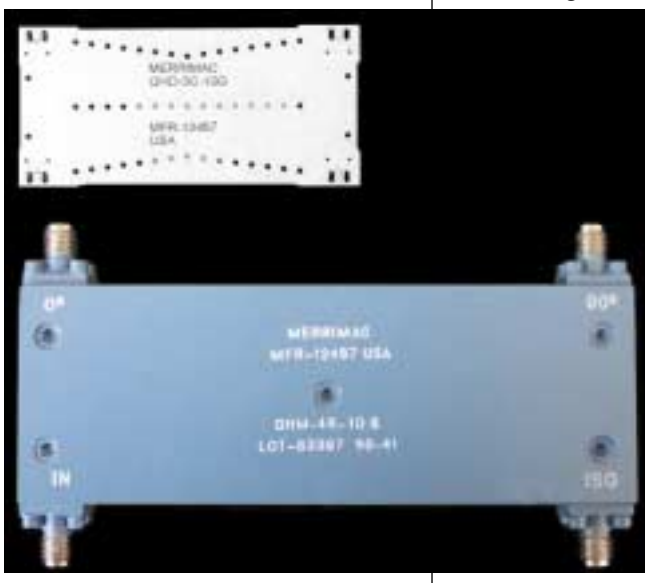
Tiny Quad Hybrid Spans 2 To 18 GHz

Multilayer technology yields a 3-dB coupler for applications in which wide instantaneous bandwidth, small size, and light weight are critical.

Reduced component size and weight pay tremendous dividends in systems requiring hundreds or thousands of components, such as phased-array radars. The QHD-3C-10G quadrature hybrid coupler from Merrimac Industries (West Caldwell, NJ) is an example of a traditionally large component that has been scaled to a fraction the size of conventional couplers, with performance from 2 to 18 GHz that is comparable to its much-larger counterparts.

The QHD-3C-10G is fabricated with the company's proprietary Multi-Mix manufacturing process, in which fluoropolymer composite substrates are fusion-bonded to form a multilayer structure. A monolithic Multi-Mix structure can contain both active components, such as diodes, transistors, and MMICs, and passive components, such as etched resistors, circuit patterns, plated-through viaholes; no additional packaging is required. The ceramic-filled polytetrafluoroethylene (PTFE) dielectric materials employed in the design are compatible with popular substrates such as FR-4, G-10, and polyamide, and the "wrap-around" ground plane provides a high level of electromagnetic-interference (EMI) shielding.



1. The QHD-3C-10G 2-to-18-GHz hybrid coupler leverages Multi-Mix multilayer circuit technology to achieve small size and weight without sacrificing power-handling capability.

Multi-Mix devices are typically only a fraction of the size of components fabricated with conventional stripline or microstrip approaches. The QHD-3C-10G **(Fig. 1)** is a fraction of the size of one of the company's conventional microstrip designs. It is 95 percent smaller, measuring only 1.6 × 0.75 × 0.065 in.

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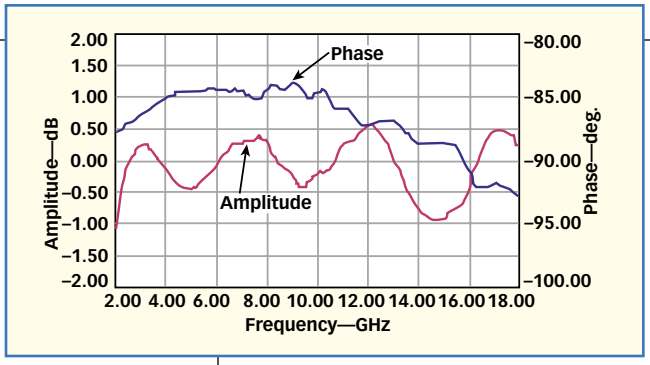
(compared to 2.85 × 1.10 × 0.50 in. for the conventional coupler), and 95 percent lighter (0.13 oz. vs. 2.5 oz.), while being compatible with surface-mount manufacturing.

The QHD-3C-10G features insertion loss of 2 dB or less, isolation of at least 15 dB, VSWR at all ports of 1.5:1 or less, and an operating temperature range of –55 to +85°C. Despite its diminutive size, the coupler can handle CW input power to typically 25 W. It maintains excellent amplitude and phase balance **(Fig. 2)** of ±0.7 dB and ±8 deg., respectively, which makes it well suited for in-phase/quadrature (I/Q) networks, multicarrier power amplifiers (PAs), and other signal-distribution configurations.



2. The amplitude and phase balance of the QHD-3C-10G hybrid coupler make it suitable for use in I/Q networks and multicarrier power amplifiers (PAs).

The size and weight savings provided by the QHD-3C-10G can be expanded (while maintaining tight control over phase and amplitude) by stacking and interconnecting multiple units via transmission lines that traverse the Z axis between the units. In addition, the device can be integrated with other Multi-Mix components to form a module that provides several functions (such as beamforming networks and other complex signal-processing functions) in much less space than the discrete functions could otherwise be realized.

The QHD product family meets environmental screening requires per MIL-STD-202 for thermal shock, burn-in, acceleration, vibration, mechanical shock, moisture resistance, thermal cycling, and resistance to solder heat. In addition to the 2-to-18-GHz frequency range, the quadrature hybrid is available in bands between frequencies of 200 MHz and 40 GHz, and can be supplied on either tape and reel for surface mounting, or with a coplanar waveguide RF interface. It can also be designed to optimize various performance parameters, including phase and amplitude, isolation, and insertion loss.

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