FLUKE®
Calibration

Working with power splitters and dividers

Application Note

The difference between power splitters and power dividers and their applications is often misunderstood, leading to incorrect choice of device and attendant measurement errors. Both devices may be used to split or combine signals, and sometimes the appropriate choice may be unclear.

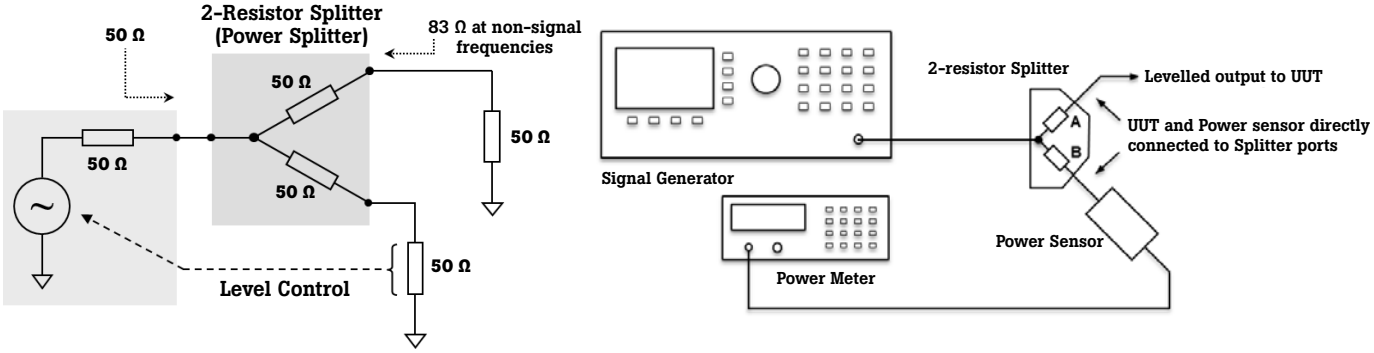

Figure 1. Power splitter (2-resistor splitter) employed for precision levelling.

The power splitter, often referred to as a 2-resistor splitter, is constructed to provide two very well matched impedances, very close to 50 Ω, between the input and each output port. Figure 1 depicts the typical power splitter application of precision leveling, where a power senor is connected to one splitter output port and the leveled signal appears at the other output port connected to the unit under test (UUT).

Feedback from the power meter, either as analog level control feedback or by computational correction, establishes the desired output level at the port connected to the power sensor. As the two splitter resistors are essentially identical, the same level appears at the other port connected to the UUT input. The effect of feedback (analog or computational) is to create a source of precise level from a very good 50 Ω impedance. However, analysis of the network impedances suggests that the output impedance should be 83 Ω. The 50 Ω impedance is only presented at the UUT at the signal frequency due to the feedback control loop, and 83 Ω is presented at all other frequencies. In practice, this is not an issue and power dividers are the appropriate devices when used in this manner for precision leveling applications.

The power divider, often called a 3-resistor divider, is constructed to be the equivalent of three equal (approximately 16.6 Ω) resistors as shown in figure 2. In practice its construction may not be three individual resistors on a substrate, instead having resistive material deposited on the substrate with three connections providing an equivalent circuit corresponding to three resistors. This power divider device may be used for simple power splitting applications, but should not be used for precision leveling applications commonly encountered in calibration applications. Its use is often more common in signal combining applications, as illustrated in figure 2. Unlike the power divider, it presents 50 Ω at all three ports. In calibration application requiring combining of signals and greater isolation between the sources (such as spectrum analyzer intermodulation testing) it is more common to use directional couplers.

In addition to the choice of device, making the connections with the correct physical device orientation is often the cause of errors, for example when using a power divider. Devices vary in their mechanical layout and packaging, with some having port configuration easier to identify than others. Figure 3 shows one style of power divider

device connected for precision leveling where its shape and labeling clearly differentiate the input and output ports.

Figure 4 shows another power divider device connected for this same application of establishing a precision level for spectrum analyzer calibration. However, it is easy to confuse the device port configuration and reverse the source and power sensor connections as shown in the right in figure 4. This confusion is reportedly a common mistake made with this particular style of splitter device, because the incorrect connection appears to offer opportunity to more easily support the power sensor when the setup is made close to the edge of the bench. Mistakes can be avoided and measurement errors reduced by employing an RF reference source which delivers an accurate input directly to the UUT (for example, the Fluke Calibration 96270A or 96040A.)

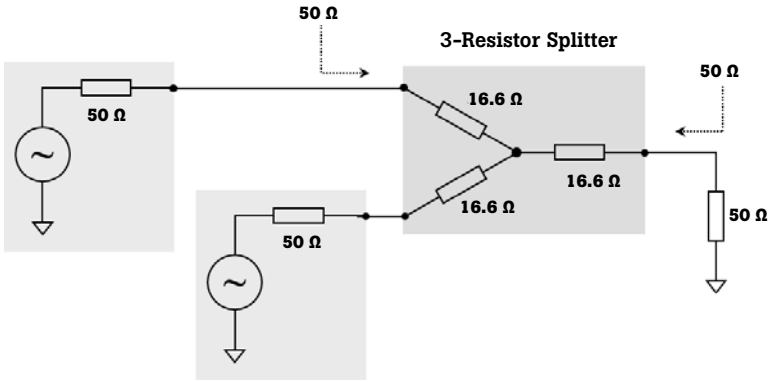

Figure 2. Power divider (3-resistor divider) employed for combining signals from two sources, also showing typical example devices.

Figure 3. An example of a power splitter employed for precision levelling in a spectrum analyzer calibration application where the device shape and labelling help to easily identify its port configuration.

Figure 4. A power splitter correctly configured (left) and incorrectly configured (right) for precision levelling.

Figure 5. Using an RF reference source like the Fluke Calibration 96270A can help you avoid mistakes and reduce measurement errors. The 96270A delivers an accurate input directly to the UUT up to 27 GHz with its unique "What you set is what you get" feature and ability to "self-characterize" or profile its output to account for losses and attenuation of system components like cables, attenuators, splitters, and connectors, effectively creating a signal reference plane at the UUT input connection.

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