

EVALUATING THE DIFFERENCES BETWEEN TRANSVERTERS AND ALL-MODE VHF/UHF TRANSCEIVERS

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INTRODUCTION

Whenever we desire to add a new band in the VHF/UHF/SHF range, we are faced with some choices as to what equipment to invest in and use. For the newcomer to these bands, choosing can be a daunting task- you want to spend your time and money wisely, getting the most “bang for the buck”, but you also want to get on the air quickly to enjoy the fun being experienced by others.

Today I will talk about the two choices in VHF/UHF/SHF equipment available to the ham for weak-signal work: All-Mode Transceivers and Transceiving Converters (commonly called Transverters). The topics covered today will include: cost, convenience, relative performance of each choice, and advantages and disadvantages of each.

GLOSSARY OF TERMS

First, it will be necessary to define some of the terms which will be discussed.

SENSITIVITY: This refers to a receiver’s ability to detect signals. The “noise floor” of a receiver is defined in its design and can be difficult to change. How closely to this noise floor a receiver can detect signals is the measure of its sensitivity. Sensitivity is usually expressed in terms of microvolts of input RF voltage required to provide a certain signal to noise ratio at the audio output, or in terms of Decibels (dB) below one milliwatt of RF power required to achieve the same signal to noise ratio. As you might imagine, the receiver’s bandwidth plays a part in this determination- the wider the bandwidth, the more noise accompanies the signal being detected.

DYNAMIC RANGE: This term refers to a receiver’s ability to handle both weak and strong signals and demodulate them accurately and without distortion. There are two types of Dynamic Range (DR) measurements. One is Blocking DR, which is the difference between the noise floor and the level of a signal that just begins to cause the receiver to distort. The other is Intermodulation Distortion DR (IMD DR), which is a measure of the impact on the receiver when two or more signals mix within the receiver at the same time. If the signals are of sufficient strength, they will produce spurious signals within the receiver which appear as false signals along with the desired ones. In simple terms, the greater the Blocking DR and/or IMD DR, the more robust the receiver is, and the less likely it will be to distort when receiving strong signals (such as during a contest when all your friends have their kilowatts running).

TRANSMIT RF POWER OUTPUT: Since we need some amount of RF power to communicate, all transverters and transceivers are rated in terms of RF output Watts (or milliwatts). Obviously, the more the better, but there is always a cost associated with more Watts in terms of complexity and actual dollars spent.

FREQUENCY STABILITY: We need to be able to do two things when operating in the vast spectrum of VHF/UHF/SHF: 1) Know what frequency we're on, and 2) Stay there. If we don't know the actual frequency, it's easy to miss a QSO with someone. If we drift around a lot, it may not be possible to stay with someone long enough to work them.

WHY A TRANSCEIVER?

What are the advantages of a transceiver?

First, Convenience. Nothing could be simpler than taking a radio out of the box, connecting it to a mike, antenna, and power source and Getting On The Air.

Second, Compactness. You have a single box, possibly capable of operating on more than one VHF/UHF/SHF band. There are not a lot of wires and other added hardware dangling from the setup. Such a rig looks very clean.

Third, Ease of Operation. This goes along with compactness and convenience. You have a limited number of connections and "extra stuff" you have to worry about- once you've learned the controls on the box, you can make it work.

Fourth, RF Power Output. There are transceivers available that produce up to 100W on VHF/UHF- more than enough for most weak-signal operation.

So, what are the disadvantages?

First, generally, transceivers cost quite a bit of money. Newer all-mode transceivers can easily run \$1-2k, more in some cases. For someone starting out on these bands, this kind of expense may be out of range.

Second, whenever a radio is made to cover a wide range of frequencies (such as several VHF/UHF bands separated by hundreds of MHz), the RF Front End (First stage preamplifier and filters) must necessarily be wideband. Since it becomes possible (due to this wideband front end) for signals other than the relatively weak amateur signals to get into the receiver (signals like those from paging transmitters, TV transmitters, public utilities, etc), it becomes possible for IMD to occur in the receiver. There is nothing in the receiver front end to limit which signals are rejected and thus, mixing of undesired signals along with the ones we want to hear, can take place. This can really tear up your ability to hear anything. The typical Dynamic Range for a multiband VHF transceiver is in the 60-80dB range. This means that if you're trying to listen to a signal that's about S1 on the meter, an undesired signal slightly over S9 will start to generate IMD products in the receiver.

Third, Sensitivity usually suffers as a consequence of the manufacturers trying to improve the IMD problem (every dB of front end gain can cause IMD to increase by as much as 3dB!). A "deaf" receiver doesn't usually have an IMD problem. The typical sensitivity of an all-mode transceiver is around 0.1uV (-127dBm).

Fourth, Selectivity is usually not optimized in all-mode transceivers. I call selectivity “Single Signal Reception Capability” - a receiver’s ability to differentiate between two closely-spaced signals in the band. Most manufacturers don’t install, or even have provisions for installing sharper IF filters in VHF/UHF all-mode rigs. Why? Because in general, these filters have not been considered necessary for casual, usually FM, VHF communications. But as more hams find the world of Weak-Signal VHF/UHF/SHF communications, the bands are becoming more crowded. Thus, the ability to reject undesired signals nearby in frequency (by narrowing the IF passband) has become increasingly more important. Typical IF bandwidths for the popular all-mode rigs are in the 2.5-3kHz range, with filters that do not have very steep skirts. Thus, the ultimate rejection is not very good.

Fifth, “You Get What You Get”. As you learn more about the VHF/UHF/SHF bands, and your desire to “push back the envelope” develops, you may find that the transceiver can’t easily be modified to accommodate the changes/improvements you want to make.

All of these factors lead us to a discussion of the transverter.

WHY A TRANSVERTER?

There are several reasons to consider a transverter for operation in the VHF/UHF/SHF bands.

First, if you already own an HF transceiver, adding a VHF band is fairly simple: You connect the transverter to the HF radio (you DO have to turn down the HF transmit power somehow- most rigs do this), you connect your VHF/UHF antenna to the transverter, connect an appropriate power source to the transverter, tune the HF radio to the appropriate band (usually 10 meters), and you start communicating on the new VHF/UHF band you’ve just added.

Second, the cost is generally lower, since the biggest part of the expense has already been made- the HF transceiver, which is now being used as a tunable IF. Good, new, state-of-the-art transverters can be purchased for \$300-500.

Third, by using your HF transceiver as the IF you can take advantage of any optional filtering it may have installed in it, such as a 500Hz CW or a 1.8kHz Narrow SSB filter, to improve the receiver’s “Single Signal Reception Capability”.

Fourth, since a transverter is designed to operate over a narrow band of frequencies (just one VHF/UHF band or a small portion of an SHF band), the front end amplifiers and filters can be made as narrow-band as necessary to prevent IMD. A front end can easily be designed to reject signals only a few MHz away from the desired band, thus passing only a small segment of spectrum and improving the robustness of the receiver. The typical DR of a transverter/HF transceiver combination is in the 80-100dB range (meaning that unwanted signals would have to be 100 times stronger than in the transceiver example in order to cause the same amount of IMD).

Fifth, a transverter lets you grow. If you want to add an external preamplifier or power amp, it is usually very easy to do when using a transverter. All the connections are available to you, and “tapping in” to add the desired stages becomes a simple task.

Sixth, a transverter is the ONLY way to become operational on the microwave bands above 1296 MHz. There are no commercially made transceivers operating in the 2.3, 3.4, 5.7 or 10GHz bands (at least as far as weak-signal SSB/CW work is concerned).

So, are there any disadvantages to transverters?

The answer is: Yes, there are.

First on the list is complexity of hook up. Earlier I said it was a simple matter to connect a transverter up and get it on the air. It really is, but it is certainly not as simple as the transceiver hookup, and you really DO have to make sure the HF rig doesn't put an excessive amount of RF into the transverter, or it will be damaged. This can complicate the connections, requiring switchable attenuators and relays.

Second is Frequency Stability. As much as transceivers may compromise certain things, they DO tend to be significantly more stable than just about any transverter. Transceivers generate the various internal oscillators they use from PLL synthesizers which run from a stable low-frequency reference signal. The high-frequency oscillators are thus just as stable as the low-frequency reference to which they are locked. Transverters, on the other hand, usually (though not always) use a crystal oscillator operating in the 90-110 MHz range. This oscillator is usually multiplied by two to 24 times to arrive at the needed Local Oscillator frequency. Any drift in the base oscillator is worsened by the number of times it gets multiplied. Without ovens or other temperature-compensating devices on the base oscillator, the transverter (especially units built for SHF use) can wander around quite a bit with temperature and voltage changes.

The third disadvantage is RF Power Output. Generally, transverters have PA stages that produce less output than most transceivers (typically in the 20-50Watt range), so an external Power Amplifier may be more desirable.

Shown on the next pages are some representative examples of VHF/UHF All-Mode Transceivers and Transverters available on the market today.



Typical DEMI transverter.
Front View. Price about \$300



Typical DEMI transverter. Rear
view.



Yaesu FT847. 50, 144, 432 MHz All-Mode. Price about \$1800.



ICOM IC910H 144, 432, 1200 MHz All-Mode. Price about \$2000

CONCLUSIONS:

Starting out, convenience and cost may be the most significant factors. A transceiver certainly wins for convenience, but probably not for cost. In areas where there are potentially a lot of stations and/or strong out-of-band signals, the transverter/HF rig is probably the performance winner, but is likely not the most convenient. The transverter will cost less initially (IF the operator already has an HF rig), and may be more easily improved upon as operating needs dictate.

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