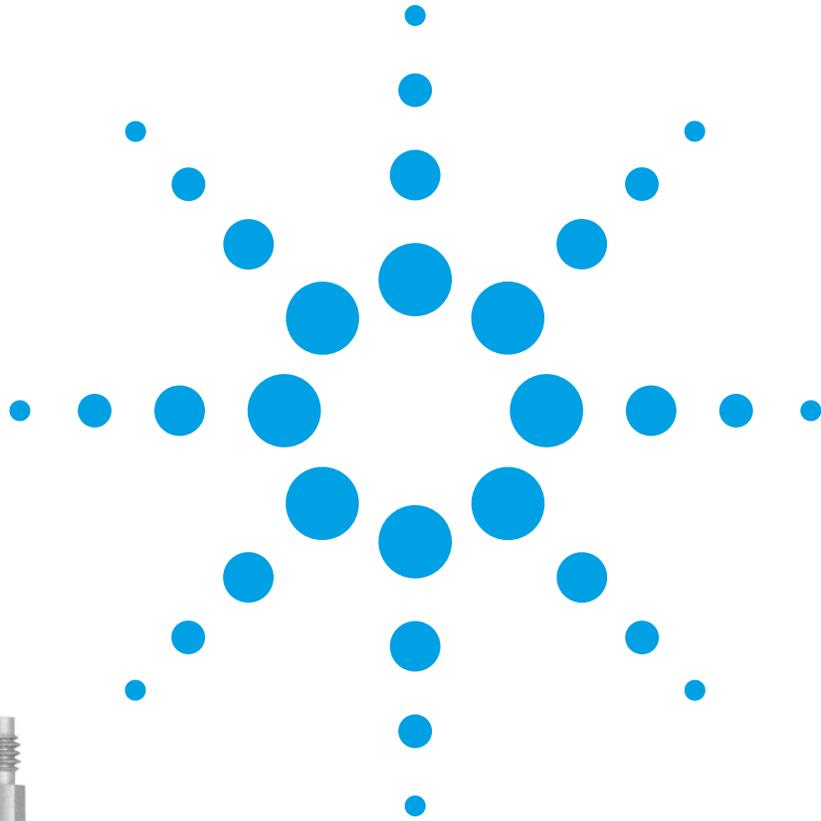


# Differences in Application Between Power Dividers and Power Splitters

Application Note



Agilent Technologies

## Introduction

Power dividers are an RF microwave accessory constructed with equivalent  $50\Omega$  resistance at each port. These accessories divide power of a uniform transmission line equally between ports to enable comparison measurements. Power dividers provide a good impedance match at both the output ports when the input is terminated in the system characteristic

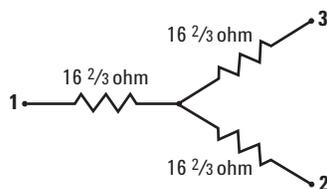
impedance ( $50\Omega$ ). Once a good source match has been achieved, a power divider is used to divide the output into equal signals for comparison measurements. The power divider also can be used in test systems to measure two different characteristics of a signal, such as frequency and power, for broadband independent signal sampling. Besides dividing power it also can act as power combiners because they are bi-directional.

Power splitters are constructed of two resistors. They are used for leveling and ratio measurement applications to improve the effective output match of microwave sources. The two-resistor configuration also provides  $50\Omega$  output impedance to minimize measurement uncertainty in source leveling or ratio measurement applications.

### Characteristics of power dividers and power splitters

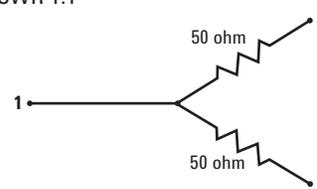
#### Power dividers

- Divide a signal equally for comparison measurements
- All ports have equivalent  $16\frac{2}{3}\Omega$  resistance
- Can be used as power combiners
- SWR 3:1



#### Power splitters

- Used in ratio measurements and leveling loop applications
- Only the input port has a  $50\Omega$  resistance, the other two ports have  $83.33\Omega$  impedance
- SWR 1:1



### Key specifications of Agilent 11636C power dividers and 11667C power splitter

#### 11636C power dividers

- Operating frequency: DC to 50 GHz
- $\pm 0.3$  dB amplitude tracking
- $\pm 2^\circ$  phase tracking
- Low SWR 1.67

#### 11667C power splitters

- Operating frequency: DC to 50 GHz
- $< 0.4$  dB tracking between output ports
- Excellent output: 1.10 SWR at the auxiliary port

# Power Divider and Power Splitter Applications

## Power divider applications

### Low power signal distribution to two antennas

In this application, a power divider divides the power into two antennas at the same time. Figure 1 shows how to make a simple connection to a power divider which distributes the low power signal equally into two antennas at one time.

### Intermodulation distortion (IMD) measurements

Power dividers can be used as power combiners for IMD measurements. IMD measurements require a signal with the appropriate phase relationships among the carriers to simulate real life conditions and provide repeatable results. A power divider accurately combines two signals from the two difference signal sources into one signal for the device under test (DUT). A spectrum analyzer is used to examine the output of DUT while it is being stimulated with multi-tone test signal.

Figure 2 shows the traditional measurement setup used to measure the IMD product with a two-tone test stimulus.

Figure 1. Simple test setup for power dividing application

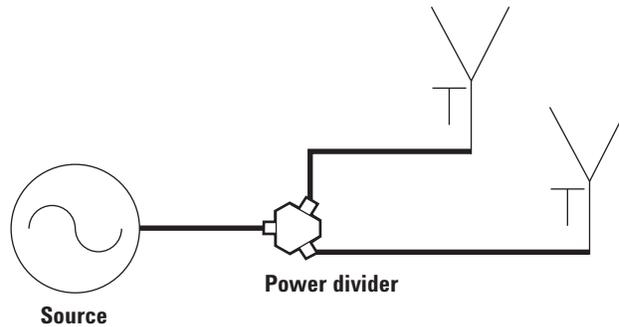
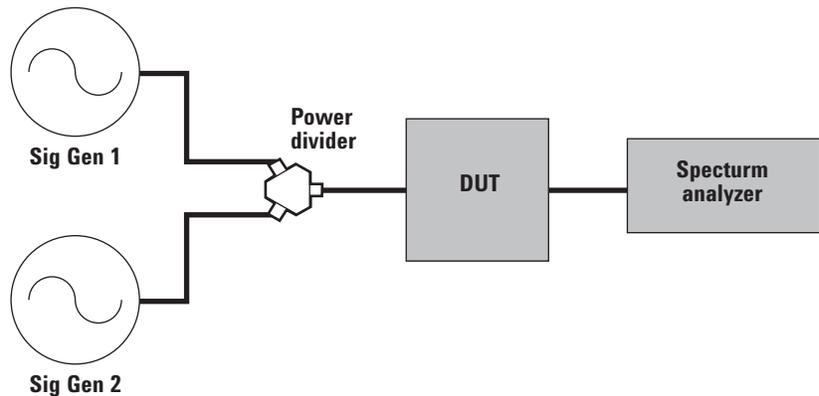


Figure 2. Power divider test setup for IMD measurements



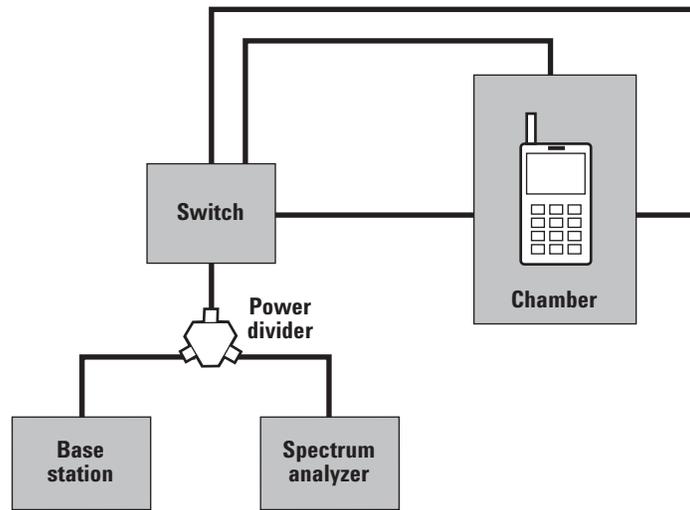
### Diversity gain measurements

The electromagnetic field in multipath environments is very strong in some positions and very weak in others. A power divider can be used to measure the diversity gain of the handset.

Figure 3 shows how to connect a power divider

This measurement setup is used to measure the diversity gain of digitally-enhanced cordless telecommunication (DECT) devices. The base station sends a signal through a power divider to a wall antenna selected by the switch. The handset then radiates the signal back to the base station. The handset is placed in a reverberation chamber so that a spectrum analyzer can receive and measure the radiated power of the signal.

Figure 3. Power divider test setup for diversity measurements

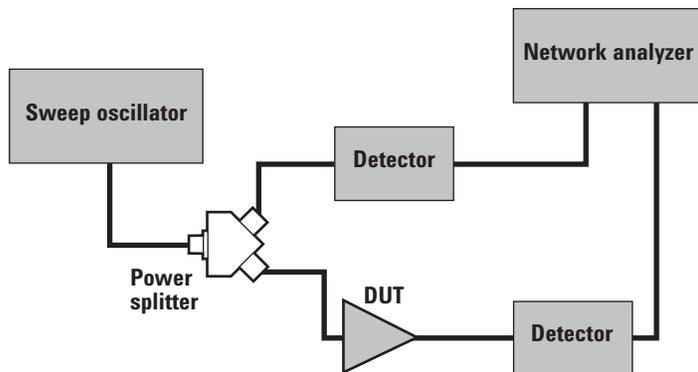


### Power splitter applications

#### Gain, compression and isolation measurements

Power splitters can be used for gain, gain compression and power testing. Figure 4 shows the basic test setup for amplifier gain, compression and power testing. The power splitter provides signal rationing that improves the source match and removes re-reflected signals so gain measurements can be taken at different RF power levels without re-calibrating.

Figure 4. Simple test setup for power dividing application



## Rationing or leveling

The effective source match can be improved by rationing or leveling the source externally. These two methods also provide similar source match improvement. Figure 5 shows the source leveling technique that uses an external crystal detector. Figure 6 shows the source leveling technique using a power meter.

Figure 5. Power splitter test setup for leveling with a crystal detector

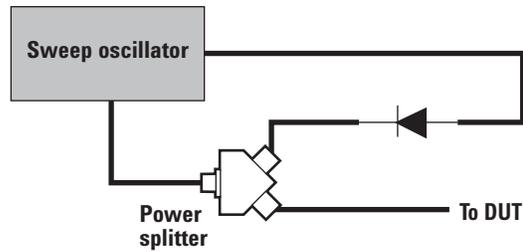
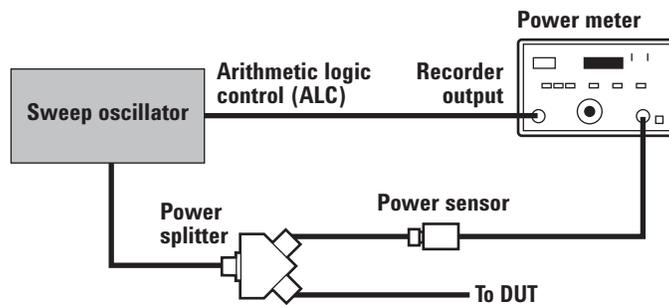


Figure 6. Power splitter test setup for leveling with a power meter



## Conclusion

Power dividers and power splitters perform different functions in test systems and, as seen in the applications above, are not interchangeable. For simple power dividing and combining, the three-resistor power divider should be used. For ratio measurement and leveling, the two-resistor power splitter is the right choice.

For more information on test accessories go to: [www.agilent.com/find/mta](http://www.agilent.com/find/mta).



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