A Transmatch for Balanced or Unbalanced Lines

Most modern transmitters are designed to operate into loads of approximately 50 Ω. Solid-state transmitters produce progressively lower output power as the SWR on the transmission line increases, owing to the built-in SWR protection circuits. Therefore, it is useful to employ a matching network between the transmitter and the antenna feeder when antennas with complex impedances are used.

One example of this need can be seen in the case of an 80-m, coax-fed dipole antenna, which has been cut for resonance at say, 3.6 MHz. If this antenna were used in the 75-m phone band, the SWR would be fairly high. A Transmatch could be used to give the transmitter a 50-Ω load, even though a significant mismatch was present at the antenna feedpoint.

It is important to remember that the Transmatch will not correct the actual SWR condition; it only conceals it as far as the transmitter is concerned. A Transmatch is useful also when using a single-wire antenna for multiband use. By means of a balun at the Transmatch output it is possible to operate the transmitter into a balanced transmission line, such as a 300- or 600-Ω feed system of the type that would be used with a multiband tuned dipole, V beam or rhombic antenna.

A secondary benefit can be realized from Transmatches of certain varieties: The matching network can, if it has a band-pass response, attenuate harmonics from the transmitter. The amount of attenuation is dependent upon the loaded $Q(Q_L)$ of the network after the impedance has been matched. The higher the Q_L, the greater the attenuation. Some Transmatches, such as the Ultimate Transmatch of **Fig 22.99**, can exhibit a high-pass response (undesirable), depending on the transformation ratio they are adjusted to accommodate. In a worst-case condition the attenuation of harmonic currents may be as low as 3 to 5 dB. Under different (better) conditions of impedance transformation, the attenuation can be as great as 20 to 25 dB.

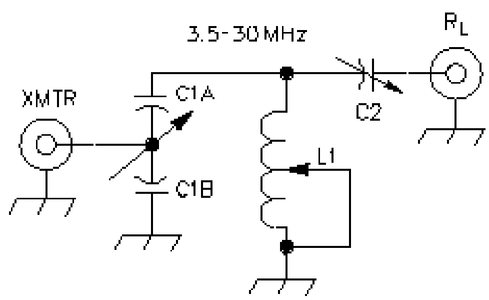

Fig 22.99—Circuit for the Ultimate Transmatch. The network can degenerate to a high-pass network under some conditions (see text). A T-network configuration provides identical matching range and does not require a splitstator capacitor at C1.

The SPC Transmatch described here was developed to correct for the sometimes poor harmonic attenuation of the network in the Ultimate Transmatch. The SPC (series-parallel capacitance) circuit maintains a band-pass response under load conditions of less than 25 Ω to more than 1000 Ω (from a 50-Ω transmitter). This is because a substantial amount of capacitance is always in parallel with the rotary inductor (C2B and L1 of **Fig 22.100**). In comparison with the Ultimate circuit of **Fig 22.99**, it can be seen that at high load impedances, the Ultimate Transmatch will have minimal effective output capacitance in shunt with the inductor, giving rise to a high-pass response.

Another advantage of the SPC Transmatch is its greater frequency range with the same component values used in the Ultimate Transmatch. The circuit of **Fig 22.100** operates from 1.8 to 30 MHz with the values shown. Only three-fourths of the available inductance of L1 is needed on 160 m. For this reason there are vernier-drive dials on C1 and C2. They are also useful in logging the dial settings for changing bands or antennas.

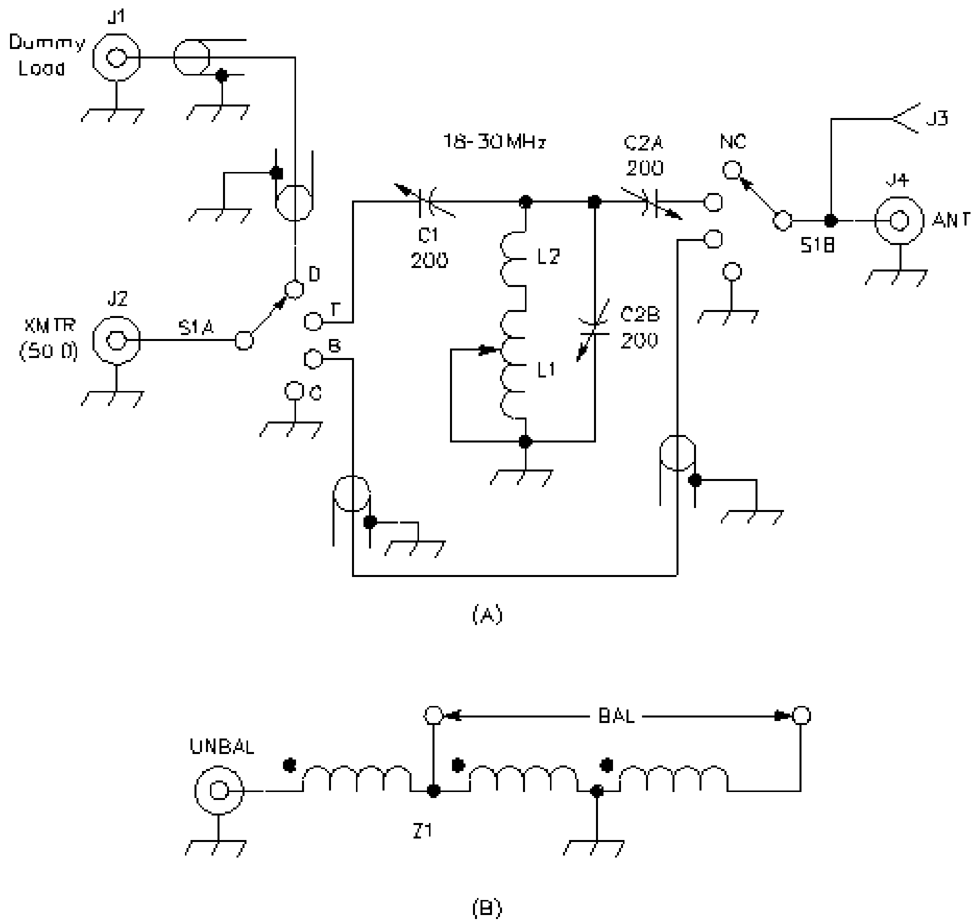

Fig 22.100—Schematic diagram of the SPC circuit. Capacitance is in pF. Contact information for parts suppliers appears in the Address List in the References chapter.

C1—200-pF transmitting variable with plate spacing of 0.074 inch or greater (supplier: RADIOKIT).

C2—Dual-section variable, 200 pF per section. Same plate spacing as C1 (supplier: RADIOKIT).

J1, J2, J4—SO-239 coaxial connectors. J4 should have high-dielectric-strength insulation (such as Teflon) if high-Z single-wire antennas are used at J3.

J4—Ceramic feedthrough bushing.

L1—Rotary inductor, 25 µH minimum inductance (supplier: RADIOKIT).

L2—Three turns #8 copper wire, 1 inch ID×1-1/2 inches long.

S1—Two-pole, four-position ceramic rotary wafer switch with heavy contacts. Two positions are unused.

Z1—Balun transformer: 12 turns no. 12 Formvar wire, trifilar, close-wound on 1-inch-OD phenolic or PVC-tubing form.

Construction

Figs 22.98 and **22.101** show the structural details of the Transmatch. The cabinet is homemade from 16-gauge aluminum sheeting. L brackets are affixed to the right and left sides of the lower part of the cabinet to permit attachment of the U-shaped cover.

The conductors that join components should be of heavy-gauge material to minimize stray inductance and heating. Wide strips of flashing copper are suitable for the conductor straps. The center conductor and insulation from RG-59 polyfoam coaxial cable is used in this model for the wiring between the switch and the related components. The insulation is sufficient to prevent breakdown and arcing at 2-kW PEP input to the transmitter.

All leads should be kept as short as possible to help prevent degradation of the circuit Q. The stators of C1 and C2 should face toward the cabinet cover to minimize the stray capacitance between the capacitor plates and the bottom of the cabinet (important at the upper end of the Transmatch frequency range). Insulated ceramic shaft couplings are used between the vernier drives and C1 and C2, since the rotors of both capacitors are floating in this circuit. C1 and C2 are supported above the bottom plate on steatite cone insulators. S1 is attached to the rear apron of the cabinet by means of two metal standoff posts.

Fig 22.98—Exterior view of the SPC Transmatch. Radio Shack vernier drives are used for the tuning capacitors. A James Millen turns-counter drive is coupled to the rotary inductor.

Fig 22.101—Interior view of the W1FB SPC Transmatch. L2 is mounted on the rear well by means of two ceramic standoff insulators. C1 is on the right and C2 is at the left. The coaxial connectors, ground post and J3 are on the lower part of the rear panel.

Operation

The SPC Transmatch is designed to handle the output from transmitters that operate up to 1.5 kW PEP output. L2 has been added to improve the circuit Q at 10 and 15 m. However, it may be omitted from the circuit if the rotary inductor (L1) has a tapered pitch at the minimum-inductance end. It may be necessary to omit L2 if the stray wiring inductance of the builder’s version is high. Otherwise, it may be impossible to obtain a matched condition at 28 MHz with certain loads.

An SWR indicator is used between the transmitter and the Transmatch to show when a matched condition is achieved. The builder may want to integrate an SWR meter in the Transmatch circuit between J2 and the arm of S1A (**Fig 22.100A**). If this is done there should be room for an edgewise panel meter above the vernier drive for C2.

Initial transmitter tuning should be done with a dummy load connected to J1 and with S1 in the D position. This will prevent interference that could otherwise occur if tuning is done on the air. After the transmitter is properly tuned into the dummy load, unkey the transmitter and switch S1 to T (Transmatch). Never hot-switch a Transmatch, as this can damage both transmitter and Transmatch. Set C1 and C2 at midrange. With a few watts of RF, adjust L1 for a decrease in reflected power. Then adjust C1 and C2 alternately for the lowest possible SWR. If the SWR cannot be reduced to 1:1, adjust L2 slightly and repeat the procedure. Finally, increase the transmitter power to maximum and touch up the Transmatch controls if necessary. When tuning, keep your transmissions brief and identify your station.

The air-wound balun of **Fig 22.100B** can be used outboard from the Transmatch if a low-impedance balanced feeder is contemplated. Ferrite or powdered-iron core material is not used in the interest of avoiding TVI and harmonics that can result from core saturation.

The b position of S1 permits switched-through operation when the Transmatch is not needed. The g position is used for grounding the antenna system, as necessary; a quality earth ground should be attached to the Transmatch chassis at all times.

Final Comments

Surplus coils and capacitors are okay in this circuit. L1 should have at least 25 µH of inductance and the tuning capacitors need to have 150 pF or more of capacitance per section. Insertion loss through this Transmatch was measured at less than 0.5 dB at 600 W of RF power on 7 MHz.