By William S. Berger, K6INJ

The Ten-Tec 6 Meter Transverter on 12 or 17 Meters

Does your older gear lack 12 or 17 meter capability? Modify an inexpensive transverter and discover what you're missing.

I am the proud owner of a Yaesu FT-901DM all-mode transceiver and it is a great performer on all of its operational frequencies. It does have one deficiency, however—it was born before the 12 or 17 meter bands became available for amateur use. It occurred to me that there are probably thousands of excellent HF transceivers still being used with the same problem. After hearing the good comments from other hams about 12 and 17 meters, I decided that I needed to design a transverter for these bands.

While doing a few paper designs, I ran across an older *QST* product review describing the Ten-Tec[1] model 1208 6 meter transverter kit for less than $100.[2] It was hard to understand how so complete a kit could be sold at such a reasonable price, especially since my own design looked like it would cost considerably more.

The kit was ordered and assembled, then put on the air. My first 6 meter contact was with Dennis, W1HOG, in New Hampshire, with a 59 report, while running approximately 8 W RF output on SSB. I made many more exciting contacts on the "magic band" while completing the design, construction and testing of the 1208 conversion to 17 meters.

My first 17 meter contact with the newly modified transverter was with Bo, K1BO/W4ZCV, in North Carolina—another big thrill. Some time later, I converted a second transverter to 12 meter operation, and my first contact on that "new" band was with Dave, AA9YE, in Wisconsin. Both of the converted units work very well and I've made many worldwide contacts on 12 and 17 during the last few years. An exciting aspect of the project was low power operation—that was the most rewarding of all.

[1]Notes appear on page 44.

The Conversion

The original circuit remains the same. The transverter modifications consist of changes to the local oscillator (LO) and radio frequency stages; the low pass, band pass, bypass filters and ¼ wave filters, as well as the changes to a few coupling capacitors and bias resistors. For 17 meters the LO is at 11 MHz and the RF stages are at 7.0 MHz. For the 12 meter band, the LO is at 21 MHz and the RF stages are at 3.9 MHz. The coupling capacitor and bias changes were required because of the increased impedance and gain at the new lower operational frequencies.

The schematic diagram of the completed transverter appears in Figure 1. Table 1 lists the required parts changes necessary for both the 12 and 17 meter modification. Both the schematic and the printed circuit board layout highlight the components that are changed.[3] Both should be followed, along with Table 1, during construction. I recommend that you first carefully read the Ten-Tec instruction manual, and then incorporate and highlight the conversion data into the manual.

A view of the interior of the transverter, before modification, appears in Figure 2. If your transverter hasn't been built yet it would be advisable to build the 1208 and get it working on 6 meters before you modify it for 17 or 12. That will limit the number of variables involved in the conversion. Above all... have fun!

The basic ideas behind the modifications are the following:

- *The 17 meter band*—convert an 18 MHz received signal to 7.0 MHz or a transmitted 5 W, 7.0 MHz signal to an 18 MHz, 8 W output signal. The band edges will read 7.068 to 7.168 MHz on the transceiver to cover 18.068 to 18.168 MHz.
- *The 12 meter band*—convert a 24 MHz received signal to 3.9 MHz or a transmitted 5 W, 3.9 MHz signal to a 24 MHz, 8 W output signal. The band edges will read 3.890 to 3.990 MHz on the transceiver to cover 24.890 to 24.990 MHz.

Coil Winding

Figure 3 shows details of the coil winding operation. The winding directions should be followed as shown in order for the inductance values to be proper and also that the inductors properly fit the PCB. As a winding example, consider the following:

For a desired inductance of 0.500 µH, using a T68-6 iron core toroid, use 8 turns of 22 gauge enameled magnet wire and wind it over a span of 175°. The number of turns refers to the number of times the wire passes *through the center* of the core. The coverage angle (span) refers to the arc of the core circumference occupied by the winding with the turns tightly wound and evenly spaced. Figure 3 can be used as a template for coil winding. Center the wound core on top of the diagram of Figure 3. Place the *outside* start winding at the 0° mark; then adjust the *outside* finish winding to the specified arc angle with the turns evenly spaced.

Instruction Manual Progress Tests

The Ten-Tec assembly manual is divided into construction groups or *phases*. The following additions and modifications to the assembly manual refer to the "Progress Test" portion of those phases, except for Phases 5 through 7, which relate to general assembly details.

Table 1

Ten-Tec 1208 12 and 17 Meter Conversion—Component Changes

[Bracketed] components and coil turns refer to the 17 meter conversion. (See article notes on page 44 for supplier contact information.)

Schematic Part Designator	*Manual Step Number*	*Was* / ***Change To***	*Part Number or Equivalent*	*Notes*	*Supplier*
C1-6	1-40, 1-41, 1-42, 1-43, 1-44, 2-22	0.01 µF / ***0.1 µF***	Disc ceramic	100 V dc	Digi-Key[4]
C7	3-21	120 pF / ***560 [220] pF***	Disc ceramic	100 V dc COG	Digi-Key
C8	3-22	560 pF / ***1200 [1200] pF (change for both bands)***	Disc ceramic	100 V dc	Digi-Key
C15	1-12	47 pF / ***150 [150] pF (change for both bands)***	Disc ceramic	100 V dc	Digi-Key
C16	1-8, 1-25	47 pF / ***150 [180] pF***	Disc ceramic	100 V dc COG	Digi-Key
C18	1-16	120 pF / ***270 [560] pF***	Disc ceramic	100 V dc	Digi-Key
C20	1-13	33 pF / ***68 [100] pF***	Disc ceramic	100 V dc COG	Digi-Key
C21	1-25	47 pF / ***100 [180] pF***	Disc ceramic	100 V dc	Digi-Key
C23	1-7	100 pF / ***68 [22] pF***	Disc ceramic	100 V dc	Digi-Key
C26, C32	3-29, 3-46	150 pF / ***470 [560] pF***	Disc ceramic	100 V dc	Digi-Key
C27, C31	1-7, 1-13, 3-28, 3-47	39 pF / ***68 [120] pF***	Disc ceramic	100 V dc COG	Digi-Key
C35	3-27	47 pF / ***100 pF [150] pF***	Disc ceramic	100 V dc	Digi-Key
C38, C40	4-18, 4-19	33 pF / ***100 [120] pF***	Disc ceramic	100 V dc COG	Digi-Key
C39, C41	4-16, 4-17	3 pF / ***[10] pF***	Disc ceramic	100 V dc COG	Digi-Key
C42	4-21	150 pF / ***560 [470] pF***	Disc ceramic	100 V dc	Digi-Key
C43	4-20	39 pF / ***120 [150] pF***	Disc ceramic	100 V dc	Digi-Key
C60	5-59	62 pF / ***180 [220] pF***	Disc ceramic	100 V dc COG	Digi-Key
C61, C62	5-60, 5-61	120 pF / ***220 [270] pF***	Disc ceramic	100 V dc	Digi-Key
C63	5-62	47 pF / ***68 [68] pF (change for both bands)***	Disc ceramic	100 V dc	Digi-Key
L1, L2, L5	1-36, 1-37, 3-14	100 µH / ***330 [220] µH***	[M8041-ND] M8043-ND	Vertical mount Miller	Digi-Key
L3	3-16	1.3 µH / ***4.7 [2.7] µH***	TK1415-ND	**(Reference 1)** Toko	Digi-Key
L4	3-23	15 µH / ***56 [33] µH***	M8034-ND [M8031-ND]	Miller	Digi-Key
L6, L9, L10, L14	1-1b, 1-51, 1-52, 3-36	3.3 µH / ***6.8 [10] µH***	M8023-ND [M8025-ND]	Miller	Digi-Key
L7	1-23	0.56 µH / ***0.82 [1.39] µH***	[M8013-ND+ M8008-ND] M8012-ND	Series-connected	Digi-Key
L8	1-9	1 µH / ***Delete (jumper) for both bands***	0.0QBK-ND (Yageo)	Insulated jumper	Digi-Key
L11, L12	3-37, 3-39	0.25 µH / ***0.660 [0.770] µH (nominal)***	143-15J12S [143-17J12S]	Coilcraft	Coilcraft[5]
L13	3-33, 3-34, 3-35	6T, 18 gauge / ***0.550 [0.750] µH***	T68-6 toroid	**(Reference 2)**	Amidon[6] (iron core)
L15	4-6	15 µH / ***33 [47] µH***	M8031-ND	Miller	Digi-Key
L16, L17, L18	4-8, 4-9, 4-10	0.25 µH / ***0.416 [0.660] µH (nominal)***	143-10J12S [143-14J12S]	Coilcraft	Coilcraft
L22, L23	5-64, 5-65	5T, 18 gauge / ***0.500 [0.750] µH***	T68-6 toroid	**(Reference 3)**	Amidon (iron core)
L24	5-26	5T, 18 gauge / ***0.440 [0.590] µH***	T68-6 toroid	**(Reference 4)**	Amidon (iron core)
R34	1-4	680 Ω / ***Delete (open) for both bands***	—	—	—
R53	5-50	100 Ω / ***330 [270] Ω***	Carbon film	1/4 W	Digi-Key
Y1 Crystal	1-3	36 MHz / ***21.0000 [11.0000] MHz***	HC-49/U (Parallel-mode crystal)	Capacitive load, 32 pF	International Crystal[7]
Misc	—	Add	Dry 1/8 inch transfers	Datamark K63-White	Datak[8]

References

1) L3—Using an ohmmeter, check for the two active pins of this variable inductor. Cut off the other three pins. The shielded inductor will now fit the PCB correctly.
2) L13—Tightly wind 8T [10T], 22 gauge, enameled magnet wire evenly spaced over 120° [165°] of the circumference of the T68-6 toroid.
3) L22, L23—Tightly wind 8T [10T], 22 gauge, enameled magnet wire evenly spaced over 175° [165°] of the circumference of the T68-6 toroid.
4) L24—Tightly wind 7T [9T], 22 gauge, enameled magnet wire evenly spaced over 150° [190°] of the circumference of the T68-6 toroid.

(The number of turns refers to the number of times the wire passes *through the center* of the core.)

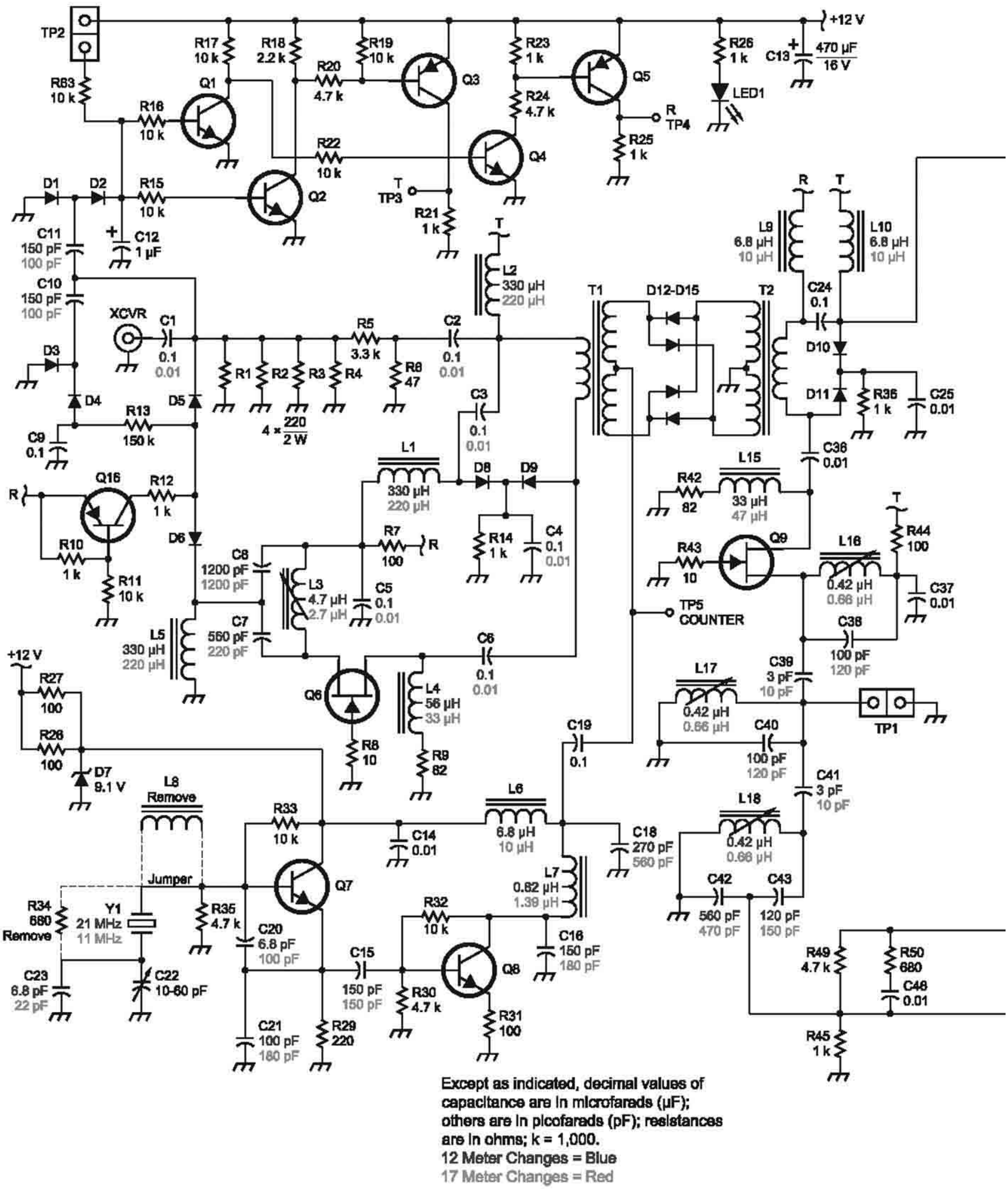
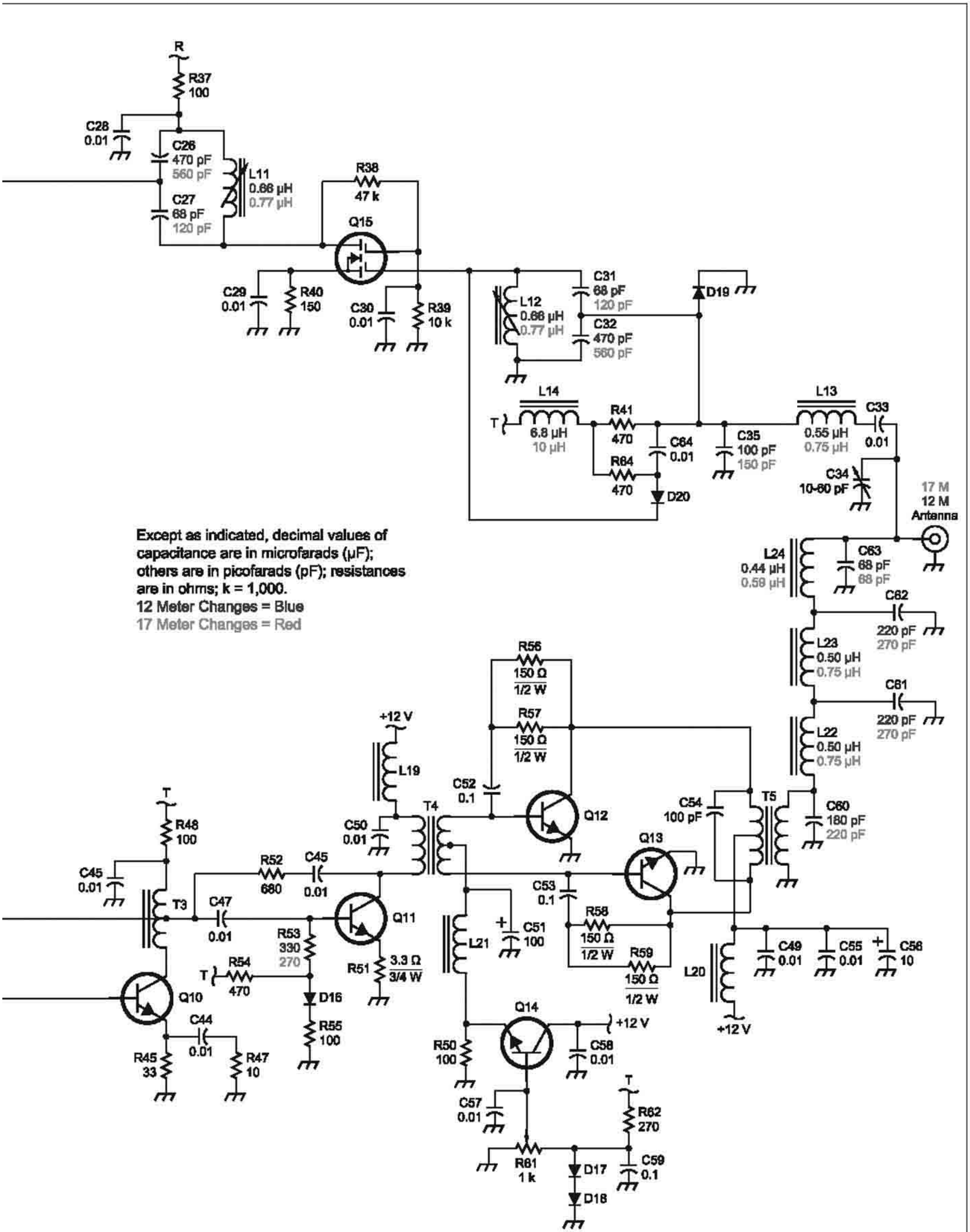


Figure 1—Schematic of the modified transverter. Note the highlighted part changes.


R
R37
100
C28
0.01
C26
470 pF
560 pF
L11
0.66 µH
0.77 µH
C27
68 pF
120 pF
R38
47 k
Q15
C29
0.01
R40
150
C30
0.01
R39
10 k
L12
0.66 µH
0.77 µH
C31
68 pF
120 pF
C32
470 pF
560 pF
D19
L14
T
6.8 µH
10 µH
R41
470
C64
0.01
R64
470
D20
C35
100 pF
150 pF
L13
0.55 µH
0.75 µH
C33
0.01
C34
10-60 pF
17 M
12 M
Antenna
Except as indicated, decimal values of capacitance are in microfarads (µF); others are in picofarads (pF); resistances are in ohms; k = 1,000.
12 Meter Changes = Blue
17 Meter Changes = Red
L24
0.44 µH
0.59 µH
C63
68 pF
68 pF
C62
220 pF
270 pF
L23
0.50 µH
0.75 µH
C61
220 pF
270 pF
L22
0.50 µH
0.75 µH
R56
150 Ω
1/2 W
R57
150 Ω
1/2 W
+12 V
L19
C52
0.1
T4
Q12
C54
100 pF
T5
C60
180 pF
220 pF
C50
0.01
Q13
T
R48
100
C45
0.01
R52
680
C45
0.01
C53
0.1
T3
C47
0.01
Q11
R53
330
270
R51
3.3 Ω
3/4 W
L21
C51
100
R58
150 Ω
1/2 W
R59
150 Ω
1/2 W
L20
C49
0.01
C55
0.01
C56
10
+12 V
T
R54
470
D16
R55
100
Q10
C44
0.01
R45
33
R47
10
Q14
+12 V
R50
100
C58
0.01
C57
0.01
T
R62
270
R61
1 k
D17
D18
C59
0.1

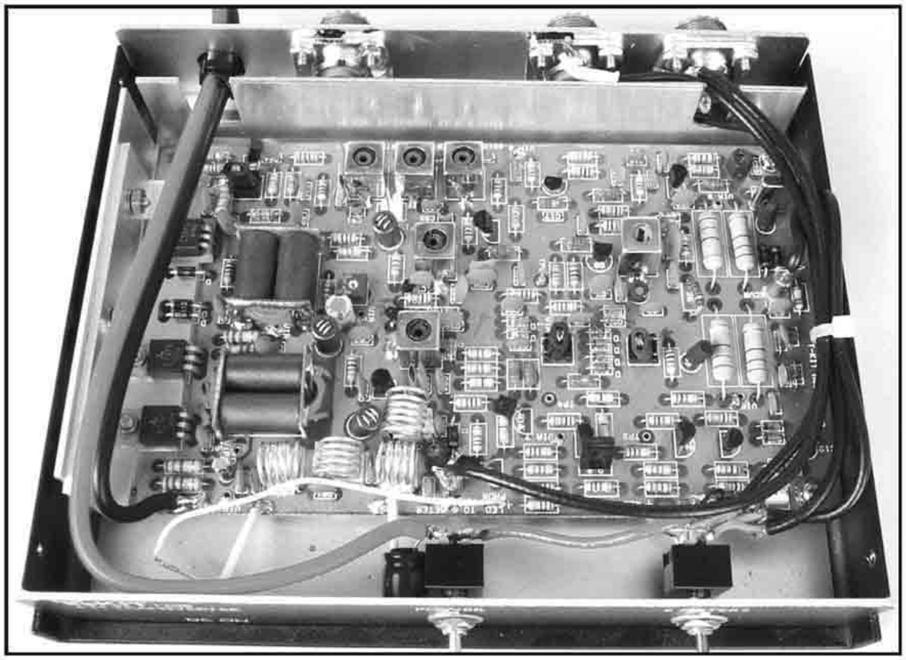


Figure 2—A view of the transverter main board before conversion. Note the air-wound coils L13, L22, L23 and L24 in the lower left. These are replaced by toroid inductors.

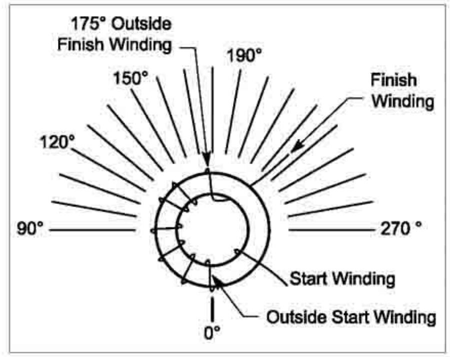


Figure 3—Coil winding diagram and template for winding the toroid inductors. This should be closely followed to ensure creation of the proper inductance values.

Phase 1.0

Follow step 5 in the manual except connect a frequency counter to test point TP5. Adjust trimmer C22 for a reading of 11.000000 MHz if you are modifying for 17 meters or 21.000000 MHz for 12 meters (per the maximum resolution offered by your counter). I used an MFJ-259 Analyzer in the frequency counter mode.

Phase 2.0

Follow steps 1 through 8 except use a low power 3-5 W test signal from your HF transceiver. Temporarily connect this to the input jack in place of the called-for handheld transceiver. The RF sensing TR control circuit does not care what frequency is applied to the transverter input, as long as it does not exceed 5-6 W.

Phase 3.0

Follow alignment steps 3-54 through 3-59, except in step 3-58 tune the receiver to where you expect to hear a signal (7.120 to hear 18.120 MHz for 17 meters or to 3.940 to hear 24.940 MHz for 12 meters). Adjust the receiver frequency until you hear a signal (you will probably hear several). See References 1-4. Delete steps 3-33 and 3-34.

Phase 4.0

Optional—Change the reference to "50 MHz" to read "18 MHz" or "24 MHz" and "6 meters" to read "17 meters" or "12 meters" depending on which modification you are doing.

Phase 5.0

Delete step 5-63 and refer to notes 1 through 5.

Phase 6.0

Follow steps 6-1 through 6-25 except substitute 17 meters or 12 meters for "6 meters" in step 6-14. In step 6-18 substitute "7 MHz" for the 17 meter modification or "3.9 MHz" for the 12 meter modification. See References 1-4.

Phase 7.0

In step 7-34, replace 14 MHz with 7 MHz or 3.9 MHz for 17 meters or 12 meters, respectively. In step 7-35, replace "6 meter" antenna with either "17 meter" or "12 meter" antenna, depending on which modification you are doing. Change step 7-36 to read "7.120 MHz" for the 17 meter modification or to "3.940 MHz" for the 12 meter modification. Change step 7-37 to read "in the 17 meter" or "...12 meter" position. Delete step 7-42. Change step 7-43 to read "11.000000 MHz" for the 17 meter modification or "21.000000 MHz" for the 12 meter modification.

Some Useful Information

Mask off any front and rear panel information you want to save and then spray the front and rear panels with satin black paint. After removing the masking tape use the Datamark dry transfer labels for any desired nomenclature on the panels.

The Ten-Tec 1208 Transverter Kit now sells for $109. The parts cost for the conversion to 17 or 12 meters (if all are purchased new) is about $110. The Coilcraft inductors are the major cost item. I purchased the M102 *Inductor Kit* directly from Coilcraft for $60. This kit contains the variable inductors required to build both the 17 and 12 meter transverters plus enough left over to supply many future projects. Have fun and enjoy your "new" frequencies![9]

Notes

[1]Ten-Tec, Inc, 1185 Dolly Parton Pkwy, Sevierville, TN 37862; 865-453-7172; **www.tentec.com**.

[2]"Product Review," *QST*, Jun 1996, pp 62-64.

[3]A layout of the printed circuit board can be found at **www.arrl.org/files/qst-binaries/6mtransverter.zip**.

[4]Digi-Key Corp, 701 Brooks Ave S, Thief River Falls, MN 56701; 800-344-4539; **www.digikey.com**.

[5]Coilcraft, 1102 Silver Lake Rd, Cary, IL 60013; 847-639-6400; **www.coilcraft.com**.

[6]Amidon, Inc, 240 Briggs Ave, Costa Mesa, CA 92626; 800-898-1883; **www.amidon-inductive.com**.

[7]International Crystal Manufacturing Co, PO Box 26330, Oklahoma City, OK 73126; 405-236-3741; **www.icmfg.com**.

[8]Datak Co, 3660 Publishers Dr, Rockford, IL 61109; 815-874-2301; **www.philmore-datak.com**. (Datamark dry-transfer labels are also available from Ocean State Electronics, 6 Industrial Dr, Westerly, RI 02891; 800-866-6626; **www.oselectronics.com**.)

[9]Both 12 and 17 meter converted transverters were tested in the ARRL Lab and were found to meet current FCC emission standards for spectral purity on their modified frequencies.—*Ed.*

William S. Berger, K6INJ, was first licensed in 1954. A retired EE, Bill spent 35 years as a designer of video monitors and other products for military and civilian use. He can be reached at 3153 E Virginia Ave, West Covina, CA 91791; **gemcap13@aol.com**.