The TAK-893 is a custom Level 17 passive double balanced mixer (DBM) manufactured by Mini-Circuits Labs (www.minicircuits.com) and similar to their TAK-3 mixer. It is an excellent receive or transmit mixer with high dynamic range and IP3 -- requiring +17dBm of LO drive. Level 7 (+7dBm LO drive) can be used if higher conversion loss is acceptable. The TAK-893 can be used where any 50-ohm passive mixer is specified with proper LO drive.

**MECHANICAL**

**BOTTOM VIEW**
- 20 mm (0.8 in.)
- 10 mm (0.4 in.)
- 5 mm (0.2 in.)

**SIDE VIEW**
- MCL TAK-893
- 8 mm (.32 in.)
- 3.6 mm (.14 in.)

**TOP VIEW**
- A3167893-1
- B0063
- PIN 1

**ELECTRICAL**

- BLUE BEAD INDICATES PIN 1
- 1 3 5 7
- 2 4 6 8

**TAK-893**

**A LOOK INSIDE**

**NOTES:**
1. Hermetically sealed in a nickel plated steel can.
2. Pin 2 is the case ground
3. Ground pins 2, 5, 6 & 7 externally.
4. Pins 3 & 4 must be connected together externally (IF output).
**G-QRP DATA SHEET**

**TAK-893**

**SPECIFICATIONS:**

*From Mini-Circuits “Designers Handbook” and Catalog for the TAK-3 (similar to TAK-893)*

<table>
<thead>
<tr>
<th>RF Input</th>
<th>FREQUENCY</th>
<th>LO Input</th>
<th>IF Output</th>
<th>LO DRIVE</th>
<th>RF INPUT</th>
<th>3rd Order Intercept</th>
</tr>
</thead>
<tbody>
<tr>
<td>.05-300 MHz</td>
<td>.05-300 MHz</td>
<td>DC-300 MHz</td>
<td>+17dBm</td>
<td>+14dBm</td>
<td>+20dBm</td>
<td></td>
</tr>
</tbody>
</table>

**Description of Specifications:**

- **Frequency** - the range of frequencies on each port for which the mixer is guaranteed to operate.
- **LO Drive** - the local oscillator drive level for which the other specifications are based.
- **RF Input** - maximum input power for which no distortion will occur. This is also the 1dB compression point of the mixer.
- **3rd Order Intercept (IP3)** - is a theoretical level for which an adjacent signal will cause distortion. The IP3 is about 7 to 10dB above the 1dB compression point. The higher the IP3, the less prone the mixer is to interference from strong, nearby stations. The IP3 of the TAK-893 is very high by mixer standards.
- **Conversion Loss** - the loss in the mixer when converting the RF to the IF frequency. Passive mixers always convert with a loss.
- **LO-RF Isolation** - a measure of how much of the LO power appears on the RF port. The higher the isolation, the less LO leakage.
- **LO-IF Isolation** - a measure of how much of the LO power appears on the IF port.

**TAK-893 Specific Notes:**

The TAK-893 is virtually identical to the TAK-3. The largest concern for the QRPper is selecting the proper LO drive level.

+7dBm (medium level) LO drive is the level used by level 7 passive mixers, such as the SBL, SRA and ADE series. Circuits using these mixers will be delivering about +7dBm to the LO port. The TAK-893 can be driven at +7dBm, but at the expense of about 10-12dB of additional conversion loss, requiring an amplifier stage before or after the TAK-893 to compensate for this higher loss.

+17dBm (high level) drive is recommended for the TAK-893 to achieve the specifications listed above. The disadvantage is a more complex drive circuit and a higher current draw to produce +17dBm power. A high level drive circuit is shown in the application notes that uses a relatively simple circuit and requires only about 10-12mA of current draw for the optimal conversion loss of 5-6dB.

**Chart demonstrates how the conversion loss changes with frequency and LO drive.** The lowest conversion loss is in the 1-100 MHz portion with +17dBm, and higher losses with the lower (+7dBm) LO drive. +17dBm curve from MiniCircuits data book; +7dBm curve from NA5N lab tests (see Application Notes).
LEVEL 7 (MEDIUM LEVEL) LO DRIVER

CKT #1 - EMITTER FOLLOWER

This circuit provides about +7dBm drive to the LO port (pins 1-2), or about the drive level of most passive mixers. Waveforms and voltages from a 40M circuit built using a 12MHz LO for a 5 or 19MHz IF. Conversion loss was 12dB (fairly high).

CKT #2 - USING PINS 7-8 AS A TRANSFORMER

Pins 7 and 8 are used to convert the TAK-893 to a transformer fed mixer since pin 7 is not internally grounded.

This circuit was built for a 40M mixer using a 12MHz LO for a 5 or 19MHz IF. This scheme can be used for feeding the RF into pins 7-8 and the LO at pins 1-2. Both schemes have a conversion loss of 12dB with the +7dBm drive, requiring some additional IF gain.

LAB TESTS

RF input: 7.000MHz at -50dBm
LO input: 12.000MHz at +7dBm
IF output: 5.000MHz at -62dBm and 19.000MHz at -62dBm

RESULTS:

Conversion loss: 12dB
LO-IF Isolation: -31dB
1dB compression: +14dBm
IP3: approx. +20dBm

Better port-to-port isolation and less conversion loss is obtained with a higher LO drive. See next Application Note.
LEVEL 17 (HIGH LEVEL) LO DRIVER

Q1, Q2, Q10 - 2N2222, 2N3904, BC108, etc.  NPN
Q3 - 2N2907, 2N3906, BC212, etc.  PNP

LED limits current and visual indication of LO drive
Total current draw approx. 15mA, including Q10 crystal oscillator
Q1 8-10dB amplifier    Q2-Q3 NPN-PNP “totem pole” emitter follower

LAB TESTS

Above driver designed by Paul Harden, NA5N for testing the TAK-893 DBM’s. Circuit tested at 80M through 2M and at different LO frequencies from 2-22MHz. Results below shown for 40M and fairly typical for the other HF bands.

RF input: 7.059MHz at -50dBm
LO input: 4.000MHz at +16dBm
IF output: 3.059MHz at -56dBm
and 11.059MHz at -55dBm
(11.059MHz is a common crystal)

RESULTS:
Conversion loss: 5-6dB
LO-IF Isolation: -46dB
1dB compression: +14dBm
IP3: approx. +20dBm or greater

Spectrum Analyzer: Tektronix 2710
O-scope waveforms: Tektronix 475
Signal generator: H-P 8657B