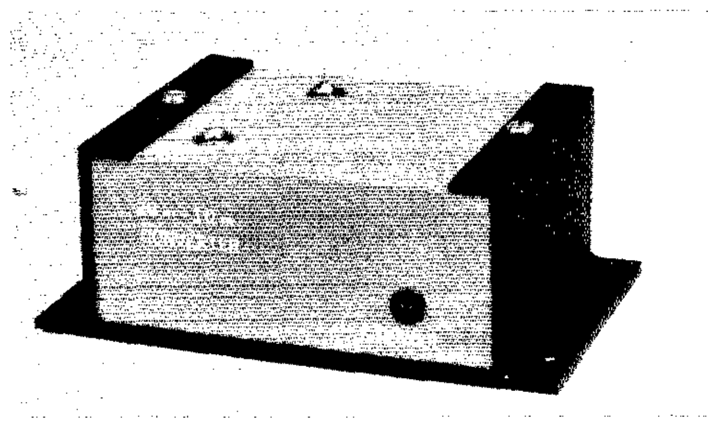
A QRP Transmitting Converter

Double up and have some fun as you chase 10-meter DX. Converting from 14 to 28 MHz is a simple technique that may be used at other frequencies as well.



By Jim Pitts,* KE4Y

Low atmospheric noise levels make the 10-meter band an excellent choice for QRP operation. Unfortunately, many QRP circuit designs cover only the 160- to 20-meter bands. This is primarily because of stability problems encountered when constructing simple VFOs for operation above 14 MHz. Also, it is difficult to build direct-conversion receivers with sufficient sensitivity and stability for use at higher frequencies. The 20- to 10-meter transmitting converter described here was designed for use with low-power transmitters or transceivers. At my station, the converter is used in conjunction with the Heath HW-8 transceiver and a separate ham-band receiver.

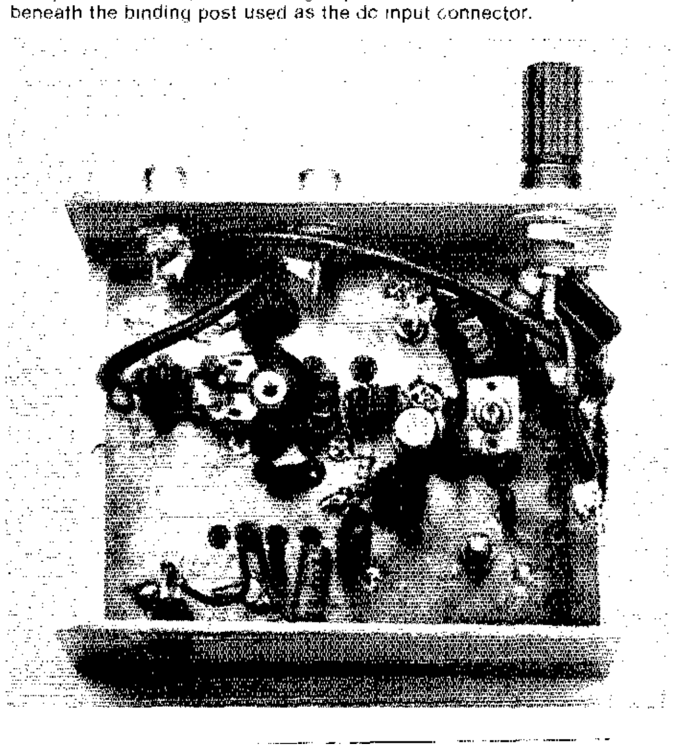
Circuit Description

The design of the converter shown in Fig. 1 is based on principles outlined in *Solid State Design for the Radio Amateur*.[1] Many different circuits, some involving several stages, were tried before this simple circuit was chosen. It features simplicity, low cost and flexibility for adaptation to other bands.

The "heart" of the converter is the frequency-doubling stage. The 14-MHz input signal is transformed into a 28-MHz output signal by the action of D1, D2 and T1. You may recognize this configuration as being similar to that found in a full-wave power-supply rectifier circuit. R1 is used to compensate for differences in the characteristics of the diodes and secondary windings of T1. Asymmetry in these components would produce a nonsinusoidal waveform which would result in strong 14-MHz fundamental feedthrough. According to DeMaw and Hayward, diode doublers can suppress fundamental feedthrough by more than 40 dB.

C1 couples the 28-MHz signal to T2 and T3, which form a broadband impedance-matching network. The 16:1 matching network feeds the base of the transistor, Q1, through a ferrite bead. This bead and R2 help stabilize Q1, which is prone to oscillation because of its high f_T. The transistor is an easily obtainable 2N3866. This is an npn silicon vhf transistor with an f_T of 800 MHz and a maximum collector dissipation of 5 watts.

The output pi network provides some protection against the radiation of harmonics of the 28-MHz signal. However, ARRL lab tests showed that the addition of a low-pass filter was required to ensure spectral purity. Pads have been provided on the pc board for the installation of the required filter components. With the addition of these components, the second harmonic is suppressed approximately 64 dB below peak power output.



The simplicity of the QRP transmitting converter may be seen here. Low-pass filter components are grouped at one corner of the pc board beneath the binding post used as the dc input connector.

Construction

The prototype of the frequency doubler was constructed on single-sided pc board using a method similar to that of the ARRL breadboard described in *QST*.[2] This method is fine for construction of small, noncritical circuits and allows circuit changes to be made with a minimum of effort. A slightly more rugged and aesthetically pleasing version may be built using double-sided pc board, and this is the method used in the model shown here. (See Figs. 2 and 3.)

The board is mounted in a small enclosure that I purchased at a hamfest. A dull-black and fawn-gray paint job adds a professional appearance to the completed unit. J1 and J2 are phono jacks, but other types of connectors may be substituted.

*1764 West Creek Way, Louisville, KY 40222

[1]Notes appear on page 37.

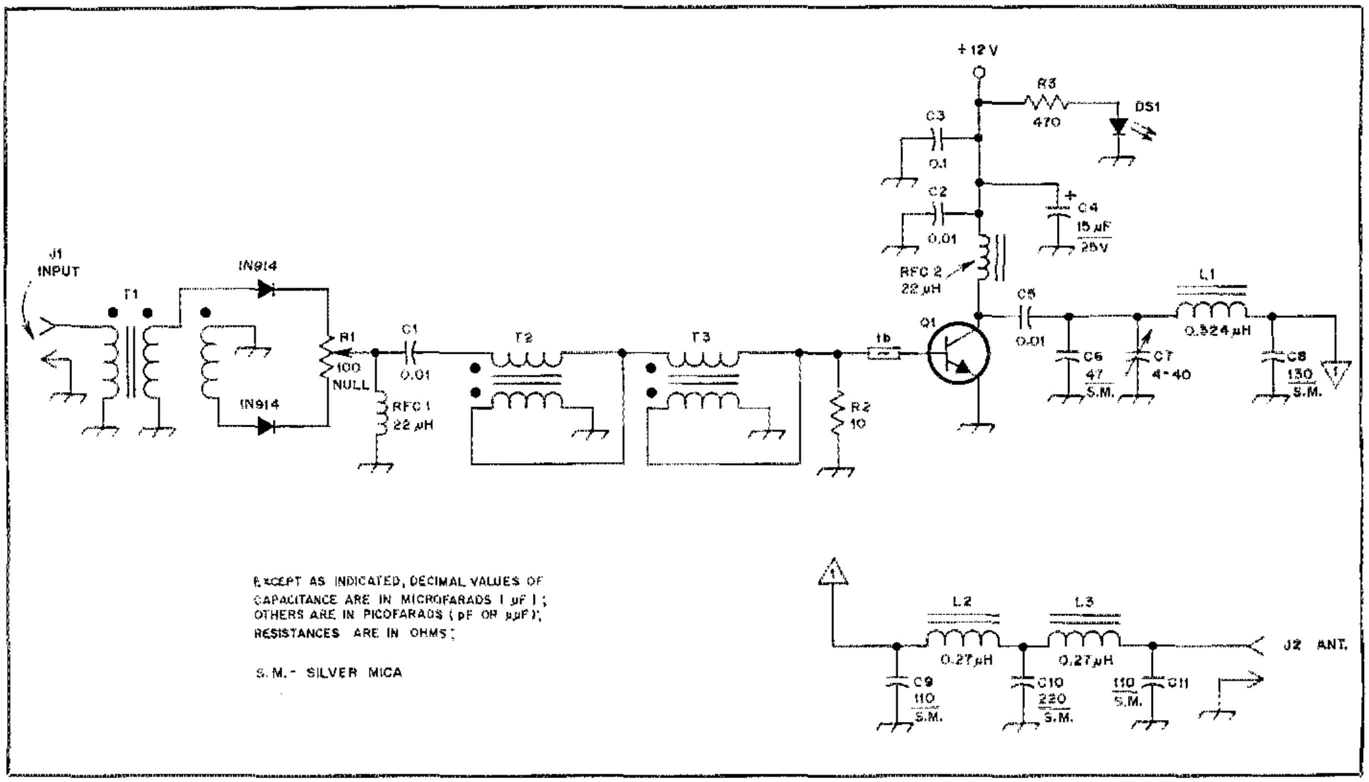


Fig. 1 — Schematic diagram of the transmitting converter. R1 is used to null the 14-MHz signal feedthrough. The low-pass filter consisting of C9, C10, C11, L2 and L3 is required to reduce the harmonic content in the output signal.

C1, C2, C5 — 0.01 µF, 100 V disc ceramic.
C3 — 0.1 µF, 100 V disc ceramic.
C6 — 47 pF silver mica or polystyrene, 100 V.
C7 — 4-40 pF trimmer (Arco 403 or equiv.).
C8 — 130 pF silver mica or polystyrene, 100 V.
C9, C11 — 100 pF silver mica or polystyrene, 100 V.
C10 — 220 pF silver mica or polystyrene, 100 V.
D1, D2 — Silicon, fast switching, 100 V; 1N914 or equiv.
DS1 — 3-V, 50-mA (max.). Radio Shack T1 mini LED (276-026) or equiv.
FB1 — Ferrite bead.
J1, J2 — Phono jacks.
L1 — 9 turns no. 23 enameled wire on T-50-6 core (0.324 µH).
L2, L3 — 5 turns no. 24 enameled wire on T-50-6 core (0.27 µH).
Q1 — Silicon npn vhf transistor (see text).
R1 — 100-Ω, pc-mount potentiometer.
R2 — 10 Ω, 1/2 watt.
R3 — 470 Ω, 1/2 watt.
RFC1, RFC2 — 20 turns no. 28 enameled wire on FT-37-61 core (0.324 µH).
T1 — 8 twisted trifilar turns no. 28 enameled wire on FT-37-61 core.

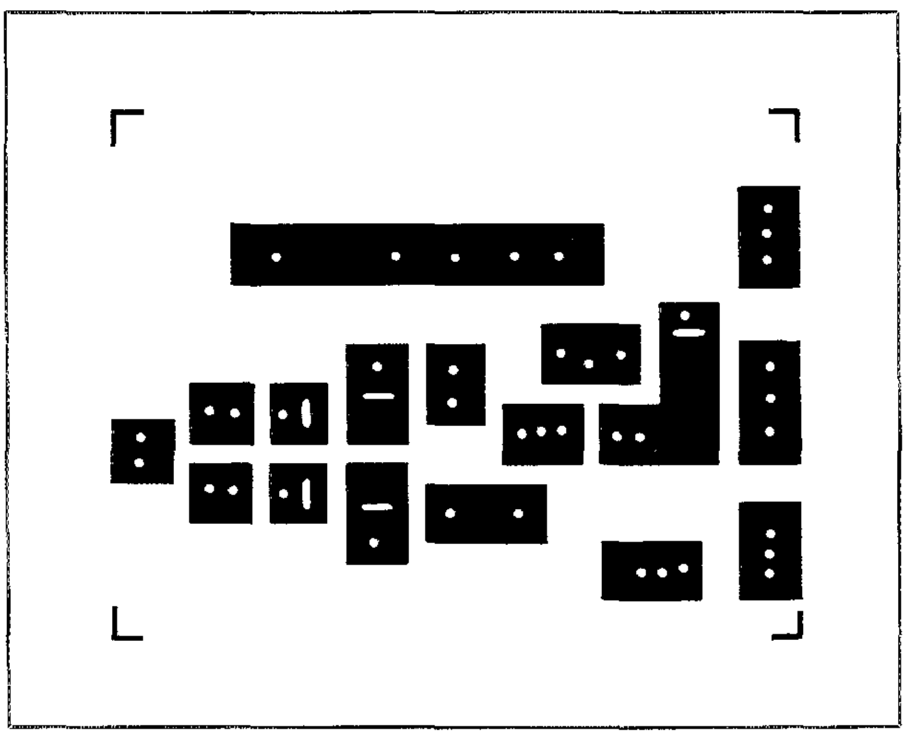


Fig. 2 — Actual size circuit-board etching pattern. Black areas represent copper. A double-sided board is used; only one side is etched. Clearance holes are drilled at the appropriate locations on the ground-plane side of the board to pass the component leads.

Connections from the board to the jacks are made with RG-174/U coaxial cable. An LED is used as a power-on indicator. A dpdt switch might be added to allow switching the doubler in and out of the line.

Alignment

The tune-up procedure is simple, but care must be taken to ensure stability. With no dc voltage applied to the converter, feed a 1-watt, 14-MHz signal into J1. While listening to the 14-MHz signal feedthrough with a receiver, carefully adjust R1 for a deep null in the signal strength. Next, attach a dummy load (a 52-ohm, 2-watt resistor will do) and power-indicating device such as a VSWR meter to J2. Apply 12 to 13.5 V dc to the converter and once again inject the 14-MHz signal at J1. Listen for the 28-MHz signal with the station receiver and adjust C7 for a peak in the signal strength; the SWR reading should be low. The converter may now be placed in the line and a careful check made for spurious emissions in the 10- and 20-meter bands. Hashy noise anywhere indicates parasitic oscillation problems. If such oscillations exist, try reducing the 14-MHz signal drive level and readjusting C7. Ensure you have the shortest possible emitter lead length on Q1. The output of the doubler should be approximately 1 watt. If more output is desired, you may try using higher values for R2, but stability is likely to be harder to achieve.

Additional Notes

The lack of tuned circuits in the doubler design is deliberate. As such, a simple change in the output-network component values makes it useful on other frequencies. Provisions could be made for switching the output networks as desired.

As with any similar multiplying scheme, VFO bandspread will be sacrificed. A 50-kHz transmitter frequency change results in a 100-kHz change at the doubler output. On the other hand, 500 kHz of the 10-meter band can be covered with a transmitter tuning range of only 250 kHz. Several 1000-mile (1600-km) contacts have been made using this transmitting doubler with a simple dipole antenna. Under proper ionospheric conditions, you too can expect similar results. QST

Notes

[1] Available from the ARRL, $7.
[2] Leslie, "Breadboard Revisited," February 1974 *QST*, p. 30.

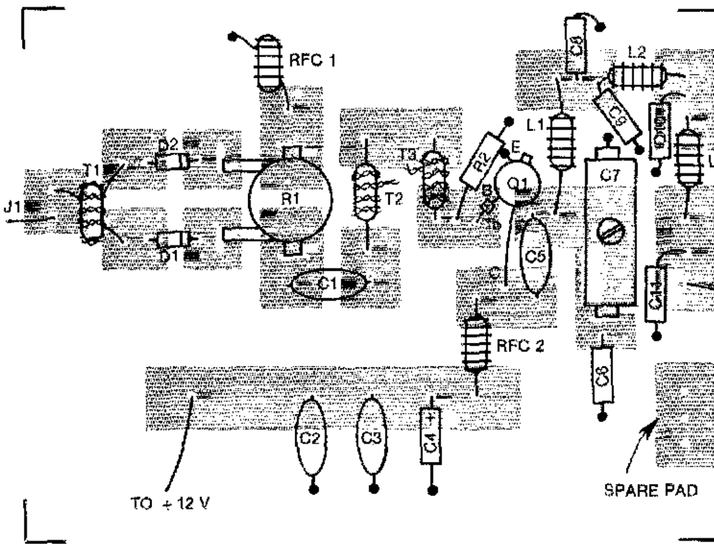


Fig. 3 — Parts-placement guide for the transmitting converter. A double-sided board is used with the components being placed on the ground-plane side of the board; the shaded areas represent an X-ray view of the etched side of the board.

Strays

John Walker, WD4HSF, and his wife, Lynn, stand before their yacht, *Gusto*, docked at Whangarie, New Zealand. The Walkers crossed the Pacific Ocean from the U.S. East Coast via the Panama Canal, and plan to resume their around-the-world voyage this spring. Look for John on 15 and 20 meters. *(photo courtesy of Paul M. Wilson, W4HHK)*

HIGH SPEED CLUB OF GERMANY

☐ The High Speed Club (HSC) is an international organization of cw operators, with headquarters in West Germany. HSC administers a number of awards and their club station is DLØHSC. For further information contact Edgar Schnell, DL6MK, or Kurt R. Schmeisser, W8LZV, 20114 Houghton Ave., Detroit, MI 48219, Tel. 313-534-4456.

WESTLINK TRUST FUND

☐ Rather than succumb to a less-frequent broadcast schedule, the weekly Westlink Amateur Radio News has set up a trust fund and is turning to the amateur community for support. If you would like to contribute, make your check payable to the Westlink Radio Network, c/o Dr. Norm Chalfin, K6PGX, P. O. Box 463, Pasadena, CA 91102.

QST congratulates . . .

☐ Gerry Wood, WB4ZQN, who was recently named Editor-in-Chief of the international music industry trade publication, *Billboard*.

ROANOKE DIVISION MEETING

☐ The Roanoke Division will hold a League Planning Meeting on May 9 and 10, 1981, at the Ramada Inn at Tyson's Corners, Falls Church, Virginia. All League members in the division are invited to attend, and each affiliated club in the division is urged to send at least one representative. All inquiries should be forwarded to: Northern Virginia Amateur Radio Council, P. O. Box 682, McLean, VA 22101. Reservations for rooms should be made directly with the Ramada Inn at 800-228-2828. Expressly request a reservation receipt. — *Gay Milius, W4UG*

I would like to get in touch with . . .

☐ anyone knowing about the disposition of equipment of the late Dr. James Hard, XE1GE, deceased circa 1941. John Nagle, K4KJ, 12330 Lawyers Rd., Herndon, VA 22071.

☐ active members of Toastmasters International. Al Markwardt, W5PXH, 826 Sherbrook Dr., Richardson, TX 75080.

☐ those in need of KH6 contacts to meet daily on 15 meters. Contact Warren O. Smith, KH6AQ, 525 Pauka St., Kailua, Oahu, HI 96734.