

The IF Rig

For most of the microwave bands, certainly those above 1296 MHz, we use a transverter and a transceiver to make QSOs. The transceiver is the real "rig" in that it performs the transmit and receive functions of modulation/demodulation, frequency and bandwidth control, provides receive gain and metering of signal levels. The transverter converts the transceiver's RF output up to the microwave frequency, and converts the received microwave RF down to the transceiver's frequency (see Figure 1). A typical transverter is a set-and-forget device, with no need for adjustments during operation.

On the lower frequencies, generally from those above HF up to 1296 MHz, transverters are typically used with transceivers operating at either 28 MHz or 144 MHz. It is this frequency that microwavers call the intermediate frequency or "IF," because it is intermediate between the microwave operating frequency and the modulation systems. So, we microwavers call our transceivers *IF Rigs*.

What makes a transceiver good as a microwave IF rig?

As with many things in amateur radio, different types of operation lead us to make different decisions. Although often we have to consider cost, there are many good affordable choices for our IF rig. Perhaps the most important consideration is whether one is building a home station, rover system or hill-topping microwave radio. In some circumstances, an IF rig

has to be subjected to some minor internal modifications. Not everyone is willing to make these changes, especially when they may potentially void warranties, so choices that require little or no modification are attractive.

The Home Station

Years ago, many middle and high-end HF radios had transverter inputs and outputs. These were usually designed to provide 1 mW (0 dBm) during transmit, and have a fairly sensitive input. Some radios provided additional support by displaying frequency based on the expected transverter operation. A few amateur radios made today still provide this capability. Often, the application of a voltage on an accessory terminal activates internal circuits, which in some cases use separate RF connections and in others reuse standard antenna connections. Power levels vary between rigs. Some radios produce a few watts, while others drop to 1 mW (0 dBm), which is the typical input power for a transverter. If yours has greater power output than your transverter's input, you will need a fixed attenuator in the transmit circuit.

In most home stations, space and weight do not constrain the choice of radio. Larger radios often have more features and performance than compact versions. Easy control of bandwidth, memories, noise removal, CW and voice memory, and spectrum scopes are examples of features that can aid in micro-

wave operation, especially during contesting at home. Often the home station will operate several microwave transverters from the same IF rig. To accomplish this, microwavers develop multi-port relay and switching systems that direct TR and IF signals to the appropriate transverter, while simultaneously controlling mast-top preamplifiers, TR relays and antenna selection.

The Rover Station

Rovers create stations within their vehicles to operate as many bands as they can with minimum setup time. Usually, these stations are meant to operate effectively in contests, where activating many maidenhead grid squares during the limited hours of the contest yields a high score.

The primary source of electricity is vehicle power, so an IF rig that runs from that source is most desirable. Although most rovers are in family vehicles, some all-out efforts are constructed in specialized vehicles, such as heavy-duty trucks with ac generators. Each situation dictates its own constraints, but smaller IF rigs that have a fairly simple operating layout are preferred. Some of the newer rigs have detachable front panels so that the bulk of the radio can be placed nearby the transverters. With a thin control panel at the operating position one has more space for the essentials: a GPS, microwave transverter switching control, laptop computer, microphone, key and a cup of coffee.

Much like a home station, a rover

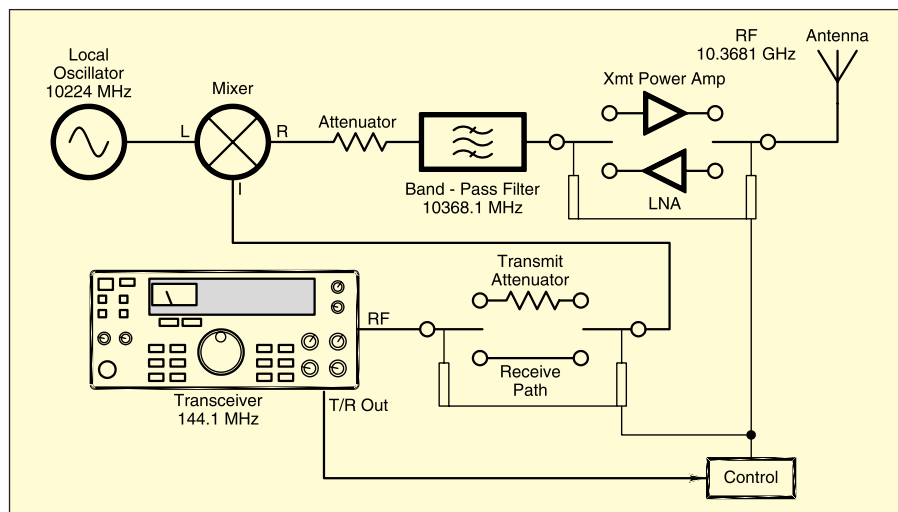


Figure 1—The function of a transverter is frequency conversion, thereby allowing the use of an HF or 2 meter radio on a microwave band.



Figure 2—The Yaesu FT-817 portable.



Figure 3—The Kenwood TS-2000.

often runs as many bands as possible, and therefore has the same concerns with easily switching bands while using the same IF rig and a control system that selects transverter, preamp and antennas.

Hilltopping

When you go hilltopping, you may need to carry your equipment, at least a short distance, but perhaps a long hike, and operate with battery power. Emphasis is on portability, so both weight and size matter. Most IF radios for hill-topping stations are 2 meter all-mode rigs designed for truly portable or mobile operation. These usually do not develop much RF power which is fine, considering that anything over 1 mW usually has to be attenuated down to that level anyway, and because power modules are naturally heavy.

Don't forget that when hilltopping you will also need a liaison radio, also usually a 2 meter SSB radio, but hopefully delivering 25 W or more. Some hams try to use the same radio as the IF and the liaison rig, but soon learn that this approach seriously interferes with efficient operation, and find a second radio.

Interfacing

Your IF rig has to be properly connected to your keying circuits. The transverter, and other circuits such as amplifiers and relays, must react to your intent to switch into transmit mode in a manner that protects all components. For instance, you do not want any transmitted RF to accidentally enter an open relay (or one in the process of being switched) or the back end of a preamplifier (LNA). To accomplish these functions amateurs have developed solutions for several popular HF and 2 meter all-mode radios. They consist of sequencers that assure the correct order of operation of each component and provide sufficient delay for relay closure.

QSK-only HF radios are generally problematic, because the transverter and relays cannot be switched between receive and transmit and back again during CW keying. Therefore, one has to defeat break-in so that a sequencer can key the rig, transverter, and microwave relays at the beginning and end of the transmission, based on a footswitch or other manual TR switch.

Two Transverters?

Note that many transverters for the higher microwave bands will start with a 2 meter IF. This is necessary because an IF as low as 28 MHz puts the transverter's LO too close to the RF for effective filtering. Unfortunately, many of the desirable rigs are strictly HF or HF+6 meters and so cannot operate at 2 meters. To overcome this, some amateurs, notably for home will



Figure 4—The ICOM IC-756PROII.



Figure 5—The Ten-Tec Model 562 "6N2."



Figure 6—The Elecraft K2.

convert the HF radio to 2 meters with a high quality transverter. Then the 2 meter signals will be routed to the microwave transverters.

This multiple conversion setup can work well, but it can also lead to problems. Most problems with any transverter system arise from not having signal levels set correctly, resulting in insufficient dynamic range. More often than not, excessive gain is the problem.

Choices

It would be difficult if not impossible to list all the HF and 2 meter radios that play well with transverters and interfacing circuits. However, here is a sampling of some radios that either claim to have transverter support, or that a number of microwavers have successfully adapted. My apologies in advance to microwavers or VHF operators if I have left out your favorite IF rig, or have included your least favorite. Before purchasing a radio for this purpose, get a copy of the user manual (many are on-line) and talk to other amateurs who have had experience with the radio you are most interested in using. E-mail lists and reflectors are a good place to start if no one in your club has the experience to help you.

These are in no particular order, are not recommendations, and don't guarantee success. See Figures 2 through 5 for photos of some of these radios.

Vertex-Standard/Yaesu

Mark V Field FT1000 and Mark V FT1000MP provide separate RX and TX transverter connections and appear to provide built-in support for transverter operation. The FT-897 HF, 6, 2, 70 cm has built in transverter function with ability to change the display. The FT-857 HF, 6, 2, 70 cm mobile has a transverter function. The FT-817 portable HF, 6, 2, 70 cm has no transverter function, but one can attenuate the relatively low output level externally. www.vxstdusa.com/

Kenwood

The TS-2000 HF, 6 and 2 m, 70 and 23 cm has built-in transverter support, a menu to set display frequency, and transmit power drops to lowest power for that frequency (several watts). The TS-570D HF radio in transverter mode provides 5 W output, has built-in support circuitry allowing the display to show 6 and 2 meter and 70 cm bands. www.kenwood.net/

ICOM

The new IC-7800 HF + 6 m, delivers full capability, transverter in/out with proper levels (0 dBm), and is very expensive. The IC-756-PRO-II has built in transverter functions with TX/RX on the same jack, proper transmit level of 0 dBm and provision for an external switch to set it into the transverter mode. www.icomamerica.com/

Ten-Tec

The Orion has a built-in transverter function, with low-level output. It operates QSK only, so it requires an external system to fool the rig to operate in a way that defeats break-in during CW operation. The Model 562 "6N2" is a 6 and 2 meter radio that has internally supported transverter outputs. It also operates QSK. www.tentec.com/

Elecraft

The Elecraft K2 is an HF transceiver kit, available in a QRP version. It is often interfaced to transverters, having some internal support including frequency display control. www.elecraft.com/

Down East Microwave

These folks have interfacing kits and products including some with the ability to match to rigs running up to a few watts. They have RF sensing models, and models specific to certain radios as well. www.downeastmicrowave.com/ 