&S® ESPI-B2, preselector switched on, preamplifier switched on | | |
| 20 MHz to 200 MHz | >45 dBc, TOI >–20 dBm | |
| 200 MHz to 3 GHz | >49 dBc, TOI >–18 dBm (–15 dBm typ.) | |
| Second harmonic intercept point (SHI) | | |
| <100 MHz | 25 dBm typ. | |
| 100 MHz to 3 GHz | 35 dBm typ. | |
| 3 GHz to 7 GHz | – | 45 dBm typ. |
| with option R&S® ESPI-B2, preselector switched on, preamplifier switched off | | |
| 4 MHz to 100 MHz | >40 dBm | |
| 100 MHz to 3 GHz | >50 dBm | |
| with option R&S® ESPI-B2, preselector switched on, preamplifier switched on | | |
| 4 MHz to 100 MHz | >25 dBm | |
| 100 MHz to 3 GHz | >35 dBm | |
| Displayed average noise level | | |
| 0 dB RF attenuation, RBW = 10 Hz, VBW = 1 Hz, 20 averages, trace average, zero span, 50 Ω termination | | |
| 9 kHz | <–95 dBm | |
| 100 kHz | <–100 dBm | |
| 1 MHz | <–120 dBm, –125 dBm typ. | |
| 10 MHz to 1 GHz | <–142 dBm, –145 dBm typ. | <–140 dBm, –145 dBm typ. |
| 1 GHz to 3 GHz | <–140 dBm, –145 dBm typ. | <–138 dBm, –143 dBm typ. |
| 3 GHz to 7 GHz | – | <–138 dBm, –143 dBm typ. |
| with option R&S® ESPI-B2, preselector switched on, preamplifier switched off | | |
| 9 kHz | <–95 dBm | |
| 100 kHz | <–100 dBm | |
| 1 MHz | <–120 dBm, –125 dBm typ. | |
| 10 MHz to 1 GHz | <–142 dBm, –145 dBm typ. | <–140 dBm, –145 dBm typ. |
| 1 GHz to 3 GHz | <–140 dBm, –145 dBm typ. | <–138 dBm, –143 dBm typ. |
| with option R&S® ESPI-B2, preselector switched on, preamplifier switched on | | |
| 9 kHz | <–105 dBm | |
| 100 kHz | <–110 dBm | |
| 1 MHz | <–130 dBm, –137 dBm typ. | |
| 10 MHz to 1 GHz | <–152 dBm, –155 dBm typ. | <–150 dBm, –153 dBm typ. |
| 1 GHz to 3 GHz | <–150 dBm, –153 dBm typ. | <–148 dBm, –151 dBm typ. |
| Immunity to interference | | |
| Image rejection | >70 dB | |
| Intermediate frequency (f <3 GHz) | >70 dB | |
| Spurious responses (f >1 MHz, without input signal, 0 dB attenuation) | <–103 dBm | |
| Other spurious (with input signal, mixer level <–10 dBm, Δf >100 kHz) | f <7 GHz: <–70 dBc | |
| Level display (receiver mode) | | |
| Digital | numerical; 0.01 dB resolution | |
| Analog | bargraph display, separately for each detector | |
| Spectrum | level axis 10 dB to 200 dB in 10 dB steps, frequency axis user- selectable, linear or logarithmic | |
| Units of level display | dBμV, dBm, dBμA, dBpW, dBpT | |

| | R&S® ESPI 3 | R&S® ESPI 7 |
|---|--|--------------------|
| Detectors | average (AV), RMS, MaxPeak, MinPeak and Quasi-Peak (QP), 3 detectors can be switched on simultaneously | |
| Measurement time | 100 μs to 100 s, selectable | |
| Level display (analyzer mode) | | |
| Result display | 501 × 400 pixels (one diagram), max. 2 diagrams with independent settings | |
| Log level scale | 10 dB to 200 dB in 10 dB steps | |
| Linear level scale | 10% of reference level per level division (10 divisions) | |
| Traces | max. 3 per diagram | |
| Trace detectors | MaxPeak, MinPeak, AutoPeak, Sample, RMS, Average, Quasi-Peak | |
| Trace functions | Clear/Write, MaxHold, MinHold, Average | |
| Setting range of reference level | | |
| Logarithmic level display | −130 dBm to +30 dBm, in 0.1 dB steps | |
| Linear level display | 70.71 nV to 7.07 V; in steps of 1% | |
| Units of level scale | dBm, dBmV, dBμV, dBμA, dBpW (log level display); mV, μV, mA, μA, pW, nW (linear level display) | |
| Level measurement accuracy | | |
| Level accuracy at 128 MHz (level = −30 dBm, RF attenuation 10 dB, ref. level −20 dBm, RBW 10 kHz) | <0.2 dB (σ = 0.07 dB) | |
| Additional error with preselector/preamplifier (with option R&S® ESPI-B2) | 0.1 dB | |
| Quasi-peak display | in line with CISPR 16-1, ≥10 Hz pulse repetition frequency (with option R&S® ESPI-B2) | |
| Frequency response | | |
| <50 kHz | +0.5/−1.0 dB | |
| 50 kHz to 3 GHz | <0.5 dB (σ = 0.17 dB) | |
| 3 GHz to 7 GHz | – | <2 dB (σ = 0.7 dB) |
| with option R&S® ESPI-B2, preselector switched on | | |
| <50 kHz | +0.8/−1.3 dB | |
| 50 kHz to 3 GHz | <0.8 dB (σ = 0.27 dB) | |
| Attenuator | <0.2 dB (σ = 0.07 dB) | |
| Reference level switching | <0.2 dB (σ = 0.07 dB) | |
| Display nonlinearity log/lin (S/N >16 dB) | | |
| RBW ≤120 kHz 0 dB to −70 dB −70 dB to −90 dB | <0.2 dB (σ = 0.07 dB) <0.5 dB (σ = 0.17 dB) | |
| RBW ≥300 kHz 0 dB to −50 dB −50 dB to −70 dB | <0.2 dB (σ = 0.07 dB) <0.5 dB (σ = 0.17 dB) | |
| Bandwidth switching uncertainty (ref. to RBW = 10 kHz) 10 Hz to 100 kHz 300 kHz to 10 MHz FFT 1 Hz to 3 kHz | <0.1 dB (σ = 0.03 dB) <0.2 dB (σ = 0.07 dB) <0.2 dB (σ = 0.03 dB) | |
| Total measurement uncertainty 0 Hz to 3 GHz Analyzer without preselection Receiver/analyzer with preselection | 0.5 dB <1.5 dB | |
| Audio demodulation | | |
| Modulation modes | AM and FM | |
| Audio output | loudspeaker and headphones output | |
| Trigger functions | | |
| Trigger | | |
| Span ≥10 Hz | | |
| Trigger source | free run, video, external, IF level | |

| | R&S® ESPI 3 | R&S® ESPI 7 |
|---|---|-------------|
| Trigger offset | 125 ns to 100 s, resolution 125 ns min. or 1% of offset | |
| Span = 0 Hz | | |
| Trigger source | free run, video, external, IF level | |
| Trigger offset | ±125 ns to 100 s, resolution 125 ns min., depending on sweep time | |
| Max. deviation of trigger offset | ± (125 ns + (0.1% × delay time)) | |
| Gated sweep | | |
| Trigger source | external, IF level, video | |
| Gate delay | 1 μs to 100 s | |
| Gate length | 125 ns to 100 s, resolution 125 ns min. or 1% of gate length | |
| Max. deviation of gate length | ± (125 ns + (0.05% × gate length)) | |
| Inputs and outputs (front panel) | | |
| RF input | | |
| VSWR (RF attenuation >0 dB) | | |
| f <3 GHz | 1.5:1 | |
| f <7 GHz | – | 2.0:1 |
| Input attenuator | 0 dB to 70 dB in 10 dB steps | |
| Probe power supply | | |
| 3-pin female: +15 V DC, −12.6 V DC and ground, max. 150 mA 5-pin mini DIN female: ±10 V DC and ground, max. 200 mA | | |
| Keyboard connector | | |
| PS/2 female for MF keyboard | | |
| AF output | | |
| mini jack | | |
| Output impedance | 10 Ω | |
| Open-circuit voltage | up to 1.5 V; adjustable | |
| Inputs and outputs (rear panel) | | |
| IF 20.4 MHz | | |
| Z _{out} = 50 Ω, BNC female | | |
| Level | | |
| RBW ≤30 kHz, FFT | −10 dBm at reference level, mixer level >−60 dBm | |
| RBW ≥100 kHz | 0 dBm at reference level, mixer level >−60 dBm | |
| Reference frequency | | |
| Output | | |
| Output frequency | BNC female 10 MHz 0 dBm nominal | |
| Level | | |
| Input | | |
| Input frequency | BNC female 10 MHz 0 dBm from 50 Ω | |
| Required level | | |
| Power supply connector for noise source | | |
| BNC female, 0 V and 28 V switchable, max. 100 mA | | |
| External trigger/gate input | | |
| BNC female, >10 kΩ | | |
| Voltage | | |
| 1.4 V | | |
| IEC/IEEE-bus remote control | | |
| interface to IEC 60625 (IEEE 488.2) | | |
| Command set | | |
| SCPI 1997.0 | | |
| Connector | | |
| 24-pin Amphenol female | | |
| Interface functions | | |
| SH1, AH1, T6, L4, SR1, RL1, PP1, DC1, DT1, C0 | | |
| Serial interface | | |
| RS-232-C interface (COM), 9-pin SUB-D connector | | |
| Printer interface | | |
| parallel interface (Centronics-compatible) | | |
| Mouse connector | | |
| PS/2 female | | |
| User interface | | |
| 25-pin SUB-D female | | |
| Connector for external monitor (VGA) | | |
| 15-pin SUB-D female | | |

| General data | |
|---|--|
| Display | 21 cm TFT colour display (8.4") |
| Resolution | 640 × 480 pixels (VGA resolution) |
| Pixel failure rate | $<2 \times 10^{-5}$ |
| Mass memory | 1.44 Mbyte 3½" disk drive, hard disk |
| Data storage | >500 instrument settings |
| Operating temperature range | |
| Rated temperature range | +5°C to +40°C |
| Limit temperature range | +5°C to +45°C |
| Storage temperature range | -40°C to +70°C |
| Damp heat | +40°C at 95% rel. humidity (IEC 60068) |
| Mechanical resistance | |
| Vibration test, sinusoidal | 5 Hz to 150 Hz, max. 2 g at 55 Hz, 0.5 g from 55 Hz to 150 Hz, meets IEC 60068, IEC 61010, MIL-T-28800D, class 5 |
| Vibration test, random | 10 Hz to 100 Hz, acceleration 1 g (rms) |
| Shock test | 40 g shock spectrum, meets MIL-STD-810C and MIL-T-28800D, classes 3 and 5 |
| Recommended calibration interval | 2 years for operation with external reference, 1 year with internal reference |
| Power supply | |
| AC supply | 100 V to 240 V AC, 50 Hz to 400 Hz, protection class I to VDE 411 |
| Power consumption | 70 VA (R&S®ESPI3) 120 VA (R&S®ESPI7) |
| Safety | meets EN 61010-1, UL 3111-1, CSA C22.2 No. 1010-1, IEC 61010 |
| RFI suppression | meets EMC Directive of EU (89/336/EEC) and German EMC law |
| Test mark | VDE, GS, CSA, CSA-NRTL/C |
| Dimension (W × H × D) | 412 mm × 197 mm × 417 mm |
| Weight | 10.5 kg (R&S®ESPI3) 11.3 kg (R&S®ESPI7) |



Ordering information

| Order designation | Type | Order No. |
|---|---------------|--------------|
| Test Receiver 9 kHz to 3 GHz | R&S® ESPI3 | 1142.8007.03 |
| Test Receiver 9 kHz to 7 GHz | R&S® ESPI7 | 1142.8007.07 |
| Accessories supplied | | |
| Power cable, operating manual, service manual | | |
| Options | | |
| Preselector/Preamplifier for R&S® ESPI (factory-fitted) | R&S® ESPI-B2 | 1129.7498.02 |
| Extended Environmental Specifications (random vibration 1.9 g RMS, temperature 0°C to 55°C) | R&S® ESPI-B20 | 1155.1606.03 |
| Trigger for Coverage Measurements | R&S® ESPI-K50 | 1106.4386.02 |
| Rugged Case, Carrying Handle (factory-fitted) | R&S® FSP-B1 | 1129.7998.02 |
| OXC0 Reference Frequency | R&S® FSP-B4 | 1129.6740.02 |
| TV Trigger and Adjustable RF Power Trigger (40 dB) for R&S® FSP and R&S® ESPI | R&S® FSP-B6 | 1129.8594.02 |
| Internal Tracking Generator 9 kHz to 3 GHz, I/Q modulator, for all R&S® ESPI models | R&S® FSP-B9 | 1129.6991.02 |
| External Generator Control for all R&S® ESPI models | R&S® FSP-B10 | 1129.7246.02 |
| LAN Interface 100BT for all R&S® ESPI models | R&S® FSP-B16 | 1129.8042.02 |
| DC Power Supply for Spectrum Analyzers R&S® FSP/ESPI | R&S® FSP-B30 | 1155.1158.02 |
| Battery Pack for Spectrum Analyzers R&S® FSP/ESPI ¹⁾ | R&S® FSP-B31 | 1155.1258.02 |
| Spare Battery Pack for Spectrum Analyzers R&S® FSP/ESPI ²⁾ | R&S® FSP-B32 | 1155.1506.02 |
| Noise Measurement Software | R&S® FS-K3 | 1057.3028.02 |
| AM/FM Measurement Demodulator | R&S® FS-K7 | 1141.1796.02 |

| Order designation | Type | Order No. |
|---|-----------------------------------|--|
| Recommended extras | | |
| Pulse Limiter 0 Hz to 30 MHz | R&S® ESH3-Z2 | 0357.8810.54 |
| Control Cable for V-Network R&S® ESH2-Z5 (2 m) | R&S® EZ-13 | 1026.5293.02 |
| Control Cable for V-Network R&S® ESH3-Z5 (2 m) | R&S® EZ-14 | 1026.5341.02 |
| Headphones | – | 0708.9010.00 |
| US Keyboard with trackball | R&S® PSP-Z2 | 1091.4100.02 |
| PS/2 Mouse | R&S® FSE-Z2 | 1084.7043.02 |
| IEC/IEEE-Bus Cable, 1 m | R&S® PCK | 0292.2013.10 |
| IEC/IEEE-Bus Cable, 2 m | R&S® PCK | 0292.2013.20 |
| 19" Rack Adapter (not for R&S® FSP-B1) | R&S® ZZA478 | 1096.3248.00 |
| Trolley | R&S® ZZK-1 | 1014.0510.00 |
| Soft Carrying Case, grey | R&S® ZZT 473 | 1109.5048.00 |
| Matching Pads, 75 Ω L Section Series Resistor, 25 Ω ³⁾ SWR Bridge, 5 MHz to 3000 MHz | R&S® RAM R&S® RAZ R&S® ZRB2 | 0358.5414.02 0358.5714.02 0373.9017.52 |
| High-Power Attenuators, 100 W 3/6/10/20/30 dB | R&S® RBU 100 | 1073.8820.XX (XX = 03/06/10/20/30) |
| High-Power Attenuators, 50 W 3/6/10/20/30 dB | R&S® RBU50 | 1073.8695.XX (XX = 03/06/10/20/30) |

¹⁾ R&S® FSP-B1 and R&S® FSP-B30 required.

²⁾ R&S® FSP-B31 required.

³⁾ Taken into account in device function RF INPUT 75 Ω.

See also data sheets

- ◆ Accessories for Test Receivers and Spectrum Analyzers: PD 0756.4320
- ◆ EMC Test Antennas: PD 0757.5743

For information on EMC training courses or on-the-job training please contact:

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



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