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The Triple-Play Transmit-Receive Switch

A T/R switch that also mutes the receiver and allows for monitoring the CW sidetone—perfect for your vintage station.

In baseball, the most exciting and memorable infield action takes place in a triple play. It is also the most effective way to end an inning. The same thing takes place in my design of a transmit-receive switch, which controls antenna switching, receiver muting and CW sidetone provision simultaneously.

The current interest in restoring vintage tube equipment is coupled with a need for reliable transmit-receive switching. Usually, this consisted of a simple SPDT relay alternately switching a single antenna between the two units. The problem remains lacking the ability to monitor CW sidetone as well muting the receiver. Both of these features are integrated in modern transceivers but were not included in earlier separate units. An article in the January 1965 issue of *QST* described a transmit-receive switch that combined antenna switching with CW sidetone monitoring.¹ This unit was named *The Mox-Box*, meaning manual operating switching. There was, however, no provision for receiver muting nor was there any arrangement for convenient control. The option remained for using a foot pedal switch to facilitate command.

Three Enhancements

I decided to upgrade the original unit with three additional features. First, I installed a pilot light on the front panel to indicate when the unit was in the transmit mode. I used a 117 V ac neon bulb wired in parallel with the original DPDT relay. I then installed an additional DPDT relay and wired it into the original circuit. One section would be used for receiver muting while the other half would be used to ground out the receiver antenna connection during transmitting. This prevents any stray radiation from a high power transmitter damaging a receiver front end. This would be a more critical consideration in receivers with solid-state front ends. The limitation of this switch is the immense number of cables to facilitate all of these functions. These involve cables for antenna switching, others for the muting circuit, as well as still others for sidetone monitoring. In any case, this permits all operations to be controlled from one switching unit.

Before attempting to build this project, the builder will require a copy of the original article. It can be found on *ARRLWeb*, or it can be ordered at no charge from the ARRL Technical Secretary.² The next step is locating an adequate size enclosure for the circuit. I would recommend the RadioShack Deluxe Metal Utility Cabinet, #270-253A, because of its all-metal



construction as well as its standard rubber feet included to prevent scratching of a finished surface. The size of the enclosure is $3 \times 5\frac{1}{4} \times 5\frac{7}{8}$, large enough for all of the components but small enough for the operating bench. Parts placement is not critical but the antenna switching relay section should be as close to the rear panel as possible. See [Figure 2](#). The code monitoring circuit requires wiring in advance for either a cathode keyed or grid block transmitter circuit. Many older transmitters, due to their design simplicity, are cathode keyed. These include the E. F. Johnson Adventurer, Heathkit DX-20 and the KnightKit T-50. Later transmitters, such as the Heathkit DX-60, used grid block keying. For the sake of simplicity, I would recommend building different units for each type of circuit and color coding the cabinets to prevent confusion.

Putting it Together

[Figure 2](#) shows how the components are placed. The code monitoring circuit was built on a separate terminal strip located at the rear left. Located in the lower right corner is the additional relay for muting and antenna grounding. Additional terminal strips were used to simplify wiring. Different-color wires were used to differentiate separate circuits. The expanded schematic illustrates how the additional relay was wired into the circuit. Keep in mind that all ac line wiring in this unit was above ground to prevent shorting and electrical shock. I installed a fuse into the ac circuit to prevent any damage to the unit. Labeling for the front and rear panel connections will make wiring easier. Solid wire was used in most of the circuits, but stranded wire was used for the moving sections of

¹Notes appear on [page 62](#).

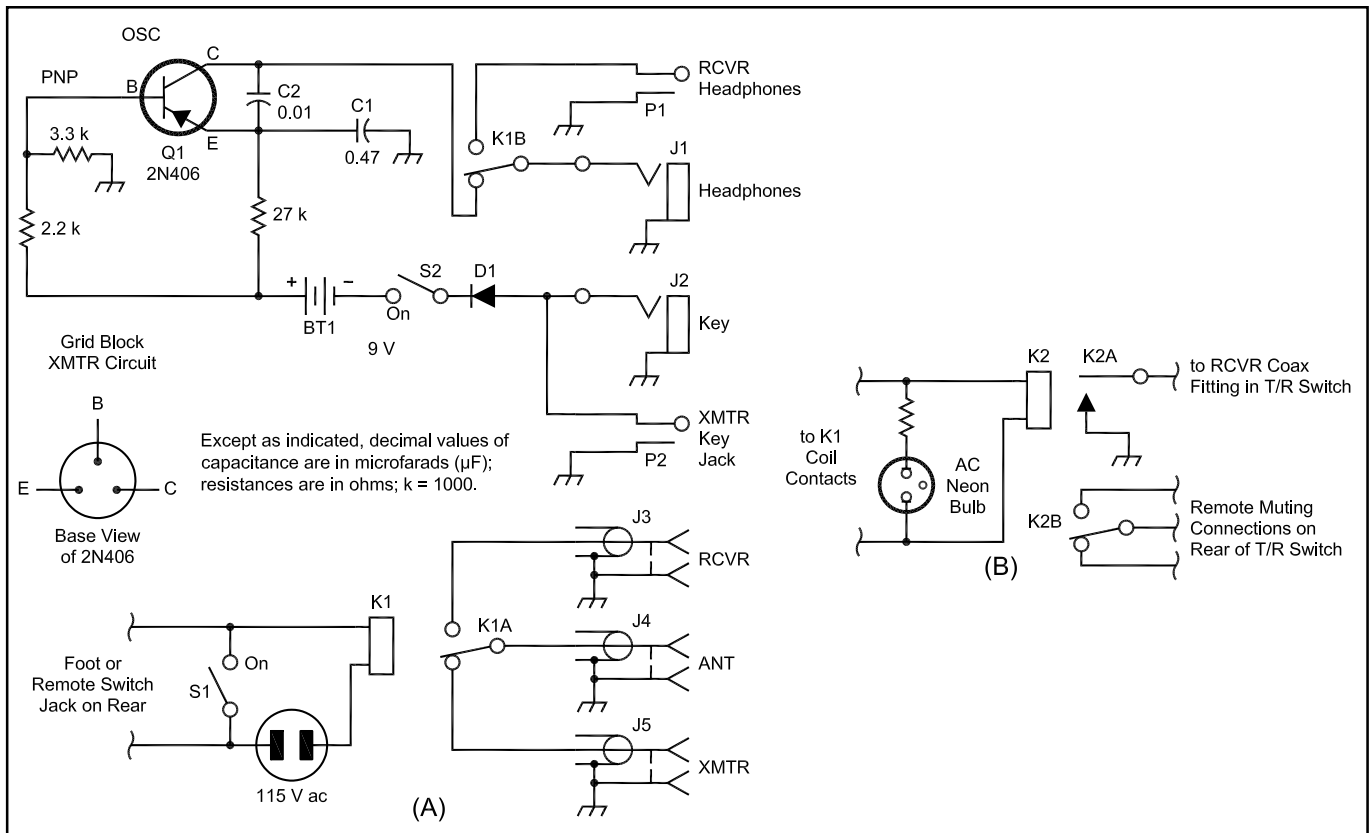


Figure 1—At A, the original Mox-Box schematic. B shows the additions the author made to the original. For transmitters having negative voltage at the key, use a PNP transistor; for positive voltage, NPN. Also, for transmitters with positive voltage at the key, the battery and diode polarities should be reversed, compared with what is shown here. Resistors are 1/2 W.

BT1—9-V transistor battery.

C1—0.047- μF paper for high impedance phones (2000 Ω), 0.15 μF for low-impedance phones (200 Ω). Any working voltage rating over 10 V is suitable.

C2—0.01- μF disk ceramic.

D1—Silicon rectifier, any PIV rating over 250 V.

J1, J2—Phone jack, open circuit.

J3-J5—Coax chassis receptacle type (SO-239).

K1—DPDT relay, 115 V ac (Digi-Key Z185-ND, plug style).

P1, P2—Phone plug. Phone jacks will also work and look better; a phone plug to phone plug cable will be required, however.

Q1—PNP type 2N406 or 2N2905; NPN type 2N647 or 2N2222.

S1, S2—SPST toggle switch.

the relays to prevent breakage from repeated use over time.

Before mounting parts on the front and rear panels, I suggest making up a template before starting any drilling. This helps to improve component spacing, which gives a project a more finished and professional appearance. Using Greenlee or other chassis punches cuts down not only on the time and effort but also creates better tolerances for component mounting. For some components other than those I used in this project that are rectangular in shape, a nibbling tool would be most useful. Remember, before wiring in the code oscillator used in the monitor, you must decide whether it will be designed for cathode or grid block keying. The next precaution is to make sure the polarity of the diode in this circuit is correct. The code monitor uses a 9-V battery but a power supply could be used instead. For the purpose of simplicity, I used the battery. Before putting this unit into actual operation, I would recommend testing it on its own. Make sure as a precaution, you do not check this unit without an antenna or dummy load on the transmitter. Also as a precaution, I added a fuse between the power line and K1.

The front panel consists of a number of controls and monitoring devices. Starting from left to right (see the title photo), there is a toggle switch to manually operate this unit independent of outside control. Then there are jacks for the headphones and the transmitting key. Finally, there is a switch to turn the code monitor on or off and a pilot light to indicate when the unit is in the transmit mode. The order in which

these controls are positioned is at the builder's discretion. I used this sequence because I am right-handed and it seemed more convenient to have the receiver tuning at my right with

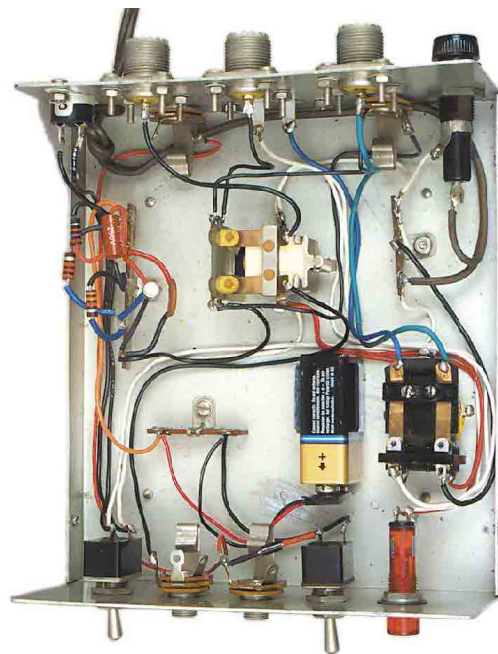


Figure 2—Photo showing the interior of the Triple Play T/R switch.



Figure 3—Rear view of the T/R switch.

the station controls at my left. When installing the toggle switches, it might be useful to use the Greenlee punch designed specifically for this purpose because the notch it creates inhibits shaft rotation. Most of the parts I used were out of my junkbox, but using new ones aids appearance. If low-impedance headphones are used, a matching transformer could easily be wired into the unit or used in an outboard capacity.

Hooking it Up

The rear panel contains all the connections needed for proper switching operation. As can be seen in Figure 3, there are three SO-239 connectors for the receiver, transmitter and antenna at the top. A Greenlee punch is used after drilling a pilot hole. A small automotive socket wrench could accelerate this procedure. From left to right, there are the fuse, receiver connection for monitoring, remote connection for receiver muting, and a phone jack for transmitter keying. Then there is the line cord opening and above it is a jack for remote operation of the unit. Remote control of the switch would ideally be controlled from

the transmitter. Many of these early ones were designed with a switch that applied full power, and if there are extra contacts, these can be used to activate this unit. Others simply have a slide switch, such as the E. F. Johnson Adventurer, which switches from grid to plate monitoring. This can be utilized in this capacity by adding a set of contacts to activate the unit. The receiver muting can be wired for either normally on or normally off, depending on the circuit.

The limitation of this unit is that it is manually operated and will demand more attention than a switch that is automatic. Constant monitoring of relay noise will pinpoint problems and prevent damage to a transmitter if the relay malfunctions. I used this switch with my separate units, the Hallicrafters SX-146 receiver and a Hallicrafters HT-46 transmitter. Its operation was flawless. My addition of an extra DPDT relay will broaden its use to other receiver and transmitter combinations. Remember, the builder must know the keying circuit type of the transmitter before using this switch or damage will occur. I recommend building both types to accommodate different keying circuits. Additionally, the muting circuit's wiring depends on the particular receiver utilized. The builder can always attempt a more complicated and automatic transmit-receive switch. Amateur publications, past and present, are replete with these options. This project was both interesting and enjoyable, primarily because of its simplicity and, most important, its utility.

Notes

¹Lewis G. McCoy, "The Mox-Box, A Simple Monitoring and Control Unit," *QST*, Jan 1965, pp 22-24, 144.

²An Adobe Acrobat file can be found at www.arri.org/files/qst-binaries/. If you would like a photocopy at no charge, send a self-addressed stamped business-size envelope to the ARRL Technical Secretary, 225 Main St, Newington, CT 06111, tel 860-594-0200, and request the "Complimentary Mox-Box article from January 1965 *QST*." QST

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