six-meter antenna coupler

This 500-watt antenna coupler for 50 MHz matches both balanced and unbalanced feedlines and uses commercially-available hardware

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Current six-meter transceiver and transverter designs follow the general supposition that the operator will be using 50-ohm coaxial cable and an antenna system of like impedance. Output tank circuits are usually pi-networks designed to match a 40- to 60-ohm load and allow little deviation beyond these limits. On the other hand, the amateur buys 50-ohm coax, assembles a 50-ohm antenna to the manufacturer's specifications, and assumes the load presented to the output of the transceiver is 50 ohms. In most cases it is not unless careful attention is given to swr measurements, antenna match adjustments, antenna location and a host of other variables.

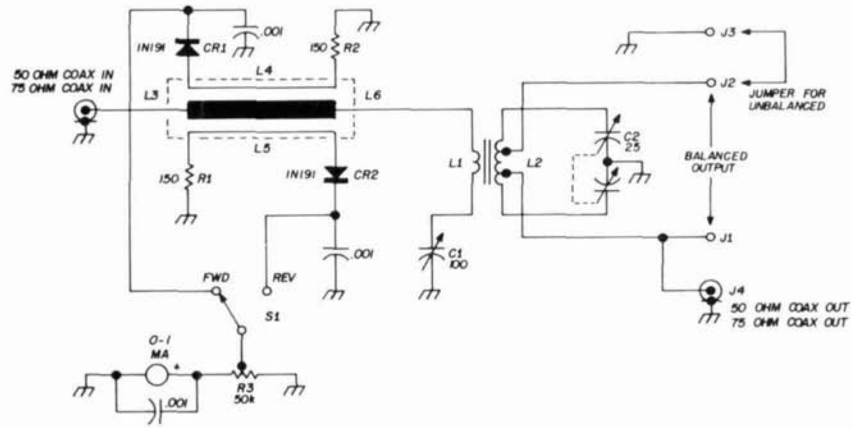
To compound the problem amateurs begin loading the system with goodies such as swr bridges, monitor scopes and the like which do nothing to improve transmission line flatness, and in most cases add to the mismatched condition by adding impedance "bumps" to which the transceiver has difficulty accommodating. The end result is a transceiver which is difficult to tune and erratic to operate.

In these situations the often maligned and usually misunderstood antenna coupler can be used to its best advantage. Many hams who lack experience with couplers have the mistaken idea that they are a panacea solution to antenna problems. However, an antenna coupler will *not* compensate for a misadjusted antenna or one in need of repair; nor will it compensate for final-tank-circuit inefficiencies.

It *will* provide the transmitter with a constant load impedance irrespective of antenna variations. In addition, it will assist in receiving by attenuating spurious signals through the introduction of another tuned circuit in the input.

construction

Many articles have been written on antenna couplers. Unfortunately, these designs often require the builder to fabricate coaxial cavities and various plastic



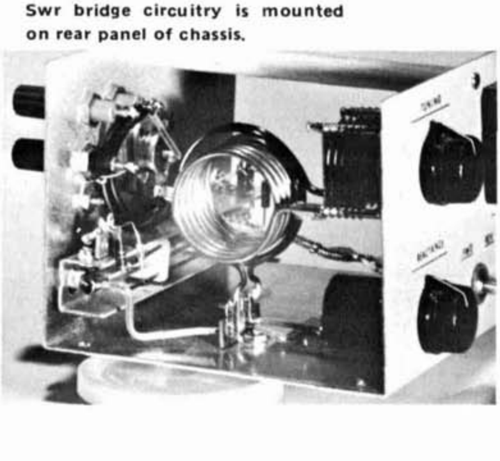
C1	25 = pF butterfly capacitor (E. F. Johnson 167-22)	L4, L5	0.062 brass rod, 4" long (Heathkit 40-99)
C2	100 pF variable (Hammarlund HF-100)	L6	coaxial section (Heathkit 40-100)
L1	2 turns no. 14 enameled, 2-1/8" diameter, over center of L2	J1, J2, J3	5-way binding post
L2	7 turns no. 10 spaced ½ wire diameter, 1½" diameter, tapped 2½ turns from each end	R3	50k pot, linear taper (Heathkit 10-11)
L3	0.250 brass rod, 5" long (Heathkit 40-98)	S1	spdt toggle or 2-position rotary (Heath-kit 63-177)

Swr bridge uses coaxial line section from Heathkit bridge.

spacers and other hardware to incorporate an swr bridge into the coupler. The coupler described here takes the lazy man's approach and uses commercially-made hardware throughout; it requires an absolute minimum of fabrication.

The coupler consists of a conventional input/output circuit of a 2-turn input coil tuned with a 100-pF variable to ground. The input coil surrounds the output coil and is inductively coupled; the output inductor consists of 7 turns of no. 10 copper wire tuned by a 7-35 pF butterfly variable to ground. The output inductor is tapped for 300-ohm balanced output at 2½ turns from each end.

Swr bridge circuitry is mounted on rear panel of chassis.



swr bridge

An swr bridge is included to provide a self-contained functional unit. The heart of the bridge consists of a coaxial cavity line and rf pickoff elements from a Heathkit swr bridge. The coaxial-section components were puchased from Heath for less than $2 and eliminated the need for sheet-metal bending, parts fabrication and chasing all over for plastic, brass rod and the like. The meter is a Radio Shack Micronta, 0-1 mA, catalog no. 22-018. The meter face was removed, and the original numbers and lettering were erased with a coarse typewriter eraser. The scale was relabeled to correspond with swr. Lettering was done with rub-on letters. The meter face was then sprayed with clear acrylic. A full-scale drawing of the meter face is shown in **fig. 1**.

assembly

Drilling templates are shown in **figs. 2** and **3**. The chassis should be drilled and all holes deburred. Burnish all exterior surfaces with 00 or 0 grade steel wool. Wipe all surfaces to be painted with a degreasing solvent or white vinegar to remove surface dirt and oils. The unit in the photograph was built for K1ZFE and was painted flat black and Dove Gray to match his equipment. Krylon spray colors were used; excellent results were obtained by applying several light coats with plenty of drying time in between. After painting, each cabinet half was baked in an oven for one hour at 200° to assure complete drying. Black transfer lettering was added to the front panel and Dymo labels on the rear.

Mechanical assembly should begin with the swr coaxial section and SO-239 input connector. The section must be shortened by one inch to fit this cabinet. The output end of the coax section center conductor is mounted to a 6-32 ceramic standoff insulator. Then add the terminal strips, terminating resistors, rectifier diodes and .001 bypass capacitors; assemble the switch, sensitivity pot and all interconnecting wiring. Wiring from the rectifier diodes to the switch should use shielded wire.

The two front-panel air-variable capacitors and the terminal tie point on the left side (bottom) of the chassis should be asembled to the cabinet next.

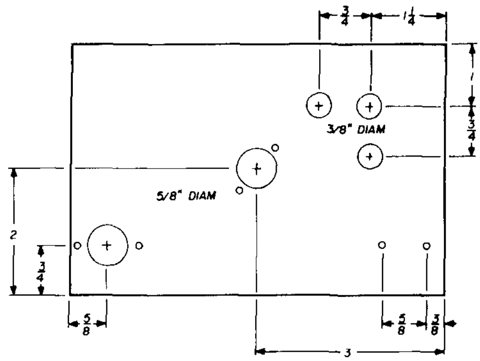


fig. 2. Rear-panel layout for the coupler.

Tie the ground lugs of each air variable together and to the center ground terminal of the tiepoint; use no. 14 copper wire. L2 is connected to the butterfly capacitor by two copper sleeves made by enlarging the diameter of a ½-inch long piece of 3/16-inch copper tubing. Use a 100- or 150-watt soldering iron for soldering.

fig. 1. New meter face for Micronta meter.

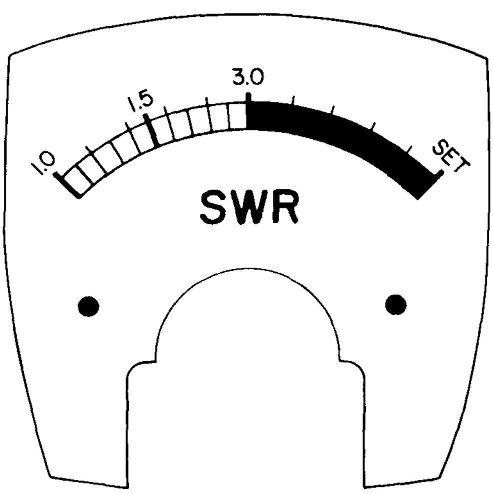


table 1. Parts list for 6-meter antenna coupler.

qty	description	cost
1	Chassis Box (LMB 564 N)	$2.95
1	Meter (Radio Shack 22-018)	2.95
1	Butterfly variable (E. F. Johnson 167-22)	3.45
1	Hammerlund variable (HF-100)	2.65
1	Coaxial section (Heath 40-100)	.20
1	Rf driver element (Heath 40-98)	.55
2	Rf pickup element (Heath 40-99)	.20
3	Plastic spacer (Heath 255-12)	.30
3	2-lug terminal strip (Heath 431-14)	.30
2	SO-239 coax connectors	1.70
1	50k pot (Heath 10-11)	.50
1	2-position rotary switch (Heath 63-177)	.85
2	1N191 Diodes	.60
2	.001 disc capacitors	.40
2	150 = ohm resistors, ½ watt	.20
1	Ceramic standoff	.45
3	Binding posts (Superior)	.90

Be sure to slide L1 over L2 prior to completing the assembly of L2 to the butterfly. Bend the legs of L1 to fit the spacing of the two ungrounded tie points and make sure that the spacing of L1 around L2 is even. Connect the output of the coaxial line to one end of L1; connect the other end of L1 to the stator of the 100-pF variable.

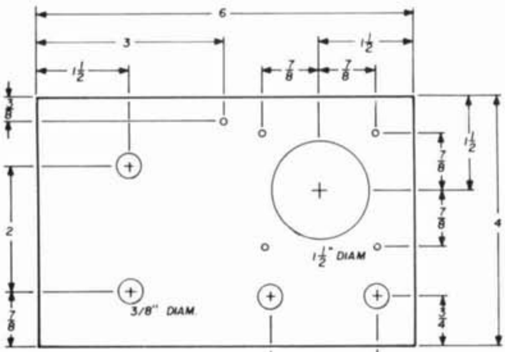


fig. 3. Front-panel layout for the coupler.

Assemble the 5-way binding posts to the chassis and the output coaxial connector to its mounting hole. Connect the upper two binding posts to the taps on L2 with a short piece of 300-ohm transmission line (preferably foam filled). Connect the output coax connector to the 5-way binding post nearest the center of the chassis. The lower binding post nearest the outside edge of the chassis should be connected to ground. Assemble the meter to the cabinet and wire it to the 50k pot. All interconnecting wiring in the L1/L2, C1/C2 section is done with no. 14 wire.

test and operation

If the coupler is to be used from one coaxial cable to another, install a jumper wire between the grounded binding post and the one directly above it. This *must* be done to use the coupler for coax-to-coax transfer. Connect the coupler between the transmitter and the antenna or a 50-ohm non-reactive dummy load such as the Heath-kit cantenna. Tune the transmitter for low power output. Set the swr bridge switch to forward and adjust the sensitivity pot for full meter deflection. Reset the switch to reverse and adjust C1 and C2 for minimum reflected power. It should be possible to adjust the reflected power to zero.

When the coupler is adjusted for minimum reflected power the transmitter can be tuned for full output power. It is possible to move 100 kHz either side of the tuned frequency before the coupler must be re-adjusted. Once the antenna coupler is set for minimum reflected power, leave it alone – tune the transmitter final to obtain maximum output, not the coupler.

conclusion

This unit will handle up to 500 watts without problem. Insertion loss has been measured at 1 to 2 percent. However, the improved efficiency provided by the coupler more than compensates for the low insertion loss. For those amateurs who already have an swr bridge, the coupler section could be built into a smaller cabinet and used with the existing bridge. Tuning procedures would be the same. Just be sure to install the swr bridge between transmitter output and the coupler input.

ham radio

Inside view of antenna coupler shows mounting of L1 and L2.