BREAKING THAT CHIP!

By "breaking a chip' we mean reprograming the address pins of the programmable divider in order to get new frequencies. In almost all synthesizer designs today, the programmable divider is built into the PLL chip. (REF: Vol. 12, page 56 BASIC PLL).

Digital circuits operate in the base 2 or binary system. This gives two possible states - hi, lo; on, off; 1, 0. Each 1 or 0 digit has a value of 2X, increasing from right to left.

EXAMPLE:

		64	32	16	8	4	2	1	Binary Weight
69 (Base 10)	=	1	0	0	0	1	0	1	(Base 2) (64 + 4 + 1 = 69)

OK - simple enough. So don't be afraid to experiment on PLL's. There are a few rules you must not violate however if you want to keep the PLL "alive".

1. The voltage on an address pin will either be hi (near VCC) or low (near ground). NO EXCEPTION. Remember, digital circuits work like a switch, either on or off, no inbetween.

NOTE: There are two ways to do this - the one used will determine how to go about making a "hi" pin "low".

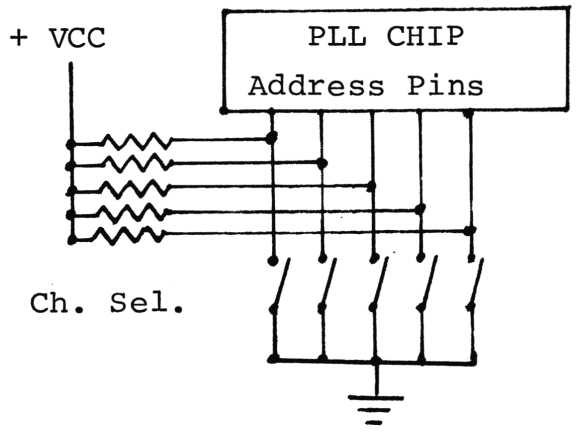

FIG. A1

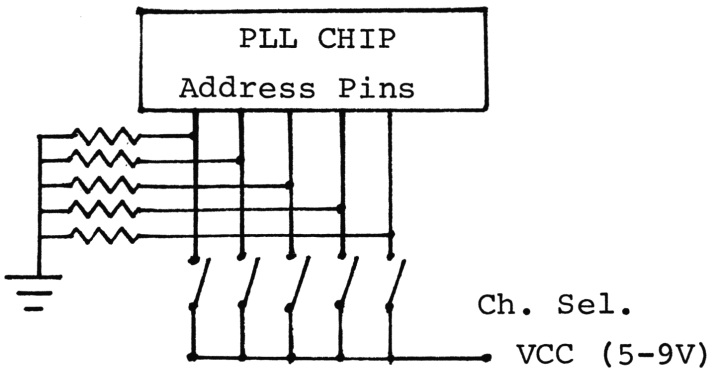

FIG. B1

REF: FIG. A1
In this configuration, address pins are "tied hi" through resistors so are normally high. The channel selector takes them low by grounding out VCC through the resistors. Sometimes the resistors are internal to the chip. CAUTION: If you want to take a "low" pin "hi" you cannot just connect it to VCC or you'll short out your VCC. The trace between the channel selector and address pin must be cut and a switch installed accross the cut. See Fig. A2

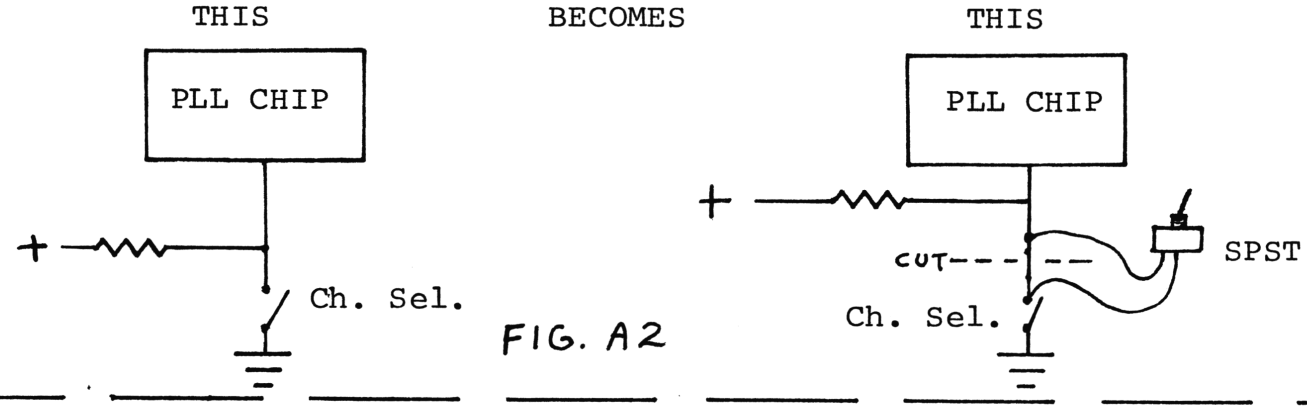

FIG. A2

REF: FIG. B1
In this configuration, address pins are usually low. The channel selector takes them "hi" by applying VCC. CAUTION: If you want to take a pin which is "hi", low, you cannot just connect it to ground or you'll short out the VCC.. What must be done is to CUT the trace from channel selector to the address pin and solder a switch across the cut. See Fig. B2

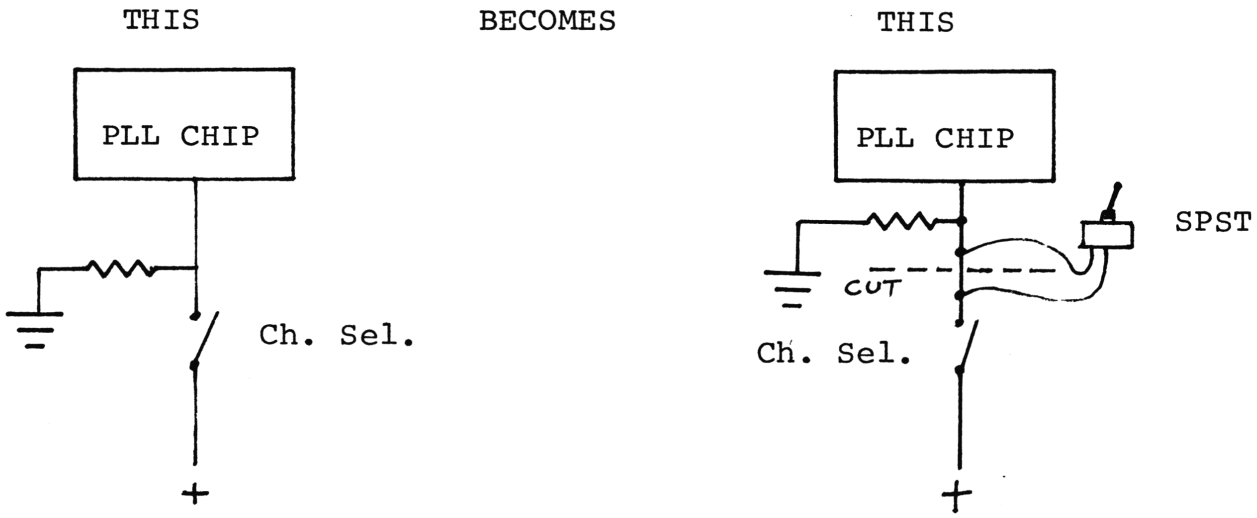

FIG. B2

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BREAKING THAT CHIP Continued:

You may run across one that is configured a little different but the same results are obtained. DO NOT attempt a modification on your own if you do not understand the switching arrangement. Like I alway say, "Its better to pay a good tech than to make it a wreck"! Remember - when a radio which has been "tampered" with is finally brought into a good tech, his rates will automatically double (if he accepts it at all). This also applies to unit brought in partially disassembled or case missing! So be warned. Enough said - If you are still with me, here is rule number 2.

2. Never apply a voltage greater than VCC to any pin! The 858 chip works on 5V, the 02A on 5V, the 8719 on 8 Volts. The point is, different PLL's operate on varying voltages.

3. If you don't know the PLL pinout (Ref. Vol. 11, page 72-77) (used to determine which pins are address pins)then you are just asking for trouble if you blindly jumper around on the chip. DONT'T DO IT unless you've got a pocket full of money to replace all those zapped chips!

Now lets discuss binary coding using positive logic (positive logic simply means a "high" equals VCC, a low equals ground. Conversely, in neg logic, OV or ground would be equal to a "hi", and a "low" would be represented by VCC.) The address pins each have a binary weight and the coding is simply obtained from the channel selector switch to give the right input to the divider. Following is an example using the 02A chip:

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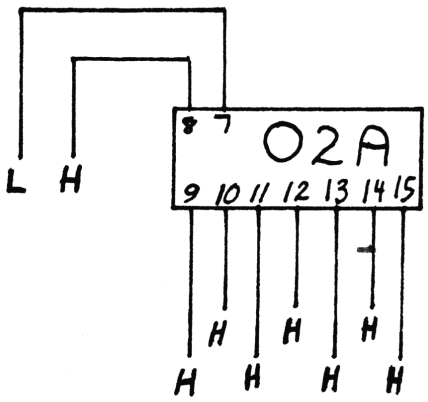

PIN	BINARY WEIGHT
15	1
14	2
13	4
12	8
11	16
10	32
9	64
8	128
7	256

Shown above is the H-L pin status for Ch 1 (26.965). A table showing individual pin status for all possible combinations is called a "TRUTH TABLE".
(Ref: Vol. 11, page 5-7, Vol. 14, page 15-17)

This illustrates that any time a "hi" appears on pins 7-15, that binary weight is added.

So the code for ch. 1 is found by adding all the weights of the "H" pins together: 1 + 2 + 4 + 8 + 16 + 32 + 64 + 128 = 255.

The next channel is ch. 2, 26.975 which has a code of 254. This is obtained by the voltage on pin 15 going low so 1 is no longer added. All other pins are same as ch. 1. (The channel selector accomplished the switching).

NOTE: Different circuits designed may have a different code for ch. 1 even though the same PLL chip is used. The above example is from the most common SSB chassis. This truth table is included in this volume.

A code of 287 = 26.645; a code of 138 = 28.135.

Just because the PLL will program this wide a range doesn't solve all problems. The VCO range must be considered along with RX/TX alignment and widebanding procedures.

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BREAKING THAT CHIP Continued:

This "pure binary system" of coding is used extensively in programing the PLL's programable divider. However, be advised that it is not the only one used. Sometime a modified version called BCD type is used. (Binary Coded Decimal) Some PLL chips have a chip select pin whose status determines if pure binary or BCD form is used. Also, the newer chips to come along, very popular in AM radios, such as TC9106 & 9109, use a ROM (Read Only Memory) built internal to the chip which responds only to valid codes for channels 1-40. All other codes result in shut-down. Then another method must be used to get extra channels, such as Xtal change or forced signal injection -(Zapper 9000 kit).

If you found this discussion interesting and would like to know more, I suggest you get your hands on a book entitled "The PLL Synthesizer Cookbook" by Harold Kinley, published by TAB Books. It is written so anyone can understand.

The programmable divider code determines the ÷ N number which controls the frequency of the VCO. The VCO frequency supplies the frequency to the RX mixer and TX mixer. There are many different designs using offset mixers, no mixers, doubling, etc. but ultimatley determines frequency of operation.