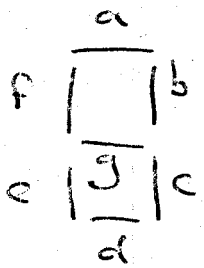

Argo
Abt. 4.5" x 1" space.

Down with Interpolation

—a digital display for the Triton and others

Brooks Carter W4FQ
Rt. 2, Box 407
Irmo SC 29063

Although designed for a Ten-Tec 540 or Triton, this readout should be easy to adapt to other transceivers using similar conversion systems. It is a very small unit that sits unobtrusively on the transceiver, costs little, is easy to build, and measures only 5 1/4" × 3 1/8" × 1 1/8" (13.3 × 7.9 × 2.9 cm). With seven ICs, six transistors, four display LEDs, and one voltage regulator, the

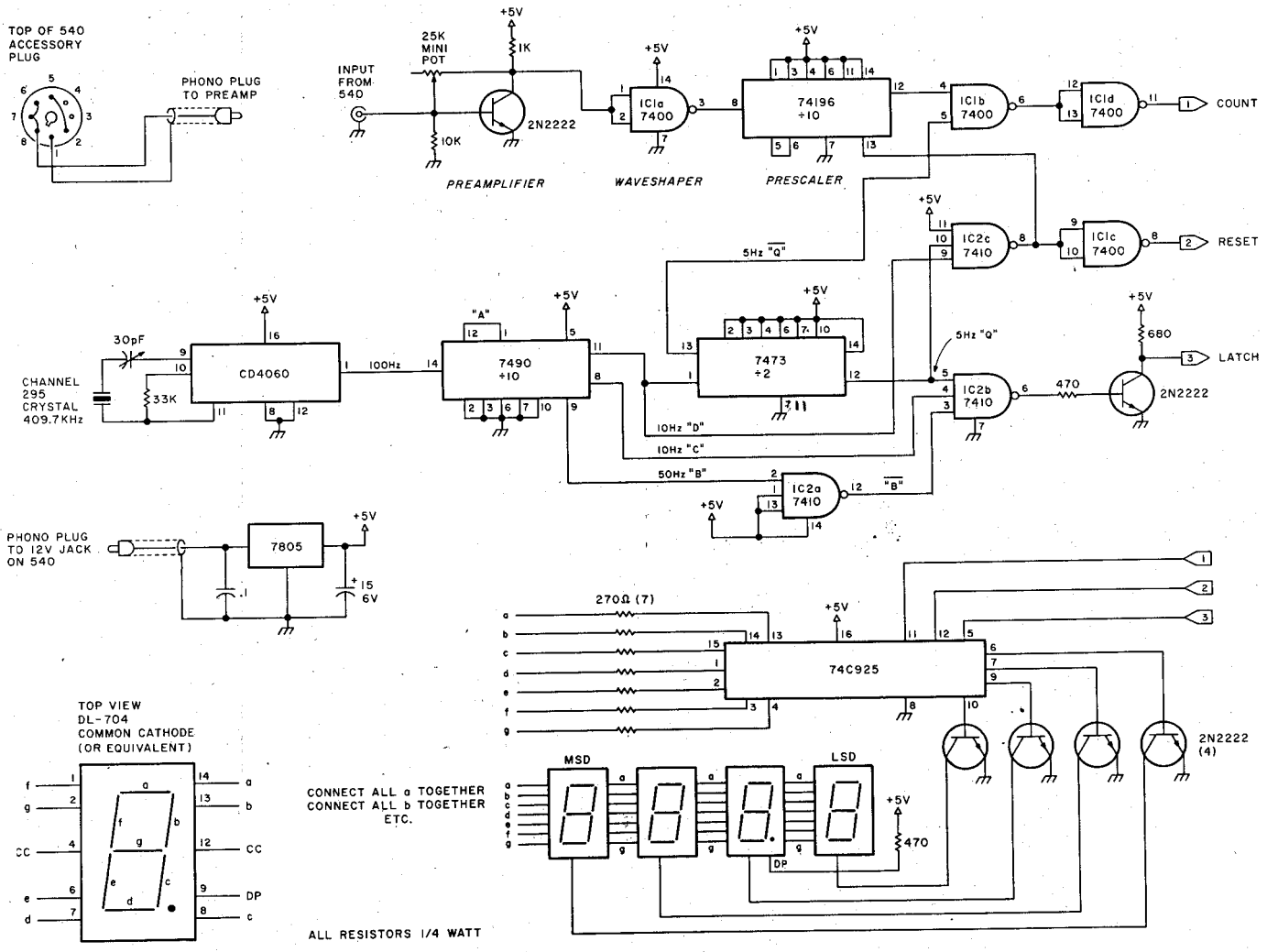

Fig. 1. Readout schematic.

parts cost is less than $20.

The 540 is single conversion, and its vfo operates from 5 to 5.5 MHz on all bands. Vfo output is mixed with signals from a crystal oscillator, with crystals for each band, to produce mixer injection frequencies between 5 and 21 MHz for conversion of incoming signals to 9 MHz. The display reads the mixer injection frequency down to hundreds of Hertz.

Megahertz are not displayed; this would necessitate a complicated switching and diode presetting arrangement and is neither worth it nor needed. As it is, no switching at all is required. Incidentally, the Ten-Tec 544 digital dial also reads the mixer injection frequency, and additional wafers are incorporated in the bandswitch to provide a megahertz display.

Integrated Circuits

Two of the seven ICs serve to eliminate an additional fifteen or more, if conventional TTL circuits were to be used. The CMOS CD4060, plus a 7490, a 7473, and a few gates provide the time base and logic circuits. The 4060 oscillates well with FT-241 surplus crystals, available from Jan Crystals.

Crystal frequency is 409.6 kHz, but a channel 295 at 409.7 kHz will do nicely; the frequency is easily pulled to 409.6 kHz with the 30-pF series trimmer in the crystal circuit. The 4060 can divide by 2^4 through 2^{14} (except 2^{11}). In this oscillator, the crystal frequency is divided by 2^{12}, or 4096, to provide an output of 100 Hz at pin 1. How much simpler this is than a long string of divide-by-ten TTLs!

The 100 Hz is fed to a 7490 to be further divided for outputs of 50 and 10 Hz. The 7473 divides the 10

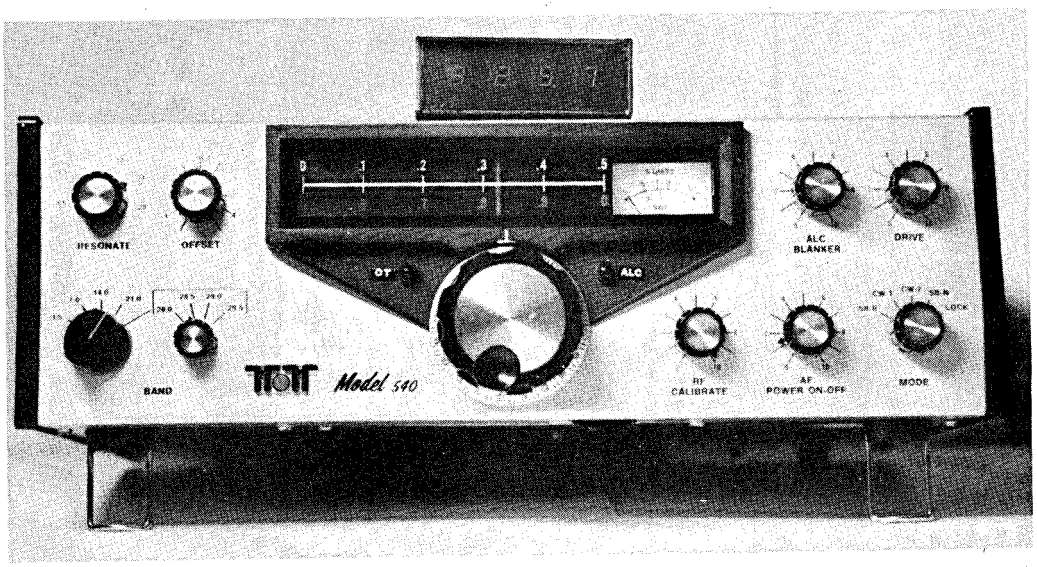

Photo A.

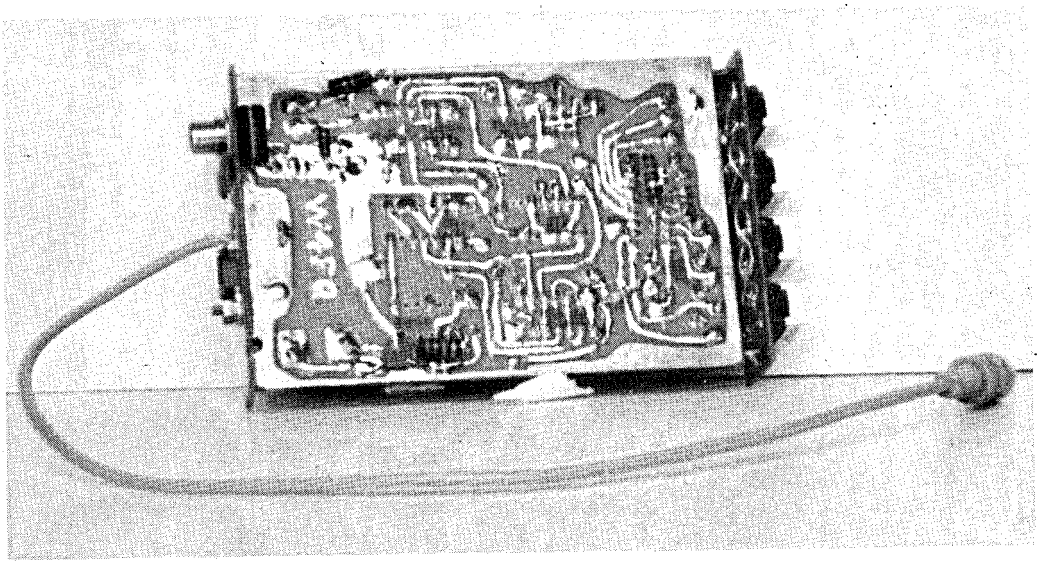

Photo B.

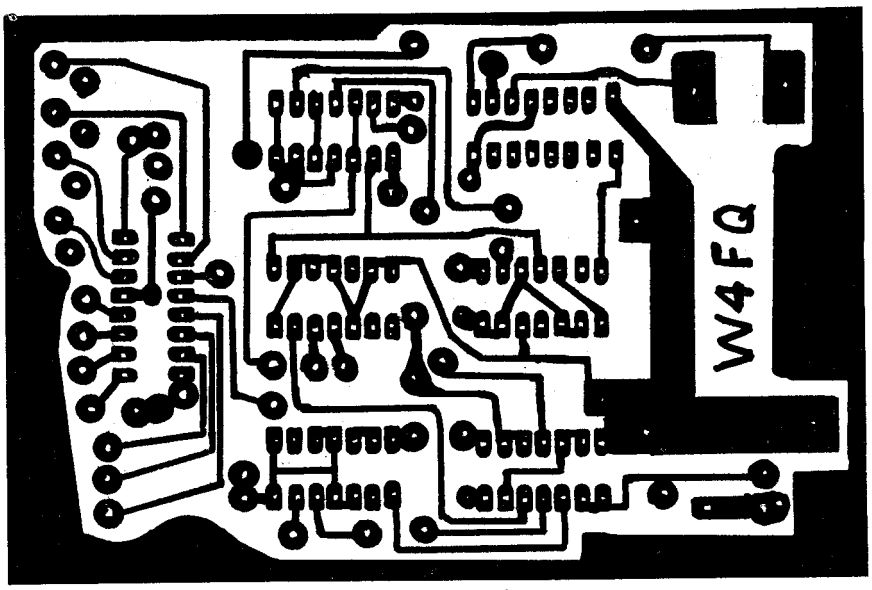

Fig. 2. Circuit board.

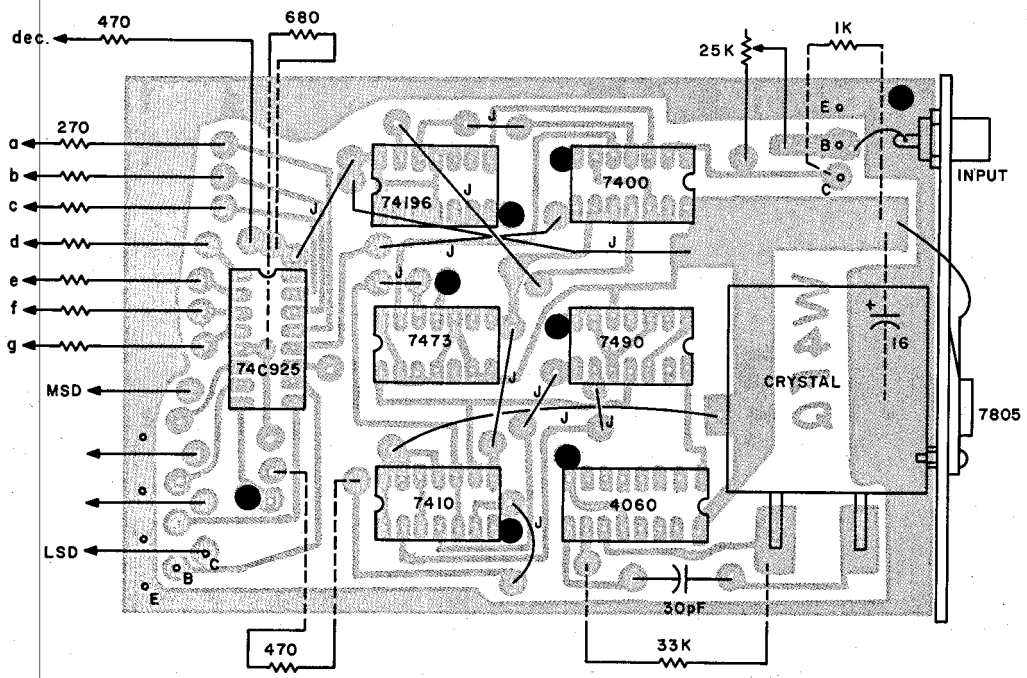

Fig. 3. Parts placement—ground plane side. A ● indicates a connection from etched side to ground plane. There are eight ground connections and 12 jumper wires. Components with dashed leads are mounted on etched side. For brighter display, use 150 Ohms in place of 270. These crystal frequencies may be used: 409.6 kHz with output from pin 1 of 4060, 819.2 kHz from pin 2, and 1638.4 kHz from pin 3.

Hz by 2 and by referring to Fig. 1, you can see we have outputs of 50, 10, 10, 5 and 5 Hz (some inverted) now available for the logic gates for count, reset, and latch pulses.

Gerd Schrick WB8IFM, in his "Universal Digital Readout" in the December, 1978, issue of *Ham Radio*, makes use of the 4060, as does Klaas Spaargaren PAØKSB in his "Drift Correction Circuit" in the December, 1977, issue.

Philip Rand W1DBM's fine article entitled "A Versatile Digital Frequency Display" in *QST* for November, 1977, is the source for part of the time base and logic circuits used here. For easy-to-understand information on logic, read this article. His waveform chart applies here also, except that the negative-going reset pulse must be inverted, as the 74C925 requires positive-going reset and latch. I use a 2N2222 as an inverter rather than another IC with only one section utilized.

John Wolcott W4CCX and Johnny Chestnut WA4PIN use the 74C925 in their "Lunch Counter," described in *73 Magazine* for December, 1978, and that is where I became acquainted with this labor- and parts-saving chip. It contains the equivalent of counters, latches, and decoders for four displays, also internal multiplexing with a free-running oscillator, and four outputs for common-cathode display LEDs.

A 74196 prescaler lowers the 5-to-21 MHz input frequencies from the 540 for the readout to 500 to 2100 kHz for input to the 74C925. The 2N2222 preamplifier has a 25k-Ohm minipot for adjusting bias and the operating point of the 7400 waveshaper. This adjustment is somewhat critical at 21 MHz. If desired, the pot can be replaced by a fixed resistor once the correct value has been determined. Be sure the pot is connected as shown, and not directly to plus 5 volts. A 2N3904 can be used here and throughout as a substitute for the 2N2222s.

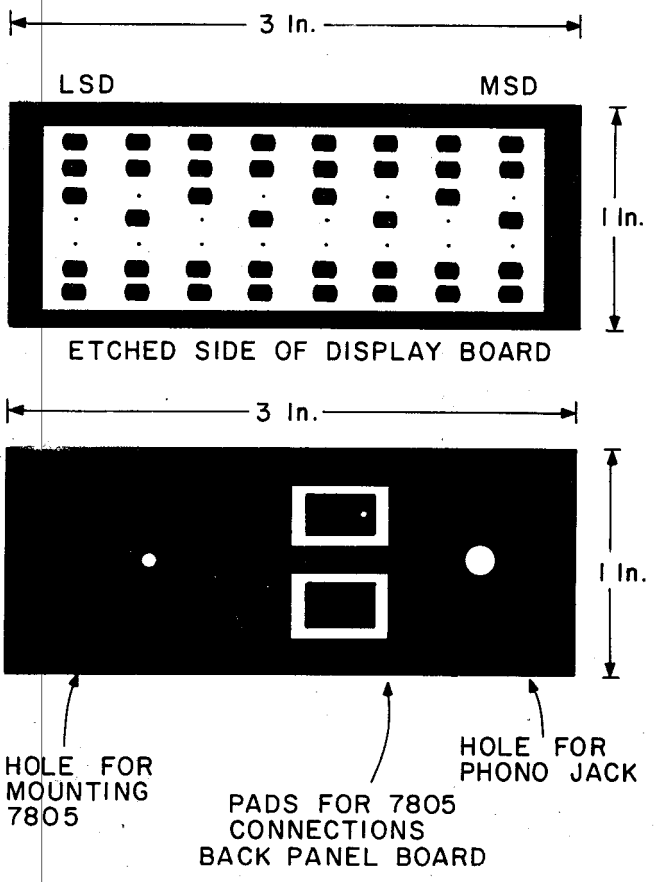

Fig. 4. Display and back panel boards.

Construction Notes

I used double-sided PC board, with the holes for the IC sockets and jumpers reamed slightly on the ground plane side to remove copper which could short pins to ground. Grounds on the etched side were wired through to the gp side. Laundry marking pens make good resist lines for the etched circuit; if you use these, buy two (at 60¢ from K-Mart). If the point dries, it probably will be tomorrow before the ink flows freely again, so keep it capped every second that it is not in use.

A damp rag and kitchen cleanser (Ajax, Comet, etc.) will clean the copper PC board before etching, and will remove the resist after. Ferric chloride is an easy-to-use etchant and takes about 30 minutes. The 1" x 3" board for the display is spaced about ¼" from the circuit board to allow room for wiring, and is fixed in place by soldering

scraps of PC board at each end. A press-fitted enclosure made from PC board and covered with black contact paper is used here to give the unit a finished appearance. A red transparent window is cemented in place, through which the display is viewed. Shielding does not seem to be necessary, so the enclosure can be made of just about anything.

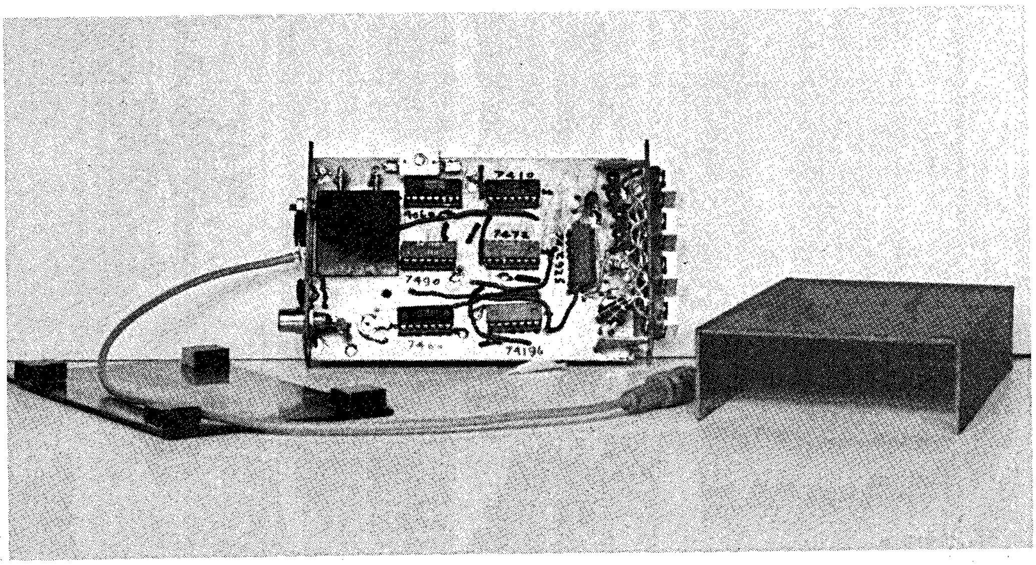

Photo C.

Checkout

When the readout has been assembled, and without ICs in their sockets, check for solder bridges between pins. Almost certainly there will be some; use an ohmmeter—don't depend on your eyes. With the ICs in their sockets and power applied but with no input to the preamplifier, the display should read 000.0 or 000.1. If not, check these pins for fast needle fluctuations on a voltmeter set for 5 volts or more: 7490, pins 5 and 12; 7473, pins 12 and 13; 7410, pins 6, 8 and 12; 74C925, pins 5 and 12 (with input to the preamplifier from the 540, there should also be fluctuations on pin 11). If any of these pins reads a steady voltage, the thing will not work and some checking is in order.

Hash from the readout is completely suppressed by the .1-uF and 15-uF capacitors at the input and output of the 7805 voltage regulator. No other bypassing is necessary. The unit draws 150 mA.

Calibration

Calibration is a snap. Zero beat the 540 with WWV on 15 MHz (bandswitch on 21, dial at 0, resonate between 3.5 and 7) and adjust the crystal trimmer until the display shows 000.0. That's all there is to it.■

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