High Dynamic Range Lumped-Element Schottky Mixer For Wireless Applications

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High performance Schottky diode mixers have become an important requirement in today’s Wireless infrastructure. High dynamic range mixers (HDMs) and high isolation mixers (HIMs) have been available for many years from a number of manufacturers, but the recent market demand to produce components at low cost, high volume, and to tight delivery schedules has raised the performance bar to new levels.

TRAK Microwave has responded to this need by continually developing new mixer products for wireless applications. A complete line of HDMs has been developed over the last five years, and constant improvements driven by market demand, have been made to Intermod (or IP3) performance.

Mixers (Brief Tutorial)

HDMs are devices that are required for most radio receivers, as they mix a low level - high frequency RF signal with a high level - LO signal which results in an output difference frequency (the IF signal). See Figure 1. In most wireless applications, the IF is selected to have a relatively narrow bandwidth (less than 10%), and usually in the range of 50-500 MHz. The RF range may be any of the well-known wireless bands (869-894 MHz, 925-960 MHz 1.93-1.99 GHz, etc). The LO is usually selected on the “low side” of the RF, but it can also be on the “high side”. Mixers unfortunately, through the use of non-linear Schottky diodes, also produce unwanted signals, or intermods. The input third-order intercept point (IIP3) is the key parameter that measures the level of unwanted signal, or distortion. It is in this parameter, highly dependant upon the LO drive level and IF bandwidth, that TRAK’s HDMs have been optimized to provide unsurpassed performance in the industry.

TRAK’s HDMs are constructed using tightly matched Schottky diode quads, and broadband RF balun transformers. Early designs (circa 1994) achieved an IIP3 of +31 dBm minimum with an LO drive of +17 dBm (ex: downconverting 1805-1880 MHz to 140+/− 3 MHz, LO= +17 dBm @ 1665-1743 MHz ). As the industry requirements for IIP3 became more stringent, TRAK improved HDM performance to offer models with IIP3 of +35 dBm to +37 dBm typical at an LO power level of +17 dBm. See Figure 2. It should be noted that in order to achieve the absolute best IIP3, the design is optimized for peak IIP3 performance only over a relatively narrow IF bandwidth. This is usually sufficient for most wireless applications. The RF and LO frequency bands can be used over a much wider bandwidth, as long as they produce the IF in the specified band.

TRAK’s HDM Family

Table 1 lists a few of the HDMs in TRAK’s High IP3 mixer family. The mixers listed are all packaged in TRAK’s standard style –02 low cost SMD package (0.50” x 0.38” x 0.19”). Other models are available in smaller packages where slightly reduced IIP3 performance can be expected. Some models are available with even better IIP3 in higher cost hermetic packages. All mixers in Table 1 exhibit excellent conversion loss and isolation (other important parameters that are not discussed herein). One of the most serious criteria to consider with an HDMs is “will it operate properly after the customer has processed the part in an automated assembly environment that reaches +240C?”. Thermal considerations, as well as cleaning solvents, play large factors in the mixers performance after the customer has assembled it to his circuit board. Thanks to recent improvements in TRAK’s design, TRAK’s HDMs successfully pass many stringent processing criteria, and perform with no degradation after assembly.

Advantages for the Wireless Designer

TRAK’s HDM’s provide a number of advantages to the Wireless designer: Unsurpassed IIP3 in a passive mixer
Rugged design/high reliability/low cost
No requirement for DC bias
Noise figure equivalent to conversion loss (6.5 dB typically)
Excellent LO-RF Isolation (typically 40 dB)
Available for high volume production today
Operating temperature range of –55 to +105C
Solder masked to greatly enhance customer solderability
Environmental test data available upon request

**The HDM Solution**

The use of TRAK HDMs can simplify and enhance overall system performance for wireless designers. For many applications, they can offer a true “drop-in” solution. For others, a new frequency design can be realized in a matter of days.