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## **2 Specifications**

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## Environmental Requirements

**Table 2-1 Environmental Requirements**

Parameter	Limits
Temperature	
Operating <sup>a</sup>	+20 °C to +26 °C
Storage	–40 °C to +75 °C
Error-corrected range <sup>b</sup>	±1 °C of measurement calibration temperature
Relative humidity	Type tested, 0% to 95% at 40 °C, non-condensing

- a. The temperature range over which the calibration standards maintain performance to their specifications.
- b. The allowable network analyzer ambient temperature drift during measurement calibration and during measurements when the network analyzer error correction is turned on. Also, the range over which the network analyzer maintains its specified performance while correction is turned on.

### Temperature—What to Watch Out For

Changes in temperature can affect electrical characteristics. Therefore, the operating temperature is a critical factor in performance. During a measurement calibration, the temperature of the calibration devices must be stable and within the range shown in [Table 2-1](#).

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**IMPORTANT** Avoid unnecessary handling of the devices during calibration because your fingers act as a heat source and may increase the temperature of the device.

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## Mechanical Characteristics

Table 2-2 lists the typical characteristics of the  $\frac{1}{4}$  wavelength shims in your kit. These are *not* specifications, but are included as additional information.

### $\frac{1}{4}$ Wavelength Shims

Figure 2-1  $\frac{1}{4}$  Wavelength Shims

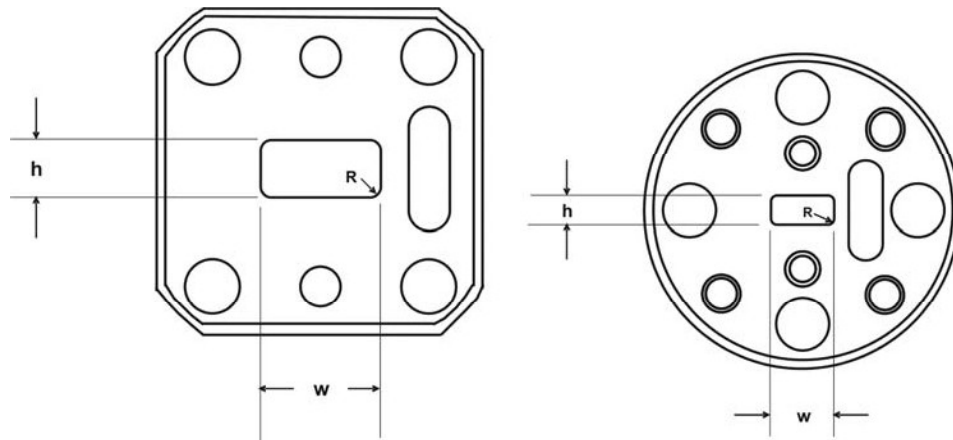


Table 2-2 Mechanical Characteristics of  $\frac{1}{4}$  Wavelength Shims

Part Number	Waveguide Band	W (mm)	H (mm)	R (mm)	Thickness (mm)
11664-20003	WR28	7.112 $\pm$ 0.006	3.556 $\pm$ 0.006	0.043 max	3.018 $\pm$ 0.013
11664-20001	WR22	5.690 $\pm$ 0.006	2.845 $\pm$ 0.006		2.422 $\pm$ 0.013
11664-20002	WR19	4.775 $\pm$ 0.006	2.388 $\pm$ 0.006		1.991 $\pm$ 0.013
11664-20013	WR15	3.759 $\pm$ 0.006	1.880 $\pm$ 0.006		1.611 $\pm$ 0.005
11664-20014	WR10	2.540 $\pm$ 0.006	1.270 $\pm$ 0.006		1.085 $\pm$ 0.005

### Shorts

All waveguide shorts are flat within 0.008 mm.

## Electrical Specifications

Table 2-3 through Table 2-5 list the electrical specifications of the terminations,  $\frac{1}{4}$  wavelength shims, and standard sections in your kit.

**Table 2-3 Electrical Specifications of Terminations**

Device	Frequency	Termination Specification
R11644A WR-28	26.5 to 40 GHz	Effective return loss $\geq 46$ dB <sup>a</sup>
Q11644A WR-22	33 to 50 GHz	Effective return loss $\geq 46$ dB <sup>a</sup>
U11644A WR-19	40 to 60 GHz	Effective return loss $\geq 46$ dB <sup>a</sup>
V11644A WR-15	50 to 75 GHz	Return loss $\geq 38.2$ dB
W11644A WR-10	75 to 110 GHz	Return loss $\geq 36.6$ dB

a. Effective return loss accounts for line section, connector, and load stability as used in a network analyzer to define directivity after calibration.

**Table 2-4 Electrical Specifications of  $\frac{1}{4}$  Wavelength Shims**

Part Number	Waveguide Band	Return Loss (dB) <sup>a</sup>
11664-20003	WR28	50
11664-20001	WR22	
11664-20002	WR19	
11664-20013	WR15	
11664-20014	WR10	46

a. Return loss specification is guaranteed by mechanical specifications.

**Table 2-5 Electrical Specifications of Standard Sections**

Device	Frequency	Standard Section Specification
R11644A WR-28	26.5 to 40 GHz	Return loss $\geq 42$ dB
Q11644A WR-22	33 to 50 GHz	Return loss $\geq 42$ dB
U11644A WR-19	40 to 60 GHz	Return loss $\geq 42$ dB
V11644A WR-15	50 to 75 GHz	Return loss $\geq 40$ dB
W11644A WR-10	75 to 110 GHz	Return loss $\geq 36.6$ dB

## Measurement Uncertainty

Vector Network Analyzer (VNA) measurement accuracy depends on the accuracy of the calibration standards, the calibration method employed, instrumentation accuracy and stability, environmental factors, and the actual characteristic of the device under test (DUT). Because of the complexity in these relationships, Agilent created uncertainty computation tools to calculate the overall measurement uncertainty of a VNA system. In the past, when the Agilent 8510 VNA system was being produced, a “Specification and Verification” RMB program was included to perform an uncertainty calculation. Currently, for the Agilent PNA and ENA families of network analyzers, a customer can download the VNA Uncertainty Calculator program. (To access this program from the Web, navigate to [www.agilent.com](http://www.agilent.com) and enter “calculator” in the Search function.) Explanations of the uncertainty model are provided in the PNA embedded Help files. Additional references on VNA measurements are available from the Agilent Applications Notes and Technical Papers Web page, accessed from [www.agilent.com](http://www.agilent.com) by clicking on the Application Notes and Technical Papers hyperlink.

## Certification

Agilent Technologies certifies that this product met its published specifications at the time of shipment from the factory. Agilent further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology (NIST) to the extent allowed by the institute’s calibration facility, and to the calibration facilities of other International Standards Organization members. See “[How Agilent Verifies the Devices in Your Kit](#)” on page 5-2 for more information.