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SHF Systems SHF 1240K 1296-MHz Transverter Kit

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Reviewed by Zack Lau, KH6CP

Looking for an inexpensive way to get on 1296 MHz? The SHF 1240K kit sold by Down East Microwave may be just what you need—if you have some soldering experience and the basic tools that it takes to maintain your Amateur Radio station. In addition to the 1296-MHz weak-signal work for which this transverter is designed, it can be used for satellite operation on 1269 MHz by changing the crystal and adding enough amplification to get the 8- to 10-dBm signal up to a usable level. The SHF 1240K is designed to be used with a 2-meter IF.

The kit consists of two double-sided circuit boards, the parts to populate them, and construction information. Both boards have plated-through holes, although only the local-oscillator (LO) board is tin plated. The LO board takes 12.8 to 13.8 V dc and converts some of it to a frequency-stable ac signal between 540 and 580 MHz. The transverter board contains the basic circuits of any transverter: mixers, amplifiers, and band-pass filters. This board also has a doubler to get the LO signal up into the 1150-MHz range, and a splitter to feed the transmit and receive mixers. To use this kit as the heart of a simple transverter system, you will need SPDT coaxial switches or relays for 2 meters and 23 cm. Although the kit doesn't come with one, a case is also available for the transverter, in case you don't want to make your own.

Unlike other transverter kits, the tuned circuits in the SHF-1240 are pretuned! Using a proven design topology and accurate circuit-board etching, the need for adjustment controls (except LO-frequency trimming) has been eliminated. As a result, virtually no test equipment is needed to align this transverter, although it is a good idea to use a frequency counter to determine your exact IF-conversion frequency. The time-honored technique of using a beacon or big contest station as a frequency reference is cheaper, though, and often works just fine.

Construction

Despite the fact that I got one of the first kits available, both the LO board and the main transverter board took only about 3 hours each to assemble, a tribute to the good design of this kit. The problems that slowed me down, such as missing circuit-board holes, two capacitors of the wrong physical size (too small) and two parts left off the parts-placement diagram, have since been fixed by the manufacturer.

Omissions in the parts-placement diagram weren't a big problem in building the LO, because a larger-than-life picture of the finished board is included in the kit documentation. This is a great touch that I wish more kits had. There is no substitute for seeing exactly what the finished product should look like.

When I first completed the kit, there was a detectable oscillation in the receive preamplifier that kept me from being able to measure the noise figure (NF) with the ARRL Lab's HP 8970/346A measurement setup, even with a 2-meter band-pass filter in line. Moving a resistor retuned the oscillation so that some measurements could

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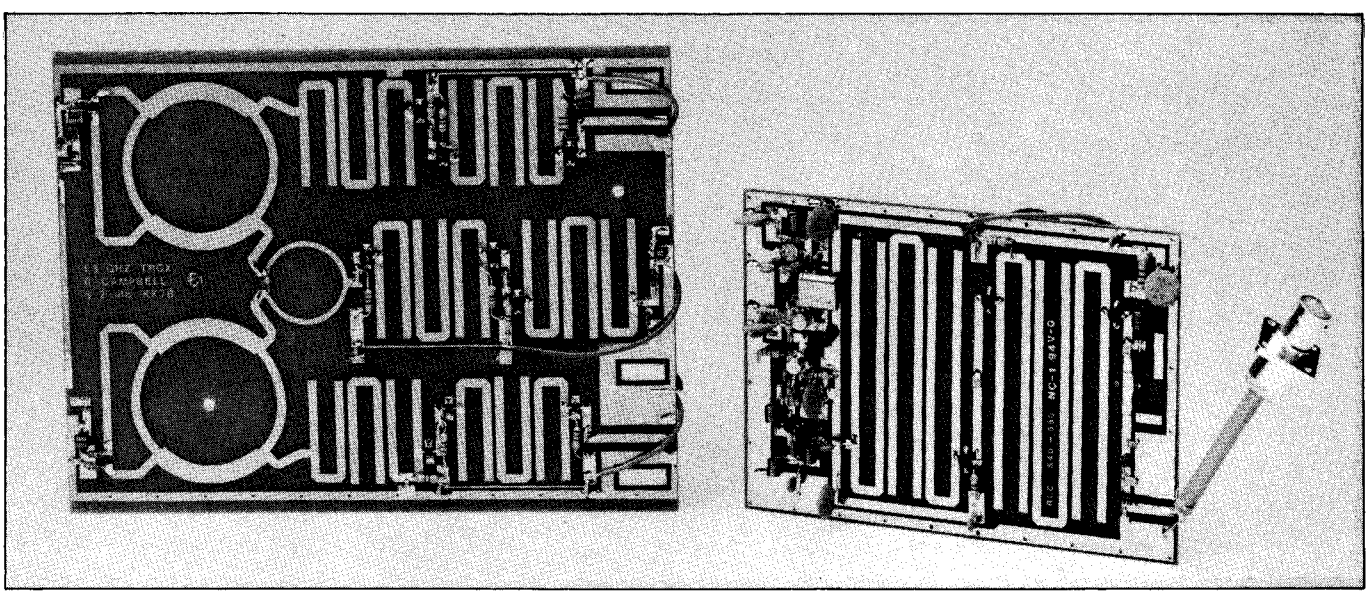
Manufacturer's Claimed Specifications	*Measured in the ARRL Lab*
Frequency coverage: Any 4-MHz segment between 1240 and 1300 MHz (with appropriate LO crystal).	As specified.
IF-drive level: 10 dBm.	As specified.
Receive-converter NF: Better than 4 dB.	5.0 dB.
Conversion gain: Not specified.	21.5 dB.
Power output: 8 to 10 dBm.	At 13.6 V, 10 dBm (saturated); 6 dBm at 1-dB compression point.
Power requirement: 12.8-13.8 V at 400 mA. 13.6 V optimum for supplied biasing components.	At 13.6 V and 10 dBm output, 440 mA.



be made. According to John Molnar, WA3ETD, of SHF systems, one of the 10 initial kits also exhibited this problem. Fortunately, his suggested cure of adding a 22-pF chip capacitor between the hairpin filter and ground worked fine, resulting in an oscillation-free, high-gain amplifier chain. This modification is included in current-production kits, although according to Bill Olson, W3HQT, of Down East Microwave, this problem is rare in all but the earliest kits.

The SHF-1240K isn't a kit for beginning builders, because soldering chip capacitors requires some skill and practice. I find that it helps to tin the capacitor terminations before soldering them into a circuit. The kit comes with no. 24 enameled wire for the coils; this is a good choice, because it's thick enough to allow easy removal of the insulation without damaging the wire. To wind the coils for this kit, you need to provide 1/16-inch and 7/64-inch drill bits to use as forms. When scraping the insulation off the coil wires, it helps to leave the coils on the drill-bit forms.

Once the transverter is assembled, the only adjustment required is setting a trimmer so that the oscillator starts reliably. The trimmer used in the review kit needs an unusual tuning tool. (I reshaped a drill shaft to make a suitable tool.) This isn't a problem in the current kits, though: A different style of tuning capacitor is now supplied with the kit.

If you hook up a stage improperly, as evidenced by abnormal current drain, troubleshooting can be easily done with a dc voltmeter. If the voltage at the output terminal of an MMIC is not between 3 and 5.5, it's not hooked up right.

Spurious Output

The spurious-signal content in the transverter's output depends on how the board is mounted. With the board unmounted, the LO spur is −37 dBc with no drive. With drive, the LO spur is −40 dBc. By tack soldering an IF attenuator to the back of the board, it is possible to *increase* the spurious content. The completed unit, without the cover on, has spurs close to the carrier that are approximately −36 dBc. The IF feedthrough is approximately 40 dB, although this can be reduced considerably by eliminating the attenuator and using a low-power source of 2-meter drive. The second harmonic of the mounted board's signal is −32 dBc.

Documentation

The seven-page-long SHF LO-board documentation is well done. The large photograph is helpful in building this kit, as mentioned earlier. A parts-placement drawing clearly indicates which parts go where. The SHF 1240K operation and main-board construction guide is less complete, and takes only five pages to cover construction and operation of a more complex circuit. No photograph of the main board is included to aid the builder, although you should learn enough from building the LO board to build this one without difficulty.

Using the SHF 1240K in your 1296-MHz Station

Of course, a 10-mW transverter kit that's as basic as this one requires additional equipment to make a functional 1296-MHz station. Assuming you already have a low-power 144-MHz IF rig, you'll need two coaxial relays or switches, an antenna, and perhaps a power amplifier and a preamplifier. Here's a rundown on what's out there. This is by no means a complete list; it's intended only to give you a start in the right direction.

Antennas

Recent editions of *The ARRL Handbook* and *The ARRL Antenna Book* describe 6- and 12-foot-boom loop Yagis designed by Chip Angle, N6CA. The *Antenna Book* also carries quagi antennas designed by Wayne Overbeck, N6NB, and 1296-MHz corner- and trough-reflector designs. Commercial loop-Yagi antennas for 1296 MHz and other bands are also available from Down East Microwave and other suppliers.

Higher Power

The easiest way to get more power at 1296 MHz is to add an MSA 1104 MMIC-amplifier stage. That should get the output up to 45 mW or so. For more power, a Mitsubishi M67715 hybrid power-amplifier module will boost an 8-mW signal to around 2.7 W. Those with design experience and test equipment could substitute a two-stage MRF581 amplifier to boost the board's 10-mW output to 0.6 W. I have also seen an MRF581-driven M57762 delivering more than 23 W, but it's an unpublished design for which I don't have any details.

Preamplifiers

The best 1296-MHz preamp design that I have built (and I've built several) is an ATF10135 circuit designed by Al Ward, WB5LUA, and covered in the *Proceedings of the 22nd Conference of the Central States VHF Society* (available from ARRL). This preamp's measured noise figure is 0.5 dB, and gain is 15.4 dB (measurements were made using the ARRL Lab's HP 8970/346A). An MGF-1402 preamp design also appears in Chapter 32 of *The 1990 ARRL Handbook*. Kits for 1296-MHz preamplifiers based on the W6PO design are available from Stephen Kostro, N2CEI, RD 1, Box 341A, Frenchtown, NJ 08825. Commercial preamplifiers for this band are sold by Down East Microwave and Microwave Components of Michigan, PO Box 1697, Taylor, MI 48180, tel 313-753-4581.

Conclusions

This kit, taking some of the recent advances in microwave technology, makes it possible for the careful amateur to build microwave gear with virtually no test equipment. This low-power, moderate-noise-figure transverter makes a nice little box for mountaintopping or repeater linking, where even a few milliwatts will go a hundred miles. And, SHF Systems makes transverter kits for 903, 2304 and 3456 MHz, as well as LO boards and LO parts kits. Assembled and tested versions are also available.

Price: SHF 1240K, including LO crystal, $139. Manufacturer: SHF Systems, PO Box 666, Nashua, NH 03061, tel 603-673-1573. SHF Systems kits, PC boards and assembled units are available exclusively through Down East Microwave, RR 1 Box 2310, Troy, ME 04987, tel 207-948-3741.

SOLICITATION FOR PRODUCT REVIEW EQUIPMENT BIDS

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The ARRL-purchased Product Review equipment listed below is for sale to the highest bidder. Prices quoted are minimum acceptable bids, and are discounted from the purchase prices.

ICOM IC-781 160- through 10-meter transceiver, s/n 1001 (see Product Review, January 1990 *QST*). Minimum bid: $3994.

Sealed bids must be submitted by mail and must be postmarked on or before February 27, 1990. Bids postmarked after the closing date will not be considered. Bids will be opened seven days after the closing postmark date. In the case of equal high bids, the high bid bearing the earliest postmark will be declared the successful bidder.

In your bid, please clearly identify the item you wish to bid on, using the manufacturer's name, model number, or other identification number, if specified. Each item requires a separate bid and envelope. Shipping charges will be paid by the successful bidder, FOB Newington. The successful bidder will be advised by mail. No other notifications will be made, and no information will be given by telephone to anyone regarding final price or identity of the successful bidder.

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