RTTY OPERATION
WITH DRAKE EQUIPMENT

GENERAL.

It is possible to receive RTTY, either wide or narrow shift, on any of the R-4 series receivers without any modifications. The passband tuning allows proper passband positioning for reception of the 2975 space tone normally used in 850 Hz shift. All that is required is a terminal unit which can be driven from the receiver audio.

Narrow shift (2125, 2295 tones) can be received on the TR-4/TR-4C without modification. To receive wide shift on the TR-4/TR-4C, the terminal unit must be modified to use lower frequency tones as the 2975 tone is above the cutoff frequency of the filters in the TR-4/TR-4C.

To transmit RTTY. some method of frequency shift keying (FSK) must be employed. Two methods are available:

1. Audio Method.

The first method is referred to as the "AUDIO" (AFSK) method. This method makes use of the fact that a single tone fed into an SSB transmitter produces a single frequency output. Therefore, if the output of an AFSK generator is fed into the microphone audio input of the SSB transmitter, the output of the transmitter will be an FSK signal. For this method to work properly, the audio from the AFSK generator must be free of distortion and the SSB transmitter must have excellent unwanted sideband and carrier rejection; otherwise, additional undesired frequencies could be present in the output. This method may be used with the T-4XC transmitter which has a "RTTY SHIFT" circuit to shift the audio response of the transmitter so that tones as high as 3000 Hz can be passed. This makes it possible to use the AUDIO method for wide shift RTTY.

Even when using narrow shift, this shift circuit provides additional carrier and opposite sideband rejection. When the R-4C receiver is used with the T-4XC, the RTTY SHIFT circuit will also shift the receiver so that true transceive operation with either PTO may be used.

This method can be used with the T-4X/T-4XB transmitters and the TR-4/TR-4C transceivers for narrow shift (2125 and 2295 Hz audio tones).

NOTE

T-4X transmitters. TR-3 transceivers and TR-4 transceivers with serial numbers below 26000 use four-pole crystal filters. These filters do not have as much carrier and unwanted sideband rejection as the newer eight-pole filters which are used in the T-4XB/T-4XC, TR-4/TR-4C above serial No. 26000. Use of the audio method with the earlier models is not recommended.

Because the T-4X/T-4XB transmitters and TR-4/TR-4C transceivers do not have the RTTY SHIFT provision, the AUDIO method cannot be used for *wide shift* with the 2975 Hz tone as this frequency will not pass through the crystal filter. Another combination of tone frequencies could be used: with the highest frequency tone below 2600 Hz and the lowest frequency tone above 1500 Hz.

NOTE

The lower limit is determined by the second harmonic frequency of the tone which should fall well above the filter cutoff.

2. PTO FSK Method.

The second method consists of direct frequency shift keying of the PTO. This can be accomplished by connecting the proper amount of capacity to the FSK terminal on the PTO and keying the added capacity with a diode switch. Sample circuits are shown below. The shift circuit illustrated is based upon the use of a terminal unit which provides a negative voltage on mark and a positive voltage on space. Such a circuit is described in detail by Irvin Hoff in the May, 1965 issue of QST. A similar circuit is shown here along with the shift circuit for the Drake PTO. The resistor Rx should have a value which will limit the current through

the diodes to approximately 1 ma. The capacitor values given are based on 850 cycle shift. If narrow shift is desired, smaller values will be required. The shift circuit can be constructed on terminal strips and mounted under the nearest convenient screw. The FSK terminal on the PTO in the TR-4/TR-4C, RV-4/RV-4C, T-4X/T-4XB/T-4XC or R-4A/R-4B/R-4C is a small lug located between the prongs of the mounting clip on the right side of PTO as viewed from the front.

3. Detail – PTO FSK Method for Drake 4-Line Transmitters.

If only separate receiver/transmitter frequency control is desired, the installation of the shift circuit on the transmitter PTO is all that is necessary. However, if transceive operation is desired, the 5645 kHz oscillator circuit in the transmitter must be modified as described below, and the station terminal unit must be modified to receive mark at 1275 and space at 2125 instead of the more commonly used values of 2125 and 2975 Hz respectively. This requirement is based on the fact that the 5645 kHz oscillator of the transmitter must be shifted by the amount of the mark audio frequency when the transmitter Function switch is in the X-CW position to insure that you are receiving and transmitting on exactly the same frequency. This oscillator cannot be shifted 2125 Hz. To modify the oscillator circuit, remove the capacitor (C1 in T-4X/T-4XB, C177 in T-4XC, see transmitter schematic diagram) and replace it with a ceramic trimmer having a value of approximately 5.5 to 18 pf (NPO). This trimmer should be carefully adjusted so that the frequency shift of the 5645 oscillator is 1275 Hz when switching the Function switch from SSB to CW.

NOTE

This modification is necessary only when the PTO FSK method is used and transceive operation is desired.

4. Detail – PTO FSK Method TR-4/TR-4C.

In order to use the PTO FSK method with the TR-4/TR-4C, the following modifications in the transceiver and in the station terminal will be necessary.

a. Modify the station terminal unit to respond to tones of 1275 Hz and 2125 Hz for wide shift or 1275/1445 for narrow shift.

b. Install a reversing switch in the terminal unit so that the above mentioned tones can be used for either mark or space.

c. Install FSK circuits in the TR-4/TR-4C or RV-4/RV-4C as described in section 2. One circuit will be used for 80, 40, 15 and 10 meters and the other will be used for 20 meters. Two circuits are required since a circuit which is correct for 80, 40, 15 and 10 meters will produce upside-down shift on 20 meters.

d. Modify the 9 MHz oscillator in the TR-4/TR-4C by installing an 8-50 pf trimmer capacitor in place of C84. C84 is connected to one terminal of the SPDT relay (K2) mounted in the small compartment under the chassis. For proper operation of your terminal unit, this trimmer must be adjusted for a shift of 1275 Hz between send and receive on 40, 15 and 10 meters and 2125 Hz on 80 and 20 meters to insure that you are transmitting on exactly the same frequency as the station you are receiving when you have the received station tuned in.

5. Control — Send/Receive.

Switching may be accomplished by opening and closing the CW keying circuit This can be done by connecting a cable from a plug inserted in the Key-jack to the Send/Receive switch on the printer. The switch should, of course, be open on Receive and closed on Transmit.

6. Operation.

To operate RTTY, set controls for CW operation if the PTO FSK method is used. Set controls for SSB operation if the Audio method is used. When using the Audio method, set AFSK generator audio output just high enough to give full output with the XMTR GAIN control at 12 o'clock position, then reduce the XMTR GAIN until output just starts to fall off.

Because of the continuous duty cycle of RTTY, it may be desirable to place a small cooling fan above the power amplifier tubes of the transmitter to extend tube life.

7. Summary.

The "AUDIO" method is recommended if a good AFSK generator is available as this method requires no modification to the transmitter or transceiver and operation is more flexible. Also, shift will remain constant at any frequency in a band as well as from band to band. The following table summarizes the necessary steps which must be followed for use of either RTTY method. Find your combination of equipment in the left hand column and the method of keying in the second column; read to the right to see what is necessary to use this method.

EQUIPMENT COMBINATION	RTTY METHOD	SHIFT	MODIFICATION TO RECEIVER	TERMINAL UNIT TONE FREQUENCIES: MARK/SPACE	MODIFICATION TO TRANSMITTER
Any R–4 Series receiver and T–4X/T–4XB transmitter	1. Audio Method. RCVR or XMTR transceive or Separate control *	170	None	2125/2295	None – Apply 2125/2275 Tones to mic input on SSB.
		850		Mark – not below 1500 Hz Space – not above 2600 Hz	None – Apply audio mark/space tones to mic input. Mark tone not below 1500 Hz, space tone not above 2600 Hz.
	2. FSK Method Separate control only	170	None	Any combination	Addition of FSK Ckt to PTO. Adjust capacitor for 170 Hz shift.
		850			Addition of FSK Ckt to PTO. Adjust capacitor for 850 Hz shift.
	3. FSK Method Separate or Transceive with Transmitter PTO	170	None	Must Use 1275/1445 tones	a. Addition of FSK Ckt to PTO. Adjust capacitor for 170 Hz shift. b. 5645 OSC modification. See text.
		850		Must Use 1275/2125 tones	a. Addition of FSK Ckt to PTO. Adjust capacitor for 850 Hz shift. b. 5645 OSC modification. See text.
	4. FSK Method Receiver Transceive control only	170	Add FSK Ckt to receiver PTO	Must Use 1275/1445	5645 Osc. Mod. See text.
		850		Must Use 1275/2125	
	5. FSK Method RCVR or XMTR Transceive or Separate control	170	Add FSK Ckt to Rcvr PTO	1275/1445	a. Same as 3 above. b. Same as 3 above.
		850		1275/2125	a. Same as 3 above. b. Same as 3 above.

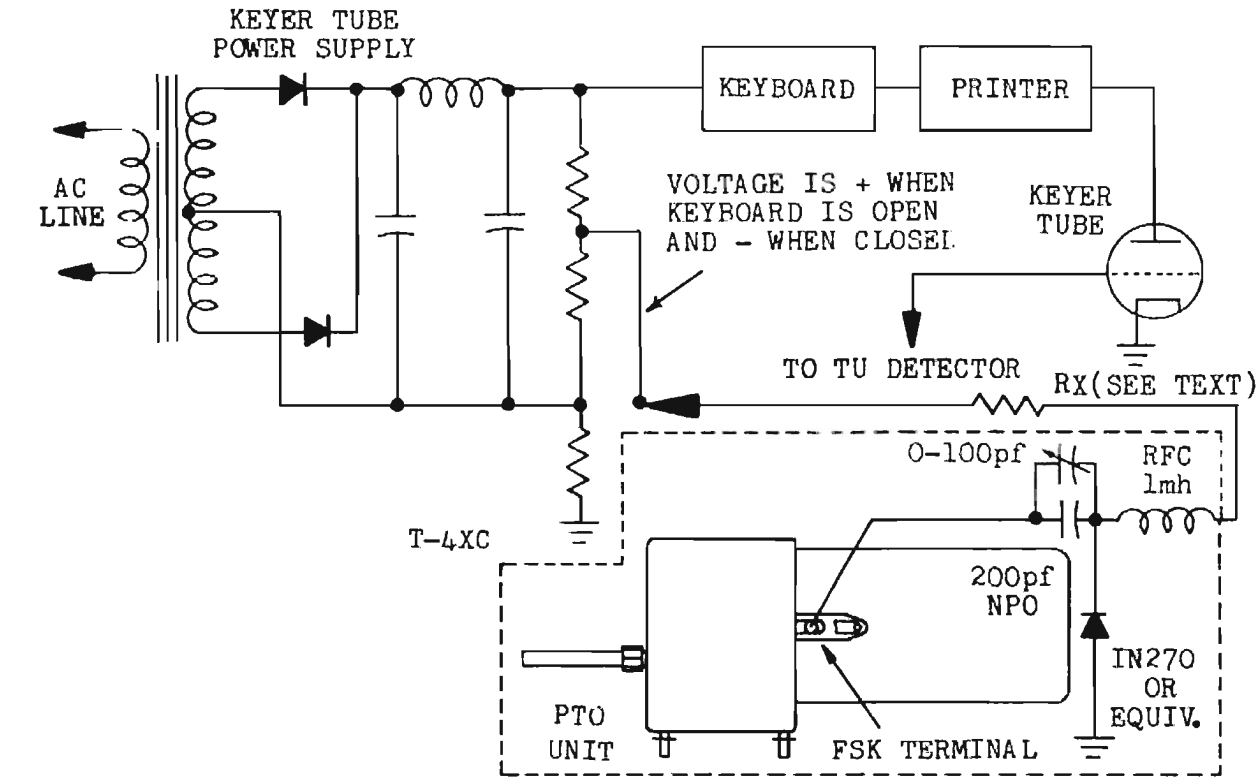
Audio Method

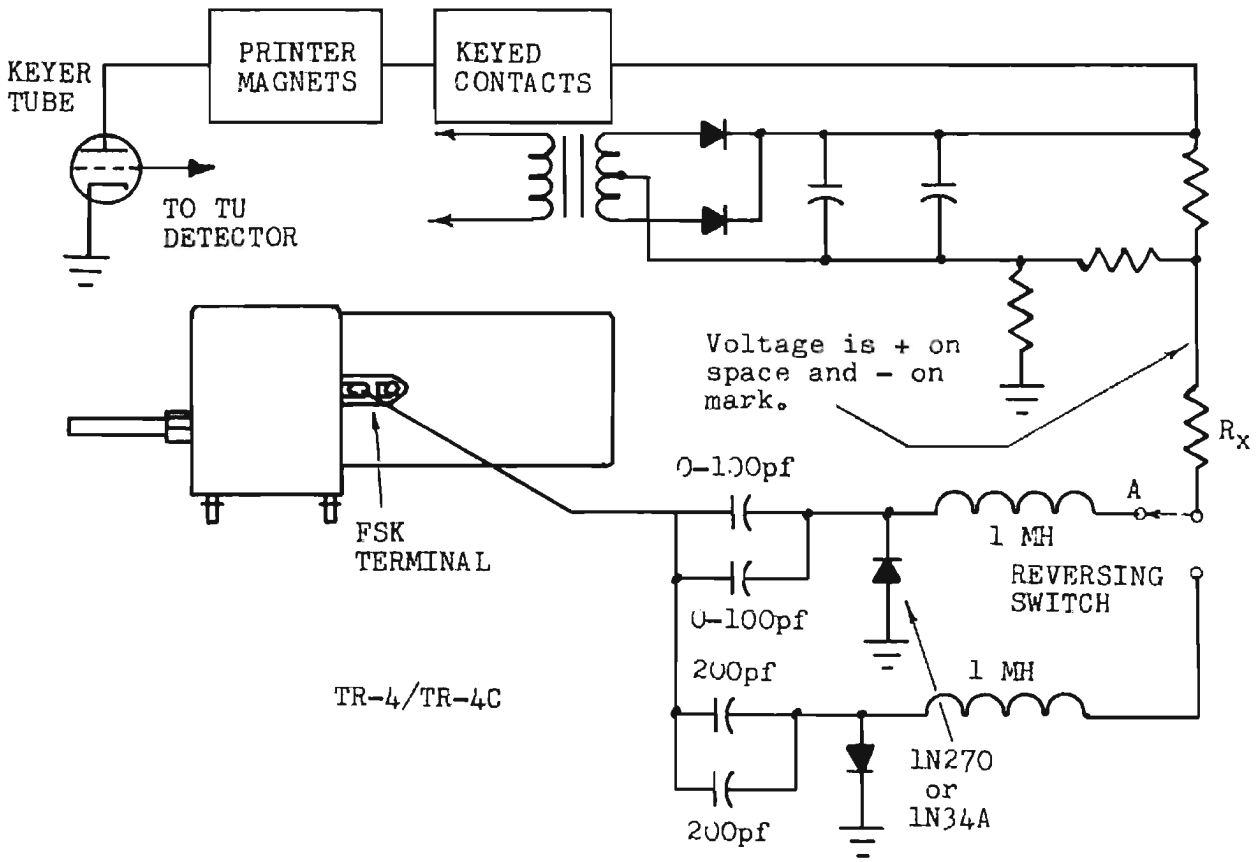
*Not recommended for use with T–4X on HF amateur bands.

EQUIPMENT COMBINATION	RTTY METHOD	SHIFT	MODIFICATION TO RECEIVER	TERMINAL UNIT TONE FREQUENCIES: MARK/SPACE	MODIFICATION TO XMTR/TRANSCEIVER
R–4, R–4A or R–4B and T–4XC	1. Audio Method Transceive or Separate	170	None	2125/2295	None – Ground RTTY SHIFT only if transceive operation is not desired.
	Audio Method Separate control only	850		2125/2975	None – Must ground RTTY SHIFT jack.
	2. 3. PTO FSK 4. Methods 5.			Same as for T–4X except capacitor to change for 5645 Osc. Modification is C177.	
R–4C and T–4XC	1. Audio Method RCVR or XMTR Transceive or Separate	170	None	2125/2295	None – Ground RTTY SHIFT jack.
		850		2125/2975	
	2. 3. PTO FSK 4. Methods 5.			Same as for T–4X except capacitor to be changed for 5645 Osc. Modification is C177.	
TR–4 or TR–4C Transceiver	1. Audio Method *	170		2125/2295	None
		850		Mark – not below 1500 Hz Space – not above 2600 Hz	None – The tone combination used must fall between 1500 and 2600 Hz.
	2. PTO FSK	170		1275/1445**	1) Add FSK Ckt to PTO 2) Modify 9 MHz oscillator as described in text (4. d).
		850		1275/2125**	

*Audio Method not recommended for use with TR–4 transceivers with serial numbers below 26000

**Mark/Space may be reversed depending on band.


KEYER TUBE
POWER SUPPLY
KEYBOARD
PRINTER
AC
LINE
VOLTAGE IS + WHEN
KEYBOARD IS OPEN
AND - WHEN CLOSED
KEYER
TUBE
TO TU DETECTOR
RX(SEE TEXT)
0-100pf
RFC
1mh
T-4XC
200pf
NPO
IN270
OR
EQUIV.
PTO
UNIT
FSK TERMINAL


KEYER
TUBE
PRINTER
MAGNETS
KEYED
CONTACTS
TO TU
DETECTOR
Voltage is + on
space and - on
mark.
R_X
0-100pf
A
FSK
TERMINAL
1 MH
REVERSING
SWITCH
0-100pf
200pf
1 MH
TR-4/TR-4C
1N270
or
1N34A
200pf