Note: Some illustrations have been reduced in this sample to shrink the file size, but are often full pages in the actual books. The text may also refer to pages or figures that are not included in this sample. These graphics were scanned using greatly compressed JPG files and do not represent the real picture quality in the books.

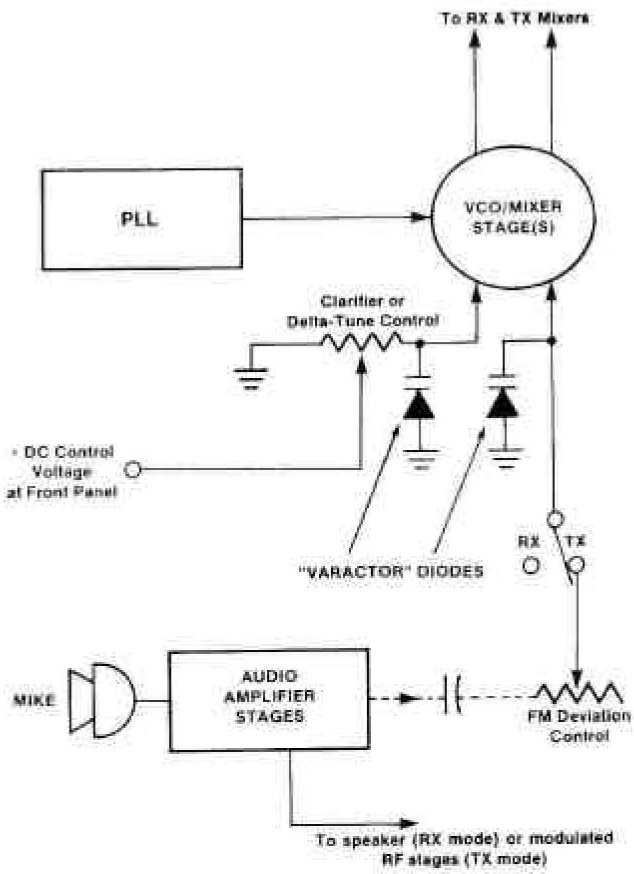
CONTENTS

…from SECTION I, PLL BASICS, Pages 13–17

CBs make very good use of the VCO's sensitivity for FM transmission, SSB Clarifiers, and Delta Tune controls on AM/FM rigs. In such models a look at the schematic will always reveal an extra varactor diode somewhere in addition to the one used for the PLL.

Figure 7 shows the general varactor idea. For the Clarifier or Delta Tune, a front panel control is used to vary the DC voltage across a varactor diode; this in turn changes the varactor's capacitance and therefore the oscillator frequency. (A much more detailed discussion of sliders along with some specific modifications and chassis types can be found in **THE "SCREWDRIVER EXPERT'S" GUIDE.**)

FIGURE 7
USING THE SENSITIVE VCO STAGE TO PRODUCE SSB/DELTA-TUNE OFFSETS OR FM



For FM TX, some of the mike audio is sampled off and used as a control voltage. This voltage, which you'll recall is changing at an audio rate, is applied to a separate varactor at a sensitive spot in the VCO or one mixer. The result is FM rather than AM or SSB. Continuing around the loop, you'll see that the output from the VCO goes right back into the Programmable Divider and then to the Phase Detector. The PD then decides whether or not an exact 10 KHz (5 KHz) match exists between the Reference Divider and Programmable Divider. If so, the loop is locked on frequency. If not, the PD senses the error and outputs a filtered DC correction voltage to the VCO. This drives the VCO up or down slightly in frequency until an exact match is found and the loop locks.

For you mechanically-inclined readers, this entire PLL process could be compared to a mechanical servo loop system, which is also self-correcting. Although it may take a number of comparison cycles to find a match, the entire process happens in the wink of an eye!

You really start to appreciate the accuracy of a PLL system when you compare it to the older crystal-synthesized radios. For example, using an 8-digit Frequency Counter I compared the accuracy of both types. When the crystal rig might indicate say, 26.965316 MHz on Ch.1 and 26.975124 MHz on Ch.2, the better PLL rig will typically show something like 26.965004 MHz, right on up to 27.405004 MHz on Ch.40. In other words, the PLL is accurate all the way down to the last decimal place, across the whole band!

We've now come full circle around the loop, and hopefully you're still with us. Now we must complicate things a bit more. There are a few more PLL circuit functions you need to know about to complete your basic understanding.

Loop Mixer or Down Converter

The need for Intermediate Frequencies and SSB offsets has already been explained. You've also seen how the sensitive VCO circuit can change the carrier frequency, slide an SSB Clarifier, and generate FM. Now there's one final mixing process to detail. Although it's used mainly in the older (but more desirable) PLL radios and will complicate the circuitry, it also makes modifications a lot easier!

The final mixer stage is known by several terms including the "Loop Mixer", "Loop Oscillator", "Down Mixer", "Down Converter", and "Offset Oscillator." All mean exactly the same thing when seen on a schematic. Figure 8 shows the addition of this stage to the PLL. Note that except for the extra mixer, it's identical to Figure 6 on Page 11. A crystal-controlled oscillator provides the extra mixing signal. It may be used directly, or multiplied up to get it close to the VCO's frequency.

The reason for this extra mixing stage is due to the slow speed of the earlier PLL ICs. They weren't able to directly divide the incoming VCO signal before it enters the Programmable Divider stage. Most CB VCOs run in either the 16-17 MHz or 34-38 MHz range. Even at 16 MHz the digital dividers just weren't fast enough.

Nowadays the current PLL chips have reached the point where they can directly divide an input signal as high as 20 MHz. (Maybe higher by the time you read this.) You'll eventually learn to hate this great technological "improvement", because the Down Mixer stage is the perfect spot to modify a CB by injecting new mixing signals with different crystals of your own.

FIGURE 8
A BASIC PLL SYSTEM WITH DOWNMIX STAGE ADDED

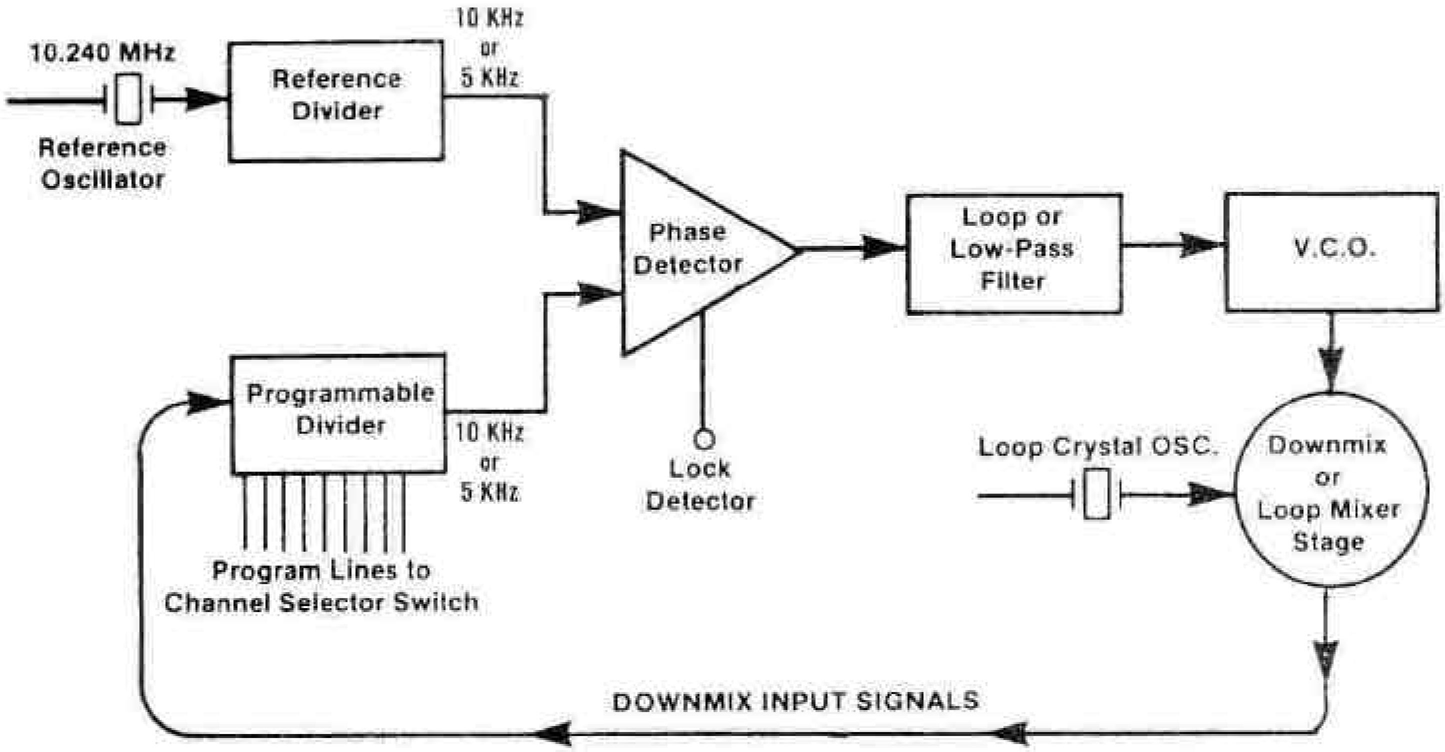
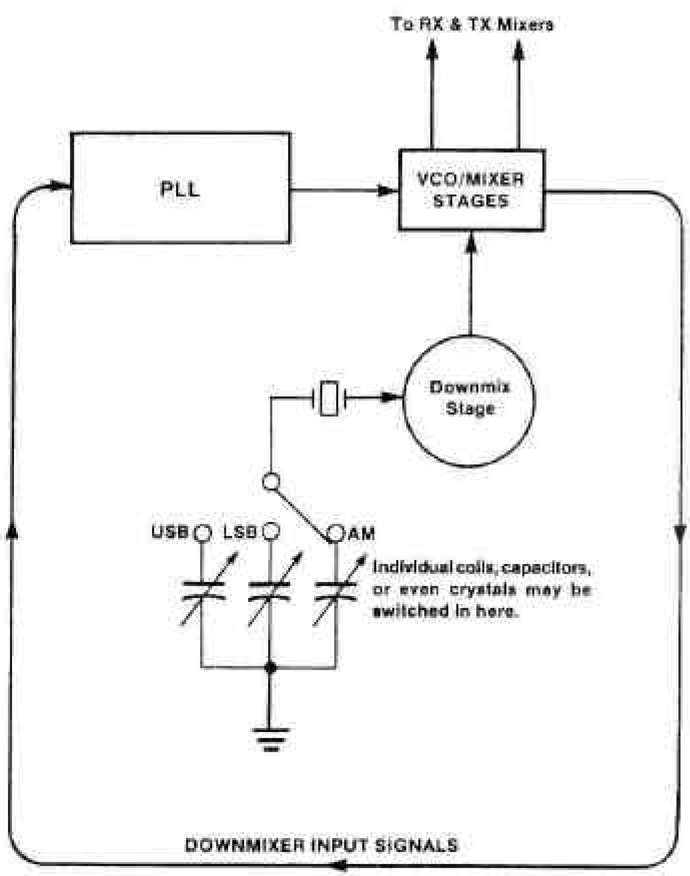


FIGURE 9
OFFSETTING PLL FOR SSB MIXING



NOTE: The Carrier Oscillator stage is normally offset also in a similiar way. This maintains a single IF frequency for all modes and thus only a single IF filter is required.

Now see Figure 9. For SSB use the Down Mixer is once again offset slightly. When you switch between LSB and USB, separate coil/capacitor networks are placed in the circuit and will detune the main oscillator by the correct amount. These offsets are typically switched by diodes or transistors, and may have fixed values or may be set at the factory. In most models the varactor circuit that controls the Clarifier is also connected here.

The Down Mixer takes a signal generated from some other (usually separate) oscillator and mixes it with the VCO. Tuned circuits then pass just the difference frequency on to the next stage, the Programmable Divider. The difference frequency is now low enough to be processed by the older type of IC dividers. This frequency is in the range of 910 KHz to 4.0 MHz.

The signal entering the Down Mixer can come from several possible sources. The most obvious is a discrete transistor crystal oscillator, and this is a common method. Often this crystal frequency is multiplied up by tuned circuits to get it close enough to the VCO range. Typical multiplication factors are x2 or x3. The end result must always be a downmix signal into the Programmable Divider that's under 4.0 MHz.

The 5.12 MHz Loop Mixer Signal

Many newer ICs include a provision for the loop mixing. This signal is 5.12 MHz, which results from dividing the 10.240 MHz reference in half and bringing it out to an IC pin.

The 5.12 MHz signal is normally tripled to 15.360 MHz by a tuning coil. This places it very close to a VCO running in the 16-17 MHz range.

There are many other loop mixing schemes. Some Motorola CBs (TC9105 PLL) used a 37 MHz VCO and multiplied the 5.12 MHz by 7 instead of 3. And in other common arrangements (PLL02A, NDC40013) the Reference Oscillator itself is doubled and sampled off for mixing.

Current Technical Trends

Loop mixing is one easy place for frequency modifications. Unfortunately the newest chips (C5121, LC7131, LC7136, LC7185, SM5123, SM5124, TC9106, TC9109, TC9119) which are used for dual-conversion AM or FM models have no loop mixing at all; they directly divide the 16 MHz VCO. In addition they sometimes have special programming tricks to further prevent changes. If you own one of these, get rid of it! There are still thousands of older models available using mixers. Most are obsolete now, but often such models can be found at swap meets, pawn shops, or ads in CB and Ham magazines. The best ones to get use the PLL02A, µPD858, and MB8719 chassis. These are the most popular anyway, and for obvious reasons.

The AM versions of the PLL02A and µPD858 have been replaced by the more foolproof chips. But used SSB versions are still quite common and in fact the MB8719 Uniden chassis is still being sold by Cobra and Uniden.

One reason the older SSB rigs are so desirable is because they all use loop mixing. Details of common modifications are shown later in this book. There's one current exception though: the LC7131 is now showing up in SSB models like the Midland 79-265 and Courier Galaxy V/VI. No easy modification in these chassis, so avoid them!

SPECIAL CHIP FUNCTIONS

There are a few more options which may be found in PLL ICs. Most deal with resistance to illegal modifications, ease of circuit design, and operator convenience features. I'll briefly summarize these here so you'll understand them when looking at a particular chip's pinout.

TX/RX Shift

This is a function found only in those ICs intended for the cheaper dual-conversion AM or FM receivers. Examples are the C5121, LC7120, LC7131, LC7136, LC7185, SM5123, SM5124, TC9106, TC9109, TC9119, µPD2814, and µPD2816. In these chips the N-Code to the Programmable Divider is shifted by a special IC pin, the T/R pin.

The IC may use one set of N-Codes when the T/R pin is HIGH (DC voltage applied) and another set when LOW (grounded). You'll find this type of chip in any rig that uses just a single 10.240 MHz reference oscillator crystal. Let's see why this function is even needed.
Because there's no other signal present in the loop which could be used for mixing or RX IF injection, it has to be created. Specifically, we need to generate the 455 KHz second IF for the RX somehow. Enter the T/R pin. It's connected through a diode or transistor switch to the mike circuit, and senses when the mike is keyed to transmit. When this happens, the output from the Programmable Divider to the PD will of course no longer match the Reference Divider signal. The PD outputs a DC correction voltage to the VCO, driving it until the loop locks again. In most models the VCO is driven higher by 455 KHz in the TX mode.

Note that the T/R shift isn't needed in SSB models since single-conversion is almost always used for SSB RX. But a few SSB types do use these ICs; they just don't connect the T/R pin. (Examples: the early Midland 6001/7001 with the µPD2816, TRS Challenger 850/1400, µPD2810 IC.) This implies that some models using a generally non-modifiable PLL IC may really be modifiable, depending upon <u>how</u> the chip is used.

The T/R chip families are among those types mentioned earlier using 5 KHz internal dividers rather than 10 KHz. This makes the T/R shift very easy: on TX they just add 91 to whatever the RX N-Code happens to be. And guess what? Multiplying 5 KHz x 91 = 455 KHz.

A few chips (PLL03/08A, TC9109) switch between 5 KHz and 2.5 KHz internal division instead, with the appropriate change in N-Codes that will give the desired output. That's because in these circuits they also shift the 16 MHz VCO down to about 13 MHz on TX, where it's doubled to 27 MHz. This scheme eliminates one extra mixing stage in the TX, and is very cheap. The method has returned again in the C5121, LC7132, LC7185, and SM5124. Don't ever buy this junk!

Misprogram Code (MC) Pin

Many newer ICs have special N-Code protection to prevent illegal changes. If you should try to force an illegal programming code on the IC pins, the MC pin is activated. The operation is very similar to the Lock Detector in that it's used to turn off the TX in the absence of acceptable program codes. Again, some of the extra "features" are for the manufacturer's and the government's benefit, not yours.

Frequency Select (FS) Pin

Some older chips had a pin that allowed selection of either 5 KHz or 10 KHz division steps. This was set by the appropriate "1" or "0" logic on the pin. Don't however confuse this choice with the 5 KHz division needed for the T/R shift; it's totally different. This feature was useful for generating things like a 5 KHz LSB offset. Remember, these early ICs had many other non-CB applications like VHF marine radios, aircraft radios, synthesizers for RF signal generators, etc. It was only when people went wild with CB modifications that the manufacturers were forced to make special dedicated ICs just for CB synthesizers.
Don't get too excited about the possibility of adding 5 KHz channel steps by switching this pin voltage; the N-Codes must also change in proportion or it won't work. Not easy to do! This pin must be left in whatever logic state will generate the 10 KHz channel steps.

Automatic Ch.9/Ch.19 Recall

This is a special feature used in many of the later ICs, like the C5121, LC7131, LC7135, LC7185, and SM5123A. Switching the logic state of these special pins will instantly recall Ch.9 or Ch.19 as appropriate, without changing the Channel Selector. (Many newer models don't even have a Channel Selector.) The pins can also be wired to a scan circuit which will stop on those channels with signals present.

In some chips these pins are internally tied to the Misprogram Code (MC) pin, where attempts to change to illegal channels will merely switch to the above priority channels instead. If these features aren't used but the chip has them and you'd like to add them, it's an easy modification; just connect a switch between the pin and +DC as shown in Figure 12, Page 26.

Scanning Interface

Certain ICs like the LC7120 and those mentioned above can be connected to special scanning ICs. Then they scan up and down the band, looking for a busy channel. Many people like this feature, but remember that it's usually only found in chips which have much more important limitations. The radios with this function are most often those having a few controls in the mike, or else the main chassis is in the trunk and is remotely controlled from the mike.

UP/DOWN Channel Control

This is closely tied to the scanning function and is found in the most inexpensive new rigs that don't have a real Channel Selector. The radio and/or mike just has an UP/DOWN button. The PLL chip has a clocking oscillator which steps continuously to control the VCO. It goes through the whole 40 channels and then resets itself, unless you stop it. Again, this feature is only found in the el-cheapo AM or FM mobiles and should be ignored, since the rest of the radio is non-modifiable anyway. This is just a sneaky way for the manufacturers to sell more radios; unwary buyers think they're actually getting a bonus, but they're <u>losing</u> much more!

(continued on next page)

…from SECTION II, MODIFICATION METHODS,
Pages 23–25

TRUTH CHARTS & PROGRAMMING METHODS IN DETAIL

The Truth Chart is the most important first step in determining how a modification can be made. Or if it can be made. Let's examine it in greater detail now.

The example just described was a very easy PLL circuit using the binary type of programming code. It's quite possible for the same chip to have different N-Codes depending upon how many crystals are used, or if it's AM or AM/SSB. The preceding circuit is one of several used with the PLL02A; this is the "2-crystal AM" loop. It used N-Codes from 330 Ch.1 to 286 Ch.40, because those were the numbers needed for exact division, correct IFs, etc. An earlier AM loop used 3 crystals and N-Codes which went up, from 224 Ch.1 to 268 Ch.40. And in the ever-popular SSB chassis the N-Codes were 255 down to 211.

CHART 3
N-Codes For Channel Assignments

	÷ N Code	Channel Freq (MHz)
Ch. 1	330	26.965
Ch. 2	329	26.975
Ch. 3	328	26.985
Ch. 4	326	27.005
Ch. 5	325	27.015
Ch. 6	324	27.025
Ch. 7	323	27.035
Ch. 8	321	27.055
Ch. 9	320	27.065
Ch. 10	319	27.075
Ch. 11	318	27.085
Ch. 12	316	27.105
Ch. 13	315	27.115
Ch. 14	314	27.125
Ch. 15	313	27.135
Ch. 16	311	27.155
Ch. 17	310	27.165
Ch. 18	309	27.175
Ch. 19	308	27.185
Ch. 20	306	27.205
Ch. 21	305	27.215
Ch. 22	304	27.225
Ch. 23	301	27.255
Ch. 24	303	27.235
Ch. 25	302	27.245
Ch. 26	300	27.265
Ch. 27	299	27.275
Ch. 28	298	27.285
Ch. 29	297	27.295
Ch. 30	296	27.305
Ch. 31	295	27.315
Ch. 32	294	27.325
Ch. 33	293	27.335
Ch. 34	292	27.345
Ch. 35	291	27.355
Ch. 36	290	27.365
Ch. 37	289	27.375
Ch. 38	288	27.385
Ch. 39	287	27.395
Ch. 40	286	27.405

Notice that these N-Codes can go up or down with increasing channel numbers, depending on the VCO design. In **SECTION III** you can compare all the PLL02A Block Diagrams to see exactly where and why these differences occur.

Those Infamous Channel "Skips"

Meanwhile, let's return to a portion of Chart 1 (Page 19) to study some of its other features. Chart 3 is a simplification showing only the channel number, frequency, and N-Codes from the original full chart.

Notice anything unusual in the N-Code sequence going from Ch.1 to Ch.40? The codes aren't all consecutive and skip some numbers at points that aren't legal CB frequencies. For example, Ch.3 is 26.985 MHz, and Ch.4 is 27.005 MHz. So what the heck happened to 26.995 MHz? Gee, it's not a legal FCC channel. This is known to CBers as an "A" channel, in this case, Ch.3A. There are also skips at Channels 7, 11, 15, and 19. And Ch.23, Ch.24, and Ch.25 of the FCC CB band are assigned out of sequence. (That's left over from the old 23-channel days.)

What this means is that all the N-Codes as well as VCO and mixer frequencies are also out of order in the chart. Many European countries that originally allowed only 22 channels simply adopted the American scheme exactly for those first 22 channels. Australia had 18 channels whose numbers didn't correspond to American/EEC numbers, but many of the actual frequencies were the same. And the UK originally assigned 40 consecutive channels with no skips at all. Remember these points when studying an older model's Truth Chart, or you may think your math is wrong when it really isn't.

Binary-Coded-Decimal (BCD) Programming

A second major program method is commonly found in many other areas of digital electronics and is called "Binary-Coded-Decimal" or just "BCD." You could think of it as a cross between the binary (Base 2) and the human decimal (Base 10) numbering systems. Chart 4 shows part of a BCD channel program as used in the very popular Uniden µPD858 first generation SSB chassis. (Major models included the Cobra 138XLR/139XLR, President Adams, Washington, Realistic TRC449/TRC457, etc.)

This chassis had an older PLL circuit that required a Down Mixer into the Programmable Divider. If you check the Block Diagram for this chassis (Page 51, bottom) you'll see the downmix frequencies are 0.910 MHz to 1.35 MHz. So the N-Codes are 91 (Ch.1) to 135 (Ch.40) for the standard 10 KHz spacings. Note the N-Codes skip from Ch.3 to Ch.4 in exactly

CHART 4

BCD Programming of uPD858 Chip Described in Text

			Ones				Tens				Hundreds	
		BCD POWERS	1	2	4	8	10	20	40	80	100	200
	÷ N	PLL PROGRAM PIN NUMBER	13	14	15	16	17	18	19	20	21	22
Ch. 1	91		1	0	0	0	1	0	0	1	0	0
Ch. 2	92		0	1	0	0	1	0	0	1	0	0
Ch. 3	93		1	1	0	0	1	0	0	1	0	0
Ch. 4	95		1	0	1	0	1	0	0	1	0	0
⋮	⋮											
Ch. 40	135		1	0	1	0	1	1	0	0	1	0

NOTE: Pin 22 permanently grounded to chassis ("0") for all 40 channels.

the same way as the PLL02A binary circuit we discussed, since Ch.3A isn't a legal CB channel. So what's the big difference?

Above each program pin number is now something called "BCD POWERS" rather than the previous "POWERS-OF-2." In this system the pins are assigned such that each successive group of pins has a significance 10 times greater than the preceding group. Within each decimal group the weights still double in the usual binary progression, but here the highest possible number in a group can't exceed "9" or its decimal multiple such as "90", "900", etc. (Assuming there were that many IC pins.)

Each decimal group can only have a maximum of 4 bits. In this IC there are only 10 rather than 12 program pins so the Hundreds Group can never be worth more than [(1 + 2) x 100] or 300. Just figure the total binary value of each group in the usual way, multiply it by 1, 10, or 100 as appropriate, then add all the groups together: Ones Group + Tens Group + Hundreds Group, etc.

Since each group has a value, the sum of the groups is the N-Code. For Ch.1, the group sum is [1 + (10 + 80)] = 91. Try the math yourself for the other channels. Also notice that Pin 22 is permanently grounded (logic "0") since its BCD weight is "200", but we never need a code bigger than "135." (100 + 30 + 5.) By using all ten pins (pins 13-22) you see there's a potential frequency capacity of (9 + 90 + 300) = 399 channels if you could program them all. This fact has been put to great use in modifications! Once again, the µPD858 chip had the excess capacity for possible use elsewhere.

Before you get too excited about all the potential channels hidden inside certain PLL chips, realize that most (American) CBs can't possibly cover that wide a frequency band without retuning internally. Modern rigs can stretch an average of 1.3 MHz total bandwidth, or about 130 AM channels of 10 KHz width each.

The BCD method was originally used in maybe 15% of the older circuits, because certain existing support hardware like BCD switches, keyboard controllers, and 7-segment LED displays needed BCD inputs. The later generations now use BCD almost exclusively. Examples are the LC7120, LC7131, LC7135, LC7136, µPD2814, µPD2816, and µPD2824. These chips only have 6 program pins, which is all you need to generate the 40 required numbers of "0" to "39."

Presettable Dividers

An interesting variation of the programming scheme is used in the newer Cobra 148GTL-DX and Uniden "clone" models. In order to get 120 channels, they start off with the same very flexible kind of chip (MC145106) used in the PLL02A chassis. Only this time, the N-Codes can be preset to a new set of 40 channels each time you change the L, M, or H band switch. This is done by using a pair of special digital counter chips (MC14008) wired such that each band selection also changes the set of 40 N-Codes. The net result is that a single Loop Mixer crystal (15.000 MHz) can be used to generate 120 channels. In previous 80- or 120-channel schemes, additional loop mixing crystals are switched in while maintaining a single set of the N-Codes all the time.

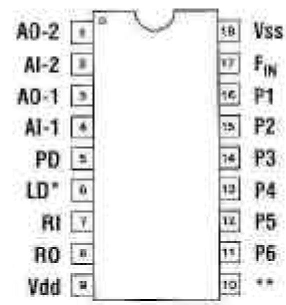
The reason for this newer scheme is purely economic: the Cobra 148GTL-DX can offer up to 120 AM/FM/SSB channels and a dual-conversion AM receiver, using a total of only 3 crystals in the whole radio. Compare this to the typical 120-channel Cybernet chassis (Ham Int'l, Colt, Major, etc.) which needs 5 crystals. The crystal cost to the manufacturer is maybe $3 while a pair of 4008 ICs is about $1. Since there's roughly a 5:1 price markup from the manufacturer's cost to the actual retail rig price, this means a savings to you of $30.

The use of presettable dividers is also found in several other early PLL chips. The most common example is the MB8719. While this IC first appears to have 7 binary program pins, closer study shows that Pin 10 is actually used to preset different N-Codes for use with different loop mixer crystals. (11.1125 MHz vs. 11.325 MHz in an otherwise identical circuit.)

In the newer Uniden and Uniden-clone European models (President Grant-DX, Stalker ST9-FDX, Superstar 360FM, Galaxy 2100, etc.) the MB8719 or MC145106 PLL is used along with the two 4008 preset dividers to generate 80 or 120 channels. In the Stalker they even include an extra Loop Mixer/Local Oscillator on its own little PC board which can be switched in to give the old 40 U.K. channels as well. (15.4825 MHz used for the first 80 “FCC” channels, and 15.55625 MHz for the 40 U.K. channels.) The N-Codes are of course different for each band, with the Band Switch changing both the loop crystal and the proper IC programming at the same time.

(sample continues on Page 63, next page)

MB8719/MB8734 (Fujitsu)



*1 = Locked, 0 = Unlocked
**N-Code Select:
1 = 64 + N for use with 11.1125 MHz crystal,
0 = 128 + N for use with 11.3258 MHz crystal (This function not present in MB8734 U.S. models only.)

AM In-Dash Models:

[S] Cobra 46/47XLR, 50/55XLR
Midland 63-445

Single-Conversion AM/SSB U.S. Models:

[S] Cobra 140GTL, Cobra 142GTL, Courier Galaxy, Midland 79-900, President P400, McKINLEY, WASHINGTON (new), Realistic TRC450, TRC490, Robyn SB505D, SBE LCBS-8, LCMS-8, Teaberry Stalker IX, XV, XX, Tram D80, D300, Uniden WASHINGTON.

Dual-Conversion AM/SSB U.S. & Export Models:

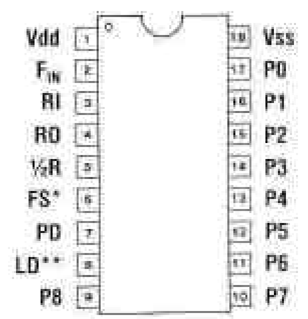
[S] Cobra 148GTL, Cobra 2000GTL, Cobra 2010GTL-WX, Pearce-Simpson Super Bengal Mk II, President GRANT (new), JACK, MADISON (new), Uniden GRANT, Uniden GRANT XL, Uniden MADISON

Multimode AM/FM/SSB Export Models:

Cobra 148GTL-DX (early, PC879)
President GRANT (export, PC899)
[S] President McKINLEY (export), Stalker 9-FDX (PC893)
Stalker XX Export

See Page 43 (top) and Page 45 (bottom). Used in the most popular Uniden chassis ever made. Still in current use, where it's been adapted to provide 80 or 120 channels plus FM. All SSB chassis are very similar. Separate FM/Loop Osc. PC boards were often found in the foreign models. In later export models a pair of MC14008 Binary Adders was used to preset greater N-Code ranges than possible with the chip alone, allowing 120-Ch. operation with a single loop mixing crystal and standard 40-channel switch. The chips use a simple 6-bit binary programming with internal pull-up resistors; program pins are normally HIGH (about 8 VDC) unless pulled LOW by external switching. The MB8719 includes a preset range, set by Pin 10. With Pin 10 HIGH, the N-Codes are [64 + N] and when LOW, the codes are [128 + N], "N" being the binary sum of whatever's HIGH on Pins 11-16. This accounts for the use of two different 11 MHz mixing crystals. In the MB8734, Pin 10 is nonfunctioning and is always HIGH. Early CB modifications replaced the MB8734 with the MB8719 in order to control Pin 10, but this method still limits the total number of channels. The best modification is to replace the 11 MHz tripler crystal directly and retune, which gives you a new set of 40 channels per loop crystal.

MC145106 (Motorola) MM55106/116/126 (National)



*1 = 10 KHz steps, 0 = 5 KHz steps
**1 = Locked, 0 = Unlocked

U.S. Models:

ARF-2001
Browning Mark 4A
[S] Dak Mark V, Robyn 440
Dak Mark IX
Lafayette LMS-40
Lake 600
Palomar SSB500 (late)
Regency CB501
SBE 54CB (Keycomm 1000)

Export Models:

Alan 87
Alaron B-4800
[S] Cobra 148GTL-DX (late), Superstar 360FM, President RICHARD (PB010)
[S] Colonel FR360, Stag 357, WKS 1001
President JACKSON (PB042)
President RONALD
Universe 5500

UNIDEN AM/FM "Clones" (EPTMARS-10Z, etc.):

[S] Galaxy 33, Superstar SS3000, SS3300, SS3500

UNIDEN SSB "Clones" (EPTZ3600-10A, -10Z, -14B, 6900, etc.):

[S] Connex 3300, 3500, Excalibur base, Excalibur Samurai, Galaxy DX44, DX88,Galaxy 2100, Galaxy II, Galaxy Pluto, Galaxy Saturn, Mirage 44, Mirage 88, President FRANKLIN, Superstar 3600, Superstar 3900, Super Galaxy, Superstar GRANT, Superstar TEK506, Texas Star

See Page 43 (top). This chip is the full-feature version of the Motorola binary PLL line, and is in fact the only one still being manufactured. (They discontinued the MC145104/SM5104 and MC145109/PLL02A in 1989 because this IC has all the same features plus a few more, in an 18-pin package.) It is currently getting heavy use in the Uniden and Uniden "clone" multimode export models, which often add a pair of MC14008 Binary Adders to extend the total channel range. (Just like the MB8719.) In some U.S. models the chip was often just a replacement for one of the earlier PLLs (like Page 51, bottom), and as such they never took advantage of its full flexibility. (But you can!) The IC uses simple 9-bit binary programming with internal pull-down resistors. Somewhat unique in that the PD output is negative-going; i.e., the output level increases as the input frequency *decreases*, and vice-versa. Easy modification by changing the programming or mixing crystal.