SWR Bridge R&S ZRA

40 kHz to 150 MHz

- Small low-end cutoff frequency
- High directivity
- Excellent matching
- High power-handling capacity
- Rugged construction

The SWR Bridge R&S ZRA is used to measure the magnitude and phase of the reflection coefficient of RF circuits and components, e.g. filters, amplifiers, mixers or antennas. The output signal a from the signal source, e.g. a signal generator, is applied to the DUT via the SWR bridge. Depending on the reflection coefficient r of the DUT, part of this signal is reflected to the SWR bridge an then routed to the receiver, which may be a voltmeter, power meter, spectrum or network analyzer that is connected to the bridge output. The output signal b is a measure of the complex reflection coefficient r of the DUT. Some of the measuring instruments convert the measured reflection coefficient into other parameters, e.g. into the impedance or admittance of the DUT. In this case, magnitude and phase as well as real and imaginary components can be displayed. The reflection coefficient stated in percent can also be converted into the return loss in dB or the standing-wave ratio SWR.

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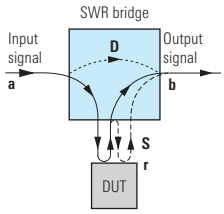
Measurement uncertainty

The accuracy of the SWR bridge is limited by its directivity D and the return loss S of the test port. The finite directivity D causes an error signal (dotted signal path D), which passes from the input of the SWR bridge directly to its output without reaching the DUT. The finite return loss S causes multiple reflections between test port and DUT. For estimating the error, it is sufficient to investigate a single reflection only (dashed signal path S).



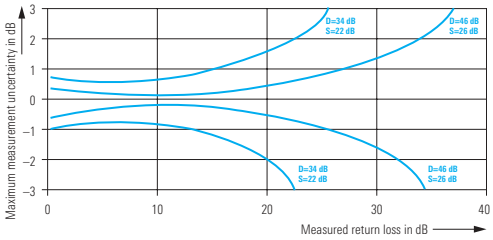
Taking into account the insertion loss T of the SWR bridge, the approximate relationship between input signal a and output signal b is:

$$b = T \times (r + D + S \times r^2) \times a$$

This equation shows that measurement of small reflection coefficients r is impaired by the finite directivity D of the SWR bridge. The relative measurement uncertainty increases with decreasing reflection coefficient. Reflection coefficients that are smaller than the directivity of the bridge cannot be measured directly. When large reflection coefficients are measured, the accuracy mainly depends on the return loss S of the test port.

With a directivity of 40 dB and a return loss at the test port of 26 dB for example, the maximum absolute error as a function of the reflection coefficient to be measured is $0.01 + 0.05 \times |r|^2$.

The diagram, which shows the maximum positive and negative measurement uncertainty as a function of the measured return loss, allows a quantitative evaluation of this relationship. It should be noted that these values are the specified limit values of the R&S ZRA. In the lower and middle frequency range, both the directivity (50 dB typ.) and the return loss at the test port (36 dB typ.) are better than the specified values. Any measurement uncertainties occurring then are smaller than the limits shown and can usually be neglected for practical measurements.



Maximum measurement uncertainty with assumed directivity of 35 dB and 45 dB and return loss at test port of 25 dB and 30 dB

Specifications

Impedance	50 Ω
Frequency range	40 kHz to 150 MHz
Directivity up to 1 MHz up to 150 MHz	 ≥45 dB ≥40 dB
Test port matching up to 200 kHz 0.2 MHz to 50 MHz up to 150 MHz	 ≥20 dB ≥30 dB ≥20 dB
Insertion loss[1)]	7.5 dB + 6 dB
Power-handling capacity	0.5 W
Rated temperature range	0 °C to +50 °C
Storage temperature range	–40 °C to +70 °C
Connectors (input, output, test port)	N female
Weight	190 g
Dimensions (W x H x D, without connectors)	52 mm x 52 mm x 41 mm

1) Attenuation: input ----> test port + test port ---> output.

Certified Quality System
ISO 9001
DQS REG. NO 1954

Certified Environmental System
ISO 14001
REG. NO 1954

Ordering information

SWR Bridge	R&S ZRA	1052.3607.52

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SWR Bridge ZRB2

Broadband impedance and reflection coefficient measurements

- Wide frequency range:
  5 to 3000 MHz
- Characteristic impedance
  50 Ω or 75 Ω
- High directivity
- Good matching characteristics
- Sturdy construction

Characteristics and uses

The SWR Bridge ZRB2 is used to measure the magnitude and phase of the reflection coefficient, e.g. of filters, amplifiers, mixers or antennas. The output signal **a** from the generator is fed via the SWR Bridge to the device under test. Part of the signal is reflected via the SWR Bridge to the indicator, the amount depending on the reflection coefficient **r** of the device under test. This part **b** of the signal is a measure of the complex reflection coefficient **r** of the device under test. Intelligent indicators convert the measured reflection coefficient into other parameters, e.g. the impedance or admittance of the device under test. In this case, display is possible as magnitude and phase as well as real and imaginary quantities.

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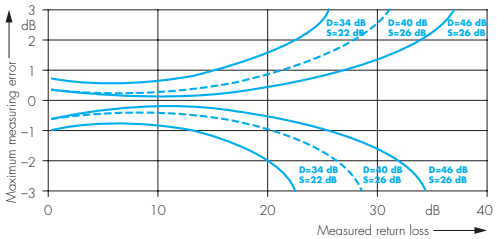
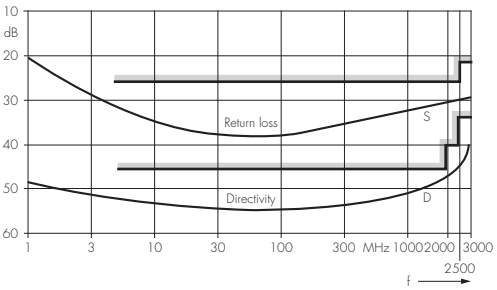
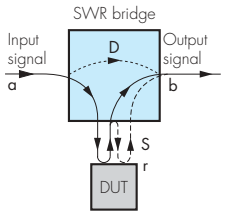
Maximum measurement errors with an assumed return loss at the test port of 22 and 26 dB (SWR = 1.17 and 1.1) and a directivity of 34, 40 and 46 dB



Precision model ZRB2 (50 Ω): typical response and tolerance limits of return loss S at test port and directivity D





Measurement accuracy

Measurement accuracy is determined by two effects (small diaram above):

1. The finite directivity of the SWR Bridge; the error signal is coupled directly to the bridge output (dotted signal path D).

2. Multiple reflections between the device under test and the test port; it is enough for the estimation of the error to consider one reflection only (dashed signal path s).

The approximate relationship between the input signal a and the output signal b is:

$b = T \times (D + r + S \times r^2) \times a$

where T = insertion loss, D = directivity, S = return loss at the test port of the SWR Bridge and r = reflection coefficient of the device under test.

This equation shows that measurement of small reflection coefficients will be detrimentally affected by the finite directivity D of the SWR Bridge. The relative measurement error increases with decreasing reflection coefficient. Reflection coefficients that are smaller than the directivity of the bridge cannot be measured dirctly. With measurements of large reflection coefficients, this error can be neglected. The error of the measurement depends on the mismatch of the test port of the SWR Bridge. With a directivity of 46 dB and a return loss at the test port of 26 dB, the maximum absolute error as a function of the reflection coefficient to be measured will be $0.005 + 0.05\,|r|^2$.

The diagram above shows the maximum measurement error to be expected with respect to the measured return loss and allows a quantitativ determination of this relationship. The plotted curves represent the highest possible positive and negative deviations of the measured value from the true value of the return loss. It is to be noted that these values are the specified limit values of the ZRB2. For the lower and middle frequency ranges both the return loss at the test port (typ. >28 dB) and the directivity (typ. >50 dB) are higher than shown. Any measurement uncerntainty that than occurs is lower than the limits plotted and can in most cases be neglected for pratical measurements.

Specifications

	Precision model 50 Ω	**Standard model 50 Ω**	**Standard model 75 Ω**
Frequency range	5 to 3000 MHz	5 to 2500MHz	5 to 2000 MHz
Characteristic impedance	50 Ω	50 Ω	75 Ω
Directivity	≥46 dB up to 2 GHz, ≥40 dB up to 2.5 GHz, ≥34 dB up to 3 GHz	≥40 dB	≥40 dB
Return loss at test port	≥26 dB up to 2.5 GHz, ≥22 dB up to 3 GHz	≥23 dB	≥20 dB up to 1.5 GHz, ≥18 dB up to 2 GHz
Measurement error (|r| = magnitude of measured reflection coefficient)	$0.005 + 0.05\,\|r\|^2$ up to 2 GHz, $0.01 + 0.05\,\|r\|^2$ up to 2.5 GHz, $0.02 + 0.08\,\|r\|^2$ up to 3 GHz	$0.01 + 0.07\,\|r\|^2$	$0.01 + 0.1\,\|r\|^2$ up to 1.5 GHz, $0.01 + 0.13\,\|r\|^2$ up to 2 GHz
Insertion loss (5 MHz)			
Total	13 dB	13 dB	14 dB
Input – test port	7 dB	7 dB	8 dB
Test port – output	6 dB	6 dB	6 dB
Power-handling capacity	0.5 W	0.5 W	0.5 W

General data	
Nominal temperature range	0 to +50°C
Storage temperature range	–40 to +70°C
Connectors	N female
Test port connector	N female or N male
Dimensions without connectors (L x W x H; mm)	72 x 57 x 20
Connector length, female	17 mm
male	19 mm
Weight	240 g
Order designation	SWR Bridge ZRB2
50 Ω, 5 to 3000 MHz, test port connector female	373.9017.52
male	373.9017.55
50 Ω, 5 to 2500 MHz, test port connector female	373.9017.53
male	373.9017.56
75 Ω, 5 to 2000 MHz, test port connector female	802.1018.73
male	802.1018.76

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