

THE WORLD SCANNER REPORT

A Journal of VHF-UHF Scanner Technology & Engineering

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TECHNOLOGY SPINS OFF FOR YOU!

It's an interesting daydream that if the typical 1942 military monitoring post were equipped comparable to today's typical hobby monitoring post, that WW-II might have been won in half the time! We'll never know for sure but it's an interesting whimsy, huh? We do know however, that today's typical hobby monitoring post is a spinoff of NASA and Viet Nam technology. The results of research & development for space and defense programs continues to filter down to the consumer level. While this may be difficult for the casual hobbyist to fully comprehend, I am pleased to offer you this month a small scale spinoff that can be understood. Let me explain...

As you probably know, my keenest focus in scanners has been on the Realistic PRO-2004/5/6 series. I doubt if this has caused any wholesale problem since over half the readers of the WSR own one of this series. But what about those who don't? That is where the spinoff comes into focus. Two examples come to mind: one, the Generic S-Meter for all scanners & other radios that appeared in V1N7 of the WSR. It was rather easy to adapt an S-meter to the PRO-2004/5/6, but unheard of for other scanners. Almost immediately after Vol-1 of my SCANNER MOD HANDBOOK was published, I was besieged with requests for an S-Meter for other scanners so I set about to learn all there was to know about S-metering. Where there's a will, there's a way and the universal S-Meter was the result. Now there's another spinoff for you this month.

One of the first modifications I performed to my PRO-2004 back in late 1986 was to increase the speed of the SCAN & SEARCH modes with a 10 MHz quartz crystal in place of the stock 7.37 MHz resonator. Fine and dandy, but the DELAY function got shortened by 35% thereby highlighting a need for an Extended Delay function. Mark Persson of New York admirably responded with MOD-29 for Vol-2 of my book. But this left me with a familiar problem: the Extended Delay for the PRO-2004/5/6 didn't work for other scanners, so I burned the midnight oil to develop an alternate Extended Delay. The method that I selected for page 157 in Vol-2 of my book worked well enough, but it was cumbersome and with three chips, was a bit too large for most handheld scanners. On top of that, some readers had problems adapting that circuit to various scanners. *Spinoff time:* I just KNEW there had to be an easier & better method of Extended Delay for scanners other than the PRO-2004/5/6. There was and it's here for you this month. The original MOD-29 method for the PRO-2004/5/6 remains unchanged but for other scanners, we've got one just as easy now! Make two small wiring changes to MOD-29 in my book and you've got an Adjustable Extended Delay (MOD-29b) that will work for most any other scanner in which MOD-29 doesn't work!

FRONT END TRANSISTOR FAILURE IN THE SONY ICF-2010 (And What You Can Do About It!) by Bob Scott, VA

The Sony ICF-2010 is a popular, potent, and low cost shortwave receiver. When used with the supplied whip antenna (or a short indoor wire) it proves to be a reliable performer with little or no maintenance.

Some hobbyists have extended the reception range of the ICF-2010 by connecting outdoor long wire antennas or externally mounted amplified antennas. Although this makes a remarkable improvement in performance, it can also lead to the destruction of a fragile Field Effect Transistor (FET) in the set's radio frequency (RF) front end. This article will show you how to prevent such damage and how to recognize and repair a typical failure.

The Problem

The 2010 uses a 2SK152-1 N-channel FET as a high-gain RF preamplifier for the internal whip antenna. This FET, designated Q-303, boosts the feeble signal from the whip antenna to a proper level for further processing by the mixer & IF amplifier stages. Connection of an external antenna to the "AM" antenna input jack bypasses the FET amplifier. This bypass and lower overall gain prevents overload of the RF front end from very strong signals that can enter from a long wire or dipole antenna.

Even when Q-303 is not used for amplification, it's still in the signal path in an "idle" mode. When an external antenna is connected, Q-303 still "sees" the input; it just doesn't amplify it. Therein lies the problem.

Normally such a sensitive transistor must be shielded from overloads or static buildup by some type of protective circuitry. Q-303 is so protected, but only when it is connected to the internal whip. In that case, back-to-back diodes protect Q-303 from voltage surges above three volts. There is no such safeguard for the external antenna jack.

So, Q-303 will happily self-destruct in the face of high voltages coming in via the external antenna. Typical sources of such hazards are nearby powerful transmitters, close lightning strikes, or static build up in heavy snow storms. (The latter gremlin terminated my Q-303!)

The Solution

The answer to this problem takes two forms: protection and caution. First, exercise caution by disconnecting the external antenna when the radio is not in use. Your radio spends most of its time turned off anyway. Simply

disconnecting the antenna during this time is the most effective protection from static damage. Second, add some electronic protection. The simplest is to duplicate the protection circuitry of the telescoping antenna circuit. Connect two pair of series connected 1N914 or 1N4148 diodes (R/S #276-1620 or 276-1122) in a back-to-back, reverse polarity as shown in Fig-1. Install the circuit across your external antenna terminals. The diodes shunt voltages higher than 1.2v to ground. Normal RF voltages will not be affected. The diodes are tiny and will easily fit in the gray junction box supplied by Sony for connecting an external antenna. Connect the "Antenna" lead of the diodes to the center conductor screw in the connector box and the "Ground" lead to the large metal ground pad below the screw. Use "creative wire bending"; close the box and secure its cover.

Recognizing a Failure

Since Q-303 is bypassed with an external antenna, failure can go unnoticed in the SW bands. The first clue might be a sharp drop in sensitivity on the AM broadcast band, both with and without the external antenna. The ICF-2010 schematic reveals the reason: when Q-303 fails, typically a Source-Drain short, the bias voltage to Q-301, (MW/LW preamp), is shorted to ground. This preamp is used full time, so a malfunction becomes painfully apparent.

If you suspect Q-303 has blown, disconnect any external antenna and tune in an AM broadcast signal. Stations that normally gave a "10" on the S-meter will be at a 4 or 5. Comparison to a known good radio can confirm poor sensitivity throughout the range of the 2010, but the problem will be most apparent in the MW/LW bands. The best test is the voltage check described below. If you aren't comfortable with electronic test equipment, a technician or a knowledgeable friend can do it for you.

Testing Q-303

Checking Q-303's operating voltages is the best bet. Required are an accurate voltmeter (50k-ohms/volt or better; preferably digital) and a Phillips screwdriver.

1. Write down any memory presets you may have programmed. The memory batteries (2 AA cells) needn't be removed but they may get jostled and cause a memory loss.

2. Disconnect external devices (AC adapter, tape deck, etc.); move the 2010 to a comfortable work table.

3. Place the radio face down on a towel, or similar pad, to protect the face plate. Orient the radio with the battery compartment closest to you and the tuning knob to your left. Remove the three "D" cell batteries, if installed. The two "AA" memory batteries can remain.

4. Touch a grounded object to discharge body static. At least touch the metal earphone jack on the radio before proceeding. Avoid static building activities from here on; shuffling feet on carpet, etc.

5. Remove the seven screws securing the case back. Four are plainly visible. Two screws are hidden by the rod antenna, if it is in its stowed position. The last screw is in the battery compartment. An open arrowhead symbol clearly marks each screw location. See Fig-4.

6. Carefully lift away the rear case. There are no wires from the case to the main chassis to get in the way.

7. Behold the wonders of Japanese engineering! Good for us that Q-303 does not reside on the large main analog board, but instead on the smaller Jack Board which is the narrow board to the right of the speaker. See Figs-2 & 4.

8. Use Fig-2 and locate Q-303. Note the meanings of its three terminals: S-Source, D-Drain & G-Gate. Note that only the Gate is labeled with a white "G" on the circuit board. The other two connection pads form a vertical line up from the "G" lead and are enclosed by a printed white box. The middle lead is the Source and the upper one is the Drain. See Fig-3.

9. Connect the AC adapter. Turn on the radio and set it to AM NARROW mode.

10. Connect the negative lead of your voltmeter to a chassis ground of the radio. The brown wire soldered from the metal shield at the top center of the radio to the center of the main PC board is a good spot.

11. Measure each terminal of Q-303 and compare readings with those shown in Table 1. If any are off by more than 10%-20%, you may have a problem. (Measurements of my Q-303 were grossly off after Q-303 had blown).

TABLE 1: Q-303 OPERATING VOLTAGES

Set Mode to: AM Narrow, Sync OFF

	<u>Normal</u>	<u>Yours</u>
Gate:	0.0 volts	_____
Source:	0.2 volts	_____
Drain:	2.9 volts	_____

12. If the voltages are in spec, or if you don't wish to proceed with replacing Q-303 yourself, turn off the radio, disconnect the AC adapter and restore the case.

Replacing Q-303

Fortune shines again. Most of the 2010 uses hard-to-find (and replace) surface mount components. Q-303 is a JFET mounted in a normal through-board style. Replacement is fairly straight forward, as both sides of the jack board are easily accessible. You'll need your favorite solder remover (vacuum or wick), side cutters and a fine-tipped, low wattage soldering pencil. A new transistor may be ordered from your friendly Sony service center as part number 8-729-800-42. If you don't want to wait for the next boat from Tokyo, a common 2N3819 works as well as the Sony part. Radio Shack Catalog #276-2035. Handle

the replacement with care as it is somewhat sensitive to static discharge (if it wasn't, you wouldn't need this article!) To replace the transistor, follow the steps above for disassembly and then proceed as follows:

3. Carefully remove the jack board by tipping up the edge closest to the speaker about one half inch, then slide it to the left until it's free of the mounting posts. No screws secure the board. Be careful of the fine wires connecting the jack board to the loop antenna. They are fragile and easily broken if strained.

14. With a helper supporting the board, desolder and remove Q-303. Note its orientation. You may wish to clip the transistor body free of its leads first, then remove each lead individually. Clean out each lead hole in preparation for mounting the new transistor.

15. If installing the Sony part (or an exact substitute), just orient the transistor in the same way as the original and solder in it. Some generic replacements (such as the Radio Shack 2N3819) may have different lead arrangements so check the data sheet for your specific FET. In my case the 3819 had its gate and source interchanged as compared to the Sony FET. If you are using a non-Sony replacement transistor and have to cross leads to fit it properly, slip a small piece of insulation (from some 22 gauge hook-up wire) over one of them to prevent a short. Remember, the pads for Q-303 are arranged Gate, Source and Drain from the bottom to the top of the jack board. Check your FET and do whatever you must to connect it right!

16. Reinstall the jack board by reversing the procedures in Step 13. Make sure the switches and jacks line up properly in their respective holes. Check the AM ATT and MAIN POWER switches for proper operation.

17. Test out your work by tuning in the AM broadcast station you used earlier. You should see quite a difference on the signal strength meter.

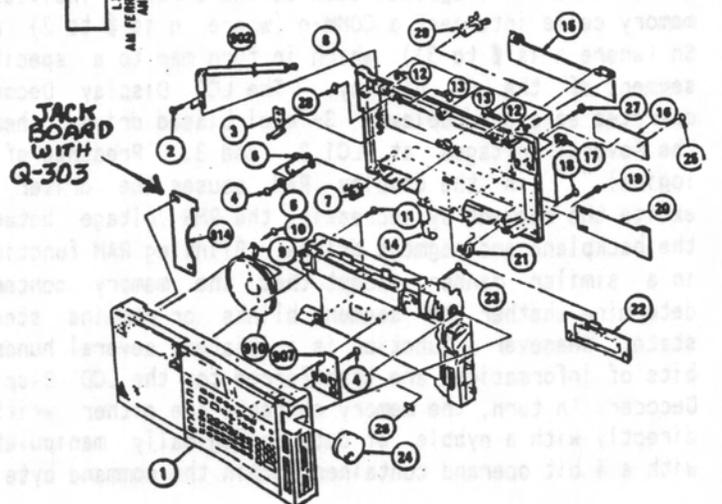
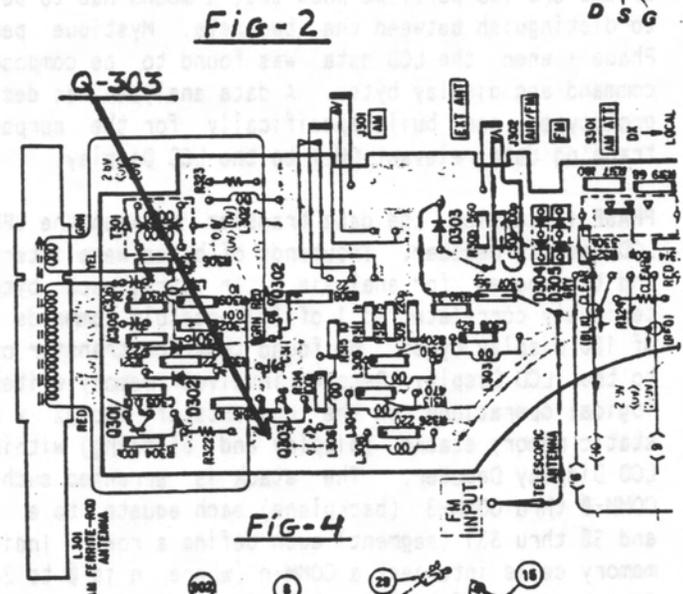
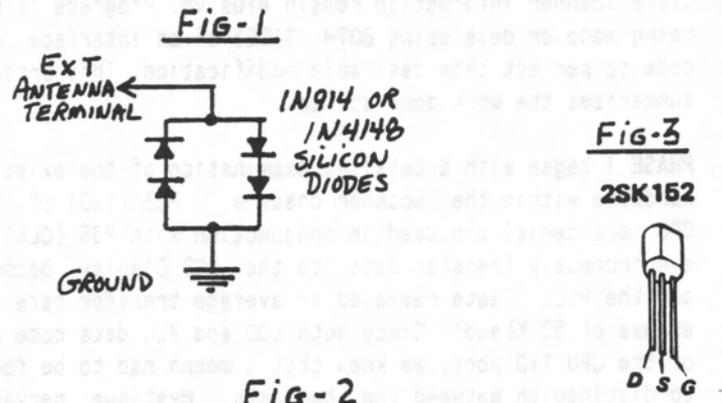
18. Replace the rear case and reinstall the batteries. That's all there is to it. Using the protective measures outlined in this article, my replacement transistor has survived two years of heavy operation. Unless you have your antenna lead tied off to the lightning rod, there's no reason you shouldn't have the same results.

If you're interested in doing any serious hacking of the Sony ICF-2010, the Service Manual is a wealth of great information. It's available from most Sony service centers as part number 9-951-647-11. Price when I purchased mine was about \$20 and it's well worth every penny. Now, anybody for a computer control interface?

difference, try touching an external antenna (or the tip of its connecting plug) to the collapsed whip. You will notice a marked signal strength increase compared to plugging the same antenna into the AM jack.

If your external antenna is relatively long, you may hear several stations at once; the result of RF overload where strong shortwave or medium wave stations appear at the multiple false locations in the SW band and obliterate any weaker signals that lie near them. This is a reason why amplification is intentionally limited at the input for an external antenna.

When using short or improvised antennas with the 2010, try first connecting it to the whip. You'll enjoy a "free" preamplifier. If you notice image problems, switch to the antenna jack. -Bob Scott-



ICF 2010 Portable Operation Tip

There are drawbacks to the automatic switching of the RF JFET preamp; i.e., connection of a short external wire is handicapped by the lack of amplification. To see the

*** * ADVANCE PRODUCT INFORMATION * ***
PRO-2004/5/6 TWO-WAY PC-INTERFACE

B. Bond, Pres.
 HB-Technologies

As you read this issue of the "WSR", HB-Technologies is vigorously pursuing Phase III of a project to fully two-way interface the PRO-2004/5/6 to a PC/clone personal computer. Yes, Phase III implies that previous events have taken place, and these events are detailed below exclusively for the readers of the WSR.

Most of you are aware that the PRO-2004/5/6 lack hardware & software to communicate with a PC. Entrepreneurs have had limited success with keyboard emulator interfaces to program the scanner but methods to retrieve, display and store scanner information remain elusive. Progress is now being made on developing BOTH SIDES of an interface and code to perfect this desirable modification. This article summarizes the work done so far.

PHASE I began with a detailed examination of the existing hardware within the scanner chassis. P35 (TxD) of the CPU is a serial pin used in conjunction with P36 (CLK) to synchronously transfer data to the LCD Display Decoder and the PLL. Tests revealed an average transfer rate in excess of 52 Kbaud! Since both LCD and PLL data come out of the CPU TxD port, we knew that a means had to be found to distinguish between the two data. Mystique pervaded Phase I when the LCD data was found to be composed of command and display bytes. A data analyzer was designed, prototyped, and built specifically for the purpose of trapping data relevant ONLY to the LCD Display.

PHASE II sampled the data transfer between the CPU and LCD Display Decoder. Thousands of bytes were intercepted and transposed for analysis. In turn, each byte was tediously correlated to 1 of 151 possible commands and 1 of 100 display bytes. We found that the transfer of data to the LCD Display Decoder involves memory writes and logical operations on the contents of two 32 x 4 bit static memory stacks (display and blinking) within the LCD Display Decoder. The stack is arranged such that COMM-0 thru COMM-3 (backplane) each equate to a column and S0 thru S31 (segment) each define a row. Individual memory cells intersect a COMM-n (where n is 0 to 3) and Sn (where n is 0 to 31) which in turn map to a specific segment of the LCD display. The LCD Display Decoder operates as a quadruplexed 3-level biased driver, hence the several voltages at VLC1,2, and 3. Presence of a logical "1" in the display RAM causes the driver to excite the segment by increasing the RMS voltage between the backplane and segment drives. Blinking RAM functions in a similar manner except that the memory contents determine whether the segment blinks or remains steady state. Whenever a function is initiated, several hundred bits of information are transferred to the LCD Display Decoder. In turn, the memory contents are either written directly with a nybble of data or logically manipulated with a 4 bit operand contained within the command byte.

Provided the display is static (i.e. manual mode) and the transfer complete, the Decoder performs all housekeeping functions associated with maintaining the display while the serial bus idles.

PHASE III is now underway to design a hardware interface that will buffer and convert relevant synchronous data to asynchronous (UART) for transfer to the serial port of an IBM/compatible PC. Hardware will be included to program or operate the scanner from the PC keyboard. Software is currently in the development stage and will be written to support a bi-directional interface with the PRO-2004/5/6. LCD Display data will be sent along with a log and date-time stamp. Long range projections include S-meter data, event counter versus time, DTMF decoding, etc. The beta release will have a rough core program to boot-up and run, however the source code will be provided for the adventurous programmers who want to carve their mark within the PRO-2004/5/6 user community.

[EDITOR'S NOTE: HB-Technologies is using a PRO-2004 for their developmental model, but fortunately anything done by the PRO-2004 can also be done by the PRO-2005/6. In case you technical types want to follow along closely with the above discussion, I have listed various IC's which were alluded to above. Refer to the below chart and to your Service Manual/schematic to correlate Mr. Bond's discussion with your scanner: /bc]

LOGIC/CPU/DISPLAY CHIPS IN THE PRO-2004/5/6

	PRO-2004	PRO-2005/6
CPU	IC-503	IC-501
LCD Display Decoder	IC-701	IC-504
Random Access Memory	IC-504	IC-505
PLL Data Decoder	IC-301/302	IC-302/303

*** * FEATURE PRESENTATION * ***

**AN EXTENDED DELAY FUNCTION
 FOR MOST ALL SCANNERS**

EUREKA, I have found it! An Extended Delay Function for most any modern scanner! It is just as simple & easy to fabricate as the one for the PRO-2004/5/6, MOD-29, page 156, in Vol-2 of my SCANNER MODIFICATION HANDBOOK. Readers of that book will know from page 157 that the alternate circuit for other scanners calls for a third chip and plenty of extra wiring. Some folks had problems with that design probably because of greater complexity and it certainly wasn't readily installed in a handheld scanner. Well, I didn't see the forest for the trees when Mark Persson submitted the design of MOD-29 for the PRO-2004/5/6 and my way to make it compatible with other scanners was not the best possible, though it does work. Comes now virtually the same circuit as the one for the PRO-2004/5/6 and in fact it is the same with two wiring changes from the diagram on pg-156 in Vol-2 of my book.

The differences are for this new circuit are easily described: refer to page 156 in Vol-2 of my book, and:

At U-1, Pins 3, 4 & 5, remove Pin 5 from 3 & 4. Leave 3 & 4 connected, though. Lift the wire at U-1, Pin 2 and reconnect it to the now empty U-1, Pin 5. Jumper U-1, Pin 1 to the now empty U-1, Pin 2. THAT IS ALL THERE IS TO IT, folks! Why I didn't see it before, I dunno; gross ignorance and sheer stupidity, maybe.

Let me emphasize that the PRO-2004/5/6 and maybe other scanners still require the circuit shown on page 156 of Vol-2 of my book. In cases where THAT circuit won't serve the purpose, first delete the alternate circuit on page 157 and use this month's circuit for most any other scanner. If you prefer a picture to words, relax...the new circuit, MOD-29b, is given for you in Fig-5.

Now two versions of the same basic circuit can offer an Adjustable Extended Delay for virtually all scanners. For the sake of clarity, we'll refer to the version for the PRO-2004/5/6 on page 156 of Vol-2 of my book as MOD-29; the discontinued bulky circuit on page 157 for other scanners will be MOD-29a. Its replacement in this issue is now called MOD-29b.

So why would you want an Extended Delay Function? Think about it from two angles: one obvious need is when the speed of the scanner is boosted with a change of the CPU's Clock Resonator. This resonator sets the timing of all the scanner's functions, not only speed, but also DELAY! Most scanners offer about a 2-sec delay but when the speed is doubled as we seem to favor, DELAY is cut in half. For a PRO-34 boosted from 8 ch/sec to 30, you may as well forget having ANY delay. Reduced or no DELAY can be a major drawback to serious scanning. Another point of view involves unmodified stock scanners. With a mfgr-provided DELAY function, you're limited to what's there with hardly any control except maybe an ON/OFF feature. Right off, I don't know of any stock scanners that offer an adjustable DELAY function. But WHY should we be stuck with the mfgr's meager handouts? There are times when less than 2-seconds DELAY is good and other times when 5 or 10 seconds is better. Why not an Adjustable Extended Delay? It can be done to most any scanner!

How Scanner Delay Works

The CPU of a scanner usually controls the DELAY function, and there's not a heck of a lot of influence we can exert on the little bugger. Fortunately, there has to be some form of logic to tell the scanner when and when not to run the DELAY function. That logic is similar in all modern scanners and its source is the infamous NFM/AM chip that we've discussed in several back issues so far (V1N4, V1N7 & V1N8). You will recall that one of four or five chips, all pretty much the same, is used in most every scanner now. The NFM/AM chip has many functions, two of which are to generate SQUELCH signals, one for the receiver's audio section to silence static when nothing is received and the other for the CPU. It's that special SQUELCH signal for the CPU that captivates our interest. This signal tells the CPU when it should SCAN or SEARCH and when it should stop or lock up. It also activates

the stock DELAY function when selected. This is done as a transmitter unkeys and the SQUELCH resets. The "reset" action starts the CPU's DELAY countdown timer. Since we're dealing with a timed function, any SCAN & SEARCH speedups will decrease the scanner's stock DELAY time.

This logical SQUELCH signal has two states, ON and OFF, usually 0 (low) and 5 or 8 volts (high). The SQ-Logic signal originates in the NFM/AM chip and can be low (0-v) when the SQUELCH is Set and 5 or 8 volts when the SQUELCH Breaks; or vice-versa. This low/high logic is recognized by the CPU's internal programming which enables it to make "decisions" on when to resume SCAN or SEARCH and when to initiate and timeout the DELAY function. Simple. The only difficult part is that some NFM/AM chips generate a low/high logic for SQ-Set and SQ-Break, where other chips are high/low for SQ-Set and SQ-Break. To make your job a little easier, Table 2 will identify for various scanners the NFM/AM chip; the associated SQ-Logic Pin #, and the type of logic. Depending on that logic, you'll select either MOD-29 or MOD-29b for your scanner.

MOD-29 was originally developed exclusively for the PRO-2004/5/6, where the SQ-Logic out of the NFM/AM chip is low-SQ-Set and high-SQ-Break but that logic is inverted to opposite logic before going to the CPU. In other words, the PRO-2004/5/6's CPU interprets a 0-v low SQ signal to mean SQUELCH-Break and a 5v high signal as SQUELCH-Set. Yet, the NFM/AM chip in the PRO-2004/5/6 works just the opposite but its logic is inverted by IC-3 before being sent to the CPU. This means that either Extended Delay circuit can be used in the PRO-2004/5/6, but since the easiest access point for installation of the Extended Delay Board is between the CPU and the Inverter, IC-3, we have to use MOD-29 at that point. You could use my new MOD-29b if installed between the NFM/AM chip and IC-3 but there's no sense in that because access to that area is limited. THIS IS A CLUE, however, for "brand-x" scanners, some of which may also have inverters in the SQ-Logic line. You may have a choice of either circuit and where to install it. Keep this in mind later.

How To Extend A Scanner's Delay Function

Easy! Remember that the NFM/AM chip generates the SQ-Logic signal, so if we intercept that signal along the way to the CPU and delay or postpone its change of state when SQ resets, the CPU cannot initiate resumption of SCAN or SEARCH until it senses the logic change. We can't do much about how the NFM/AM chip generates the SQ-Logic but we can intercept that SQ-Logic and process it to generate an artificial delay. Now it's a matter of the proper circuit and where to intercept the SQ-Logic.

Where To Insert An Extended Delay And Which One?

First, let's identify the NFM/AM chips and their SQ-Logic pins for a number of scanners so you will know what to look for and which circuits to examine and may the Cosmic Light help you if you don't have a Service Manual for your scanner.....because I sure won't!

TABLE 2: NFM/AM CHIPS & SQUELCH LOGIC OUTPUT PINS FOR VARIOUS SCANNERS

SCANNER	NFM/AM CHIP Ckt SYM	NFM/AM CHIP TYPE	SQUELCH LOGIC Pin #	LOGIC TYPE S/B*
PRO-2006	IC-2	TK-10420	13	0/8
PRO-2005	IC-2	TK-10420	13	0/8
PRO-2004	IC-2	TK-10420	13	0/8
PRO-2003	IC-104	MC-3357P	13	0/8
PRO-2002	IC-101	MC-3357P	13	0/6
PRO-2024	IC-2	MC-3361N	13	0/5
PRO-2022	IC-1	MC-3361N	13	0/5
PRO-2021	IC-2	TK-10420	13	0/5
PRO-2020	IC-101	MC-3357P	13	5/0
PRO-2011	IC-1	TK-10420	13	0/5
PRO-37	IC-101	TK-10420	13	0/5
PRO-35	IC-401	TK-10421M-2	16	5/0
PRO-34	IC-101	TK-10420	13	0/5
PRO-32	IC-101	TK-10420	13	0/5
PRO-31	IC-1	TK-10420	13	0/5
AR-800	IC-200	MC-3361N	13	?/?
AR-900	IC-201	MC-3361N	13	?/?
AR-950	IC-201	MC-3361N	13	?/?
AR-1000	IC-4	TA-7787AF	7 ??	?/?
AR-2002	IC-4	MC-3357P	14	?/?
BC-100XL	IC-1	MC-3359P	15	?/?
BC-100XLT	IC-401	TK-10421M-2	16	5/0
BC-200/205	IC-401	TK-10421M-2	16	5/0
BC-250	IC-3	?	13	?/?
BC-400/560	IC-1	NJM-3359D-A	15	5/0
BC-760/950	IC-2	NJM-3359D-A	15	5/0
BC-800XLT	IC-1	MC-3359P	15	?/?
BC-855XLT	IC-401	TK-10421M-2	16	5/0
TurboScan 2	U-201	3130-6056-502	14 ?	8/0 ?
HX-1000	U-201	TK-10420	13	?/?
MX-7000	IC-4	MC-3357P	13	?/?
MX-5000	IC-4	MC-3357P	13	?/?
SR-15	IC-1	TK-10421D-2	13	5/0
R-1600	IC-2	NJM-3359D-A	15	5/0
R-4030	IC-401	TK-10421M-2	16	5/0

? = Unknown or not sure
 *S/B = SQ-Set/SQ-Break (volts)

Using the above information for YOUR scanner, start at the NFM/AM chip and its SQ-Logic pin, (in some scanners, this is called the SCAN CONTROL function), and trace the line to the CPU (if that's where it goes; some don't). As you follow the trace, you will probably run into a couple of resistors and capacitors along the way and maybe a branch (Y) or two, but stay on the main trace to the CPU and identify that pin of the CPU as the SQUELCH or SCAN CONTROL input. Once you're familiar with the circuit, go back to the NFM/AM chip's SQ-Logic pin and again work forward to the FIRST place where you can intercept that SQ-Logic path. Such a spot might be a resistor, or perhaps an exposed circuit trace or, if you're lucky, a handy wire. This spot may be cut later and the Extended Delay Board connected between the cuts.

First, measure the voltage of the logic levels at that point. Rotate the SQUELCH back & forth to make it Set and Break. If the low logic is between 0 - 1.7v and if the high state is 4.2 - 5.5v, then one of my two Extended Delay circuits will work. Now let's determine which one:

Again, measure the logic voltages at the chosen intercept spot. If Squelch is SET (silence) and the spot measures between 0 and 1.7-v, and if when the Squelch breaks (noise), the spot measures between 4.2v and 5.5v, then you'll need the circuit in this issue, MOD-29b. If measurements at your chosen intercept are high (4.2-5.5v) for SQ-Set and low (0-1.7v) for SQ-Break, then you'll need MOD-29, page 156 in Vol-2 of my SCANNER MODIFICATION HANDBOOK. I'm giving you this method of deciding because your scanner may have a logic inverter between the NFM/AM chip and the CPU like the PRO-2004/5/6. The specific circuit of choice will be dependent on the logic of the intercept spot you selected. It is impossible for me to give explicit directions for all scanners because of the variables discussed above. But if I teach you how to determine for yourself....then mission accomplished!

Find a good spot to intercept the SQ-Logic signal, but before you cut that path, make sure it's between the NFM/AM chip and any branches or Y's. After cutting the path, the broken lead closest to the NFM/AM chip will be the SQ-INPUT lead to the new Extended Delay Board. The other broken lead will tie to the SQ-OUT and continue on to the CPU or where ever it is supposed to go from there.

If all circuit tracing fails to disclose a prime location to connect the EDB, you can always snip the SQ-Logic pin of the NFM/AM chip and install the EDB between the cuts. The main caution here is that the logic voltage must be 0-1.7v, low and 4.2-5.5v, high. See IMPORTANT NOTE below.

IMPORTANT NOTE: there are caveats. MODs 29 and 29b are designed for scanners where the CPU operates on +5 volts and/or where the SQ-Logic is near 0 and 5 volt levels. You should determine the operating voltage of the CPU first before installing the EDB because if the CPU runs on +8 volts, you'll have to substitute U-1 and U-2 of the EDB with 8v equivalents, probably the CMOS 4000 series. I haven't done the research for this contingency so make sure first. All scanner CPUs of which I am aware operate from +5v but don't take that to the bank.

Next you must measure the actual SQ-Logic voltage at the selected intercept point for the EDB. If it's more than 5.5v, you will either have to make a voltage divider/reducer to drop that higher voltage down to +5 volts or else find a place on the SQ-Logic line that has 5-volt logic. I mention this because U-1 & U-2 of my EDBs are rated at a max 5.5v input/output and DC power. Also, NFM/AM chips in the PRO-2004/5/6 and some other base scanners happen to run from +8v which results in SQ-Logic of about 0 and 8-v. Most scanners of this type will have a voltage divider/reducer for the CPU somewhere near the NFM/AM chip anyway, so maybe you can break the trace after the voltage reduction point.

It is essential, however, that the EDB be inserted in the SQ-Logic trace at a point between the NFM/AM chip and the first branch or "Y". Squelch Logic sometimes has to branch off to serve the needs of other circuits, too, so the EDB must serve any branch paths in addition to the CPU. If the SQ-Logic at the EDB insertion point is greater than 5.5 volts, it will have to be reduced before going into the EDB. This means then, that 5 volts will exit the EDB which then could be too low for the circuit ahead, so you'll have to look for the voltage divider/reducer down the line and clip it out of circuit since the EDB's 5-v will be just right for those circuits without further reduction. The very best thing you can do where the SQ-Logic exceeds 5.5 volts is to trace that circuit down and install the correct type of EDB at a point after where the SQ-Logic is reduced to 5-volts.

About The MOD-29b Extended Delay Circuit

Here's how MOD-29b works; first let's assume the Extended Delay is OFF so that you either have no delay at all or only the scanner's stock delay; in other words, NORMAL. When S-1 of the EDB is open (off), a high (+5v) is on pins 12 & 13 of U-1; the output of which is inverted to a low (0-v) at Pin 11. This low is sent to U-2, Pin 3 which deactivates U-2 and creates a high (+5v) at U-2, Pin 4 which sends that high back to U-1, Pin 5. Assuming that the SQUELCH is set, a low is coupled out of the NFM/AM chip into Pins 9, 10, 1 & 2 of U-1. Since U-2 is inactive, the effect at Pins 9 & 10 is not pertinent. A low on Pins 1 & 2, however, is inverted to a high at U-1 Pin 3 and then to Pin 4 of U-1 where a high already exists at Pin 5. Highs at Pins 4 & 5 are inverted to a low at Pin 6 which is then sent on to the CPU. Therefore low-in equals low-out just as it should.

Now let's assume that the scanner's SQUELCH breaks with an incoming signal. A SQ-Logic high is coupled into Pins 9, 10, 1 & 2 of U-1, and as before, since U-2 is deselected, Pins 9 & 10 are of no consequence. The high at Pins 1 & 2 is inverted to a low at Pin 3 of U-1 and sent to Pin 4. A "permanent" high is on Pin 5 and with a low on pin 4, the output of Pin 6 goes high, again as it should. When the scanner's SQUELCH resets, the SQ-OUT and the SQ-IN will always follow each other providing normal SQUELCH and stock DELAY functions.

Now close S-1 to activate the Extended Delay function. This comes about by a low placed on U-1, Pins 12 & 13 which inverts to a high at Pin 11 and is sent to U-2, Pin 3 to activate U-2. If the SQUELCH is set, the SQ-In and SQ-Out will be low as normal. Now, when SQUELCH breaks and SQ-In goes high, the normal sequence as discussed above happens again, except that the high on Pins 9 & 10 of U-1 is inverted to a low at U-1, Pin 8 where that low goes to U-2, Pin 1 to prepare U-2 for action. Nothing else happens until the SQUELCH resets and SQ-In goes low. At the instant that SQ-In goes low and which otherwise would be sent on to the CPU as normal, a very interesting effect is generated by U-2, a Retriggerable Monostable Multivibrator. U-2, Pin 4 which is normally high, drops

low for a time that is determined by the values of C-1 and VR-1. C-1 is fixed, but VR-1 is the DELAY adjustment! That low from U-2 Pin 4 is sent to U-1 Pin 5 which, regardless of the value at Pin 4, makes Pin 6 remain HIGH even though SQ-In has gone low again! Pin 6 remains high until the time set by VR-1 (0-12 sec) expires, at which instant U-2 Pin 4 goes high again. In turn, this causes U-1 Pin 6 go low to emulate SQUELCH reset, albeit DELAYED! It's this elaborate process that artificially creates a delayed SQUELCH Reset to the CPU, and in turn delays the activation of the SCAN/SEARCH Resume function.

Another thing worth mention here is that the scanner's stock/normal DELAY function will not be initiated until the Extended Delay period has expired. Therefore, you get two delays in series. If the Extended Delay is set for 4-sec and the scanner's stock DELAY is 2-sec, then you'll have a total 6-sec delay if the normal DELAY is set; if not, then 4-sec. This offers a 2-stage DELAY; you can preset the stock DELAY function for some channels and not for others which will have the effect of two different delay times, depending, or set all DELAYS off!

Building, Installing & Operating the Extended Delay

Build the circuit on as small of a piece of perf-board as possible, consistent with the space available in your scanner. Don't get too luxurious in use of space because you'll want to install other mods later. If a handheld scanner, you're going to have to carefully measure any nooks and crannies and build the Extended Delay Board (EDB) to suit what's available. This could mean that you'll have to build U-1 on one tiny board and U-2 on another with a wiring harness between them to make things fit! That's ok because layout and construction are not critical. Just use very small and flexible hookup wires. Install the switch and LED (if you want it) in a suitable place on the exterior. VR-1 can be an ordinary volume-control type of potentiometer if you have the luxury of mounting room; otherwise, a tiny trimmer potentiometer can be rigidly mounted behind a hole drilled in the case for access with a small screwdriver. Once you determine a preference for an Extended Delay Time (mine is 4-sec), it won't be adjusted all that often, but it will be nice to have the trimmer handy for when readjustment is desired. I like the trimpot mounted behind a hole in the case for occasional screwdriver adjustments. The right kind of trimpot can be superglued to the inside of the case for a convenient fit. Some trimpots can't be done that way so beware; plan things out first.

There are three operable parts of the Extended Delay: the LED for indicating whether it is On or Off; the switch to turn the Extended Delay On or Off; and VR-1 by which to preset the desired amount of Extended Delay, 0-12 sec. The Extended Delay draws about 2-ma OFF and about 5-ma ON, so current drain is not a major consideration.

PROBLEMS & DEBUGGING will be minimal or zilch if you build the circuit properly and correctly install it in the scanner's Squelch-Logic line. If you've done every-

thing perfectly, certain peculiarities might still arise. For example, you've done the job and the scanner works fine and the Extended Delay work but...during the period of the Delay, you may hear a static sound that sounds like the receiver isn't SQUELCHed. If you get this far and this is the only problem, relax; you did everything right and there's no fault with the scanner or EDB. You will just have a little more work to do to remedy THAT difficulty. Understanding things is the first step.

Two SQUELCH-like functions are generated by the NFM/AM chip, one of which we've been working with above. The other is called MUTE and is mostly an internal function. MUTE is what performs the silencing of the receiver when no signals come in. SQUELCH initiates the MUTE function and sometimes does other things, too. Typically the scanner's CPU generates a MUTE signal based upon a SQ-Set signal. During the period of the Extended Delay there is no SQ-Set logic to the CPU so it "thinks" the scanner should be UNMUTED and playing sound. The typical MUTE signal from a CPU is 0v for MUTE and 5v for UNMUTE. The 0-v MUTE signal is usually applied to the vicinity of the scanner's Volume Control which has the effect of shorting out any undesired static and audio. This MUTE signal is what silences the receiver. You can experiment with using one of the signals from the EDB to serve as a MUTE function during the period of the Extended Delay. The signal at U-2 Pin 4 is normally high at 5v except during the period of the Extended Delay where it drops to 0v. U-2 Pin 13 (unused) provides an opposite logic to Pin 4; it is normally low but rises to a high for the period of the Extended Delay. Depending on what kind of MUTE logic is used by your scanner, one of these two signals can be pressed into service to MUTE the annoying static during the Extended Delay period. I can't offer much more help on this because every scanner is different and different techniques will be required for each scanner. But you can get started with assessing and understanding the scanner's MUTE function and associated circuits. Just remember, if you need my assistance, it will be gladly given PROVIDED that you and I have a copy of the Service Manual for your scanner. We can't work without it.

TEST your Extended Delay Circuit before installing it in general accordance with instructions given in Vol-2, page 162. Use the logic (low/high) for the EDB that you built.

*** * * PRESS RELEASE * * ***
NEW SCANNER FREQUENCY RECORDS TOOL

DataFile, Inc. has announced the release of ProScan, Version 1.0, a powerful, yet easy to use MS/PC-DOS program designed for the scanner enthusiast desiring to track frequencies and their users.

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ProScan requires IBM or compatible, MS/PC-DOS version 2.0 or higher, 640k RAM, hard disk and works with IBM, Epson and compatible printers. ProScan comes complete with printed documentation. The regular price for ProScan is \$59.95. Until March 1st, 1992, ProScan is being offered for a special introductory price of \$39.95 (add \$3.50 for shipping in the US). To order ProScan, send check or money order to DataFile, Inc, PO Box 20111, St. Louis, MO 63123. Please specify 5-1/4" or 3-1/2" disk. (Missouri residents add \$2.29 sales tax). IBM, PC-DOS & Epson are trademarks of their respective owners.

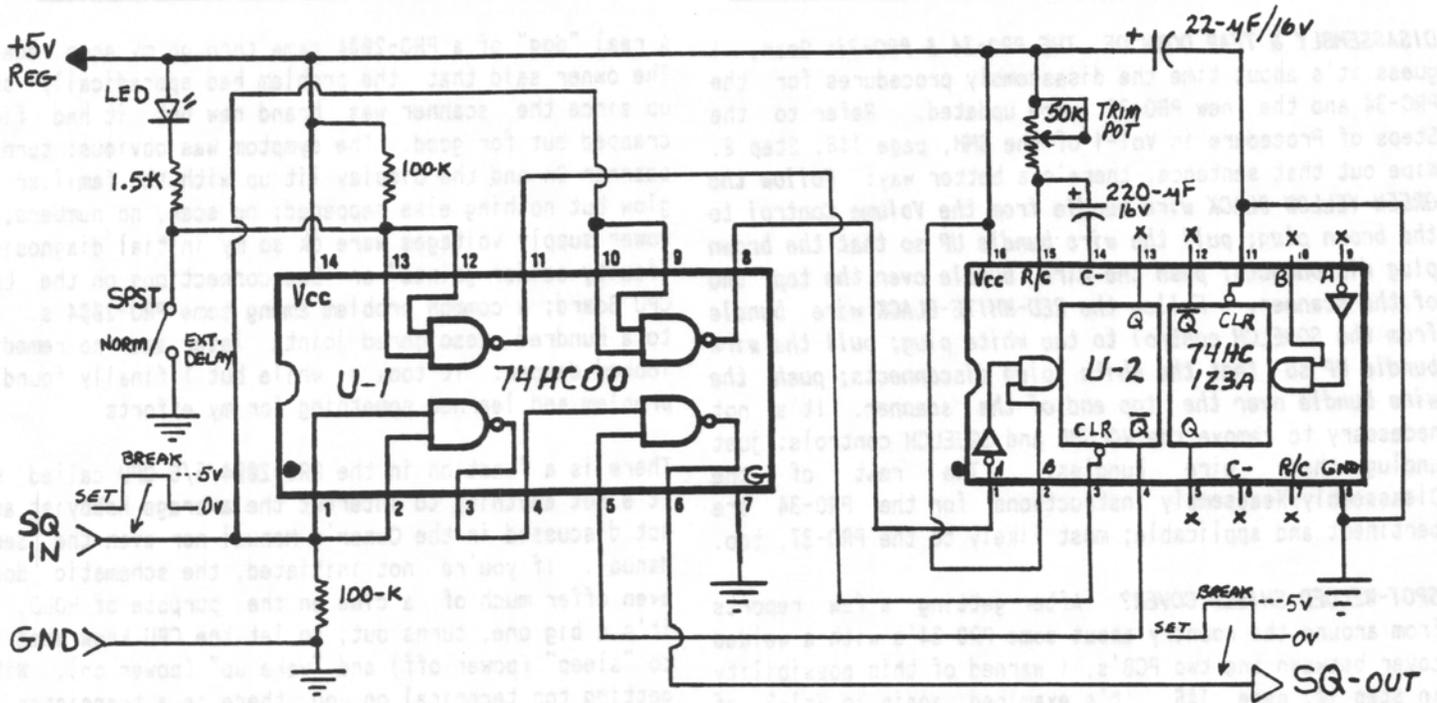
BC-100XLT MEMORY EXPANSION UPDATE

A procedure is in V1N6 to liberate 100 more channels from the BC-100XLT. Close, but no cigar. I was on the right track but didn't go far enough. More work is required. Also needed are a small memory chip, switching transistor & 4 resistors. The circuit board for the BC-100XLT is the same as the one in the BC-200XLT, so the work left to be done isn't extensive. Vacant solder pads are on the BC-100XLT board for the parts. Order the parts from Uniden because the transistor and memory chip will be hard to find. Call UNIDEN PARTS DEPT; 9900 WEST POINT DR; INDIANAPOLIS, IN 46250; (800) 428-5340 or (317) 842-1036 and order repair parts for the BC-200XLT as follows:

<u>Component</u>	<u>Ckt Symbol</u>	<u>Part Number</u>
Service Manual for the BC-200XLT		
Memory IC	IC-206	CXK1013P
Transistor	Q-208	2SD1777C1
Resistor	R-219	22-k ohms
Resistor	R-222	10-ohms
Resistor	R-250	RZ021 <Unknown resistance values
Resistor	R-252	RZ021 <of R-250, 252 & 253. Not <specified in Serv. Manual

Use the BC-200XLT Service Manual to identify the locations where the above parts belong and install them in your BC-100XLT accordingly. The step that I gave you back in V1N6 is correct: **remove & discard R-253; in its place solder one end of a 47-k 1/4-watt resistor to the original pad for R-253 that's closest to the CPU. Solder the other end of the resistor to a nearby ground spot.** Install the above components in their proper locations according to the BC-200XLT Service Manual, page 39. In the process, remove & discard D-204 that's in the s where R-222 goes. This will complete the steps to gain 100 more channels for your BC-100XLT. Sorry for any inconvenience this slip may have caused. PS: Forget adding 800 MHz to the BC-100XLT; just buy a BC-200XLT!

FIGURE 5: EXTENDED DELAY FOR MOST SCANNERS EXCEPT PRO-2004/5/6 (MOD-29b)

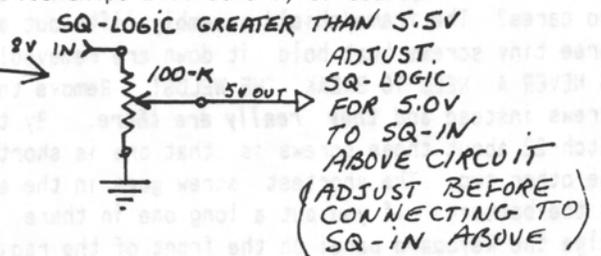


NOTES

A. This circuit for scanners with Squelch Logic that is low for SQ-Set and high for SQ-Break and where low is less than 1.7v and high is not greater than 5.5v. See Note B if your Squelch Logic is 0 to 8v.

B. Use 100-k trimmer voltage divider/reducer if Squelch Logic exceeds 5.5v. Set trimmer so that middle lug of trimmer equals 5.0v when SQ-High is present at top lug. SEE TEXT. If 5v EDB output doesn't work because circuit down line needs 8v, look for a voltage reducer/divider and remove it.

C. Where SQ-Logic is 0 & 8v, you might consider using a 4011 Quad NAND and a 4538 Multivibrator. Pinouts of these two chips differ from above so the circuit will have to be changed accordingly. Just correlate each function shown above with the new chips. Vcc for 4000-series chips will be 8-v, of course.



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DISASSEMBLY & TEAR DOWN OF THE PRO-34 & PRO-37: Gosh, I guess it's about time the disassembly procedures for the PRO-34 and the new PRO-37 were updated. Refer to the Steps of Procedure in Vol-1 of the SMH, page 146, Step 8. Wipe out that sentence; there's a better way: *Follow the GREEN-YELLOW-BLACK wire bundle from the Volume Control to the brown plug; pull the wire bundle UP so that the brown plug disconnects; push the wire bundle over the top end of the scanner. Follow the RED-WHITE-BLACK wire bundle from the SQUELCH control to the white plug; pull the wire bundle UP so that the white plug disconnects; push the wire bundle over the top end of the scanner.* It's not necessary to remove the VOLUME and SQUELCH controls; just unplug their wire bundles! The rest of the Disassembly/Reassembly instructions for the PRO-34 are pertinent and applicable; most likely to the PRO-37, too.

SPOT-WELDED SHIELD COVER? After getting a few reports from around the country about some PRO-34's with a welded cover between the two PCB's, I warned of this possibility in Step 10, page 146. It's examined again in Vol-2 of the SMH, HINT-3 pg 16 by a well-meaning hobbyist who figured out how to "break the welds" on that shield cover, actually a metal frame! Unfortunately for HIM, the metal frame between the two PCB's is always held in place by three tiny screws, one each in the upper corners of the frame and one in the middle by the battery. I guess lots of people didn't look close because sure enough, the flat shield is spotwelded to the sides of the frame. But who cares? The frame/shield assembly lifts out after the three tiny screws that hold it down are removed! **THERE IS NEVER A NEED TO BREAK THE WELDS!** Remove the three screws instead and *they really are there.* By the way, Catch-22 about those screws is that one is shorter than the other two. The shortest screw goes in the end hole by the battery. If you put a long one in there, it will bulge the keyboard panel on the front of the radio.

A real "dog" of a PRO-2004 came through my shop recently. The owner said that the problem had sporadically showed up since the scanner was brand new but it had finally crapped out for good. The symptom was obvious: turn scanner On and the Display lit up with the familiar blue glow but nothing else happened; no scan, no numbers, etc. Power supply voltages were ok so my initial diagnosis was "faulty solder joints" or bad connections on the Logic/CPU Board; a common problem among some PRO-2004's. Fifty to a hundred resoldered joints later and no remedy, I looked deeper. It took a while but I finally found the problem and learned something for my efforts.

There is a function in the PRO-2004/5/6 CPU called HOLD. It's not anything to interest the average hobbyist and is not discussed in the Owner's Manual nor even the Service Manual. If you're not initiated, the schematic doesn't even offer much of a clue on the purpose of HOLD. But it's a big one, turns out; to let the CPU know when to go to "sleep" (power off) and "wake up" (power on). Without getting too technical on you, there is a transistor that senses when the Memory Retention Battery is active and which can happen ONLY when power is OFF. When the scanner is ON, the transistor sends a low (0-v) to the CPU and makes it's current draining memory circuits "wake up". A high (5-v) tells the CPU when the scanner is OFF, so that it can shut down current drain and go to "sleep". This is why the Memory Battery lasts for months; only a few microamps are required to keep memory fresh and ready for action when the scanner is turned on.

In the above problem, I found this transistor to be blown out for no apparent reason. Replacement with a common NPN 2N3904 restored the scanner to proper operation. It's Q-30 in the PRO-2004, and Q-29 in the PRO-2005/6.

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