

Application Note

Choice and use of fixed attenuators

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1. Purpose of the document

General recommendations on use and choice of a fixed coaxial RF/microwave attenuator

2. Summary

Before operating the attenuator, users must first confirm the impedance of the device under test; otherwise, reflections will occur. The connection sequence is also crucial: the attenuator output should be connected first, followed by the input, to avoid direct connection while the device is powered on. Power handling capability is easily overlooked and must be handled with care.

3. Standard Usage Method

a. Impedance Matching

Ensure the attenuator's input/output impedance matches the system's characteristic impedance (Typically 50Ω or 75Ω).

b. Operating Steps:

1. Turn off the device power. Connect the attenuator in series between the signal source and the load (e.g., signal source → attenuator input → attenuator output → receiving device).
2. When connecting cables or using adapters to convert interfaces, a torque wrench must be used to ensure the interface is securely tightened without any looseness.
3. Before use, confirm the output power of the signal source (amplifier) to avoid product burnout caused by excessive input power.

c. Power Control

i. Continuous Wave (CW) Power:

For steady-state signals, don't exceed the attenuator's nominal CW power value.

ii. Peak Power:

For pulse signals (such as radar), the pulse width and duty cycle requirements must be met. (e.g., 100W 5μs pulse width, 1KW peak power 5% duty cycle)

d. Connector Specifications:

The connector types must match (such as SMA, N-type, 2.92mm), and male/female connectors must not be forcefully mismatched.

4. Key Precautions

a. Power Limitations

1. Strictly Prohibit Exceeding Power Rating: otherwise, the internal resistors may be burned out.
2. Strictly Prohibit Reverse Connection: If the attenuator has an IN/OUT direction indication, it must be operated according to the input and output ends. Reverse connection may cause product damage. (Products without direction markings on the product itself are considered bidirectional by default.)

a. Temperature and Humidity Limitations

The surface temperature of the product must be monitored during use. If the surface temperature rises, the operating power of the product must be reduced; otherwise, the product may be damaged (use according to the temperature derating curve). Ensure proper temperature control of the product.

Temperature changes may cause attenuation drift ($<0.004\text{dB/dB/}^\circ\text{C}$).

If there are peak power requirements, the pulse width, peak power, and duty cycle to be used must be confirmed beforehand to avoid damage.

If the product requires protection levels, it must be specified before purchase.

b. Maintenance and Service Life

1. Regularly check for interface oxidation/wear.
2. Verify attenuation accuracy and VSWR using a network analyzer.

a. Usage Recommendations:

1. It is recommended to use the attenuator and load at half power. If 100W (CW) is required, it is recommended to purchase a 200W product. This will extend the product's stability, reliability, and lifetime.
Also, some complex modulation (such as WCDMA....) may create high power "pulse".
2. It is not recommended to use high-frequency (18GHz) high-power (100W and above) attenuators to cover the entire frequency band. Purchase and use them separately for each frequency band.
3. Before purchasing attenuators or loads, please confirm the pulse width, peak power, and duty cycle of the product. If only average power is required, this can be ignored.

a. Safety Warnings:

The power supply must be disconnected prior to any operation to avoid electrostatic breakdown.

Avoid touching the ports when the RF attenuator is operating, as high-frequency radiation may be harmful to health.