ANODE

Editor's Comments

**May 2006
Volume 6 Issue 10**

Its Winter Coming on...

What projects should you do during the winter months?

Seen in the Newsgroups...

Can anyone help me with research for my degree.

I'm looking for information on ham radio enthusiasts who suffer from manic depression (bipolar syndrome). I have a theory about rf fields and their effect on electrical activity in the brain. I believe this particular form of mental illness could be specifically at risk.

Can you put me in contact with anyone who could help me?

Thanks
Gerry G.

XP SP2 "breaks" some DOS programs.

Yes, XP service pack two does interfere with programs that used to work quite well under Windows XP. Most of the DOS amateur radio programs that worked well under MS-DOS worked quite well under later versions of Windows. With the drive to more secure computing or the eradication of 'outside interference', this service pack/patch limits

New Quad at Club house

Editors Comments & News

the access of more 'unmanaged' programs. This is one of the major reasons why MS wanted to install the .NET framework into the new operating systems.

The "cure" for this problem is simple; use a 'DosBox'. This is a complete DOS environment that functions under both Windows 32 bit systems and Linux. It provides all the low level access and support for sound cards.

Originally designed to run DOS games, this Open-Source utility has 'fixed' a lot of popular amateur radio DOS programs.

You can get it from Source-Forge as an installable program or as a set of source files. Its now at version 0.65. Go to: **http://dosbox.sourceforge. net/**

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WILRO 100 & West Rand Amateur Radio League

The Organizing Committee of the WILRO 100 would like to thank you and your team for the invaluable support afforded our race on 30th April 2006.

With the assistance of your members, the support shown to the cyclists was fantastic, and the feedback we received was extremely positive, and overwhelming. It is greatly appreciated, and we hope that we can continue to build a strong and lasting relationship way into the future.

Any concerns or comments regarding this 8th edition of the WILRO 100, please notify us, and we will strive to build on the race forwards.

Please convey our greatest appreciation to the members that assisted with the event.

The Organising Committee

WILRO 100 Cycle Challenge.

Results for the race are available on
 www.championchip.co.za.

Just for Keith! You can now buy these pole-hugging statues for your car aerial.

Noise Surgery 101

How to cure the transmitter in your PC.

Does your PC interfere with your two-meter receiver or 137-MHz weather satellite receiver? Do you hear hash, buzzes, or full quieting carriers when your PC does the RAM check, accesses the hard drive or is just sitting idle at the DOS prompt? Read on and I'll tell you how I eliminated the noise from my PC. The modifications to your PC will take about four hours and a few inexpensive parts.

History

I use JVFAX on a PC to digitize weather satellite imagery from the NOAA satellites transmitting on 137.5 and 137.62 MHz. You don't need a really fast machine for this software-I used a 286 20 MHz for months. One day I turned on the PC and it wouldn't start. It had died, so I replaced its motherboard with an old 386 25 MHz that I had taken out of our family PC when I upgraded it to a 486. With the new motherboard installed. I figured that everything would work as before.
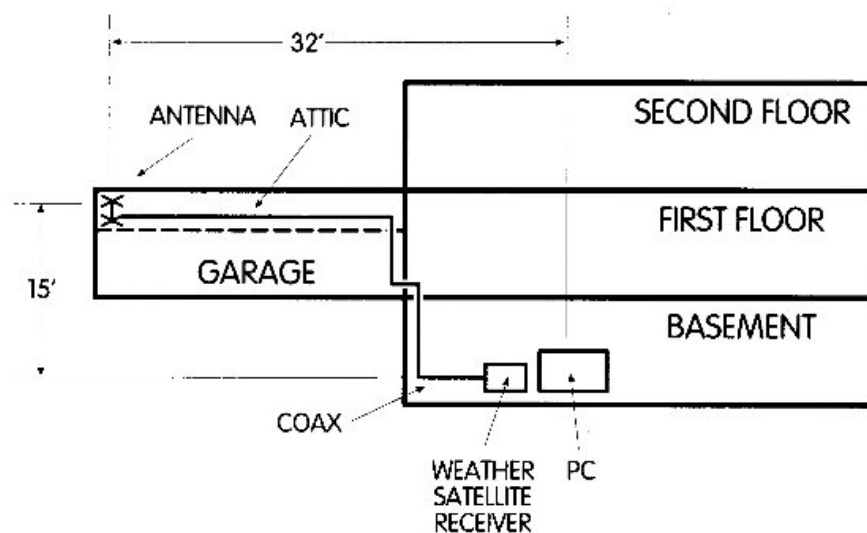
The first time I turned it on and waited for a satellite pass, I thought there was some problem with the receiver or antenna. The signal from the satellite was buried in noise! I quickly shut off the PC and the signal was suddenly in the clear. Uh-oh! Now what do we do?

I considered changing to a different antenna-one that had the most pickup straight up and not too much off the sides or underneath it. But I knew that wouldn't work, since I wanted to get horizon-to-horizon coverage as the satellite moved across the sky. I used my HT to try to locate where the case might be leaking, and found full quieting carriers all over the basement (where my ham shack is located), all over the first floor, and all over most of the second floor of our house. What we had here was a transmitter that covered at least 137 to 148 MHz! My antenna is inside and above the garage, approximately 25 feet above and to the side of the noisy PC. See **Fig. 1.**

Fig. 1. 137 MHZ interference being radiated from the basement PC to the antenna in the garage attic.

What didn't work?

I knew I couldn't use the rubber ducky to localize the leakage from the PC. The signals were so strong you couldn't tell when you had found a leak in the case by the signal getting stronger. The signals were already full quieting! At this point, I tried putting a clamp-on ferrite filter (see **Photo A**) on the coax, thinking that the interference was being picked up by it and reradiated at the antenna. No difference. I tried a clamp-on filter on the IDE cable at the controller card. No difference. I pulled all the exterior cables from the PC (except for the 115 VAC power cable). No difference. I pulled out all the plug-in cards (video, I/O, disk controller, interface to weather satellite receiver). No difference. I tried one of the new low emission cases with overlapping/ interlocking

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mating edges (see Fig. 2). Nope, no difference. Dismally, I envisioned encasing the entire PC in a metal screen.

What did work

Where I work we used to do EMI testing. I remembered seeing a probe **(Photo B)** that the EMI engineers had used to locate specific components that might be emitting a lot of EMI, or a bad connector that was leaking RF, etc. At the end is a BNC connector that is connected to a monitor receiver. I scrounged up three of the old probes. Each was coated with a different colour of rubber to indicate a different frequency range. All the frequency range labelling had been rubbed off, so I just picked a probe at random.

I connected it to my "other satellite receiver and began probing around inside the PC after powering it up with the case open. As I had suspected, the CPU chip generated a lot of noise at 137 MHz. The power supply leads were also very noisy. The disk controller card was noisy when I accessed the hard drive. As I pulled the probe a few inches away from the noisy locations, the signals dropped away to nothing. Aha! So this is how the professionals do it!
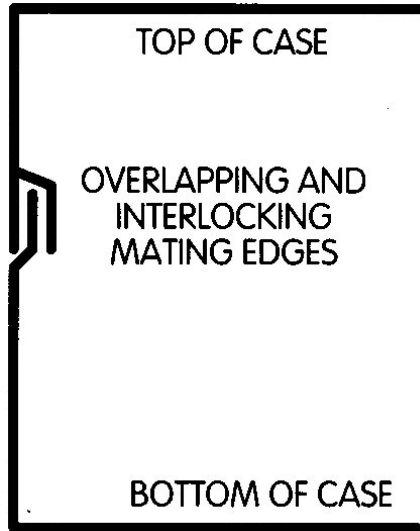

Fig. 2. Low-emission cases utilize interlocking panels to create an RF-tight enclosure.

I closed up the case, powered up the PC and began probing all around the case. The worst locations for EMI emission were the power supply fan air outlet, all along the sides of the case where the top and bottom panels meet, the I/O expansion slots at the back of the PC, and the front of the PC where there used to be a large five-and-a - quarter-inch hard drive. (I've since upgraded to an IDE hard drive, so this spot is empty-there is just a big hole there now, covered by a plastic snap-on panel.)

Again, where I work, we measure the electrical resistance between various parts of the products we manufacture. We typically specify that the bonding resistance be less than 2 milliohms-that's .002 ohms. I measured the resistance between the top and bottom

panels at several ohms. This resistance changed value as I lifted the lid on my flip-top case, indicating that the bond between the top and bottom was very poor.

Between the drive bay (the bracket that holds the floppy drives) and the bottom panel, I measured an open circuit. The I/O expansion bracket that holds the plug-in cards was totally isolated from the bottom panel. The fan outlet is a big hole to RF since the fan is made of plastic and so doesn't block any RF. Likewise for the big hole that used to hold the hard drive. What I had was a bunch of floating metal panels that were not connected to anything! You don't need a probe like the one I used to clean up your PC-just follow my instructions and you should be able to do it quite easily.

The following parts and tools will be needed to complete the job:

- ☐ wrist strap for preventing static damage to the sensitive motherboard and plug-in cards
- ☐ screwdriver or small nut driver socket to fit the metal tapping screws
- ☐ electric hand drill
- ☐ rotary wire brush for the hand drill
- ☐ set of small-diameter drill bits
- ☐ ohm meter that can resolve resistances down to 0. I ohm (most DMMs should work

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fine)

- [ ] s h e e t   a l u m i n i u m approximately one-sixteenth-inch thick (a few pieces)
- [ ] metal shears to cut the sheet aluminium
- [ ] 2 ceramic disc capacitors, 0.0I pF 1,000 v
- [ ] I miniature DPDT toggle switch rated at 250 VAC, two amps or better
- [ ] an assortment of metal self-tapping screws
- [ ] I ferrite/iron toroid core, about one inch inside diameter
- [ ] I five-inch- square piece of metal window screen
- [ ] 10-15 sets of 6-32 x 1/4-inch screws, 6-32 nuts, and size 6 external or internal star washers.

What you are going to do is create an RF-tight case. The case-must be as near one solid piece of metal as possible. All parts must have good electrical contact with each other. When two panels contact each other for a long distance, you will need to provide several points of metal-to-metal contact. All large holes must be covered with metal plates or metal screen.

First things first

Begin by making a map showing where all the cables and connectors go. Note which way the ribbon cable connectors go on-most will fit either way. Mark each of the cables with a small dot of paint or marking pen, then make a similar dot on your map. See Fig. 3. Now go back and re-check the diagram against the PC itself.

Next, pull the AC cord from the PC and the wall. Then get a

Fig. 3. *Draw a diagram of your PC's hookup before disassembly.*

static strap so you don't zap any of the parts when you slide around in your chair and build up a nice healthy charge. Its function is simple: It drains all the charge from your body to the PC chassis through the wire and resistor instead of through the ICs. (This is also a good tool to have whenever you replace boards, add RAM or other times when you have your hands inside the PC.) Before touching anything inside, put the band around your wrist. Then connect the alligator clip to the power supply case. (Since I had a floating case, I had to pick some point as ground. The power supply had to be connected to all the electronic parts, so I chose it

for the around connection.) You will need to completely disassemble your PC down to the major component level. Remove the disk drives, power supply, plug-in cards, and motherboard.
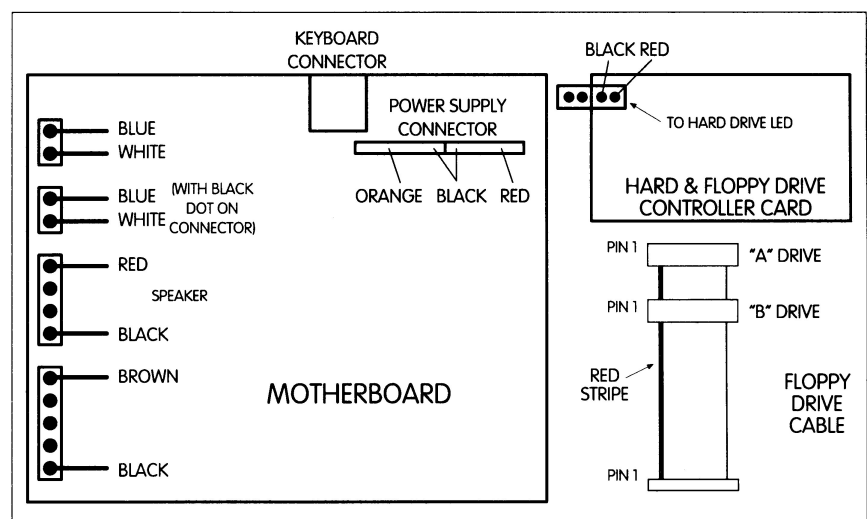
Fig. 3. Draw a diagram of your PC's hook-up before disassembly.

When removing the power connectors from the motherboard and disk drives, be very careful not to apply too much twisting force-you could damage the circuit boards. The power connector on the power supply cable must be tilted away from its mate on the motherboard and then pulled straight up. Practice on a junk board if you've never done it before, or get some help from someone who has. Likewise, in reassembling the PC, use minimal force when plugging

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in the power connectors to the motherboard and disk drives.

Next take the case completely apart, including all panels and brackets that attach to each other with screws. My case is a flip-top that uses screws to hold the drive bay and I/O expansion bracket (located at the back of the PC) to the bottom of the case.

Power supply

Next we'll modify the power supply. Mine had a large red plastic bat-handle on/off switch on the side (see **Photo C).** I removed it and covered the hole with a piece of aluminium. (I measured a * lot of leakage at this point, but I'm not sure that this size hole would allow 137 MHz energy to escape. It could have just been leaking out of the gap between the top and bottom panels right next to this switch.) Measure the resistance between the new aluminium plate added here and the power supply chassis, making sure you have a good connection.
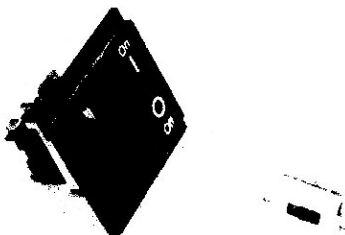
Photo C. The large plastic on/off switch was removed, and the
hole sealed -with an aluminium plate. The 1201240 VAC switch was removed and its wiring was bypassed, and the new on/off toggle switch was mounted in its place.

Remove the voltage selector switch (see **Photo C)** and solder together the wires that the selector switch used to short together. In its place, mount a miniature DPDT toggle switch; it will be the new power on/off switch. The new switch plugs the hole nicely. I doubt that any RF would leak out here, but plugging it can't hurt. At the 115 VAC input connector, bypass both lines to ground with the .01-pF capacitors, using short leads. Make sure the capacitors' leads have a good, low-resistance connection to the power supply chassis.

While you have the power supply apart, vacuum it out. Most will have some dust inside, and some will have a lot of dust. The power supply will run cooler if the components don't have a blanket of dust to insulate them.

Remove the fan; noting which way it is mounted. When you replace it, you want the air to exit the back of the PC. If there is a stick-on label near the centre, peel the label back and put a few drops

of light oil on the shaft. Some fans I've seen also have a rubber plug that must be removed to get access to the shaft. Seal it back up with the label or some black electrical tape to keep the dust out.

My drive bay uses plastic runners to hold the two floppy drives. I noticed a grounded spade lug at the connector end of the five and a quarter-inch drive chassis, so I pushed on a mating connector (commonly used in automotive electrical circuits) with a short wire connected to the power supply chassis. The three and a half-inch chassis didn't have a ground lug, so I added one and connected it to the power supply chassis. The hard drive mounted on the side of the drive bay using a small bracket made specifically for three and a half-inch drives. This bracket provided a good ground for the hard drive.
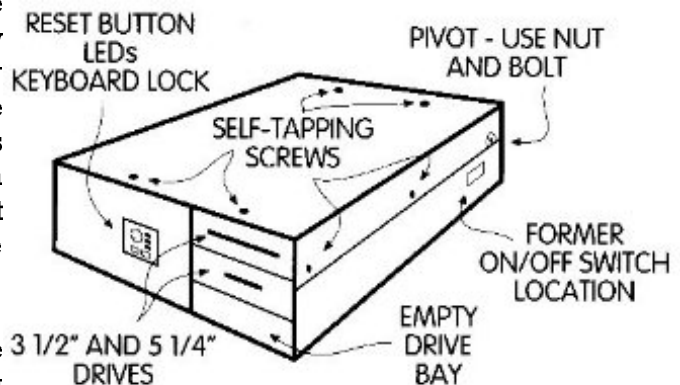
Fig. 4. Case Modifications (front view).

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(Continued from page 6)

Replace the fan, but put a piece of metal window screen between the fan and the power supply chassis. You will need to punch four holes in the screen for the screws that hold the fan in place. Use the wire brush and electric drill to remove any chrome-looking coating where the screws attach the two parts of the power supply chassis together. You want a good, low-resistance connection at all screw locations.

Put the power supply back together. Use the wire brush to clean up around the holes on the power supply where it attaches to the case rear panel. Clean up the matching locations on the rear panel. My case had a very thick layer of paint, so I had to scrub hard to remove it.

Drive bay bracket

Next is the drive bay bracket. This bracket is used to hold the five and a quarter- and three and a half-inch floppy drives. An empty space not accessible from the outside would normally hold the hard drive but I have a three and a half-inch hard drive so this large slot was empty. The drive bay bracket in my PC was attached to the bottom of the case with metal tapping screws.

I measured the resistance between the drive bay bracket and the case and found no connection-another instance of a floating part in the PC! I used the wire wheel to remove the paint where the metal screws touched the drive bay and put them back in place with a star washer between the parts.

Case top

Next comes the case top. Before I removed any paint or drilled holes I looked along the edges of the top and bottom panels to see where I could put short metal self-tapping screws without damaging anything inside. I found that I could put two screws through the top surface at the front and back to secure the top to the front and rear panels. See **Figs. 4 and 5.** I also put three screws on each side where the top and bottom panels overlapped. Since my case is a flip-top there are two large holes at the back where the top pivots. I used the wire wheel to remove the paint at these pivot points and put a screw and nut at each hole to provide a good connection.
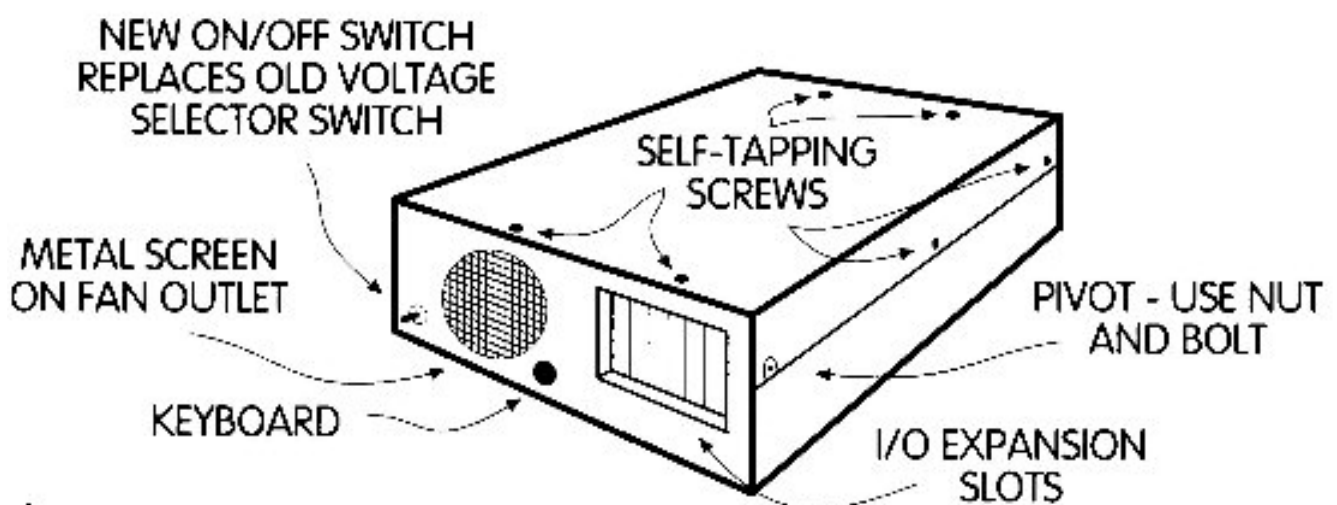
Tightening up the screws produced the zero-ohm resistance that is required.

Fig. 5. Case modifications (rear- view). Note new on/off switch in lower- left.

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I/O expansion bracket

Next comes the I/O expansion bracket on the back panel. Every time I switched motherboards, I had trouble getting cards far enough into the motherboard connectors such that the top of the bracket would touch the top of the back panel. I would tighten the screw enough so the bracket would just start to bend and then stop there.

I checked to see that the motherboard was properly placed and was as close to the bottom of the case as it should be. It was as low as it could go and still the plug-in cards wouldn't go low enough. When I removed the bracket from the rear of the PC, I noticed that there were slotted holes where it attached to the rear panel. Obviously, these were slotted to allow adjustment of the bracket height.

I used the wire wheel to remove the paint where the screws go through and where the card brackets touch the expansion bracket. I then put the motherboard in place, and put the rear panel in place with its screws just hand-tight. Then I put a few plug-in cards in place and adjusted the expansion bracket so that it just touched the underside of the card brackets. I tightened the screws that held the rear bracket to the rear panel and all was as it should be. Problem solved! Any unused slots should have their corresponding hole covered with a blank bracket.

Front panel

Last comes the front panel indicator LEDs, push-buttons, and keyboard lock switch. On my chassis, these parts are mounted on a plastic bracket that sticks out about an inch from the front metal panel. I passed all the twisted pairs through a one-inch toroid core just inside the case front panel. Pass the wires through the core as many times as possible until you run out of room on the core or nearly run out of wire and the wires barely reach their location on the motherboard. The core and wires form an RF choke that stops any RF these wires might pick up from inside the case and reradiate outside.

When drilling holes in the case top and bottom, make the hole in the *outside* panel larger than the screw threads so it has some room to move around. The hole in the *inside* panel has to be smaller than the screw thread. Practice on a piece of scrap metal when selecting a drill bit for the inside panel hole. If the hole is too large, the threads in the panel will strip away easily. If the hole is too small, you may end up breaking off the head of the screw, since the screw is trying to displace so much material. (I've actually broken off the head of a screw when putting a self-tapping screw into steel!) The front and rear panels of my PC are steel, so I had to select the drill bit sizes properly.

That's all you should have to do to make your case RF-tight. Remember to take your time, and make good notes and diagrams showing where everything goes *before you* remove anything.

Problems

I know you don't want to take apart your PC. After all, it does work properly and you might screw up something. Also, it does look nice. But remember, you can't hear those weather satellite or packet signals clearly! Proceed carefully while making the changes and clean up that noise!

There are several problems with these modifications. First, the PC won't look as nice as before since there will be some paint missing where the screws bind the top to the front and rear panels and the top and bottom panels together. Buy some matching touch-up paint and go over the spots ~ Where you removed the paint.

Another problem is that it will take more work to replace cards, since you have to remove so many screws to get to the inside. Also, the threads in the panels will eventually strip after the screws have been removed/rep laced a few times. This can be minimized

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by starting the screw by hand to make sure it engages with the thread already in place rather than starting a new one each time you put the screw back in place. My advice is to plan your changes carefully and make several changes at once if possible, or if you're unsure of a change, test it be-fore you put the case back together.

I've included weather satellite pictures showing the quality of the pictures after the modifications **(Photos D, E, F - NOT shown here).**

I didn't bother saving any pictures with the noise in them, so I can't show you how bad they actually were. The pictures before modifications had two or three lines of noise (no picture data) every 10 to 20 seconds whenever the program wrote data to the hard drive. I wanted to show how bad the pictures used to be, so I removed the top of the case and began digitizing a satellite pass. To my surprise there was no interference in the receiver! Now I couldn't force the PC to interfere! Maybe you won't have to drill any holes in your case top/bottom to silence it. Try all the changes except for drilling holes in the case to see if that is adequate for your PC.

Other people have PCs similar to mine and don't have interference. Maybe I had a very noisy motherboard, an exceptionally leaky PC case, a bad antenna location, or the combination of all these. The bottom fine is that I eliminated the noise and I learned a lot in the process.

By the way, you might keep this article handy. In the future, PC microprocessor speeds are only going to go up and the holes in your case that don't leak EMI now will let the higher frequencies right through! Microprocessors are running at 233 MHz in the new PCs now, with speeds twice that high probably not more than a few years away. The techniques in this article may help you later if you have problems with EMI.

If you make these changes to your noisy PC I would be interested in hearing from you. I'd like to know how it helped or if it didn't. Good luck-and go slowly when making the modifications. Remember, too, that tampering with your PC might void its warranty if there is one-be sure to check this if it matters to you.

And finally, many thanks to my wife for helping review this article and to Ben Jagla for the photos.

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73 Amateur Radio Today .
April 1998

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Bulletins (Sundays at …)
11h15 Start call in of stations
11h30 Main bulletin start

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439.000MHz   7.6MHz split
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West Rand members - we need your input!

To make this the best ham radio magazine in South Africa we need your input. Please submit articles, comments, suggestions etc.

Please send plain text with no formatting to the email address below.

In July 2003, we re-published an Anode Compendium on CD. It has the issues from July 2000 until June 2005. This included the new Adobe reader. It has been updated, check with the chairman for details.
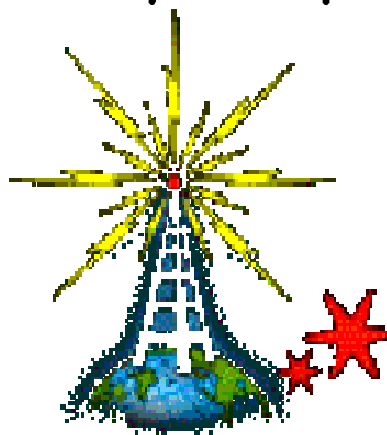
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