The use of double-balanced mixers in transmit and receive converters has been explored in numerous magazine articles. The construction of mixers for vhf and uhf service is a relatively straightforward matter, and consists of a quad of matched Schottky-barrier diodes in a ring or bridge arrangement and two wideband toroidal transformers. However, with the cost of commercial double-balanced mixer modules now less than $10, it hardly pays for the experimenter to build his own.

I was first introduced to commercial double-balanced mixers by Joe Reisert, W1JR, who showed me how to use a dual-inline packaged mixer in a 432-MHz converter. He later published information on a DIP pinout which is now used by many manufacturers for dc-500 MHz mixers (see table 1). The standardization of flatpack microwave mixers allowed me to develop a universal PC layout for use at 1296 MHz. In this article I will present a similar PC layout for use with any of the uhf mixer modules listed in table 1.

**Mixer Circuits**

The double-balanced mixer circuit shown in fig. 1 is based upon an article by Reisert. Except for different pin-numbering schemes used by various manufacturers, fig. 1 is an accurate representation of all the mixers in table 1.

Note that two pins (3 and 7 in fig. 1) are connected together to form the i-f port. In some (but not all) mixers, these pins are tied together internally. To build a circuit board which is compatible with all the

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mixers in Table 1, there must be a circuit trace between these pins. Also, in some mixers, the ground points (shown as pins 2, 4, 5, and 6 in Fig. 1) are internally connected to the mixer case; in others they are not. Therefore, the PC board must provide for external grounding of these pins.

Of course, in mixers which are not internally grounded, it would be possible to connect pins 2 and 6 together for use as the i-f port, and ground pins 3 and 7. Similarly, if pin 1 were grounded, pin 5 could serve as the LO port. The same possibilities hold for pins 4 and 8 at the rf port. For that matter, in any double balanced mixer the rf and LO ports are completely interchangeable. However, since grounding is to be provided on the PC board, an internally grounded mixer will require a particular orientation on the board (more on this later).

When the mixer has been properly grounded, and the i-f pins have been tied together, the three mixer ports can be connected to coaxial connectors. To minimize impedance discontinuities it is advisable to use 50-ohm microstrip transmission lines when interfacing the mixer to coaxial connectors.

**circuit board**

Fig. 2 is a full-sized layout of a circuit board which will accommodate any of the mixers listed in Table 1. As with all microstripline circuits, it is etched on one side of double-sided printed circuit material. The other side remains unetched and serves as a groundplane. The dimensions of the circuit were chosen to provide a good impedance match to 50 ohms at all ports (1/16 inch or 1.5mm thick fiberglass-epoxy circuit board). At the operating frequencies of these mixers the thickness of the copper cladding is of little consequence; I used 2-ounce copper (about 2.8 mils or 70 microns thick) with no observed difficulties in either performance or etching.

The active pins of the mixer, as well as the center pins of the three coaxial connectors, must all be isolated from ground. This can be easily accomplished by using a 1/8 inch (3mm) twist drill as a countersink to remove the groundplane metallization from around the active pins as shown in Fig. 3.

Drilling instructions for the etched board are also shown in Fig. 3. Note that all mixer and coax connector pins require no. 56 (1.2mm) clearance holes, while the no. 42 (2.4mm) mounting holes in the corner of the board easily accommodate no. 4 (M3) mounting hardware. This circuit board is designed to be used as the top cover of a Pomona Electronics 2417 die-cast aluminum box. This enclosure provides excellent shielding as well as an attractive appearance, as seen in the photograph.

![Fig. 2. Full-size printed-circuit board for dual-inline packaged double-balanced mixer modules.](image-url)
coaxial connectors

High quality coaxial connectors are recommended to minimize impedance mismatches at uhf. I have had excellent results with type SMA connectors, a military designation standing for Sub-Miniature, Type A. The SMA connector is a gold-plated precision threaded unit, with a 3mm reference plane dimension. They were originally developed by the Omni-Spectra Company under their brand designation OSM, a name by which they are often referred regardless of the manufacturer. SMA-compatible connectors have become a standard catalog item of numerous companies; the ones I use are E. F. Johnson JCM series. Their female chassis connector (part no. 142-2098-001) costs less than $3.00 and operates well into the microwave region. For interconnection to other modules, you will want to make up a few jumper cables. These can be fitted with E. F. Johnson 142-0261-001 plugs which mate well with the female chassis connector and cost about the same.

mixer pinouts

If you examine the data sheets of the mixers listed in Table 1, you can see that the devices have different pinouts. This is because the manufacturers use different pin-numbering sequences, as shown in Fig. 4. Fortunately, all suppliers mark pin 1 in some way, usually by providing an odd-colored glass bead at the seal. Regardless of the pin numbering scheme, the internal mixer configuration is basically the same. Thus it's possible to install all these mixers on the same circuit board.

Installation of the mixer on the board is straightforward. With the board oriented as shown in Fig. 3 (groundplane side up, coax connectors toward you), position the mixer so pin 1 (the one with the odd-colored bead) is away from you and toward the right. The pins will fall readily into place, and can be soldered to the microstrip lines on the opposite side of the board.

When installing the coax connectors, run a bead of solder around the connector body on the groundplane side of the board; then solder the four ground pins on the microstrip plane. This provides "through-the-board" grounding of the applicable mixer pins.

parts availability

Most of the manufacturers listed in Table 1 will sell their mixers directly to the individual experimenter in small quantities; a few may require that orders be placed through a regional representative. Circuit boards can be etched from the artwork in Fig. 2.*

*Etched, drilled, and plated circuit boards are available for $4.50 from Microcomm, 14908 Sandy Lane, San Jose, California 95124, postpaid.

references


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