Operation of the new FPS-4 Front Panel Switch
Plus Some Alignment Tips

The replacement dual-concentric switch and knobs for roofing filter selection and AGC control operate as follows.

We added an AGC speed between Fast and Medium and a second one between Medium and Slow. Thus the AGC knob now turns two more positions further clockwise than normal, with the AGC speed getting progressively slower as you rotate it clockwise. The knob for the AGC is the larger rear knob.

For the roofing filters, the small front knob more or less follows the PBT position.

For CW, the 600 Hz roofing filter is selected with the rear FPS-4 switch set to 10 o'clock. Passband tuning must be set in the LSB range to align with the roofing filter centered on an approximate 700 Hz beat note, +/- 250 Hz.

For LSB, set the FPS-4 switch to 11 o'clock.

The original 8 kHz filter, for optimum blanker performance or AM operation, is selected at 12 o'clock, straight up. This returns the R-4C to stock operation.

For USB, set the FPS-4 switch to 1 o'clock.

Crisscrossing a roofing filter with a second IF filter will result in little or no signal. In other words, if the roofing is filter is set to LSB and the PBT to USB, little will be heard.

For CW operation, one may not always want to use the 600 Hz roofing filter and a 500 Hz or narrower second IF filter. Under some conditions of high noise, or in cases in a contest where stations are coming back to you off frequency, you may choose to use the LSB roofing filter in combination with a CF-1700/8, FL-1500 or FL-1000 filter in the second IF. Of course one could also operate on CW on the USB side by selecting the USB roofing filter. However the T-4XC will not transceive properly in this mode.

Operating with a wider SSB roofing filter and an appropriate wider second IF filter on CW maintains most of the vast improvement of the Sherwood roofing filter system. Opposite sideband leakage is still eliminated. High-pitched leakage above 2 kHz is also eliminated. Second-mixer overload is significantly reduced over the stock 8 kHz filter, though not as much as when using the CF-600/6.

Third-mixer LO operation and calibration:

In SSB mode, the 3rd mixer LO comes from the transmitter. In CW, or if the receiver is not connected to the T-4XC, the 3rd mixer LO comes from the R-4C. The frequency adjustment is the top compression trimmer under the mode switch cover. The oscillator crystal drifts down about 100 Hz during receiver warm-up. A counter may be plugged into the Carrier Oscillator jack on the rear of the receiver for adjustment purposes. I generally set the oscillator 50 Hz high with the radio cold. If the 3rd mixer oscillator is significantly off frequency, it will affect the centering of the roofing filters.

Some comments on alignment:

Over the years, I have developed a method of aligning the receiver that is somewhat different from the method described in the Drake manual. Of great annoyance is the factory method of soldering in two 10K resistors across the premixer LO injection coils for alignment of the preselector. The two LO coils are over coupled, thus they have a double hump in the passband, making it inappropriate to try to just peak them. One may do all front-end alignment by using the S meter and crystal calibrator, though a signal generator is nice to have.

To solve the over coupling problem, tune in the calibrator at mid band, and misadjust the rear-most band trimmer to drop the S meter as much as possible, though not below S3. A 20 dB drop or more is desirable. Try turning the trimmer both to maximum or minimum capacity, to achieve the desired out of alignment condition. Then peak the second from the rear capacitor for maximum S meter reading. Without retouching the second from the rear compression trimmer, re-peak the rear-most trimmer. Now peak the two front RF amplifier trimmers for maximum S meter reading.

Often I see R-4Cs arrive with some of the front-end preselector compression trimmers adjusted very tightly. Often I will tune the preselector knob a bit more counter clockwise (more inductance), and then retune the four trimmers per band. I feel the alignment is more stable if the trimmers are backed off more, so there is good range with the trimmer screw in either direction. That way a tiny mechanical shift in the compression trimmer over time has less effect. One should be able to turn the trimmers a turn or two counter clockwise and clockwise from where they peak. In general I see the gain of the receiver is better with a little more inductance in the slugs and a little less capacitance in the trimmers than the other way around.

If the S meter is calibrated properly, the crystal calibrator should read around S9 +10 on 80 – 10 meters on the even frequencies (7200 kHz, 7250 kHz etc.) The reading is higher on 7225 and 7275, for example. 160 meters is usually down 10 dB from the higher bands, an insignificant issue due to band noise on 160. The WARC bands will usually be a bit lower than 20 meters.

If you have a calibrated signal generator, the S meter should read about S3 with a 1 uV signal on 80 – 10 meters. If the RF gain is backed off fully counter clockwise, the S

meter should read S9 + 60 or a bit above that. When in mute the S meter should read slightly higher than with the RF gain fully counter clockwise.

The S meter reads significantly higher than S9 at 50 uV. 20 uV for S9 is not unusual.

If you have a blanker installed, you do NOT want the gain pot in the blanker at maximum gain. This just makes the radio noisier. As viewed from the front, the nub on the blanker pot is usually set between 9 and 10 o'clock.

The AGC bias pot in the bottom middle of the radio adjusts the maximum gain of the radio. The best place to measure the voltage is the cold side of the grid resistor of the RF amplifier V1 tube. This is a 2.2 megohm resistor. There is a terminal strip at that point for easy access. The value should be between -1.3 and -1.4 volts. This must be measured with no signal, and the RF gain full clockwise. Usually the range of the pot is from about -0.8 volts to several volts negative, such as -3 to -4 volts.

The key to whether you have a good alignment is whether you can hear a good noise peak with the preselector on any band with no antenna connected. It should peak 6 dB or maybe a bit more if you use a meter to measure the audio level at the speaker.

Peak the compression trimmer on the bottom side of the radio for maximum S meter reading. Do the same with T-6 next to the 3rd mixer tube socket. With our MIX-4 kit, the peak on T-6 is more broad, since the IF chain peak is not also affecting the LO injection.

T-5 should be peaked on the CF-600/6 if it is installed.

If the 3rd mixer is on frequency, and the lowest-pitched band noise does not occur with the PBT set to 12 o'clock, then the BFO slug needs slight adjustment. The pitch of band noise at 9 o'clock and 3 o'clock on the PBT control should be very similar, though possibly not exactly identical.

The most critical tube in the radio is the last IF tube, that is very difficult to remove. To change it, I remove the blanker board, and remove the rear-most screw holding the left blanker bracket in place. Rotate the bracket clockwise to obtain better access to the tube. One can also completely remove that bracket by removing both screws.

Don't trust tube testers for the R-4C. Some of the grid circuits have very high grid resistors, as high as 10 megohms. Any grid leakage will degrade the AGC operation. This is most obvious when the S meter won't go above S9 +40 dB with the RF gain counter clockwise. (This assumes the S meter pots are set reasonably accurately.)

When all is well, the rear S meter zero pot should be mid scale. The two internal S meter pots (zero and max scale) should be somewhere near mid scale. If they are way off mid scale, then you either have a bad tube or the one fixed resistor in the S meter bridge is off value. It is not unusual for this 560 ohm resistor to be fried and read way low or way high. The S meter will never work properly if that one resistor is off value. Also it is

some times necessary to replace the internal S meter pots, as they can become damaged if there was an overload at some time in that part of the circuit. If the S meter zero wanders all over the place, be suspicious of bad resistors / pots in the S meter circuit. A leaky tube can also cause the S meter zero to wander.

I always check tubes by substitution, and I only buy new old stock tubes, preferably Sylvania. If you try a couple tubes in a given socket, and get no more gain (S meter reading), put the original back in place. Rarely is it necessary to re-tube the whole radio.

In very rare instances the gain of the radio may die over time. I have seen a calibrator read S9 or above, and then over 30 minutes go to near S1. If the tubes have been checked out and are good, and the above mentioned S meter bridge resistors are OK, then the most likely solution is to replace the AGC detector transistor. This is a rare 2N3877. I have them in stock should you need one. This is not a typical problem, but it does happen.

If you cannot get the total gain up to the desired level, consider the following. Originally the PTO output Pi network had a pair of 390 pF mica capacitors in the circuit that feeds the first mixer. Later the output 390 pF was changed to 680 pF, likely dealing with some out-of-band spurious problem, possibly affecting the WARC bands when in transceiver using the receiver PTO. In any case, the level of LO injection is lower with the 680 pF mica compared to the 390 pF value in earlier R-4Cs. The first mixer LO is not operated anywhere near saturation. Changing the 680 pF back to 390 pF will increase the gain of the first mixer. I don't know why Drake made this change, and I don't know what affect it has on transmit. My R-4Cs use the 390 pF value.

Finally, a comment on 30 meters. The manual for the T-4XC says to use a different crystal than for the receiver. I assume this has to do with transmit spurs. This makes the PTO read non-standard. We try to carry both crystal frequencies for the 30 meter band. HC-6/U crystals are getting very hard to have made, so don't wait too long to fill out your WARC bands and 10 meter band crystals.

73, Rob Sherwood, NC0B

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