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CB to 10

—part XII: convert a Kraco PLL rig

When a CB transceiver gets down to $20 or $30, it's time to consider buying one for use on 10 meters. Like many others, I did just that. After looking over the many rigs available in the $30 class, I decided to tackle the Kraco Model KCB-2310B. The main reason for selecting this rig was its phase locked loop synthesizer, especially since most of the conversion articles I had been reading usually advised the reader to stay away from rigs with PLL because of the complexity of the conversion. To a certain extent, those articles are correct.

In any event, once I had purchased the rig, I set out to learn as much about phase locked loop circuitry as possible. Not having had much need for this information before, I was extremely ignorant in this area. I am most grateful to George R. Allen W1HCI for his excellent article, "Synthesize Yourself," in the October, 1977, issue of *73 Magazine*. This allowed me to familiarize myself with the basic operation of the PLL circuit and understand its operation.

When I began looking at the schematic diagram of the unit, one thing became immediately apparent. I wasn't going to learn much by looking at it, and, besides that, it was too small. So I trotted down to my neighborhood electronics parts distributor and purchased *SAMS Photofact CB-153*, November, 1977. Although this does not have the Kraco Model KCB-2310B, it does have the 2320B, which is identical except for a Delta-Tune selector.

After many days of examining the new schematic and block diagram of the circuit, I began wondering if I had bitten off more than I could chew in attempting this conversion. I just couldn't make heads or tails of what was happening inside the PLL chip, an NPC 7624 (ECG 1167 is listed as a substitute). Endless on-the-air conversations failed to enlighten me very much more. I am, however, grateful to WB5HVV and many others for their many suggestions and comments.

Finally, when things began to look their blackest as far as the conversion was concerned, I saw a little light on the horizon. While browsing in a local Radio Shack, I came across the National Semiconductor *CMOS Databook*, and in it was a circuit for a CB transceiver PLL. After examining the application data for their MM55114 chip, I concluded that this chip and circuit description looked very similar in appearance to the one in my Kraco.

The Kraco, like the circuit in the *Databook*, uses a 3-crystal setup. It uses a 10.240-MHz crystal for the reference oscillator, a 10.695-MHz transmit mixer, and a 11.8066-MHz offset generator. For our purposes, we can forget the first two crystals and concentrate on the third. This 11.8066-MHz oscillator is the key to the circuit's conversion.

The frequency range for the conversion I selected was that recommended by the 10-10 International, Inc., in its *Fall Bulletin*. The frequency to be covered by AM rigs is from 28.760 through 29.050 MHz. Simply put, replacement of the 11.8066-MHz crystal with a 12.4047-MHz crystal and realignment of the transmitter and receiver, plus the synthesizer's vco (voltage-controlled oscillator) output circuit, will be all that is necessary to put your Kraco 2310B or 20B on ten meters.

For those of you who are interested in the "how it works" aspect of the PLL, I will cover that in greater detail at the end of the conversion.

The frequency-determining factor for the circuit is the 37-MHz output from the unit's vco. In normal 11 meter operation, this output is heterodyned against a 10.695-MHz transmit crystal for output on 27 MHz. The vco output is from 37.6592 MHz for channel 1 through 37.9492 MHz for channel 23. It is our intent to raise the output of the vco by 1.795 MHz. This will raise the vco to 39.4542 through 39.7442 MHz. This, in turn, gives us coverage from 28.760 to 29.050 MHz.

Although a frequency counter would be a definite plus, the station receiver, transmitter, dummy load, VTVM, and rf probe were all that was really required in the way of test equipment. My Drake TR-3, keyed into a dummy load, was used for realignment of the Kraco receiver. The Drake's receiver section was used to align the synthesizer upon completion of the conversion.

The first step in the conversion is to apply power to the CB transceiver, turn to channel one, and check test point #8 (one side of R-113) for 1.5 volts dc. A switch of the channel selector to channel 23 should change the voltage to about 2.7 volts. Switching to the blank position on the channel selector will cause the voltage to change to approximately 5 volts. It is important to observe that these voltages vary as you change from channel 1 to channel 23 and that this voltage is the controlling voltage for the vco. We will come back to this test point in a moment.

The next step is to replace crystal X101 (the 11.8066-MHz crystal) with a 12.4047-MHz crystal. This is an HC-18/U crystal holder and the tolerance is ±.001 percent. Once the crystal has been installed, you will observe that the dc voltage at TP #8 jumps to 5 volts, regardless of the position of

the channel selector. Turn the rig again to channel 1 and adjust vco-output transformer T-101 until the voltage begins to drop. Generally, this requires turning the slug in a clockwise direction. Continue adjusting this slug until you read 1.5 volts at TP #8. This indicates the vco is functioning correctly, and rotation of the channel selector will again indicate a gradual increase. This nearly completes the vco alignment. Attach an rf probe to TP #3 and adjust T-111 for maximum. If the output is too low to measure here, attach the probe to the collector of Q-108 and again adjust T-111 for maximum. This completes the vco alignment.

Having completed the synthesizer adjustments, we now turn to the receiver. With a signal generator (or in my case, my Drake transceiver), provide a receive signal at approximately 28.9 MHz. I loaded my Drake into a dummy load (lightly) and adjusted T-104 and T-105 for maximum S-meter reading on the Kraco. This required a couple of turns and completes the receiver alignment.

With a dummy load connected to the Kraco, attach the rf probe to the collector of Q-110 (xmit mixer) and adjust L-103 and L-104 for maximum rf out. Move the probe to the base of Q-111 (xmit buffer) and adjust T-102 for maximum. Again check and adjust L-103 and L-104 with the probe still connected to the base of Q-111. Next, attach the probe to the collector of Q-111 and adjust T-103 for maximum. By this time, you should have enough rf to see output on your power or wattmeter. With the probe at the antenna connector, adjust L-106, L-109, and L-110 for maximum output. On my rig, it was about 4½ Watts.

Turn the channel selector to channel 4. With the station receiver tuned and calibrated to 28.8 MHz, key the Kraco into a dummy load and adjust CT-101 until the output of the rig is exactly 28.8 MHz. I found the rig to be within 2 kHz prior to this adjustment. This completes the conversion.

For those of you who are wondering how the Kraco's synthesizer works, let me say this. First of all, I am not an electronics engineer and I may not be totally accurate in my description of what is going on internally within the PLL chip, but I feature it to be happening like this: The 10.240-MHz output from the reference oscillator is internally divided by a 1024 oscillator/divider which outputs a 10 kHz signal to the frequency detector. This, by the way, establishes the 10-kHz spacing for the vco. The vco is being controlled by the frequency detector. Its output is approximately 39.455 MHz. This signal is mixed with the output of our 12.4047-MHz oscillator's third harmonic of 37.215 MHz (rounded off for convenience). The resultant 2.240-MHz signal is fed to the PLL's programmable divider (divide by 224 through 250), where in this case it is divided by 224. This 10-kHz output is also fed to the frequency detector causing the vco to lock on 39.455 MHz. The channel selector changes the programmable divider, and changing it to a new channel will cause the signal fed to the frequency detector to be more or less than 10 kHz. This will vary the vco output until the input signals again match, and a new locked condition is met. For more information, I refer you to page 4-25 of the *CMOS Databook* by National Semiconductor.

I hope this information is of some use to anyone considering converting their Kraco to ten meters. I know I had a lot of difficulty finding information about such conversions. The majority of information was garnered from *73 Magazine*. ■

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