Differences in Application Between Power Dividers and Power Splitters

Introduction

Power dividers are an RF microwave accessory constructed with equivalent 50 Ω 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 Ω). 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 Ω output impedance to minimize measurement uncertainty in source leveling or ratio measurement applications.
Power dividers

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

<table>
<thead>
<tr>
<th>Power dividers</th>
<th>Power splitters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Divide a signal equally for comparison measurements</td>
<td>Used in ratio measurements and leveling loop applications</td>
</tr>
<tr>
<td>All ports have equivalent 16 ( \frac{2}{3} ) resistance</td>
<td>Only the input port has a 50 Ω resistance, the other two ports have 83.33 Ω impedance</td>
</tr>
<tr>
<td>Can be used as power combiners</td>
<td>SWR 1:1</td>
</tr>
</tbody>
</table>

![Power divider diagram](image1)

![Power splitter diagram](image2)

**Characteristics of power dividers and power splitters**

**11636C power dividers**
- Operating frequency: DC to 50 GHz
- ± 0.3 dB amplitude tracking
- ± 2º 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

**Key specifications of Keysight Technologies, Inc. 11636C power dividers and 11667C power splitter**
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.

![Power divider schematic](image)

Figure 1. Simple test setup for power dividing application

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.

![IMD measurement setup](image)

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 slot 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](image)

Power splitter applications

Gain, compression and isolation measurements

Power splitters can be use 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 ratioing that improves the source match and removes re-reflected signals so gain measurements can be taken at different RF power levels without re-calibrating.
**Ratioing or leveling**

The effective source match can be improved by ratioing 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.

---

![Diagram](attachment://diagram.png)

**Figure 4. Simple test setup for power dividing application**

**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.keysight.com/find/mta