

The WORLD SCANNER REPORT

A Journal of VHF-UHF Scanner Technology & Engineering

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CONCLUDING OUR 2nd YEAR!

Hard to believe, but this is the 20th issue since V1N1 rolled off the press in January, 1991! Its feature article was on **Subsidiary Carrier Authorization (SCA)** for the PRO-2004/5/6 and other receivers with WFM-mode and the 88-108 MHz band. Indeed, there are very interesting signals hidden in the FM Broadcast Band and we presented the theory of SCA and a method by which to extract that programming that you're forbidden by law to monitor without permission from the Broadcasters! Nothing much has changed since then, except that there's probably more SCA programming on the air now than ever. If your interest is up, see the first issue of the *WSR* for the gory details of a kit that can be built and installed in your PRO-2004/5/6 and other WFM receivers to detect SCA signals. You can purchase this kit from:

FM ATLAS (Bruce Elving)
PO BOX 336; ESKO, MN 55733 (218) 879-7676

Bruce Elving regularly publishes and frequently updates a directory of the FM Broadcast stations of the US, Canada and parts of Mexico. The **FM Atlas** is very detailed, with local maps and triple cross-indexing by station call letters; frequency and city. Information about specific station programming, including SCA subcarriers is also included in the **FM Atlas**; a handy reference for the complet monitoring shack. Elving also publishes a periodical newsletter, the **FMedia**, which lists expired, new & changed FM license data with regular articles on the FM market and broadcast technology.

TIME TO RENEW NOW !

Check your mail label now! If there is a florescent pink slash across the EXPIRE DATE on the label, then this will be the last issue you will receive unless you renew! In keeping with tradition established last year, we will be glad to send you one more issue if budgetary constraints prevent your renewal before the January, 1992, issue. You only need write a note of explanation and we'll extend your subscription for a month. We understand how the coming Holidays can drain the ol' budget.

U.S. ANTI-SCANNER LAW PASSED!

Another Freedom is gone!. Not only since 1986 have we been forbidden to monitor cellular telephone conversations, but NOW, also forbidden will be scanners and other radios which are capable of receiving the cellular telephone bands! Furthermore, and to add insult to injury, radios that can be "**easily modified**" to receive cellular frequencies will also be forbidden by law! I think this law is to take effect six months after the President signs the bill, which he is not expected to oppose.

Go figure, then, that by July, 1993, you may not be able to legally purchase a new PRO-2006, BC-760XLT, PRO-2022, PRO-2026, BC-800XLT, BC-855XLT. This might also include the BC-200XLT and PRO-43, depending on what is meant by "**easily modified**". Without question, an entire market array of other radios may become illegal, almost overnight, to include the ICOM R-9000, R-7100, R-7000, R-100 and R-1; not to mention ICOM's line of amateur radios with wideband receivers! Also to vanish into oblivion will be the Kenwood RZ-1, Yaesu FRG-9600 and their lines of amateur radios with wide-band receivers! ACE Communications may as well go out of business since most of their scanners are in that law's bullseye.

This law will accomplish little to deter the arts and sciences of monitoring the cellular bands! Consider that most 800 MHz scanners, even if not equipped with the cellular bands, will STILL be capable of receiving cellular signals by "**image frequencies**". Say you have an unmodified PRO-37 and want to listen to 880.000 MHz. No sweat: Perfectly readable image frequencies of 880 MHz exist at $F \pm (2)(I.F.)$ where **I.F.** is the receiver's intermediate frequency and **F** is the frequency of interest.. The PRO-37's is 10.7 MHz. So, let's figure:

Image 1 = $880.000 \text{ MHz} + (2)(10.7 \text{ MHz})$
= $880.000 \text{ MHz} + 21.4 \text{ MHz}$
= **901.400 MHz**, and

Image 2 = $880.000 \text{ MHz} - (2)(10.7 \text{ MHz})$
= $880.000 \text{ MHz} - 21.4 \text{ MHz}$
= **858.600 MHz**

Take your choice: either of the above two images of 880 MHz are readily detectable by the PRO-37 (and most other 800 MHz scanners). The PRO-43 and the PRO-2004/5/6 scanners will not detect image frequencies by virtue of advanced design with *triple conversion* IF's. The PRO-37 and most other scanners sport only *dual conversion* IF's. Therefore, the legislative intent of Congress, in it's infinite wisdom, will be easily defeated by inferior technology! But this loophole doesn't stop there! A television receiver with a Ch-14-83 UHF Tuner will readily detect cellular telephone signals! So, this new law will serve mostly to limit the resources and technology available to consumer/hobbyists. Might there be a connection between this new law and the fact that most people in Congress have cellular telephones? Is there a connection of this law between the Cellular Industry's high-financed lobby and hobbyists' lack of one?

Like it's forerunner, the Electronic Communications Privacy Act of 1986, this new law is founded upon gross ignorance and sheer stupidity. It's based upon a premise not much different than making it illegal to eavesdrop on nearby, spoken conversations; like maybe that from an adjacent table in a restaurant! The RF spectrum differs little from the audio spectrum (they're both just there) and yet, we're denied the right to monitor portions of it and the technology to do so is to be crippled with legislation. Oh, and it doesn't stop there.

I hear that the FBI is seeking the authority and power to cripple the nation's telephone networks and to invade the privacy of the nation's telephone communications with legislation for and against certain technologies and for a capability to interconnect to the telephone networks right out of their offices!! Apparently, the FBI wants to be able to connect into the telephone trunks with their computers and monitoring equipment anytime they want without the assistance or knowledge of the telephone companies! They allegedly *claim* they'll still get a Court Warrant before doing any actual monitoring! Ha! Now think: for if this is to be, then telephone technologies *have to be legislated* or dictated to keep them nailed down to standards that can be monitored by the FBI. Kind of like a mandate for a national language so that government eavesdroppers can understand everything that's said. The FCC has long mandated "plain language" and standard electronic signals for the various radio services so that they can monitor the sum and substance of communications. The FBI wants to do much the same thing with the nation's telephone networks.

Given the new anti-scanner law, the ECPA of 1986 and the FBI's efforts to weasel into the telephone system, I have to conclude there are ample grounds for concern! Seems the government wants to eavesdrop more and make sure Citizens do it less. To borrow a slogan: *"When guns are outlawed, only outlaws will have guns."*

I don't see a hell of a lot we can do about these goings-on other than to stock up on all the PRO-2004/5/6's that your budget, car and shack can handle. I don't like to editorialize on this business, either, because several years ago, the FCC shut down another newsletter that I published. The *WSR* is more fun than the old one and less controversial, and it would be nice to keep it that way. But I thought you might like to know what's coming down. Times are a'changin', folks.

THE READERS WRITE...

From J.G., Denver, CO: Dear Doc: Enclosed is my subscription renewal. \$25 is a bargain, considering you saved me that much by publishing *Marymac's* low price on the PRO-43. By the way, *Marymac* quoted me \$169.95 for the new PRO-2026. Where else can you get 800 MHz and 100 channels at such a price? At the local hamfest in a year or two...used, maybe.

I would like to see you share this letter with the readers of the *WORLD SCANNER REPORT*, lest we techno-junkies get too involved in computers at the expense of exploring more basic, but equally powerful ways to use our scanning equipment.

Those readers who have a PRO-2004/5/6, but lack in the computer department (or, like me, can't hijack the family computer whenever it suits me), may be interested in a little trick I've learned. With the *PS-90 Search & Store Module* from Key Research Co, and a tape recorder, it is easy to log new frequencies without having to go the route of a computer interface. The best part is you don't even have to be in your shack. Now don't get me wrong, I'm not a *down-on-computers* type. Computer interfaces will reshape the scanning hobby, but simple solutions can be satisfying in their own right, and make good sense.

Set up a *LIMIT SEARCH* range, say in the military aero band. Engage the *Search & Store Module*; fire up the tape recorder on it's voice activation setting, and go skiing, or take the kids to the beach for the weekend. When you get home and feel up to it, listen to the tape and step through the new freqs in the scanner's memory.

The key is in the "BEEP" which happens at the beginning and end of each *search & store* cycle. At the end of each transmission, which will be signaled by that unmistakable "BEEP", pause the tape recorder and write down the channel number and a few notes about what you've heard. Then step to the next channel on the scanner, and resume listening. In this way you not only have a record of what was heard, but also the frequency. The advantages of this simple method: (1) you're not tying up the computer for hours at a time; (2) the new freqs are already in the scanner's memory; (3) every transmission is saved on tape; and (4) you can be miles away when a C-130 bellies-in through your backyard. What more could you ask for (except another vacation)?

Editor's Reply: Why, a scanner/computer interface, of course! <Grin> Seriously, I'm in tune with ya! By no means do I think computers are the end of the rainbow. In fact, I am not very computer-literate, period. But I am a mechanic...an engineer...a technician...a manager and I'll danged sure make use of any "tool" that can make my job and/or hobby more fun; better quality; more productive with less drudgery. But there ARE times when I want my hands ON the work that's at hand. See the V2N6 issue, page 7, of the *WSR* for a related technique!

There will always be applications where computers cannot exceed human creativity and intelligence. Imagine, though, being able to wield a set of mechanics tools by sheer mind power while you sit off to one side sipping a cool, frosty or a steaming hot one!

Imagine, pumping that floor jack under your car by telekinesis, and then with no more effort, zip off a set of lugnuts; change the tire and go cruising again, all without ever getting a bit of gunk & grime under your fingernails? Expound upon that thought to include jerking the engine out from under the hood; giving it a thorough diagnostic & blueprint; change a piston here; a valve there; and be off on your way again without ever straining a muscle or losing a nut or coming up with an extra gasket that, for the life of you, you don't remember where it was supposed to go.

*Well, THAT much remains a head-trip but computers DO offer a comparable scenario in many, many different situations now! I began my writing career with pencil & paper; went into hock to rent a manual typewriter at \$10 a month; graduated to a portable electric typewriter which was absolutely the cat's meow until one of the keys finally stopped working. Then I sprung for an IBM Selectric II and went to town! But a couple of years later, it broke and couldn't be fixed. By that time, my oldest son was studying computers in high school and talked me into going for broke on an Apple IIe. **ComputerLand, here I come**, and walked out with the Apple, Word Juggler word processor software, dual disk drive and a printer, all to the tune of \$1800 or so. That was eight years ago.*

That same Apple IIe is still in use here with a twin in the kids' study and there are five more computers doing various things around here now. Let me venture to submit that in the last three years, I have written MORE quality material than in the forty years previous! Not only THAT, but these computers perform the work that several employees would have been needed to do only a few years ago. Barely over a year ago, I was proudly proclaiming that my Apple computers could do anything the IBM's could do. Good thing I saw the light and switched rather than fought!

Now I have access to the knowledge of the world via my computers. I haven't had to run back and forth between home and library in a year; the WORLD is my library now, right at my fingertips. The FCC stopped me from communicating via CB radio several years ago, but now I communicate around the globe at whim and fancy right from my keyboard. Computers allow me to do things at a high level of quality that were beyond my reach without them. I am not a "gamester" nor a computer hobbyist. Everything I ever learned about the damned things came painfully and slowly, and STILL does. But I won't let that obstacle deter me. You and our dear Readers ought not let obstacles deter you, either. Henry Ford, Wilbur & Orville Wright and John Glenn ran into adversity, too. What if they had stopped in their tracks?

*But like I said, I'm WITH you. Your approach to analog data acquisition is exceptionally sound and well worth the knowledge, skills and minor investment to perform. Tape recorders operate much more reliably under conditions of emergency power than do computers. In a major disaster, for instance, like war, earthquake, hurricane, tornado, etc, computers will be the first to fail. Yet scanners and tape recorders run very nicely for a long time on batteries. Computers will never be a substitute for knowing how to get the job done! That's like calculators; **who doesn't use one now?** Yet, you really need to know the math you're doing before the calculator can be of any real assistance. If you don't know what you're doing, a computer will only make things worse. Thank you for your fine suggestion and time you took to write it up.*

Key Research Co. and their models PS-90 and SS-45 Search & Store Modules played an important role a few years ago in launching the Scanner Hacking Revolution. The PS-90 still ranks up there among the most significant scanner hacks ever to hit the market! We've discussed the S & S Mods before and I can't imagine anyone not knowing about them now, but the PS-90 and SS-45 are still available for the PRO-2004/5/6 from **Key Research Co at PO Box 846-W, Cary, NC 27511-0846**. For those not in the know, the S & S mods are a very effective way to make a scanner SEARCH for and STORE active frequencies, all without human intervention. The price is right and installation couldn't be much easier.

There are two minor side effects to the S & S Modules, both of which now have a remedy! It has long been known that the S & S Modules do not work properly on scanners that have been speeded up with a crystal to replace the stock resonator. The fix for this comes in two parts, and if the first one doesn't work, the second one will. First, add a 1N4148 or 1N914 silicon switching diode in series with each of the Yellow, Green and Gray wires where they connect to the scanner's keyboard termination. The cathodes (banded-ends) of the diodes go toward the S & S Module while the anodes go to the scanner. Now, if this doesn't work or produce reliable results, then leave the diodes in place, but add a 100-k resistor to each of the Brown and Violet wires where they terminate at the scanner. Solder the two free ends of the resistors together and then to a nearby ground spot in the scanner! Voila! The PRO-2004/5 can then be speeded up to roughly 10 MHz without adverse effects. As far as I know, the PRO-2006 can be speeded up to 16 MHz without ill effects and for some odd reason, the S & S modules seem to work quite well on speeded up 2006's without the above diode & resistor modifications, but keep these remedies in mind just in case. Now for the great fix!

The Search & Store Modules are susceptible to an annoying effect caused by the design of the scanner and for which little can be done outside of my great fix! There is a definite time sequence that has to elapse during a Search & Store cycle. Try it manually to see what I mean: as soon as an active frequency is found, press MONITOR, followed by PROGRAM, ENTER and then SEARCH-UP or DOWN. If you go too fast, the scanner will ignore one or more of your keypresses. Now, back to reality: if a static burst or an atmospheric burp should occur on a frequency encountered during a SEARCH & STORE sequence whereby the SQUELCH breaks and sets in something under a tenth of a second, the S & S function will hang up and seemingly lock. It won't resume SEARCH until another signal comes in to trigger its completion sequence. What if that freq is unused in your area and another signal doesn't come in? The S & S function will stay hung up until you come along to release it. Well now, it just happens that one of my slick little (unrelated) mods offers 100% assurance of no hang-fires in SEARCH & STORE operations! See MOD-29 in Vol-2 of my **Scanner Modification Handbook**, the Extended Delay! Also refer to V1N6 and V1N9 for more related material on Extended Delay and Search & Store.

To get this free "hang-fire" insurance, you need only move the

ORANGE wire of the S & S Module from the scanner's IC-3, Pin 3 to the SQ-Out point of the Extended Delay circuit (U-1, Pin 6). The rest is even easier: start an S & S operation; turn ON the Extended Delay and set it to about 1/4 to 1/2 second of Delay. *That's it*, because even the shortest atmospheric burp to break the SQuelch will result in the Extended Delay holding the SQuelch open plenty long enough for the S & S sequence to do its work and get ready to SEARCH again! There's no liability to this technique, because if you turn OFF the Extended Delay for any reason, then the S & S operation will behave exactly as if the Orange wire were still connected to where Key Research specifies it to go at IC-3, Pin 3. I don't know why you'd want to turn off the Extended Delay when it works so well, but someone might accidentally flip the switch, I suppose. But there you have it, the latest good word on the excellent Search & Store Modules from Key Research.

FROM CINDY IN "WSR" ADMIN.....

Dear Readers: I usually stay "behind the scenes" and behind my desk, but I have to speak out to many of you who knowingly or otherwise make life more pleasant for me! It's that time of year again, where many of you are renewing your subscriptions. I want to offer my **thanks** to those who have taken some of the drudgery out of my daily work by cutting off and using the subscription blank. You see, the reverse side of it has your mailing label which also contains your identification numbers.

I start work very early in the morning and busy myself all day (and more times than not, into the night hours) with incoming and outgoing phone calls, processing in and out mail, receivables and payables, ordering and obtaining supplies, reviewing monthly statements, settling problems and/or complaints (just a few of my laborious duties). Every once in a while, I get a subscription renewal with the mailing label included, which is **VERY MUCH** appreciated! I always try to get your orders and subscriptions filled and/or shipped within one to three working days, but I have to confess that those with ID numbers usually go to the top of the stack, as they go faster and I can get them done in record time.

I also want to personally thank all of you for your patience and support whether you've been with us since the days of the old *EMTJ* or just came on board. It is a pleasure to serve you.

Sincerely, Cindy Cheek; Administrator

EDITOR's NOTE: Cindy didn't tell you about the other things in her Job Description Mother, Wife, Organizer, Transporter, Conniver, Chef, and about a dozen other things. But don't anybody get the idea that Cindy is overworked around here. She will get other things to do in her spare time, maybe after the first of the year when the rush of subscription renewals settles down a bit. Maybe a better shudup before I get into trouble? Yes.....

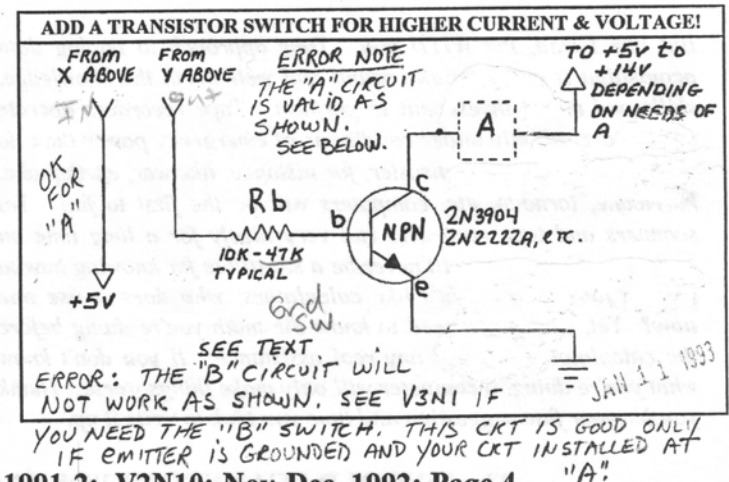
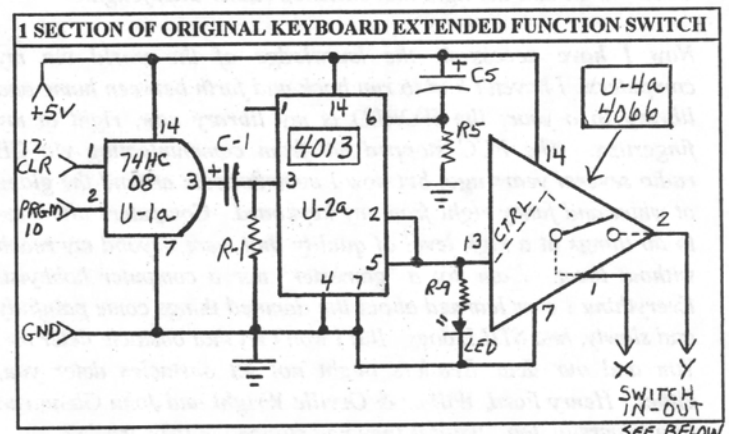
A PROMISE KEPT FROM WSR-V1N3

Oops, several people have reminded me that I didn't make good on a promise of something to come after V1N3. Sure enough, there it is on page 6, 3rd paragraph where I said I'd show you how to apply the Keyboard Extended Function Switch to higher current needs.

First, here's the deal on the KeyBoard Extended Function Switch: it's a way to eliminate the need for external switches on your PRO-2004/5/6 scanners by pressing TWO KEYS at the same time to activate or deactivate added circuits & functions. My KeyBoard Memory Block Selector for the Extended Memory Mods is a related cousin of the KEFS. Anyway, we found when you press and hold the scanner's CLEAR key, that the scanner goes right on doing whatever it was doing without interruption, BUT any other keypress at the same time is ignored so long as the CLEAR key is pressed! How convenient! So the KEFS was evolved to consist of an AND gate driving a Flip-flop which drives a CMOS Bilateral Switch, like the common 4066. The KEFS is a simple push-on, push off type of an electronic switch and is interfaced to the scanner's Keyboard Connector to take advantage of the keypad switches. But there is one problem.

CMOS bilateral switches are really great for low-voltage, low current, high impedance circuits, to the extent that a single switch section is limited to 25-ma of current at a voltage not higher than the supply voltage of the CMOS chip. This really is perfectly great for many of our switching needs, but the limitations have to be taken into account. Here's an example: take my Automatic Tape Recorder Switch (MOD-33) for instance, which is powered by +12 volts and which draws 35-ma or so. No way you can turn this puppy on and off by means of the KEFS. Or is there?

Sure, it just takes an extra circuit is all and a simple one at that: a bi-polar transistor switch! Shown below in the first figure is one complete section of the KEFS as it appeared in V1N3. The next figure shows what to add to increase the voltage and current capability of the switch! Nothing out of the ordinary at all!



HB-232 SCANNER/COMPUTER INTERFACE UPDATE

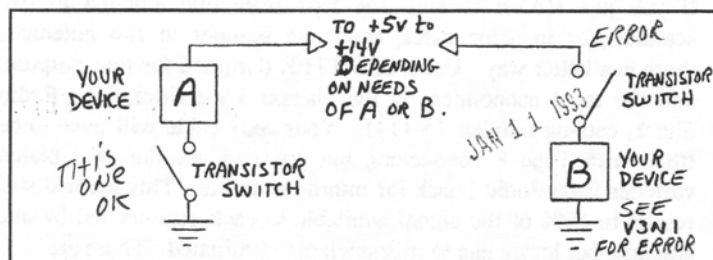
Note in the second figure how there are two places to insert the circuit to be switched. If your device is installed in the Collector (A) circuit, then the ground to your device is switched. In that case, **all ground points** on your device **MUST NOT** touch the scanner's ground anywhere, and instead must all be tied together before being wired **ONLY** to the transistor's collector. If your device is installed in the Emitter (B) circuit, then you're switching power to your device. Either method can be acceptable, but (B) is simpler and results in less to worry about. Switched grounds (A) can get hairy unless you use great care in construction and be sure that no part of your device is grounded except to the Collector of the transistor! Now here is how the transistor switch works:

LATE NOTE: SWITCHED "B" IS IN ERROR, SEE V3N1.

In order for a bipolar transistor to conduct, its emitter-base junction must be **forward biased** to about 0.5-volts or more. A point around 0.4-0.5 volts makes the transistor just begin to conduct, but at that point, it's a current limiter and useless as a switch. The transistor must be biased close to 0.7 volts for it to be able to pass the desired current. The purpose of **Rb** is to set the right bias at the base.

Now, when there is **NO** positive voltage, or **ANY** negative voltage on the base of an NPN transistor, it absolutely will not conduct, and therefore acts like an open switch. When a positive voltage of 0.5 to 0.7 volts is applied to the base, the transistor will conduct, thereby acting like a closed switch. If full bias is applied (0.7-v), then the transistor will conduct maximum current as demanded by the resistance of your device. Normally, this is not of any major consideration, but if your switching needs are high current, you will want to check the characteristics and maximum limits of the transistor of choice before putting it into your circuit. The transistor of our example, an NPN type of 2N3904 has a maximum current limit of 200-ma and a maximum voltage of about 35-v. As you can see, it is more than adequate for most scanner hack needs.

Looking at the second figure, we see where one terminal of the KEFS CMOS bilateral switch is connected to full time +5v; the other terminal of this switch connects to the free end of **Rb** on our new switch. Thus, when the CMOS switch is open, the base voltage on the transistor will be zero and the transistor cannot conduct (Switch Off). When you activate the KEFS to make the CMOS switch close, then +5 volts is applied to one end of **Rb** and then to the base of the transistor. (Switch On). The value of **Rb** is not critical, but should be high enough to not let the transistor conduct much more than you want. A value of 47-k is about right for switching needs up to 50-ma or so, but you can experiment. Values as low as 10-k down to 1-k may be required for higher current needs. As current needs increase, the value of **Rb** must decrease to allow the transistor to conduct more. We could go on with basic transistor theory, but let me refer you to other sources for more detailed info. There you go; promise from V1N3 fulfilled. The below box depicts a simple analysis of the A & B options:



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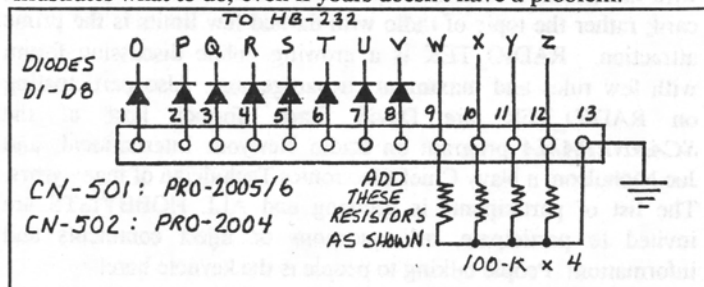
The Charley Test period has been concluded and the HB-232 Interface is well on its way to carving a new dimension in the dimensions of scanning. First, here are some statistics. Out of almost 150 units sold to date, only three requests for refund have been received. We don't know why, but it's safe to say that one look at the kit and Manual made them think the job was beyond their capabilities. A 1.5% return isn't too bad. We had one person who became **VERY** frustrated when his HB-232 failed to work, despite several rounds of suggestions and help. **THEN**, he came back, happier than a pig in a dirt pile, when he found that it was his computer that was at fault and that his HB-232 worked perfectly. It seems that some of the early Wang computers aren't quite PC/XT/AT-compatible. Quite a number of others, maybe as high as 20% or so, have had some sort of problem at initial startup of the HB-232, but the majority are fully resolved in one or two rounds of questions & answers. Only a few problems take more than three go-rounds to resolve and all have been resolved to date. The neat thing is that 90% of all problems fall into only a few distinct, easily resolved areas:

1. Interconnecting wiring errors
2. Defective solder joints; errors on the HB-232 Board
3. Failure to follow certain specific instructions:
 - A. Scanners with speedup crystals won't work with the HB-232
 - B. Certain wires from HB-232 to scanner cannot exceed 30"
 - C. Incorrect wiring of the serial input connector
 - D. Improper Program startup/operation procedures
 - E. Incompatible computer
4. Defective or improperly setup serial (COM) port

And these have been the sum and substance of all reported problems to date. No matter where a problem happens to be, we are able to direct the User to the location and a quick remedy.

NEW INFO AND A GREAT SOLUTION

Referring to 3.A. above, the HB-232 often would not perform properly when Wires O-Z exceeded 30" in length. Some users found problems with lengths of 24". So far, 22" and under seems to be problem-free, but now we have a fix that allows up to as long as 4.5-ft. Thanks to the efforts of Larry Jenkins of Hendersonville, Tennessee, we found that four 100-k resistors, all soldered together at one end and soldered to a nearby scanner ground and with one each connected to the scanner's KeyBoard Connector, Pins 9, 10, 11 & 12, where Wires W, X, Y & Z terminate, will eliminate the problems associated with cable length! The below diagram illustrates what to do, even if yours doesn't have a problem:



HB-232 PROGRAM VERSION 1.0 ALMOST READY

At long last, the Release v1.0 version of the HB-232 control program is almost ready to go out the door. Until now, everyone who has purchased an HB-232 Kit is using the Charley 1A Program which has been thoroughly overhauled and upgraded for release. We hope to have Release v1.0 on the Hertzian Intercept BBS ready for **free** downloading by HB-232 Owners on or around November 11, 1992. If you prefer your program upgrade to be on disk, please specify which disk size and include \$5 S&H with your order. The HB-232 Release v1.0 Program has a host of changes for the better, including user-configurable color settings; expanded AutoLogger function; greatly expanded User Tools menu including a DOS shell; and an evolved and upgraded Script Function. Also, it is no longer necessary to use the scanner's back panel RESTART button at program bootup! The HB-232 v1.0 is exceptionally smooth in operation; has plenty of pull-down help screens and lots of minor improvements over the Charley Test version. By the time you get this issue, Release v1.0 should be ready to ship or download. Come get yours or order right away.

HB-232 NETWORK EXPANDING!

Host BBS: Hertzian Intercept; (300-16,800-baud), San Diego, CA (619) 578-9247 (6pm - 1pm)

The Feedhorn BBS (300-9600 baud, 8N1); Los Angeles, CA (818) 907-7906 (24-hrs)

The Tri-State Data Exchange (300-9600 baud, 8N1); Dubuque, IA (319) 556-4536 (24-hrs)

HighSierra On-Line (300-9600 baud, 8N1); Lake Tahoe, CA (916) 577-4438 (24-hrs)

The Red Onion Express (300-14,400 baud, 8N1); Wawayanda, NY (914) 342-4585 (24-hrs)

D.T.S. BBS (300-2400 baud, 8N1); Dallas, TX (214) 748-4873 (24-hrs)

The General Alarm BBS (300-2400 baud, 8N1); Indian Springs, CA (619) 669-0385 (24-hrs)

EVERYONE NOTE: Even though the above BBS's are networked for the purpose of making the HB-232 Technical Support Conference as widely available as possible, they also carry the up and coming RADIO_TEK conference which is open to anyone interested in radio technology and re-engineering. By checking into any of the above BBS's, you can be in direct contact with me within 24-hours or less! But I am not the only drawing card; rather the topic of radio with darned few limits is the prime attraction. RADIO_TEK is a growing public discussion forum with few rules and maximum encouragement. Also participating on RADIO_TEK are David Stark, former host of the **SCANNERAMA** program on Radio Newyork International; and Joe Nicholson, a Navy Chief Electronics Technician of many years. The list of participants is growing and ALL HOBBYISTS are invited to participate, ask questions or inject comments and information! People talking to people is the keynote here!

COMPUTER NETWORKING is about people talking to people! Perhaps this concept is what draws so many of us into radio, but not all of us are able to communicate by radio, thanks in part to the FCC's rigorous license requirements and perhaps to the cost of acquiring the proper equipment. Even so, given the unique characteristics of radio signals, it is not possible to talk to just anyone you want, any time you want. Computer networking is much different; a lot like a "meeting hall" where anyone who wants can speak, but only one at a time. And yet, hundreds of speakers can participate just as easily as two. It is something you have to see to believe, but **COMPUTER NETWORKING** is perhaps the very best forum for scannists and shortwave listeners to meet and interact with one another without regard for political and geographical boundaries! All you need is a computer, a modem and a moderate interest in meeting others like yourself! You wouldn't believe the amount of information and data "out there" that's available to you through networking! Think about it: a vast public library of information on your favorite subject right at your fingertips. So much the better if you favorite subject is scanners and scanning! Chances are that you are in rare or seldom contact with very many of your fellow hobbyists; therefore, your ability to keep up on the latest developments and techniques is hampered. By networking, however, you can have a solid grip on the very lifeline of your hobby.

ANTENNA SPLITTERS & SWITCHERS

This subject comes up all the time around hobby radio circles by virtue of the fact that hobbyists more often than not have to work under strict limitations of space and budget. The implications are clear: you may have one scanner and two different antennas; or two scanners and one antenna. and wish to switch between them for various situations. There are several permutations and convoluted ways hobbyists try this sort of thing, and virtually ALL cause some measure of performance to be degraded.

SIGNAL SPLITTING: The first method, not really a switch, is to connect one antenna through a "tee" fitting to the inputs of two different scanners. That way each scanner can run independent of the other and they'll both pick up signals. Sure do lose a lot of performance that way. Look at it like this: what happens when you put a "Y" at the end of your garden hose? Half the original volume of water goes through each output leg of the "Y". So, too, does have the signal from one antenna go to each of two scanners connected on a "tee". Not only THAT, but additional LOSS of signal is caused by the impedance mismatch of two coaxial cables connected to one! Add to that an additional loss caused by the electro-mechanical connections (3) to the "tee". A lot of performance can be LOST by this improper splitting method.

If you just HAVE to split the feed from one antenna to two scanners, or in some cases, from one scanner to two antennas, there is a better way. Use a SPLITTER designed for that purpose, and the most economical is the cheapo TV-splitter from Radio Shack, catalog number 15-1141. Your coax cable will have to be fitted with Type F connectors, but you can use the gold plated varieties from Radio Shack for minimum losses. This method still results in 50% of the signal available to each scanner fed by one antenna, but losses due to mismatch are eliminated. There are

commercial models of RF Splitters available for hams & hobbyists but they are expensive and not always any better. If you want to look into it more, contact the below company for details about their complete line of RF connectors, fittings, splitters, switches, coax cables and more! Please mention that I referred them to you.

PASTERNAK ENTERPRISES; Phone (714) 261-1920
PO BOX 16759; IRVINE, CA 92713

RF & ANTENNA SWITCHERS: By far, it's better to switch your signals than split 'em. You'll recoup the 3-dB loss (50%) that goes with splitting. There can be less misc LOSS as well, thanks to fewer connectors and no mismatches, but there are pitfalls to avoid when buying or building your own Antenna Switchers!

First, you have to understand the nature of Radio Frequencies (RF) and especially VHF and UHF frequencies. We've all built cheap and easy switches for DC and audio/stereo needs and this is fine for the most part since you can hardly go wrong with direct current & audio. At VHF-UHF, it's another world, where losses can be caused by mechanical contacts; unshielded wires and shoddy construction techniques. It is possible to make relatively loss-free coaxial cable or antenna switchers, but pretty much out of the question for the home scanner hobbyist whose interests begin at about 30 MHz and go all the way up to 1300 MHz or so. Signals at these frequencies do not behave like DC and audio signals. We don't have the space to go into all the theory here, but if you can understand how VHF & UHF signals don't even like coax cable which is designed to channel RF signals, then you maybe can understand how these signals don't like to go through switch contacts, bare wires and unshielded PCB traces! That's the problem with conventional switches where the signal goes into a connector on the back of the switch, down through a wire, into and out of the switch contacts and then back up a bare wire to a another connector on the rear of the switch. Geeminy snakes, boys & girls, that's enough potential for loss to gag a small elephant, and much too much for our palates.

There might be a better way. But first, please understand that it is BEST to not SPLIT or SWITCH at all. If you must switch your RF signals, then let's roll our own and do it such a way as to have fun and come up with something truly unique and useful as hell!

DIODE SWITCHING IS BEST for RF and that's all there is to it! If we can keep our RF signals from passing through a set of switch contacts, then we'll overcome a major LOSS point right there! Diode switching is easy, because when a diode is forward-biased, it conducts; when not forward-biased, it does not conduct. Sound familiar? From page 4, this issue, perhaps? Yes, but a diode switch is simpler than a transistor switch! Not much to it at all, frankly. Schematically, it is exceptionally simple. The complexity comes in how you put it together, but it's not all that bad, either.

Construction techniques involve keeping ALL unshielded RF conductors as short as possible and less than 1" ideally. For situations where you have to use an unshielded conductor, it is best to make it on a printed circuit board (flat traces) if you can, otherwise, you can use solid copper #18 or #20 gauge, pounded out or pressed into a flat ribbon shape! Flattening a conductor reduces its inductance! Use light strokes with a hammer to flatten any RF-

carrying copper conductors. Keep the need for length of RF conductors to 1" or less! How can you do this?

First of all, use a SMALL, die-cast metal box. Radio Shack doesn't have any, but most electronic supply houses do. Die-cast metal boxes are distinguished by thick walls and a very snug, tight-fitting cover. I bought several at a local surplus firm which measure about 2"W x 2"L x 1"D; perfect!

Another consideration is to avoid at all costs, sharp bends, kinks and twists in your RF conductors! Straight and short is the key! Now let's talk about the best components to use for our VHF-UHF Antenna Switch. You won't find them at Radio Shack, either! Not exactly, anyway. The integral parts of our antenna switch are the switching diodes. And not just ANY diode will do, although if you want to only be half-serious about this, then the common garden variety 1N4148 or 1N914 silicon diode can be used. If you take your scanning on a more serious note, why not go along with the old saying, "When in Rome, do as the Romans do." Meaning, let's go for the type of switching diodes like those used in the RF circuits of the PRO-2004/5/6 scanners: HSR277, a standard Japanese part number for which I don't know the US cross-reference, but no matter: these can be ordered from Tandy National Parts in Ft. Worth, TX: (800) 442-2425. You only need two, but may as well get a half-dozen or so for good measure. So when you call, specify you need parts for the PRO-2006, Cat #20-145, Diodes D3-D8, Part # HSR277. These little puppies are leadless surface mount diodes, especially designed for fast switching at ultra-high frequencies. Actually, they do have tiny tabs of sorts to make soldering a little easier than ordinary SMT devices. By the way, the green band on these diodes is the cathode.

Next most critical component is the capacitors. Like with the diodes, not just ANY type will do, though if you are only half serious, you can use common ceramic disk capacitors. If you take your scanning seriously, then let's use the same kind as in the PRO-2006 diode switching circuits: a ceramic 0.001-uF/50-v surface mount capacitor. May as well order these from Tandy National Parts when you order your diodes. Again, specify for the PRO-2006 Cat #20-145, capacitor C-1, Part # RMUMK212B102K. You might ought to order ten or twelve of these while you're at it. They're tiny, easy to lose and easy to damage. Spares won't hurt, and neither the diodes nor the capacitors are all that costly.

Now for the resistors. Same deal; not just any resistor will do, although if you're half serious and will accept half-results, I suppose you can use regular leaded resistors. At least get "metal film" resistors. If you order other parts from Tandy, then order three each of their 470-k and 1-k SMT resistors, parts # RCM474J55 and RCM102J55, respectively. Again, specify these to be for the PRO-2006, resistors R-6 & R-15.

That's it for the critical stuff, I guess. Of course, you should use high quality BNC chassis-jacks, available from Pasternak Enterprises, mentioned earlier in this article. Half-decent BNC jacks are available at Radio Shack. Suit yourself, depending on how seriously you take your scanning. The rest of the stuff, including one switch of ANY type, two 220-ohm resistors and a 1.0-uF capacitor are rather generic and non-critical.

HOW IT WORKS is uncomplicated and easy to comprehend. The switch, which can be of any cheapo or desired variety, switches a DC voltage, +5 to +12 volts, through one or the other of the 220-ohm resistors and then through the mating 1-k resistor to the anode of the pertinent diode. A positive voltage on the anode of a diode with a 470-k resistor at its cathode produces a forward bias for the diode and thereby allows it to conduct the RF signals fed to its cathode via the particular antenna. When the switch is flipped, then that diode becomes unbiased and cannot conduct, while the other diode becomes forward biased and conducts. You will see how two diode circuits are used for this switching need, but you can add a third, a fourth or as many identical diode circuits as you need for your purposes. The only other change will be the switch which should have at least as many positions as desired for the number of antennas to be switched, obviously.

HOW TO BUILD THE ANTENNA SWITCH can be as varied as the number of people who build it, but there will be a few common factors: (1) The RF path from either INPUT to the OUTPUT will be very short. (2) The RF path from either INPUT to the OUTPUT will be as straight as possible, with no twists, kinks or sharp bends. (3) The 470-k and 1-k resistors where they contact the RF paths will not have ANY lead length; i.e., the bodies of these resistors will be soldered to the RF paths so that there is no lead-branch from the RF path. (4) The *ideal* circuit will be built on a printed circuit board, with the RF paths about an eighth of an inch wide and with a ground foil running along each side of the RF path. Other conductors are not important, with exception of the ground foil which should cover every inch of the printed circuit board that isn't needed for something else!

If you don't use a printed circuit board, then build the circuit on perf board or a flat piece of plastic, perhaps. Build it in the same fashion as the printed circuit model depicted in this article except use a dab of super glue to hold the parts in place BEFORE soldering them later. Do NOT bend leads through holes in the perf board; make all connections on the same side of the board, which serves mostly as a foundation for the parts. Use flattened copper wires for the RF paths and stay as close to the printed circuit design as possible. If you use leaded resistors, cut all but about a sixteenth of an inch of lead from the end that solders to the RF path. The body of the resistor should butt up against the RF trace or path so that there is no lead branch. Disk capacitors are more difficult to work with than resistors because it's almost impossible to not have a lead in the RF path. This is not great, but can be acceptable if you use very small capacitors with very short lead lengths. Chip capacitors are best, though, if you can get them. The 0.001-uF values specified herein are not critical, and the more common 0.01-uF chip caps can also be used.

WHY THE EMPHASIS ON SPECIAL PARTS? Well, you can throw out the window most everything you ever learned about Basic Electricity and Electronics, if what you learned or think you know was accented on DC and low frequency AC. Resistors, capacitors, inductors, diodes, transistors, and other electronic parts and conductors only behave the way you were taught when used with direct current or low frequencies, including audio and RF up to about 2 MHz to 30 MHz, depending. Above 30 MHz, and it become a whole new ball game. This isn't because the theory falls apart; quite the contrary, it holds up, but the thing is that ordinary

parts don't behave the way you might expect at higher frequencies. For example, a short length of wire may have an inductance of ten nano-henries (nH), which is insignificant at DC and low frequencies. However, at 800 MHz, that 10-nH will present an impedance of 50-ohms; enough to cause a signal loss of several dB in the right place at the input to the receiver! Antenna switchers are always in the "right" place. Leaded electronic components always have some extra inductance AND capacitance in those leads, which offer no effect at DC and low frequencies, but at 800 MHz, there are many effects, most of which are uncouth.

You can "get away" with use of conventional components in your Antenna Switcher if you employ the suggested construction tips & techniques, but there is always a price to pay for compromise. The proper components are available through Tandy and other sources so you may as well use them and not pay the price for compromise just because it's "easier" or more convenient.

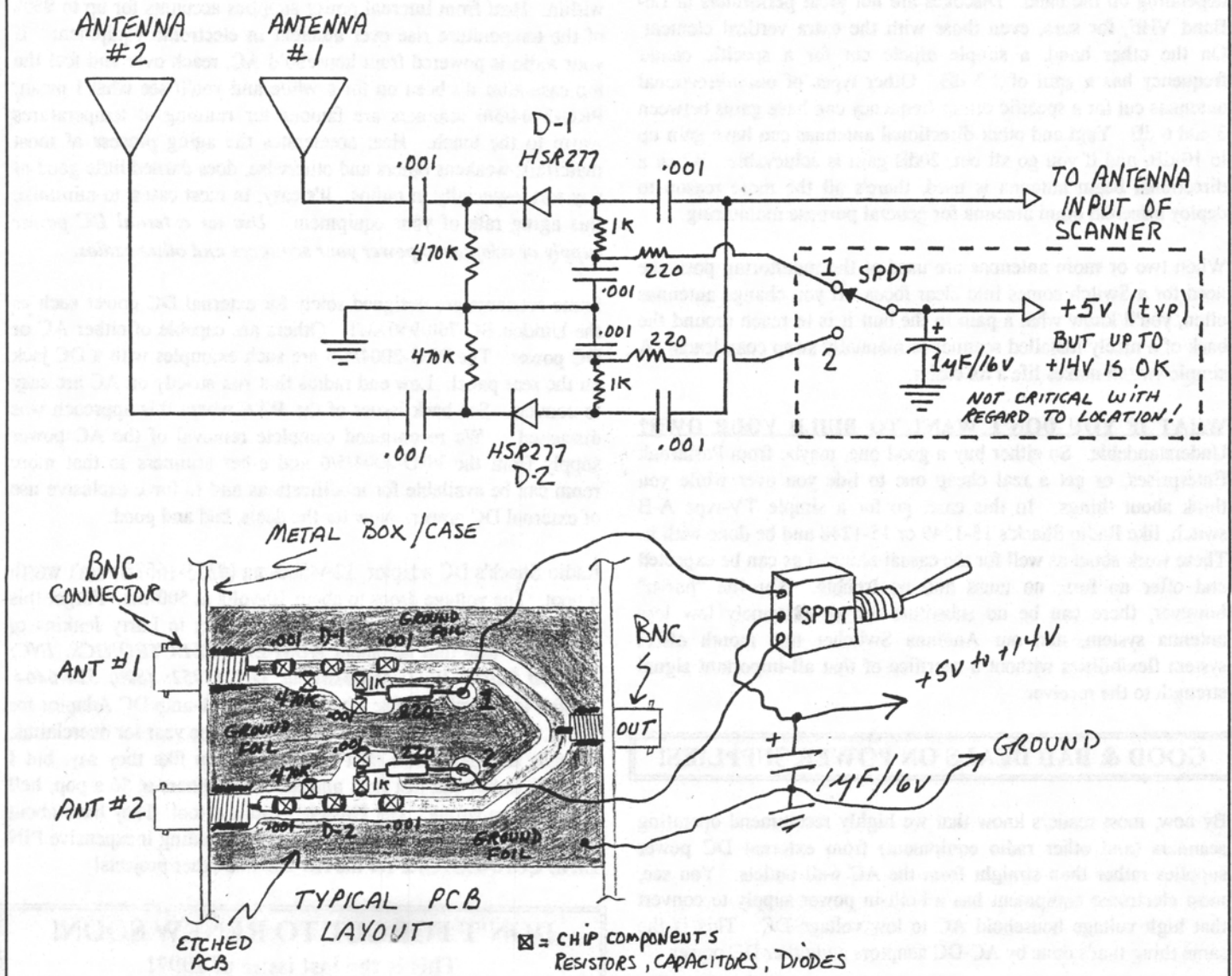
INSTALLATION OF THE ANTENNA SWITCH can be just about anywhere, including right at the back of your scanner(s). But there can be one super neat application provided you build the unit inside a weatherproof enclosure. Suppose you have two antennas on one mast? There's no real pressing need to run TWO long lengths of expensive coax from each antenna down to the back of your scanner! Install the weatherproof Antenna Switch up on the mast, close to the antennas, and then run just ONE coax down to the station along with a pair of wires for the DC switching that's needed! The shield of the download coax is ground, so a cheaper wire pair is less costly and will give your station that "professional" look and feel!

Otherwise, setup your Antenna Switch anywhere that's convenient and install the DC switch somewhere even more convenient. Feed the downloads from each of two antennas to the (A) and (B) inputs and run a coax patch cable from the (C) output to the back of your scanner. The other way the Antenna Switch can be used is exactly backwards, using one antenna to be switched between two (or more) scanners. In this instance, connect the antenna to the (C) port and short coax patch cables from the (A) and (B) ports to the antenna inputs of each scanner. The DC switch can go anywhere.

One very convenient place to install the DC switch is inside the scanner where it will always be handy. You can get the +5v to +12v diode bias voltage from the scanner as only a minuscule amount of current is drawn. If you were into a little more work, you could even install the Antenna Switch board inside the scanner, too. An extra BNC jack can be installed on the rear of the scanner to accommodate two antennas. The internal feed from the stock BNC jack will have to be disconnected and fed to one of the A-B ports and the C-port fed back to where the stock BNC connection was cut. Because of this extra level of work, this option is not for everyone, but I thought I would mention it.

ADVANTAGES OF TWO (or more) ANTENNAS? Most of us have a favorite slice of the VHF-UHF spectrum. Some people are into Lo-band VHF; some 800-MHz; some railroads, some aero. And yet from time to time, we like to sneak a peek at others areas of the spectrum. It makes perfectly good sense, then, to have one antenna that's expressly designed for your favored slice of the spectrum, and yet another for all-round, general purpose needs.

LOW-LOSS VHF-UHF ANTENNA SWITCHER



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Your basic, casual discone, the most popular of the all-purpose antennas has no gain, essentially 0-dB or even negative gain, depending on the band. Discones are not great performers at Lo-Band VHF, for sure, even those with the extra vertical element. On the other hand, a simple dipole cut for a specific center frequency has a gain of 2.2 dB. Other types of omnidirectional antennas cut for a specific center frequency can have gains between 3 and 6 dB. Yagi and other directional antennas can have gain up to 10-dB, and if you go all out, 20dB gain is achievable. When a directional beam antenna is used, there's all the more reason to deploy a second omni antenna for general purpose monitoring.

When two or more antennas are used at the monitoring post, the need for a Switch comes into clear focus. If you change antennas often, you'll know what a pain in the butt it is to reach around the back of a nicely installed scanner to manually swap coax leads! A simple switch makes life a lot easier.

WHAT IF YOU DON'T WANT TO BUILD YOUR OWN?

Understandable. So either buy a good one, maybe from Pasternak Enterprises, or get a real cheap one to tide you over while you think about things. In this case, go for a simple TV-type A-B switch, like Radio Shack's 15-1249 or 15-1248 and be done with it. These work about as well for the casual scannist as can be expected and offer no fuss, no muss and no trouble. For the "purist" however, there can be no substitute for an extremely low loss antenna system, and our Antenna Switcher this month offers system flexibilities without a sacrifice of that all-important signal strength to the receiver.

GOOD & BAD DEALS ON POWER SUPPLIES!

By now, most readers know that we highly recommend operating scanners (and other radio equipment) from external DC power supplies rather than straight from the AC wall outlets. You see, most electronic equipment has a built-in power supply to convert that high voltage household AC to low voltage DC. This is the same thing that's done by AC-DC adaptors and other DC power

supplies with an essential difference! An internal power supply gives off heat **INSIDE** the radio and adds to the buildup of heat within. Heat from internal power supplies accounts for up to 95% of the temperature rise over ambient in electronic equipment. If your radio is powered from household AC, reach over and feel the top case after it's been on for a while and you'll see what I mean. PRO-2004/5/6 scanners are famous for running at temperatures warm to the touch. Heat accelerates the aging process of most materials; weakens others and otherwise, does darned little good of any sort, especially in radios. It's easy, in most cases, to minimize this aging rate of your equipment. *Use an external DC power supply or adaptor to power your scanners and other radios.*

Some scanners are designed solely for external DC power such as the Uniden BC-760/950XLT. Others are capable of either AC or DC power. The PRO-2004/5/6 are such examples with a DC jack on the rear panel. Low end radios that run strictly on AC are easy to convert. See back issues of the *WSR* where this approach was discussed. We recommend complete removal of the AC power supply from the PRO-2004/5/6 and other scanners so that more room can be available for modifications and to force exclusive use of external DC power. Now for the deals, bad and good.

Radio Shack's DC adaptor, 12-v/500-ma (#273-1652B) ain't worth a hoot. The voltage drops to about 10-volts at 500-ma. Forget this one, but now comes the good deal! Thanks to Larry Jenkins of Tennessee who told me about **HOSFELT ELECTRONICS, INC;** at 2700 Sunset Blvd; Steubenville, OH 43952; (800) 524-6464. Hosfelt is a surplus-house with a great 12-v/1-amp DC Adaptor for \$5.98. Order their #56-178. This must be the year for overclaims, because the above unit isn't good for 1-amp like they say, but I tested it to 800-ma just fine, and for our scanners at \$6 a pop, hell you can't go wrong! Get Hosfelt's catalog, too! They have about 3,467 other things that you might want, including inexpensive PIN LINE CONNECTORS for the HB-232 and other projects!

DON'T FORGET TO RENEW SOON!

This is the last issue of 1992!

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- + US Anti-Scanner Law Passed! Cellular-capable scanners' days are numbered!
- + How to calculate image frequencies; Thanks from Cindy in WSR Admin
- + Reader Explains How to SEARCH & STORE with a tape recorder
- + Update on Key Research SEARCH & STORE Modules; How to overcome their limits!
- + Continued (belatedly) from *WSR VIN3*; Using the KEFS for higher current switching needs
- + IIB-232 Scanner/Computer Interface Update; New BBS's; Solutions; Computer Networking
- + Antenna Splitters & Switchers; Make your own Antenna Switch! Explanations & theory
- + Good & bad deals on power supplies; a great source: **HOSFELT ELECTRONICS**