



T-R SWITCH

CATALOG NO. 250-39

design file

INSTALLATION AND OPERATING INSTRUCTIONS

GENERAL DESCRIPTION

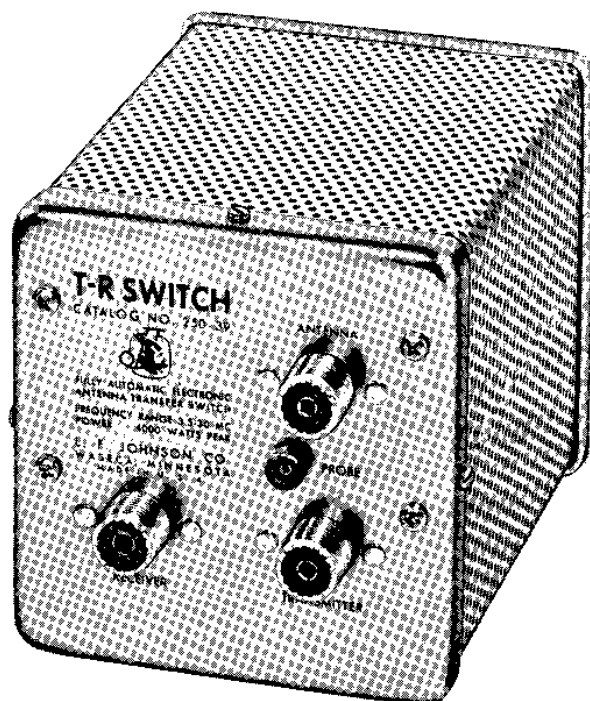
The Johnson T-R Switch is a device to provide instantaneous and automatic transfer of an antenna from receiver to transmitter, electronically. It will replace the usual antenna relay with its moving parts and attendant problems. It will provide perfect automatic break-in on AM, CW, or SSB. The Johnson T-R Switch is designed to operate over the frequency range of 3.5 to 30 mc with transmitter power inputs up to 4000 watts peak envelope power without any tuning or other manual control functions. The T-R Switch has no power loss on transmitting, does not alter the antenna SWR and actually provides a gain of from 2 to 6 db minimum on receiving, depending on the operating frequency.

The unit is housed in an attractive nickel plated steel cabinet which is shielded and ventilated. The cabinet is 4 1/4 inches wide by 4 1/2 inches high and 5 9/32 inches deep. It has three type SO-239 coaxial connectors to accommodate the coaxial lines from the antenna, transmitter and receiver. It has no controls and need only be provided with 115 volt 60 cycle power.

THEORY OF OPERATION

The Johnson T-R Switch utilizes a type 6BL7 tube operating as a cascode type amplifier, see schematic diagram, Figure 2. When receiving, the signal from the antenna is coupled to the first grid of V1, which is a grounded cathode type amplifier. The amplifier signal from the plate of V1A is coupled to the cathode of V1B which is connected as a grounded grid stage. The plate of V1B feeds a broad band r-f transformer which provides a suitable plate load impedance to the tube over the frequency range of 3.5 to 30 mc. The output of the r-f transformer is tapped and feeds the RECEIVER connector. These two stages of amplification provide a gain of somewhere between 2 to 6 db on receiving.

When power is applied to the transmitter, it delivers r-f energy to the antenna. The TRANSMITTER and ANTENNA coaxial connectors are connected in parallel. This energy also appears at the grid of V1A. As soon as the r-f voltage on the antenna overcomes the cathode bias on the tube, the grid begins to conduct thus generating a negative voltage. This negative bias cuts off the plate current of the first tube. The bias is also applied through the filter network of R2, R3, R4, C7 and C8 to the grid of V1B thus cutting it off too. This provides two stages of isolation between the transmitter and receiver while transmitting. This cut-off action is virtually instantaneous thus permitting perfect CW and SSB voice operation break-in. The return to a receiving condition is just as fast thus allowing one to copy in between CW characters or breaks on SSB.



The 6BL7 is a rugged dependable tube capable of handling large power inputs due to its large grid voltage ratings. In the Johnson T-R Switch, the cathode bias on the first section of the 6BL7 is such that strong local signals, amateur or otherwise, will not cause spurious signals to be generated and introduced to the station receiver, thus making copy of weak signals difficult — a common fault in other types of T-R Switches.

A 6X4 tube is used in a well filtered full wave rectifier circuit to provide power for the 6BL7. The a-c line is filtered with "L" section filters to provide good TVI suppression.

INSTALLATION

Installation of the Johnson T-R Switch is simple, requiring only three coaxial cable connections and 115 volt power. It is recommended that the T-R Switch be located as near the transmitter as possible so as to keep the length of the cable between the transmitter and T-R Switch to a minimum. It is also recommended that the station low pass filter be placed between the antenna and the T-R Switch. Refer to Figure 1.

Connect the cable from the transmitter output to the TRANSMITTER connector on the T-R Switch. Connect the cable from the receiver antenna input connector to the RECEIVER connector on the T-R Switch. Connect the coaxial cable from the low pass filter or the antenna to the ANTENNA connector on the T-R Switch. Plug the 115 vac plug into a power receptacle.



E. F. JOHNSON COMPANY
WASECA, MINNESOTA, U.S.A.

2-0250-039

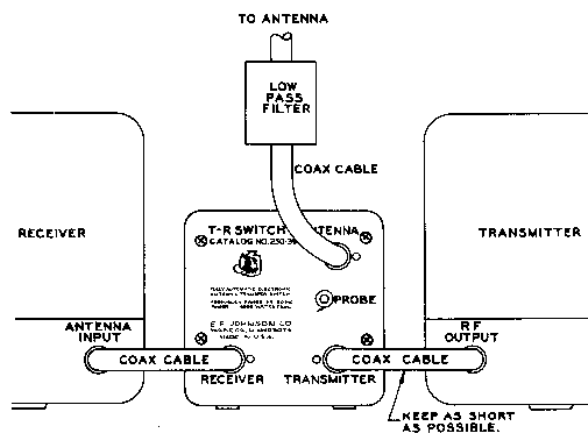


FIGURE 1.

OPERATION

The operation of the Johnson T-R Switch is automatic. There is no ac power switch on the unit, so it is recommended that the unit be powered from an outlet that can be switched along with general station power. If an adverse length of coaxial cable is used between the transmitter and the T-R Switch it is possible that the impedance of the transmitter output might be reflected and transformed so that it appears as a shunt across the antenna. This may degrade the signal level at the receiver. To check this, disconnect the transmitter cable from the TRANSMITTER CONNECTOR. If the signal level at the receiver improves, it may be necessary to use a different length of line between the transmitter and the T-R Switch. A good discussion of this problem is found in the May 1956 issue of QST magazine and is recommended reading. It might be mentioned at this point, that any noise present at the transmitter output in the receiving condition will be amplified by the T-R Switch. It is essential that the transmitter be blocked off sufficiently in the receive condition so that diode noise from the power tubes is not present. Most commercial transmitters such as the Johnson Ranger, Valiant, Pacemaker, 500 etc., have sufficient blocking bias supplied to suppress this noise. If noise is experienced in the receive condition, it may be necessary to take steps to eliminate this noise from the station transmitter.

A nylon tip jack is available on the front panel of the T-R Switch and is coupled directly to the antenna through a 3 uuf capacitor. This may be used for providing r-f power for monitors or scopes to check on the transmitted

signal. It may be necessary to increase or decrease the size of the coupling capacitor depending on how this probe is used.

There is no provision in the T-R Switch for muting the station receiver. This is not a problem in CW since it provides a means of monitoring one's sending, however, in SSB and AM it may cause audio feedback into the microphone and as such one will have to provide a means of muting or placing the station receiver in standby when the transmitter is energized. Most commercial SSB and some AM transmitters have this function provided for in their voice operate or push-to-talk relays. Other AM transmitters may require some external means for muting the receiver such as a set of contacts on a push-to-talk relay.

The T-R Switch runs quite warm to the touch. This is normal and should cause no concern.

TROUBLE SHOOTING

The components of the T-R Switch are operating well within their ratings and should require little maintenance. In the case of difficulty, a list of resistance and voltage readings is provided in Table I. It is difficult to predict the dc voltage at the grids of V1 under the transmitting condition since they will vary with the transmitter power level and antenna impedances. It will be approximately equal to $V/2PR$ where P is approximate output in watts and R is the antenna resistance in ohms. This negative voltage will appear at pin 1 of V1 when transmitting. The voltage at pin 4 in this condition will be equal to about 95% of the value at pin 1. The 6BL7 cathode voltages in the transmit condition would be nearly zero and the plate voltages will be about 190 vdc.

TABLE I
RESISTANCE AND VOLTAGE MEASUREMENTS

Readings may vary $\pm 10\%$

PIN	1	2	3	4	5	6	7	8
6BL7								
Voltage	0	170	3.6	0	170	7.3	0	6.2 vac
Resistance	1.05 meg	100K	100	2 meg	100K	560	0	.3
6x4								
Voltage	190AC	0	6.2 vac	0	0	190AC	197	
Resistance			.3	0			100K	

Measured with 20,000 ohms/volt multimeter
Resistance Readings in ohms, taken with Power Off

Voltage Readings taken with 115 vac input, No RF power at ANTENNA or TRANSMITTER Connectors.

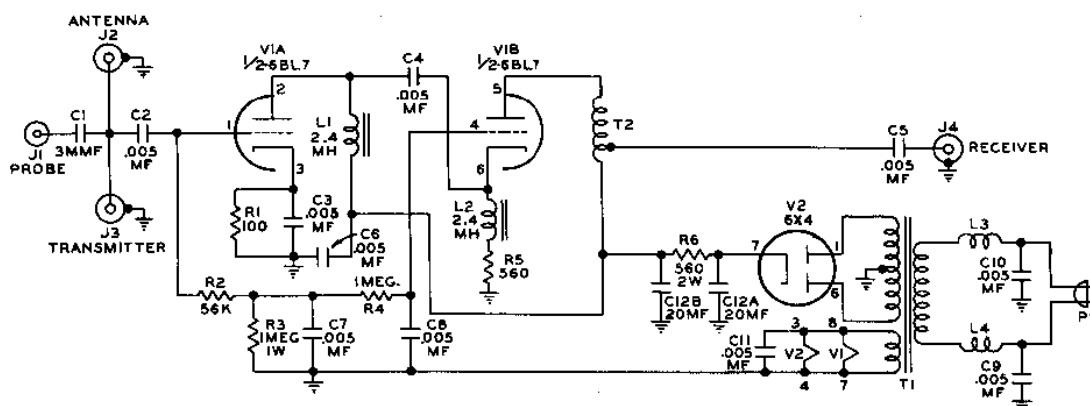


FIGURE 2.