ProductTechnology

Surface-Mount Mixers Are WJ Replacements

These compact frequency mixers for broadband applications from DC to 3000 MHz fill holes left behind by a number of discontinued legacy models from another high-frequency component supplier.

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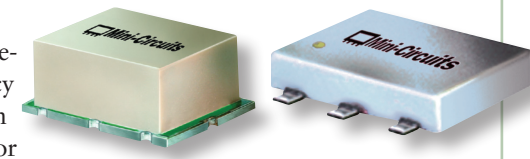
Replacing a discontinued component, such as a mixer, in an existing design can pose challenges when a trusted part is no longer available. Fortunately, in the case of broadband surface-mount mixers from Watkins-Johnson and, until recently, offered by TriQuint Semiconductor (www.triquint.com), a number of miniature packaged passive diode mixer models from Mini-Circuits (www.minicircuits.com) serve as excellent substitutes with no sacrifice in system performance. The "replacement" mixers cover a total frequency range from DC to 3 GHz and can be used as frequency upconverters or downconverters and no external bias is required.

Of the discontinued mixer models, the broadest-frequency unit is the WJZ1050H, with identical RF, local oscillator (LO), and intermediate-frequency (IF) range of 10 to 3000 MHz. The corresponding replacement mixer from Mini-Circuits is the model SYM-30DHW+ (see table), which has an RF and LO range of 5 to 3000 MHz and a narrower IF range of 5 to 1500 MHz. Perhaps as important as matching the frequency range, both mixers are designed for optimum performance with LO drive power of +17 dBm.

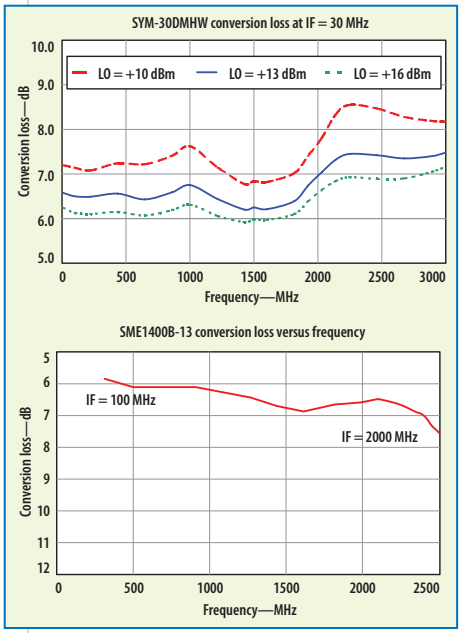


1. The "replacement" mixers are available in a variety of different surface-mount housings, including these compact packages measuring just 0.500 x 0.380 x 0.230 in. (left) and 0.310 x 0.220 x 0.112 in. (right).

How closely do these two mixers compare in performance? The WJZ1050H mixer exhibits single-sideband (SSB) conversion loss of typically

Finding a replacement WJ/TriQuint mixer

MINI-CIRCUITS MODEL	RF RANGE	IF RANGE	WJ/TRIQUINT MODEL	RF RANGE	IF RANGE
SYM-30DLHW+	5-3000	5-1500	SME-1400B-10	1-2200	1-2200
SYM-30DMHW+	5-3000	5-1500	SME-1400B-13	1-2200	1-2200
SYM-30DHW+	5-3000	5-1500	SME-1400B-17	1-2200	1-2200
SYM-30LHW+	5-3000	5-1500	WJZ1000H	1-2700	1-2000
SYM-30MHW+	5-3000	5-1500	WJZ1010	1-2500	1-2000
SYM-30DHW+	5-3000	5-1500	WJZ1020H	1-2700	1-2000
SYM-25DHW+	80-2500	DC-1000	WJZ1030H	10-2500	10-2500
SYM-30DHW+	5-3000	5-1500	WJZ1050H	10-3000	10-3000
SYM-2+	10-1000	DC-1000	WJZ1070H	10-1000	10-1000
ADE-25MH+	5-2500	5-1500	WJZ3000	10-1500	10-1500
ADE-2+	5-1000	DC-1000	WJZ3010	10-1000	10-1000
ADE-1ASK+	2-600	DC-600	WJZ3020	10-250	10-250
ADE-1ASK+	2-600	DC-600	WJZ3030	10-250	10-250



2. The SYM-30DMHW mixer provides similar conversion-loss performance with frequency (top) to that of the SME1400B-13 mixer (bottom) when used with LO drive of +13 dBm.

6.5 dB for RF/LO range of 10 to 1300 MHz and IF range of 10 to 1000 MHz and conversion loss of typically 6.6 dB for RF/LO range of 10 to 3000 MHz and IF range of 30 to 1000 MHz. The typical LO-to-RF port isolation is 39 dB (and minimum of 24 dB) from 100 to 2500 MHz, with typical LO-to-IF isolation of 40 dB and minimum of 35 dB) from 100 to 2400 MHz. The RF-to-IF isolation for this unit was not available on the data sheet. The typical input third-order intercept point is +24.1. The RF port VSWR is typically 1.80:1 through 2500 MHz, while the LO port VSWR is typically 1.70:1 through 2500 MHz, and the full-range IF port VSWR is typically 1.30:1. The WJZ1050H is supplied in a lead-free, RoHS-compliant surface-mount package measuring 0.500 x 0.375 x 0.175 in.

In contrast, the size of the SYM-30DHW+ and its RoHS-compliant surface-mount package (**Fig. 1**) is almost identical to that of the WJZ1050H mixer, at 0.500 x 0.380 x 0.230 in. The conversion loss for the SYM-30DHW+ mixer is typically 6.6 dB for RF and LO frequencies through 1000 MHz and typically 7.24 dB for RF and LO frequencies through 3000 MHz. The LO-to-RF isolation is typically 34.48 dB through about 2500 MHz while the LO-to-IF isolation is typically 46 dB through about 2500 MHz. The RF port VSWR is typically 1.44:1 through 2500 MHz while the LO port VSWR is typically 1.12:1 through 2500 MHz. The typical third-order intercept point for the SYM-30DHW+ mixer is +26 dBm.

The lineup of WJ/TriQuint mixers include three models, SME-1400B-10/13/17, that essentially differ by their optimum LO drive levels, with nominal levels of +10, +13, and +17 dBm, respectively for the three mixers. The three mixers cover RF, LO, and intermediate-frequency (IF) ranges of 1 to 2200 MHz with typical conversion loss ranging from about 6.5 dB through 1000 MHz and 8.0 dB through 2000 MHz. The three mixer models can be replaced by the models SYM-30DLHW+, SYM-30DMHW+, and SYM-30DHW+ mixers from Mini-Circuits. All three replacement units cover RF and LO frequency range of 5 to 3000 MHz and IF range of 5 to 1500 MHz, with respective optimum LO drive levels of +10, +13, and +17 dBm.

For example, the SYM-30DMHW mixer from Mini-Circuits matches the conversion-loss performance with frequency of the SME1400B-13 mixer when used with LO drive of +13 dBm (**Fig. 2**). The SME1400B-13 is a double-balanced passive diode-ring mixer capable of input IP3 of +22 dBm and 1-dB compression point of +9 dBm. It achieves conversion loss of typically 6.5 dB for RF and LO signals to 1300 MHz, 7.5 dB for RF and LO signals from 10 to 2500 MHz, and 8.0 dB for RF and LO signals from 1 to 2200 MHz. The surface-mount mixer provides typical LO-to-RF isolation of 30 dB to 2000 MHz and 25 dB to 2500 MHz. It offers typical LO-to-IF isolation of 26 dB to 2000 MHz and 22 dB to 2500 MHz. The broadband mixer exhibits RF port VSWR of typically 1.70:1 to 2000 MHz and 2.0:1 to 2500 MHz, with LO port VSWR of typically 1.60:1 to 2000 MHz

and 2.0:1 to 2500 MHz.

In comparison, the SYM-30MHW+ is a triple-balanced mixer in a surface-mount TTT167 package. The triple-balanced configuration should provide additional port-to-port isolation (although the arrangement often results in somewhat higher conversion loss than a double-balanced mixer). In the case of the SYM-30MHW+ mixer, the conversion-loss performance slightly exceeds that of the SME1400B-13 mixer, with typical conversion loss of 6.20 dB for RF and LO signals through 1459 MHz, 7.42 dB for RF and LO signals through 2491 MHz, and 7.48 dB for fullband operation (RF and LO signals from 5 to 3000 MHz). The typical LO-to-RF isolation for the SYM-30MHW+ mixer is 35.83 dB to 1953 MHz and 29.50 dB to 2491 MHz, while the typical LO-to-IF isolation is 42.8 dB to 1953 MHz and 42.5 dB to 2491 MHz. The typical RF port VSWR is 1.41:1 to 1953 MHz and 1.41:1 to 2491 MHz, while the typical LO port VSWR is 1.37:1 to 1953 MHz and 1.19:1 to 2491 MHz. As with the SME1400B-13 mixer it replaces, the SYM-30MHW+ mixer achieves a typical input IP3 of +22 dBm when driven with +13-dBm LO power.

For more narrowband applications, the WJZ3020 and WJZ3030 mixers from WJ/TriQuint have been proven performers through 500 MHz. The WJZ3020 operates over an RF, LO, and IF range of 10 to 250 MHz while the WJ3030 mixer offers RF, LO, and IF coverage of 10 to 500 MHz. Both mixers can be replaced by a model ADE-1ASK+ mixer from Mini-Circuits with RF and LO range of 2 to 600 MHz and IF range of DC to 600 MHz and similar LO drive requirement of +7 dBm.

The ADE-1ASK+ provides typical conversion loss of 6.29 dB through 600 MHz with typical IP3 of +16 dBm. The LO-to-RF isolation is typically 45 dB or more through 600 MHz while the LO-to-IF isolation is typically 35 dB through 600 MHz. The ADE-1ASK+ mixer is supplied in a RoHS-compliant surface-mount housing measuring just 0.310 x 0.220 x 0.112 in.

In short, the WJZ series mixers have been proven performers in a wide range of applications through 3000 MHz, providing excellent broadband performance in compact, surface-mount packages. Fortunately, although these mixers are being discontinued, the search for a replacement mixer in a similar-sized package with similar (if not better) performance can end with a glance at the table. **Mini-Circuits, P. O. Box 350166, Brooklyn, NY 11235-0003; (718) 934-4500, FAX: (718) 332-4661, Internet: www.minicircuits.com.** MRF