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Surface-Mount Power Dividers Reach 26.5 GHz

These tiny power splitters/combiners deliver outstanding performance over wide bandwidths, and come in packages that save board space in miniaturized designs.

DISTRIBUTION OF RF/MICROWAVE signals throughout high-frequency circuits and systems relies heavily on power splitters/combiners. As modern design trends shrink passive components like power splitters/combiners to ever-smaller sizes, a major challenge confronts designers: How does one manage reasonable levels of signal power without suffering the consequences of difficult-to-dissipate heat within a circuit or system design?

To address that issue, Mini-Circuits (www.minicircuits.com) developed a new series of true surface-mount-technology (SMT) power splitters/combiners that provide outstanding electrical performance over a wide bandwidth covering a frequency range of 2.0 to 26.5 GHz. Power-handling capabilities extend to 2.5-W continuous-wave (CW) power and beyond in QFN packages measuring a mere 4 × 4 × 1 mm.

1. The surface-mount power splitter/combiner model EP2K+ (left) operates from 5 to 20 GHz, while model EP2K1+ extends the frequency range from 2.0 to 26.5 GHz, both in packages measuring 4 × 4 × 1 mm.

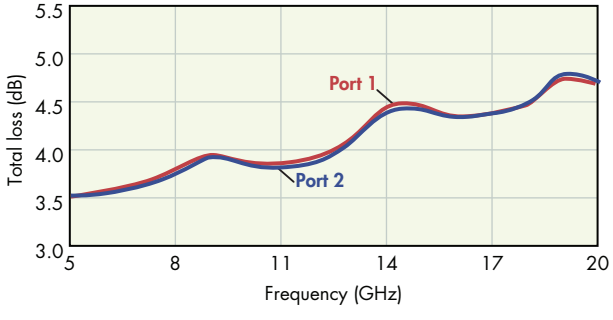
The new power splitter/combiner series includes the 5- to 20-GHz model EP2K+ and the 2.0- to 26.5-GHz model EP2K1+, both two-way, 0-deg. dividers/combiners based on GaAs integrated-passive-device (IPD) technology *(Fig. 1)*. They can be used to combine two input signals into one output signal, or divide an input signal into two output signals, with 0-deg. phase difference between the two output signals (when multiple versions of the same signal are needed).

Traditionally, power splitters/combiners are fairly large components in microwave printed-circuit boards (PCBs) and systems, with coaxial connectors or even waveguide flanges used for connection to other components within a particular system. The larger size will typically bring higher power-handling capabilities along with it, but often the power combining or dividing function may be required for lower-level rather than high-power signals. Surface-mount components provide the flexibility to add those functions almost anywhere on a PCB.

SIZE REDUCTION VIA GaAs IPD

One proven approach for shrinking the size of passive components, including power splitters/combiners, is to fabricate passive circuits using semiconductor substrate materials and processes. GaAs IPD technology, which employs GaAs substrates with multiple layers of metallization, has proven quite effective for realizing compact passive circuitry with excellent high-frequency performance. Mini-Circuits' new devices employ GaAs monolithic-microwave-integrated-circuit (MMIC) technology to fabricate the small die required to fit within the miniature surface-mount packages.

SMT power splitters/combiners are not new for Mini-Circuits. The firm offers many configurations of these and other active and passive components, including an earlier power splitter/combiner model in the "EP" product family with extremely broad frequency range that's also packed into a 4- × 4- × 1-mm SMT housing. This earlier device—the 0-deg., two-way model EP2C+—offers excellent performance over a wide bandwidth ranging from 1.8 to 12.5 GHz, but nowhere near approaching the upper-frequency limits and bandwidths of the two latest EP family members.



2. The total loss for the EP2K+, which includes the 3-dB power-division loss, is 2.1 dB or less across the full 5- to 20-GHz frequency range.

Depending on the frequency coverage required, all three power splitters/combiners are designed for reliable thermal management, capable of relatively high levels of internal power dissipation, and tested to handle input-power levels as high as 2.5 W CW when used as power dividers. The EP line of power splitters/combiners are also built to last under less-than-ideal operating conditions, featuring operating-temperature ranges of –40 to +85°C and electrostatic-discharge (ESD) protection.

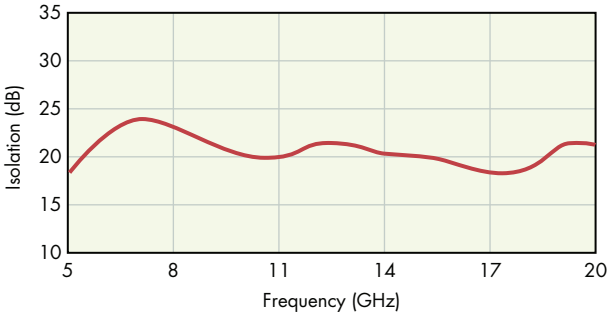
5- TO 20-GHZ MODEL SPECS

The lower-frequency model of the new SMT power divider/combiner pair, the 5-to-20-GHz EP2K+, exhibits typical insertion loss of 1.1 dB from 5 to 10 GHz; 1.7 dB from 10 to 18 GHz; and 2.1 dB from 18 to 20 GHz *(Fig. 2)*. It achieves typical isolation of 22 dB from 5 to 10 GHz; 20 dB from 10 to 18 GHz; and 20 dB from 18 to 20 GHz *(Fig. 3)*.

This tiny MMIC splitter/combiner maintains tight control of amplitude and phase characteristics across its wide frequency range. The specified amplitude unbalance is typically within 0.1 dB across the full frequency range, with worst-case performance within 0.5 dB across the full frequency range. Phase unbalance is typically within 2.3 deg. from 5 to 10 GHz; 3.7 deg. from 10 to 18 GHz; and 4.2 deg. from 18 to 20 GHz. The VSWR is typically 1.40:1 or better at all ports through 18 GHz, and typically better than 1.50:1 at all ports through 20 GHz.

2- TO 26.5-GHZ MODEL SPECS

The higher-frequency member of the new series, the EP2K1+, operates from 2 to 26.5 GHz and actually provides usable performance (in terms of low loss and VSWR and high isolation) from 1.8 to 28.0 GHz. The two-way, 0-deg. power divider/combiner achieves typical insertion loss of 0.8 dB from 2 to 5 GHz, 1.1 dB from 5 to 10 GHz, 1.7 dB from 10 to 18 GHz, and 2.4 dB from 18 to 26.5 GHz. It provides typical isolation of 14 dB from 2 to 5 GHz, 22 dB from 5 to 10 GHz, 20 dB from 10 to 18 GHz, and 21 dB from 18 to 26.5 GHz.



3. Isolation for the EP2K+ power splitter/divider is typically better than 18 dB across the full 5- to 20-GHz frequency range.

The EP2K1+ is fabricated with a tightly controlled GaAs MMIC process that results in outstanding amplitude and phase balance. Typical amplitude unbalance is 0.1 dB from 2 to 5 GHz; 0.1 dB from 5 to 10 GHz; 0.1 dB from 10 to 18 GHz; and 0.3 dB from 18 to 26.5 GHz. Typical phase unbalance is 1.5 deg. from 2 to 5 GHz; 2.3 deg. from 5 to 10 GHz; 3.7 deg. from 10 to 18 GHz; and 5.4 deg. from 18 to 26.5 GHz. The EP2K1+ exhibits VSWR at all ports, which is typically 1.50:1 or better at the lowest and highest frequencies (2 to 5 GHz and 18.0 to 26.5 GHz) and 1.40:1 or better at all other frequencies.

The small size and broad bandwidths of these RoHS-compliant devices suits them for WiMAX, Industrial-Scientific-Medical (ISM), test-and-measurement, radar, electronic-warfare, and satcom applications. Both can pass as much as 0.2-A current for applications, such as antennas, that might require passing dc current along with RF/microwave signals. mw

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