Nuts & Volts

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Exploring Electronics And Technology For The Hobbyist And Professional

August 1998 Vol. 19 No. 8

The Year 2000 Problem

As the new century draws nearer, computer systems large and small are headed for disaster. Find out just why, what, and how ...

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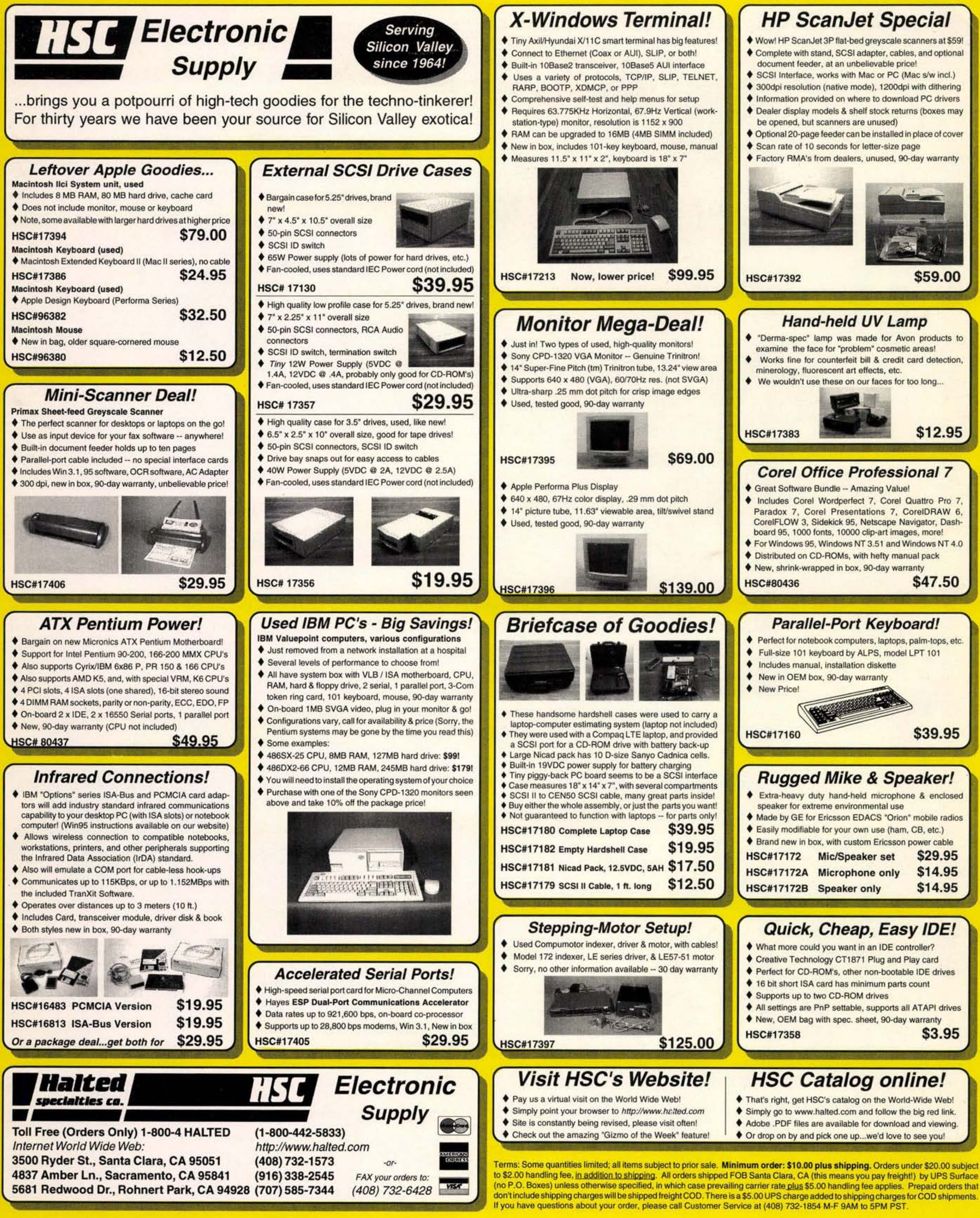
Write in 146 on Reader Service Card.



Write in 147 on Reader Service Card.

How to make your car invisible to radar and laser

Rocky Mountain Radar introduces a device guaranteed to make your car electronically "invisible" to speed traps—if you get a ticket while using the product, the manufacturer will pay your fine!

by Phil Jones

■ *The Phazer will "jam" both radar and laser guns, preventing police from measuring your speed.*

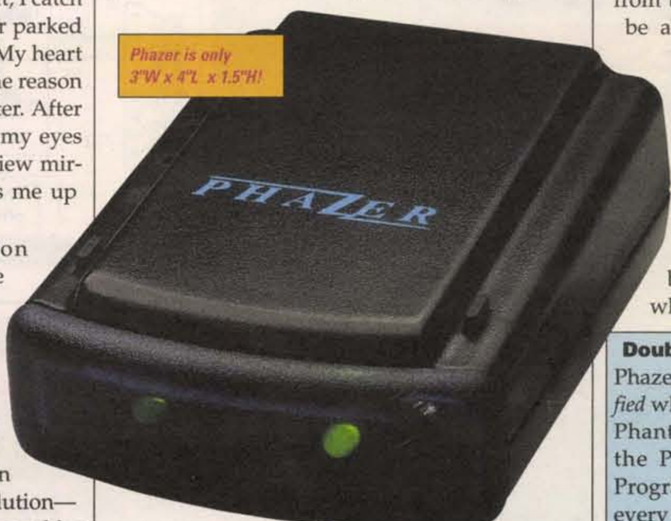
If your heart doesn't skip a beat when you drive past a speed trap—even if you aren't speeding—don't bother reading this. I can't tell you how many times that has happened to me. Driving down the interstate with my cruise control set at eight miles over the limit, I catch a glimpse of a police car parked on the side of the road. My heart skips a beat and for some reason I look at my speedometer. After I have passed the trap, my eyes stay glued to my rear view mirror, praying the police officer will pass me up for a "bigger fish."

It seems that as speed-detection technology has gotten more and more advanced, speeding tickets have become virtually unavoidable. And although devices exist that enable motorists to detect these speed traps, they are outlawed in many states... including mine.

The solution. Today, Rocky Mountain Radar offers drivers like me a perfect solution—the Phazer. Combining a passive radar scrambler with an active laser scrambler, the Phazer makes your automobile electronically "invisible" to police speed-detecting equipment.

The radar component works by mixing an X, K or Ka radar signal with an FM "chirp" and bouncing it back at the squad car by way of a waveguide antenna, effectively confusing the computer inside the radar gun. The laser component transmits an infrared beam that has the same effect on laser Lidar units.

Perfectly legal. Some radar devices have been outlawed because they *transmit* scrambling radar beams back to the waiting law enforcement vehicle. The Phazer, however, *reflects* a portion of the signal plus an added FM signal back to the police car. This, in effect, gives the waiting radar unit an electronic "lobotomy." Best of all, unless you are a resident of Minnesota, Oklahoma or Washington, D.C., using the Phazer is completely within your legal rights.



How it scrambles radar. Police radar takes five to 10 measurements of a vehicle's speed in about one second. The Phazer sends one signal that tells the radar the car is going 15 m.p.h. and another signal that the car is going 312 m.p.h. Because police radar can't verify the speed, it displays no speed at all.

■ *The Phazer makes your car invisible to police radar and lasers or the manufacturer will pay your speeding ticket!*

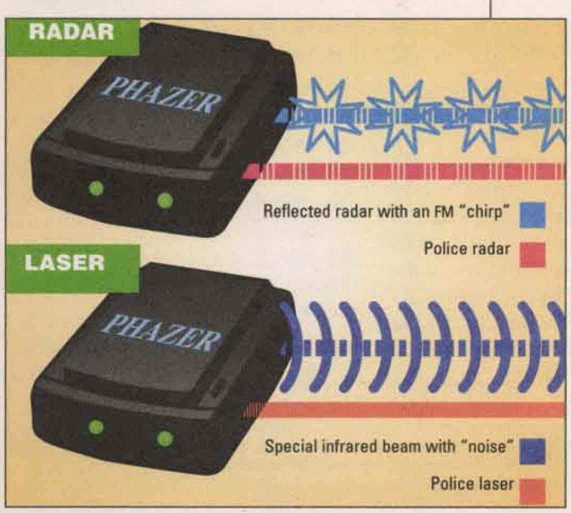
Works with laser, too! The Phazer also protects your vehicle from Lidar guns that use the change in distance over time to detect a vehicle's speed. The Phazer uses light-emitting diodes (LEDs) to fire invisible infrared pulses through the windshield. Laser guns interpret those pulses as a false indication of the car's distance, blocking measurement of your speed.

Range up to three miles. The Phazer begins to scramble both radar and laser signals as far as three miles away from the speed trap. Its range of effectiveness extends to almost 100 feet away from the police car, at which point you should be able to make visual contact and reduce your speed accordingly.

Encourage responsible driving. While the Phazer *is* designed to help you (and me) avoid speed traps, it *is not* intended to condone excessive speeding. For that reason, within the first year, the manufacturer will pay tickets where the speed limit was not exceeded by more than 30%, or 15 miles per hour, whichever is less.

Double protection from speed traps. If the Phazer sounds good, but you prefer to be *notified* when you are in range of a police radar, the Phantom is for you. The Phantom combines the Phazer (including the Ticket Rebate Program) with a radar detector. It's legal in every state except Minnesota, Oklahoma, Virginia and Washington, D.C. Ask your representative for more details!

Risk-free. Speed traps don't make my heart skip a beat anymore. The Phazer and Phantom are both backed by our risk-free trial and three-year manufacturer's warranty. Try them, and if you're not satisfied, return your purchase within 90 days for a "No Questions Asked" refund.



HOW TO MAKE YOUR CAR DISAPPEAR

Radar and laser scramblers are devices that foil speed traps by making vehicles electronically "invisible" to police radar. Radar scramblers mix a portion of the radar signal with background clutter and reflect it back to the squad car. This technique, pioneered by Rocky Mountain Radar, creates an unreadable signal that confuses the computer inside the radar gun.

The laser scrambler in the Phazer works in a similar manner. It transmits a special infrared beam with information designed to scramble the laser signal. The result? Readouts on police radar and laser guns remain blank. As far as the police officer is concerned, your vehicle is not even on the road.

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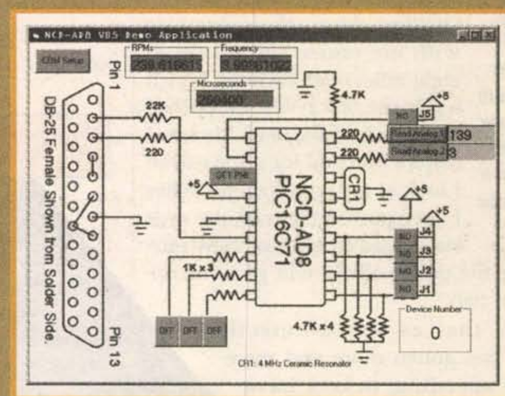
ON THE COVER ...



COLUMNS

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The Year 2000 Problem

by Jeff Stefan

As the new century draws nearer, computer systems large and small are headed for disaster.

The earth orbits the sun in approximately three hundred sixty five and a quarter days. When the earth passes through space and time on December 31, 1999, traffic lights will no longer behave predictably, food will remain unsold on supermarket shelves, machines will stop or behave erratically, paychecks will not be issued, and commerce as we know it may abruptly halt. Why?

Because most computers do not contain the proper date mathematics to accurately track dates into the next century. This is commonly called the Year 2000 Problem, The Y2K Problem, or the Millennium Bug.

It's been estimated that over 36 million computer programs will be affected by the Year 2000 Problem. Here are some of the areas of everyday life that are potentially affected.

Finance and Accounting

Three trillion dollars change hands electronically every day. The process of dollars changing hands electronically means that all transactions must be correctly and securely time and date stamped. If the time and date stamps on electronic financial transactions are incorrect or meaningless, mountains of interest dollars will be lost or calculated incorrectly. Think of even a minute's worth of interest lost on $3 trillion dollars and you can see the huge financial risk that hangs on solving the Y2K Problem.

These interest problems trickle down to your own personal bank account. Is your bank working on solving the Y2K problem? It may be worth finding out. How about your mortgage company? Will their interest schedules go haywire when the Year 2000 hits, and how will it affect your mortgage payment?

For the consumer, credit card expiration dates will be unpredictable. When you use your credit card, it may work at one point of purchase, but not another. Stocks and bonds may take a big hit. Some people are quietly pulling out of the stock market and are investing in precious metals, such as gold and silver. Expect the price of gold to skyrocket.

What about people living on fixed incomes? People depending on pensions, social security, and insurance benefits will be adversely affected if the computer programs that produce pension checks and insurance benefits are not Y2K compliant.

Building Environment Control

Modern buildings rely on computers for heating, air conditioning, water usage, elevator control, personnel entry and exit, and security. Most of these functions rely on real time clock information to sequence and control devices and events. When the Year 2000 Problem hits, air conditioning and heating systems may not function, toilets may not flush, and you might get stuck in an elevator (if your entry-access card allows you to enter the building at all). Security systems could go haywire, laying valuable physical and intellectual property in the building open to theft or destruction.

Food Supply

Most perishable food is labeled or delivered with an expiration date. If the dates are incorrect or absurd, such as a negative date code, then there is no way to trust the quality of the food item. What do store owners do? If they stock the food, they run the risk of causing an epidemic of food poisoning. If they refuse to stock the food, they run the risk of going out of business. One or two stores wouldn't matter, but scale this scenario up to major food outlets on a national level, and it becomes a serious, potentially life-threatening problem.

Medicine, Waste, and Water Treatment

The quality of life depends on some fundamentals: an adequate food and water supply, and proper medical care. An uninterruptible supply of safe drinking water is the cornerstone of modern civilization. Water treatment plants are subject to breakdown due to the Millennium Bug.

Most valves in water treatment plants are controlled by embedded systems, programmed to go on or off at certain times. If these systems fail, then so does the water treatment plant, and so does the water supply. The same scenario applies to waste treatment plants.

The Y2K problem can affect medical diagnostic equipment, such as CAT scanners and MRI machines. These contain real-time clocks, as do other medical diagnostic equipment, which are controlled by-and-large by embedded computer systems. On the clerical end of medicine, patients records can become dangerously muddled due to invalid birth dates values or incorrect diagnostic data. At worst, emergency rooms may not be able to adequately and reliably treat patients.

Manufacturing and Industry

Business programs are a breeze to fix compared to programs running on the factory floor. Why? Because a lot of industrial programs run from ROM (Read Only Memory) in embedded systems. The programs that run from ROM may be old and have no source code available, let alone development tools such as compilers, linkers, and debuggers. Even if the tools were handy, the time to reverse-engineer and correct the code, then debug the running program takes a lot of time and pulls the manufacturing machinery off-line, resulting in production slowdowns, stoppages, and layoffs.

There are no consistent languages or operating systems in embedded systems, and a lot of systems are dependent on hardware, such as real-time clocks. A real-time clock is a chip set or add-on board that stores current date and time information.

A lot of early real-time clocks store the year with two bytes, resulting in the year 2000 looking like year 00. In an embedded system, it may be impossible to tell what will happen when the year 2000 hits. Large manufacturing companies may be able to replace or upgrade their equipment, but small machine shops where money is tight may have to simply wait and see what happens. Expect many small manufacturing enterprises to fold.

Traffic Management and Transportation

The General Accounting Office recently issued a report noting that there is a real possibility of air traffic control systems failing if the FAA doesn't hurry its effort to correct the Millenium Bug. KLM, the Dutch Airlines, has publicly stated that it may ground its planes before the Y2K Problem hits until it considers air travel safe.

Recently, the Air Transport Association conducted a survey of 44 airlines regarding Year 2000 compliance. Sixty seven percent of the airlines surveyed are anticipating that their computer systems will be fully compliant by October 1, 1999. That leaves 33 percent possibly non-compliant. The Y2K Problem not only affects flight schedules but, more importantly, affects aircraft maintenance.

Back on the ground, traffic lights are controlled by real-time clocks. If these clocks fail, then traffic lights will go haywire. The potential for long-term traffic chaos and serious accidents exists. Public transportation systems such as trains, subways, and busses may be disrupted or disabled due to mangled schedules.

Communications and Energy Infrastructure

Telephone switching stations and networks, if not updated, will not work. Thrown into the mix are loads of embedded systems, making the problem of bringing the communications infrastructure to Y2K compliance as difficult as the manufacturing and industry problem.

Some telephone companies have been working on the Y2K Problem for some time, but there hasn't been an FCC initiative to insure that long distance service and local exchanges correct the Millennium Bug. Be careful making phone calls on January 1, 2000. Your telephone bill may be grossly inaccurate.

In the public energy arena, power generating stations are at risk. Power stations, both conventional and nuclear, contain a large quantity of embedded systems that control values similar to water and waste treatment plants. Expect potential blackouts and brownouts.

A Brief History of Time

In the early days of commercial computing, programs and data were entered into mainframe computers via punched cards. Those of us that have been around awhile remember the painful process of writing programs on punched cards.

The cards must be punched perfectly, and must be in the correct order. Each card can hold 80 characters of data. The 80 character width spilled over to early CRT displays, and have held on to this day. This is analogous to text display in DOS mode, which is 80 character wide. If you type in one line across the screen, that's how much data one punched card can hold.

Mainframe storage in the early days — which consisted of magnetic drums — was very expensive, so shortcuts and data reduction tricks were valued. One obvious area of data reduction was using a two byte date code. In the 1960s up to the 1980s, you would be hard pressed to find anyone who seriously thought that the systems they were writing programs for would be around in the 21st century. They were wrong. That's the root of the problem that has the potential to disrupt civilization as we know it: two bytes of storage.

The world of computing is sometimes ironic. While some things change at blistering speed, other things move no faster than natural evolution. In the late 1950s, three languages were invented that still persist today. These languages are FORTRAN, Lisp, and COBOL.

FORTRAN is still used for sophisticated numerical processing, Lisp is still the premier language for artificial intelligence research, and COBOL is used for most business and financial processing. COBOL is by far the most widespread of these languages.

COBOL stands for Common Business Oriented Language and its origin is attributed to the late Admiral Grace Hopper, a brilliant and long-lived computer scientist. It's a testament to brilliance, quality, and hard work that these languages still persist, but with this persistence comes the source of the Year 2000 Problem.

Old code written in old languages hang like a millstone around the world of information and data processing. Even if you have new hardware, you're probably running old software.

For all practical purposes, the beginning of time for computers is January 01, 1900. This is the date that almost all computers subtract from the current date. I checked out some old COBOL textbooks, and searched for date references. One interesting example is the format of the ACCEPT statement. The ACCEPT statement allows formatted data to be input to a COBOL data element via a console device, such as a video terminal.

The ACCEPT statement is specified as:

ACCEPT identifier FROM {DATE} | {TIME}

The date format is given as yy/mm/dd, where yy is the year, mm is the month, and dd is the day. This means that July 4, 1998 is formatted as 980704. In COBOL, this is a six digit unsigned numeric integer data type. This is okay for the Twentieth Century, since 1998 - 1900 = 98. But if a date of July 4, 2000 is entered, then the 2000 - 1900 = 100. That's one digit to the left too many, so 100 is truncated to 00. This winds up as date code of 000704, which makes no sense to a COBOL program.

Why is it so hard to fix?

The two-digit date code is not the only Y2K problem. There have traditionally been two problems plaguing program development since the birth of commercial computing: lack of rigorous software engineering methods and lack of software engineers. There are a lot of programmers, but highly disciplined software engineers are much less abundant. This isn't a slam; it's just the way things are in software development.

In a lot of situations, programmers are forced to produce code before a suitable design for the program is constructed. It's like dropping a load of glass and steel at a construction site and expecting a building to be instantly constructed without a blueprint. It will emerge ugly and barely usable, and it surely won't pass any building codes!

The situation is getting better as companies realize that software is what makes their products work, from toaster ovens to fighter planes, but the "software crisis" didn't get its name for nothing. Why is there a software crisis?

Because software was generally thought to be an afterthought, a trivial exercise after the hardware for a project was completed. After billions of dollars lost due to late or failing software projects, industry and academia have finally taken notice and addressed the problem. Add the lack of good software engineering practices in the past to the Y2K Problem and you can see that there is no easy, universal fix.

Place yourself in the situation of trying to understand, change, compile, and test a program that's been kicking around for years. This kind of program is called legacy code. The code has probably been modified many times by many different programmers. Probably most of the programmers are long gone, so there's no chance to talk to any of the original authors about a change he or she made in the code.

Chances are, they wouldn't remember the change anyway. If you're lucky, some of the code changes will be well documented. Most of the time, programs are modified with little or no supporting documentation explaining why the change was required and how the change fits into the overall design of the program.

Once you understand the program, you need to find all of the support tools, such as editors, compilers, linkers, and debuggers. These tools must be available to make any changes to the program. On older programs, these tools may no longer exist. If you've gotten as far as acquiring the tools, you're doing well, but the hard part is just beginning.

After you make changes to the program, you need to compile and test it to see if it works properly. This means taking the computer off line and out of the production loop. If the program is a accounting application, it will stop printing paychecks and processing invoices because you've taken the computer off line for testing. If the program is an industrial application, machinery and production lines will stop, forcing work stoppages and idling workers. All of this costs an incredible amount of money.

Fixing a software problem is sometimes greatly underestimated. The bug itself may be easy to fix, but getting to the bug is another story. It's very similar to flying from one city to another. Flying from Detroit to Chicago takes about an hour, flight time.

Here's what really happens when you make the trip: you leave the house, drive to the airport, park the car, check your bags, go through security, wait to taxi and take off, fly, land, taxi to the gate, wait to get off the plane, stand in line to get your bags, stand in line to rent a car, get out of the rental lot, then drive in unfamiliar territory to your destination.

The flying part is just a small part of the equation, and the trip generally takes about five to six hours. So it is with making changes in software. The actual change may be small and take little time, but gathering the tools and setting up the environment to make the change may be a larger effort than making the change itself.

How much will it cost to fix?

Cost figures to correct the Millennium Bug are usually given in several forms, which are cost per line of code, cost per bug, and the overall cost. The cost per line of code estimates range from 35 cents per line of code to $1.65 per line of code. That averages to one dollar per line of code to fix. The cost per bug has been estimated at $4,666.00.

The overall estimates are staggering, some as high as $600 billion US dollars. Some estimates are $50 million to $100 million dollars per company. Some companies have over 100,000,000 lines of code in their systems! General Motors alone is spending about $550 million to fix the Y2K Problem.

What are companies doing to fix the problem?

Some companies are doing a lot and have anticipated the problem for a long time, and some other companies are doing too-little-too-late or nothing at all. Bell Atlantic has been working on the Y2K problem since 1994, and expect to be complete by July 1999. It's been estimated that only 35% of North American businesses have seriously addressed the Y2K Problem.

This leaves the door open to massive lawsuits based on a company's product or services failing to meet Y2K compliance. Expect board room blood baths as executive heads roll when the complaints, warranty returns, and lawsuits come flooding in.

Potential lawsuit costs resulting from the Millennium Bug are estimated at $1 trillion dollars.

Y2K Checklist

I have a Y2K checklist stuck to my refrigerator that I created, and plan on checking off the items if and when they occur. (See Figure 1.)

This is a minimal checklist, so add as many items that you can think of. Undoubtedly, there will be loads of Year 2000 post-mortem articles and reports written citing these and many other problems. It'll be interesting to go back to the list and see which events actually occurred.

If you think we have it bad, look at Europe. On January 1, 1999, the Euro, which is the unified European currency, is being introduced. This directly impacts European financial transactions and European financial software. Thousands of programs must be changed or re-written to conduct all European financial math in a new, uniform unit.

Throw the Year 2000 Problem on top of this, and the entire European economy may come tumbling down, ultimately affecting us. Any financial program in the United States that deals with the Euro will also have to be modified.

The Y2K problem has a fixed deadline: January 1, 2000. This deadline is non-negotiable. Like a freight train lumbering along in the distance, the Year 2000 is approaching at a steady and inalterable rate.

Remember the recent Galaxy satellite failure and how it impacted business, government, and industry when pagers failed? That's just a small taste of what lies in store when the Y2K Problem hits.

Just make sure you're not stuck in an elevator at the stroke of midnight, December 31, 1999. On second thought, that may be the safest place to be! NV

FIGURE 1

Year 2000 Checklist

- ☐ Are any of your city services, such as water, power, garbage collection, or fire and police protection being disrupted?
- ☐ Are you being charged too much, or not enough, for any city or municipal services?
- ☐ Are you getting paid on time for the correct amout of time worked?
- ☐ Are you having coverage problems with insurance and health benefits?
- ☐ Are you temporarily unemployed due to the Y2K problem?
- ☐ Are you temporarily over-employed trying to fix the Y2K problem at your organization?
- ☐ Have you been stranded traveling due to the Y2K problem?
- ☐ Are your local traffic light working erratically?
- ☐ Has your local supermarket been effected. Are they selling food with unreliable expiration dates?
- ☐ Did your local ATM fail to work properly, if at all?

Open Channel

by Joseph J. Carr

Want to Earn an Electronics Technology Degree?

Several times in this space, I have addressed distance education. What surprised me was the intense interest there was in this subject. A number of people contacted me for more details. So many, in fact, that I got tired of typing out the same details, and answering the same questions.

But perhaps I was wrong to be surprised. The electronics field has a long history of effective distance learning ("correspondence courses"), as well as a long and honorable history of people learning on their own. I recently talked to an 18-year-old kid, a reader of this column, who knew as much or more about microwave receivers as most professional engineers I know.

One of the problems that you will face if you try to get employment in electronics technology is credentials. The days of a stand-up interview to "... show the boss what you know" are basically over. All but the lowest entry level or dead-end jobs require some sort of diploma or certificate. At one time, that function was filled nicely by the FCC Radiotelephone Operators license. Having a "first phone" or "second phone" ticket from FCC showed that you knew at least something. Except in a few areas, the FCC commercial licenses aren't even required anymore, so the General Radiotelephone Operators Permit is of less value than the old second phone license.

In many areas of electronics, especially in servicing, the ISCET Certified Electronics Technician (CET) certificate serves as a credential. Prospective employers know that a technician with the CET knows at least a certain minimum essential body of knowledge, and has a certain number of years of experience. I've even seen on advertisement for a Excepted Service position with the Central Intelligence Agency that called for an electronics communications technician, and stated "ISCET Certified Electronics Technician" as one of the desired (although not mandatory) qualifications. So you CETs, if you want to be a techno spook, the Cuban Invasion Authority thinks highly of you.

The vocational and technical institute diploma has also been well regarded by many people. Anywhere from one to three years of training, often a mix of on-the-job supervised learning and classroom work, leads to a diploma that can be used as a credential to obtain employment. Vo-tech schools vary from the very, very good to the very, very poor, with at least a few being out-and-out frauds. The latter are usually in business to collect students loans and government grants, not to educate the student.

Be wary of commercial vo-tech schools that seem to have too few laboratory facilities. You might be especially interested in asking them two questions: 1) "What is the percentage of students starting who actually finish?" and 2) "What is the percentage of those who graduate that find jobs for which they were trained in six months or less?" The answers might surprise you.

A large and increasing number of jobs are requiring, at least implicitly and often explicitly, a college degree in electronics technology. There are two levels of degree: Associates and Bachelors. The former is sometimes called Associate of Applied Science (or Associate of Science) in Electronics Technology (AAS or A.Sc.). The latter is nearly always called the Bachelor of Science in Electronics Technology (B.Sc. or BSET).

The traditional way to obtain an electronics technology degree is to attend classes at an accredited institution for two years (Associates level) or four years (Bachelors level), and take the degree at the end. That may well be the ideal situation, especially for young students. But there is another course of action open to those who have knowledge of electronics technology based on any of the following:

- Military courses
- Company courses
- Self-study
- Correspondence courses
- Work experience
- College courses
- ... And so forth

As I said up front, there are myriads of ways that people learn electronics. Perhaps more so than most fields, electronics has attracted a large number of people who gain college-level knowledge of the subject in non-traditional ways. There is a way for many of these people to earn an Associates or Bachelors degree in technology.

One problem faced by many of these people is that such knowledge does not necessarily come while in high school. Indeed, it probably came only after a number of years in the field. Unfortunately, those are the very people who find it the hardest to take time off to go to school. Marriage, mortgages, and responsibilities make it difficult to pursue such a course of action. I was one of those people.

My high school diploma was of the vocational variety because I knew I needed the skills to earn a living in those days before financial aid was widespread. It took me: 1) two years of post-high school classes to qualify to get into college; 2) 11 years of part-time study and full-time work to earn a Bachelor of Science degree, and 3) another two years to earn a Master of Science in Electrical Engineering. That's 15 years ... a heckuva long time.

But I was also very knowledgeable ... a result of my own drive and curiosity, aided and prompted by a couple of good mentors (actually "kicked in the butt" is a better way of saying it than "prompted"). Fortunately, there is help for people who, like me, attained a lot of knowledge at the college level through any of the mechanisms that I mentioned above.

Regents College [7 Columbia Circle, Albany, NY 12203-5159; **518-464-8500** (voice), **518-464-8777** (FAC), **518-464-8501** (TDD); **http://www.regents.edu**] offers both Associates and Bachelors degrees in various technology fields:

ASSOCIATE'S LEVEL

1. Computer Software
2. Electronics Technology
3. Nuclear Technology
4. Technology with Specialty

BACHELOR'S LEVEL

5. Computer Information Systems
6. Computer Technology
7. Electronics Technology
8. Nuclear Technology
9. Technology with Specialty

Regents College was originally founded as a credit bank where people, especially military, could have an official transcript of what they had learned. It was set up and operated by the New York State Board of Education. In New York, the Regents of the University of the State of New York control higher education.

When the program was authorized to grant degrees (1971), they were originally called Regents External Degrees ("external" means no residency requirement at the school). The school was eventually renamed Regents College. Later, the Board of Regents realized that a conflict of interest existed when they were both regulating degree granting institutions, and operating one. So on April 9, 1998, Regents College became a separately chartered college in New York state.

The one thing that you must be absolutely certain of in any school that you select is its accreditation. There are many fine unaccredited learning institutions, I am sure, but their degrees are de-valued by the lack of proper accreditation. There are regional accrediting bodies, recognized by other colleges and the US Department of Education, which accredit colleges in the USA. Regents College is accredited by the Commission on Higher Education of the Middle States Association of Colleges and Schools. Being accredited in the 1970s, Regents College has a reasonable claim to being the oldest and largest virtual university in the USA.

Degree Requirements

As with all degree programs, Regents requires that you possess knowledge in three main areas: 1) general education; 2) foundations of the specific field of study; and 3) elective subjects. The "general education" component is that area where many technology people ask "Why do I need to know that stuff?" The reason is simple: It's the level of educational achievement expected of college educated people. It consists of the humanities and skills, such as quantitative methods (college catalog way of saying "math") and both oral and written communications.

There are a number of ways that you can earn credit, including credit for what you already know. But don't get the idea that "it's a skate." Perhaps because some people, out of ignorance, have been generally critical of distance education, colleges that offer it tend to be real sticklers for the integrity of their processes.

If you claim a body of knowledge, and want college credit for it, then it will have to be demonstrated in some objective manner that will withstand scrutiny. You will not pop into the program and gain credit for any and all educational and training experiences, or that vague thing called "life experience." To be sure, credit can be based on these factors, but only when supported by some objective means such as a proctored examination or review by some competent authority.

If you do a little research (e.g., Dr. John Bear's web site (http://www.degrees.net and book), you will find that most schools that seem a little too quick to grant "credit" based on shabby credentials are not accredited (and for good reason!).

But there are a number of traditional and non-traditional ways of earning credit at Regents College.

Transfer of Credit. Many of the people who earn Regents College degrees do so through standard courses at accredited two- and four-year colleges. Unfortunately, if you are like me, then moving around a bit meant going to too many different schools to add up to a complete degree program in any one of them (most schools do not transfer 100 percent of your credit from other schools ... gotta get those tuition dollars!). Either that, or you are not in one place long enough to satisfy degree requirements (e.g., the military). You can apply any qualified and non-duplicative course from traditional colleges, including: classroom courses, computer and video courses, telecourses, supervised independent study, and print-based courses.

College Level Proficiency Exams. There are a number of proctored examinations that can be applied for credit at Regents and other colleges. These include Regents College Examinations (known outside New York State as ACT PEP Regents College Examinations), College Level Examination Program (CLEP), Defense Activity for Non-Traditional Education Support (DANTES), and the subject area tests of the Graduate Record Examination, Advanced Placement Examinations, Ohio University Exams, University of North Carolina Exams, New York University Foreign Language Proficiency Tests, and the Thomas Edison College Examination Program (TECEP). You can check the Regents College web site for their DistanceLearn program for others.

Another way to earn credit is for programs reviewed by either the American Council on Education (ACE) or the New York National Program on Noncollegiate Sponsored Instruction. These include quite a number of corporate, business, industry and military training programs, some proprietary schools, licenses or certificates in certain subjects, professional examinations (e.g., EIT or PE), and certain credit-by-examination programs.

One final way is the Regents "special methods" approach. These include a Special Assessment examination, a portfolio examination, Federal Aviation Administration certificates, and credit-by-evaluation programs.

A Portfolio Examination is performed in collaboration with Ohio State University, Charter Oak State College, and Empire State College. This approach is for people who have acquired college level education, and can prove it through a portfolio of written works, letters of recommendation or testimonials from certain types of people (e.g., college faculty). The documentation will be evaluated and a decision made on whether or not (and how much) credit is awarded.

A Special Assessment is an individualized examination used to measure learning that is difficult to evaluate through any of the standard proficiency examinations. Each Special Assessment Exam is individually arranged, and will be conducted by at least two faculty members expert in the subject area being examined. It may consist of any or all of the following types of activities: oral exam, written exam, demonstrations, performances, and/or exhibitions of your works.

I went through the Special Assessment process in 1978, and earned more than 40 credit hours. It consisted of a three-month-long review of some of my books and articles, and a three-hour-long oral examination by three professors from colleges in New York State. Not all of my books qualified, but those that were at a professional level, and those that were being used as textbooks in colleges, were included in the mix. Of course, it didn't hurt a bit to have written a few college textbooks. (I have had the rather odd experience of being asked to not take a particular undergraduate course in college because the Graduate Teaching Assistant conducting the class found out that I had written the textbook he was using!)

At any rate, if you are interested in pursuing a technology degree, then contact Regents or

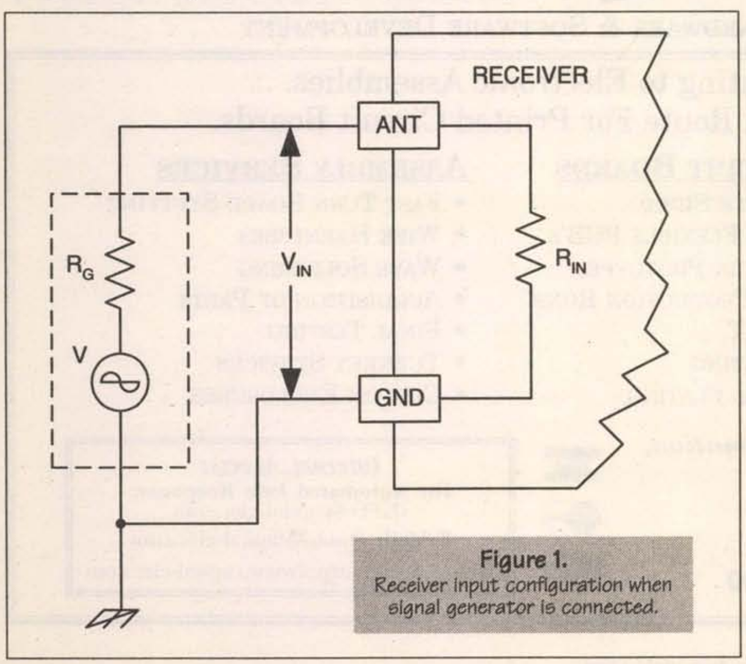

Figure 1.
Receiver input configuration when signal generator is connected.

visit their web site at http://www.regents.edu.

Two-Minute Technical Tutorial (T3)

This month, I want to try something a little different. I am calling it a Two-Minute Technical Tutorial, or T3. These pieces will be focused, technical short subjects.

Radio Receiver Sensitivity

The sensitivity of a radio receiver describes its ability to respond to weak signals. In analog receivers, sensitivity is defined in terms of the signal required to produce a specified demodulated signal-to-noise ratio (SNR). In digital receivers, the measure is the bit error rate (BER). In some cases, the raw number is insufficient, so sensitivity is described in terms of the signal level to produce an SNR of at least 20 dB 95 percent of the time.

A number of different factors must be considered when determining a receiver's sensitivity: equivalent input noise factor, equivalent noise bandwidth of the system, the signal-plus-noise to noise ratio (S+N/N), among others.

The way of specifying the receiver input signal level must be considered when discussing receiver sensitivity. Consider Figure 1. The signal generator can be modeled as a voltage source, with an open-circuit (no load) value of V, and an internal impedance, RG. The receiver can be modeled by its input impedance, RIN. When the signal generator is connected to the receiver input, the open-circuit voltage (V) is dropped across RG so that the closed-circuit voltage VIN is proportional to RIN/(RIN + RG).

The usual procedure is to define the sensitivity in terms of the open-circuit output voltage (V), but the output level meter on signal generators is usually calibrated in terms of closed-circuit voltage (VIN in Figure 1), i.e., when a load equal to RG is connected across the output terminals. When RG = RIN, V = 2VIN. In order to make the output meter of the signal generator read the correct value, it is common practice to insert a 6 dB attenuator in series with the signal path between the signal generator and the receiver (Figure 2).

For most commercial receivers, the usual test condition is the sensitivity required to produce a 10 dB signal-plus-noise-to-noise (S+N/N) ratio in the mode of interest. For example, if only one sensitivity figure is given, one must find out what bandwidth is being used: 5 to 6 KHz for AM, 2.6 to 3 KHz for single sideband, 1.8 KHz for radioteletype, or 200 to 500 Hz for CW.

Bandwidth affects sensitivity measurements. Indeed, one place where "creative spec writing" takes place for commercial receivers is that the advertisements will cite the sensitivity for a narrow bandwidth mode (e.g., CW), while the other specifications are cited for a more commonly used wider bandwidth mode (e.g., SSB). In one particularly egregious example, an advert claimed a sensitivity number that was applicable to the CW mode bandwidth only, yet the 270 Hz CW filter was an expensive option that had to be specially ordered separately!

Another indication of sensitivity is minimum detectable signal (MDS), and is usually specified in dBm. This signal level is the signal power at the antenna input terminal of the receiver required to produce some standard S+N/N ratio, such as 3 dB or 10 dB. In radar receivers, the MDS is usually described in terms of a single pulse return and a specified S+N/N ratio. Also, in radar receivers, the sensitivity can be improved by integrating multiple pulses. If N return pulses are integrated, then the sensitivity is improved by a factor of N if coherent detection is used, and the square root of N if non-coherent

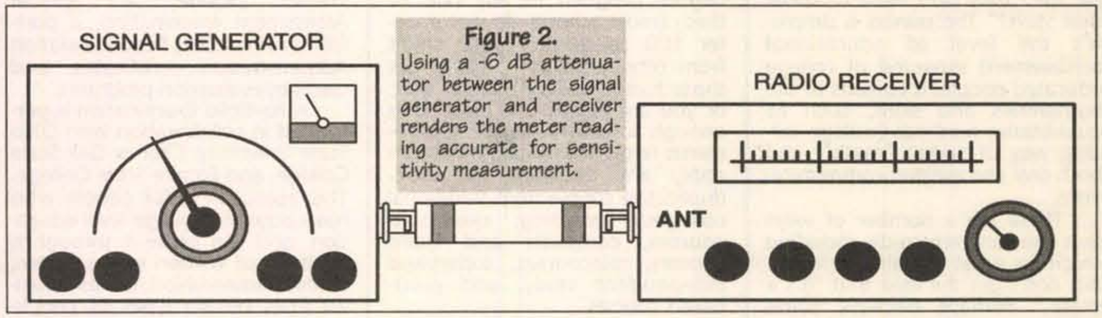

Figure 2. Using a -6 dB attenuator between the signal generator and receiver renders the meter reading accurate for sensitivity measurement.

detection is used.

Modulated signals represent a special case. For those sensitivities, it is common to specify the conditions under which the measurement is made. For example, in AM receivers, the sensitivity to achieve 10 dB SNR is measured with the input signal modulated 30 percent by a 400 or 1,000 Hz sinusoidal tone.

An alternate method is sometimes used for AM sensitivity measurements, especially in servicing consumer radio receivers (where SNR may be a little hard to measure with the equipment normally available to technicians who work on those radios). This is the "standard output conditions" method. In some manuals, they will specify the audio signal power or audio signal voltage at some critical point, when the 30 percent modulated RF carrier is present. In one automobile radio receiver, the sensitivity was specified as " X ¼ V to produce 400 mW across an 8-ohm resistive load substituted for the loud speaker when the signal generator is modulated 30 percent with a 400-Hz audio tone. "The cryptic note on the schematic showed an output sinewave across the loudspeaker with the label "400 mW in 8 © (1.79 volts), at 30% modulation 400 Hz , 1¼ VRF."

The sensitivity is sometimes measured essentially the same way, but the signal levels will specify the voltage level that will appear at the top of the volume control, or output of the detector/filter, when the standard signal is applied. Thus, there are two ways seen for specifying AM sensitivity: 10 dB SNR and standard output conditions.

There are also two ways to specify FM receiver sensitivity. The first is the 10 dB SNR method discussed above, i.e., the number of microvolts of signal at the input terminals required to produce a 10 dB SNR when the carrier is modulated by a standard amount. The measure of FM modulation is deviation expressed in Kilohertz. Sometimes, the full deviation for that class of receiver is used while, for others, a value that is 25 to 35 percent of full deviation is specified.

The second way to measure FM sensitivity is the level of signal required to reduce the no-signal noise level by 20 dB. This is the "20-dB quieting sensitivity of the receiver." If you tune between signals on an FM receiver, you will hear a loud "hiss" signal, especially in the VHF/UHF bands. Some of that noise is externally generated, while some is internally generated. When an FM signal appears in the passband, that hiss is suppressed, even if the FM carrier is unmodulated. The quieting sensitivity of an FM receiver is a statement of the number of microvolts required to produce some standard quieting level, usually 20 dB.

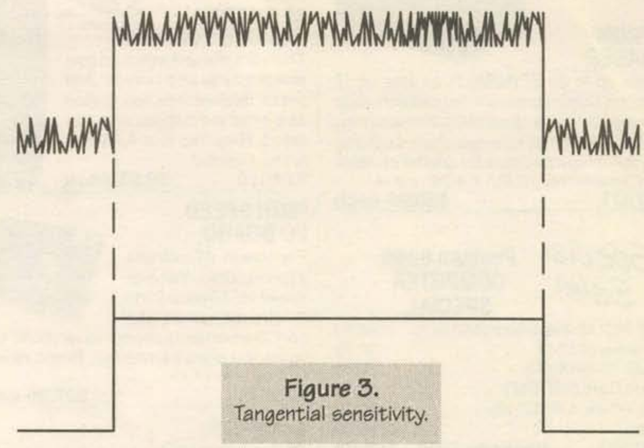

Figure 3.
Tangential sensitivity.

Pulse receivers, such as radar and pulse communications units, often use the tangential sensitivity as the measure of performance, which is the amplitude of pulse signal required to raise the noise level by its own RMS amplitude (Figure 3).

Sometimes, the sensitivity is defined not in microvolts required to create the specified output conditions, but rather the power level. Power is V2/RIN where RIN is typically 50 ohms (75 or 300 ohms in TV receivers). The power is usually described in terms of dBm, i.e., decibels relative to one-milliwatts dissipated in a 50-ohm resistive load. A typical value might be -113 dBm, which is comparable to 0.5 (V across the 50-ohm load.

When evaluating a receiver for sensitivity, make sure you understand what is being discussed. When you see a number quoted, know the bandwidth and mode being cited, as well as the output conditions assumed. **NV**

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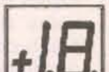

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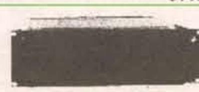
95L007 **$7.95 each**



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Mini tower case with power supply, two 5.25" and two 3.5" external bays, plus one internal bay for hard drive. LEDs for power, turbo and HDD.

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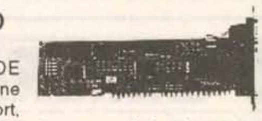

Two IDE ports, one floppy port, two serial ports, one parallel port.

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0.5" x 1.625" active area. 0% to 23% transmission. Switching rate up to 4 KHz. Specs included.

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25 feet long, with BNC connector on each end.

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Copper braid, solid center conductor.

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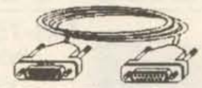

BASIC PARALLEL CABLE FOR pcANYWHERE

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Dear Nuts & Volts:

Is anyone looking for an automatic way to obtain full charge on both batteries of an RV from the engine alternator?

The bottom line on the standard two diodes is a little over 1/2 charge to both batteries.

For a way to up voltage output of the alternator: approximately one volt to overcome diode and cable drop.

Robert D. Layton
Vista, CA

Dear Nuts & Volts:

Although I enjoyed Fred Blechman's April '98 article about an inductance meter, the meter has some design problems. Furthermore, the classic Q-meter is a simpler (and older!) circuit for measuring inductance and Q.

Quick Henry's first design problem is the oscillator injection circuit. The value of R1 is only 4.7K. A 1H choke at 500 Hz (1H and 0.1 uF) has a reactance of 3K, so the instrument could not measure a Q higher than 1.5. The Q-limit for a 100 mH inductor is about 5.

The RF injection port has similar problems; a 50-ohm generator places about 1.25 kilohm across the resonant circuit using C5. A 1 microhenry inductor at 16 MHz has a reactance of 100 ohms, so the Q-limit is 12.5.

The meter circuit also loads the measurement. At 1600 Hz, the reactance of L1 is only 25 ohms, so the diode and meter resistances load the resonant circuit while the diode conducts. The meter circuit distorts the resonator waveform and affects the resonant frequency and the Q. The L/R time constant of the meter circuit less than eight microseconds (D1 is about 300 ohms at full scale), implying a cutoff frequency of 20 KHz. The mechanical inertia of the meter — not the inductor — does the filtering below 20 KHz.

Although Blechman's original unit was built 30 years ago, there were simpler designs around. Fifty-five years ago Frederick Terman (*Radio Engineers' Handbook*, McGraw-Hill, 1943, page 916) described the classic Q-meter.

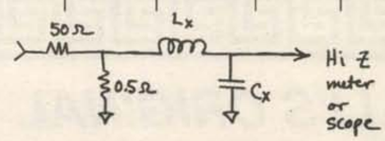
With a variable capacitor, the Q-meter offers direct readouts of L and Q. The Q-meter injection circuit works for both audio and RF frequencies. The Q is simply the ratio of the output voltage to the input voltage at the resonant frequency; the operator does not search for the 3 dB points.

The table below compares Quick Henry and Q-meter measurements. The 100 uA meter was simulated with a 47-ohm resistor. The measurements used the same inductors and capacitors, so the resonant frequencies should be identical for both instruments, but they are not. The actual capacitor and inductor values are unknown, but we can use one inductor to calculate the ratio of C2 to C3, and then use a second inductor to see if we get the same ratio.

The Q-Meter measurements are consistent (and show the ratio of C2 to C3 is off by eight percent), but the Quick Henry ratios are inconsistent (showing 10 percent in one measurement and 20 percent in another). Notice Quick Henry reports a higher resonant frequency and much lower Q even for these modest inductors.

Gerald Roylance
Mountain View, CA

Test Conditions			Quick Henry			Q-Meter		
Turns	Inductance +-20%	Capacitor	f, kHz	L, mH	Q	f, kHz	L, mH	Q
11T	.390mH	C3 = 0.01uF	84.89	.352	5.39	82.75	.369	15
		C2 = 0.1uF	25.6	.387	--	25.20	.399	17
20T	1.29mH	C3 = 0.01uF	49.93	1.02	--	45.33	1.23	20
		C2 = 0.1uF	14.4	1.22	--	13.79	1.33	22
31T	3.01mH	C2 = 0.1uF	9.15	3.02	3.15	8.85	3.23	24



Q-Meter circuit with 50-ohm drive and 0.5-ohm series resistor...

Response:

I congratulate Mr. Roylance on his well-written technical analysis challenging the accuracy of my simple "Quick Henry" device to measure inductance.

As stated in the last two paragraphs of that article, the accuracy of Quick Henry does not qualify it as a laboratory standard by any means. Numerous errors are cumulative, such as distributed capac-

Continued on page 71

SECURITY ELECTRONICS SYSTEMS AND CIRCUITS — Part 7

by Ray Marston

Ray Marston concentrates on practical build-it-yourself anti-burglary circuits in this month's episode of the series.

INTRODUCTION

Last month's episode of this series explained anti-burglary principles and described the basic operation of modern 'hard-wired' and 'wireless' burglar alarm systems. This month's episode starts off by briefly describing three basic categories of wireless burglar alarm and by looking at some basic types of intrusion sensor, and then goes on to describe a variety of practical hard-wired build-it-yourself anti-burglary circuits.

WIRELESS ALARM SYSTEM CATEGORIES

Domestic wireless burglar alarm systems vary greatly in price and performance, but can be roughly divided into the categories of 'low-cost,' 'mid-range,' and 'top-of-the-range' types. *Figures 1* to *3* illustrate the basic features of typical examples of each of these system types.

The cheapest and most popular types of wireless burglar alarm system are those that give levels of protection that are quite adequate for use in small flats or apartments, but give only very basic protection when used in two or three bedroom houses. *Figure 1* illustrates — in block diagram form — the basic features of a typical low-cost system of this type.

This system offers a total of four defense zones, but these are not individually selectable; in the unit shown, the user has the simple option of making either all four zones active (when the premises are empty), or of making all but one zone (Zone 4, the sleeping and bathroom areas) active (when the occupants are resting). The system gives no protection against burglars who enter the house while the occupants are watching TV, etc.

Systems of this type rely on the control unit's built-in siren to scare off any intruders; often, they are not supplied with an external siren, but have provisions for driving an optional external siren that is powered by the control unit. Such sirens can be disabled by simply cutting their feed cables.

Figure 2 illustrates the basic features of a typical 'mid-range' wireless burglar alarm system that is designed for use in most houses and in small commercial premises. This system offers a total of six defense zones, all of which are individually selectable, and offers good protection against all types of burglar, including those who enter the house while the occupants are watching TV, etc.

Systems of this type are usually supplied complete with an internally-powered external siren/strobe unit that is cable-wired to the main control unit and is fully protected against tampering and cable-cutting, etc.

Finally, *Figure 3* illustrates the basic features of a typical 'top-of-the-range' wireless burglar alarm system that is designed for use in large houses or medium-sized commercial premises. This system offers a total of 12 defense zones, all of which are individually selectable, and offers excellent overall protection.

The system shown is completely wireless, with no cable link between the main control unit and the external siren/strobe unit, which is wireless-activated (by the control unit), is fully protected against tampering, and is powered by an internal battery that is trickle charged by an integral solar panel.

INTRUSION SENSOR TYPES

The two types of intrusion sensor most widely used in modern domestic burglar alarm systems are PIR movement detectors for 'area' protection, and reed-and-magnet switches for 'spot' protection on doors and windows, etc.

Other types of sensor commonly used in domestic systems are pressure mat switches for spot 'floor' protection, vibration sensors to give 'object' protection, and window foil and glass break detectors to detect window breakage.

All of these sensors are similarly used in burglar alarm systems designed to protect commercial premises, which sometimes also use IR light beams or brittle wires — built into walls, floors, or ceilings — to detect break-ins via the building's shell.

Note that modern PIR movement detectors are relatively inexpensive and have a high immunity to false alarms, and have consequently replaced once-popular but unreliable capacitive proximity detectors and microwave and ultrasonic movement detectors in most modern commercial 'area' protection systems.

Older readers may also note that once-popular 'dual-purpose loop' burglar

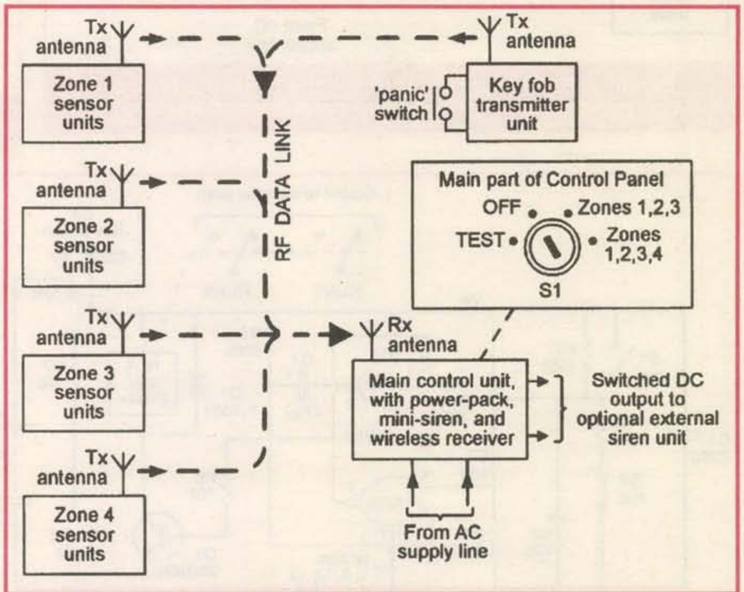


Figure 1. Block diagram showing the basic features of a typical 'low-cost' wireless burglar alarm system.

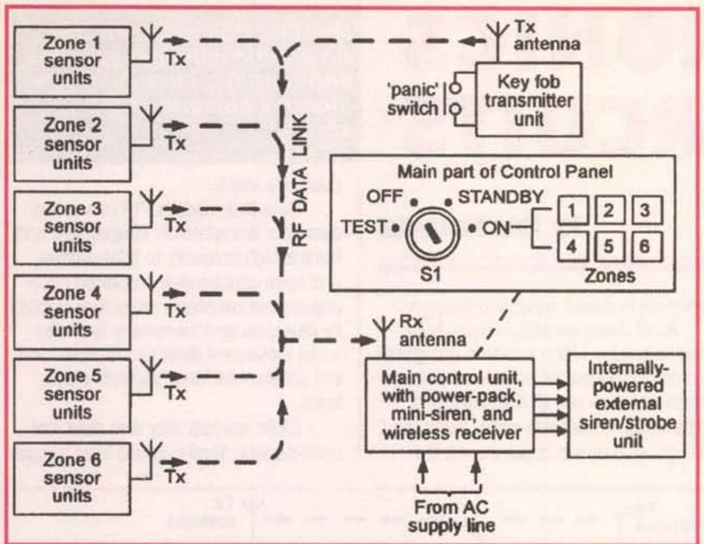


Figure 2. Block diagram showing the basic features of a typical 'mid-range' wireless burglar alarm system.

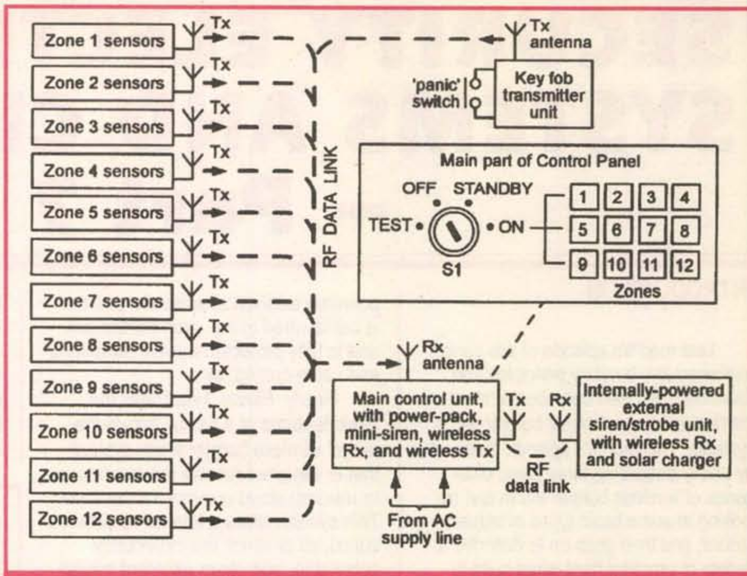


Figure 3. Block diagram showing the basic features of a typical 'top-of-the-range' wireless burglar alarm system.

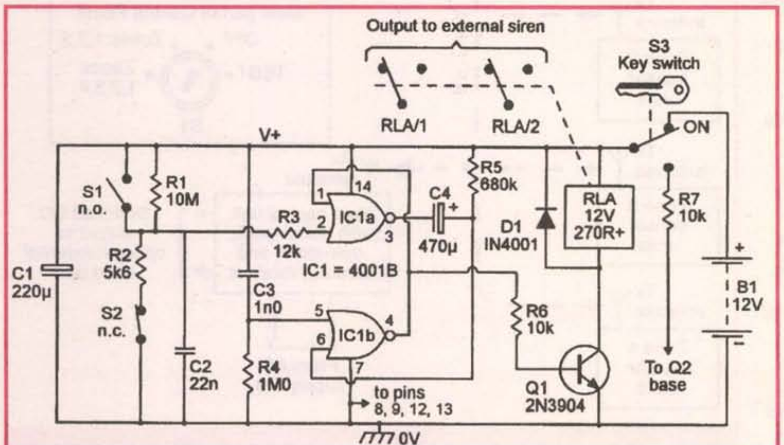


Figure 5. Shed/garage burglar alarm, with external on/off switch.

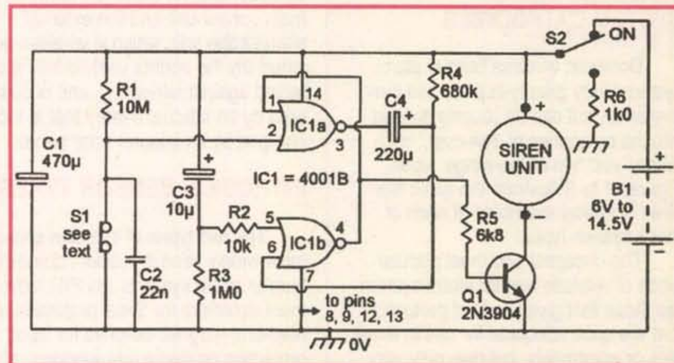


Figure 4. 'False key' booby trap alarm circuit.

alarm systems — in which all contact sensors are wired to a continuously-monitored loop that is fitted with an end-of-line resistor — are no longer used in the modern domestic security systems.

PRACTICAL BURGLAR ALARM CIRCUITS

INTRODUCTION

Modern microcontroller-based domestic burglar alarm systems are, like TVs and many other electronic 'consumer' products, so reasonably priced that few people would seriously consider DIY-building — rather than buying — such products. This is particularly true of wireless burglar alarm systems, which must use wireless Tx sections that have passed stringent tests laid down by a government testing/licensing authority.

It is, however, possible to cost-effectively DIY-build a variety of fairly simple and inexpensive 'conventional' burglar alarm and accessory circuits, and a number of these are described in the remaining sections of this article.

A 'FALSE KEY' BOOBY TRAP CIRCUIT

Some people hide a spare front door key under a flower pot or porch mat or on a porch ledge when they leave the

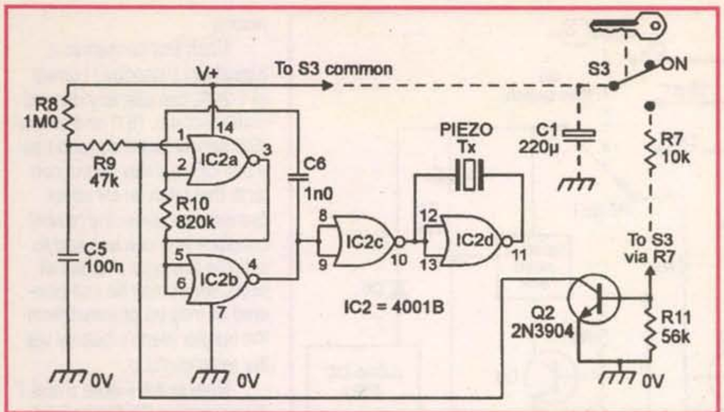


Figure 6. Optional state-indicating sounder, for use with the Figure 5 circuit.

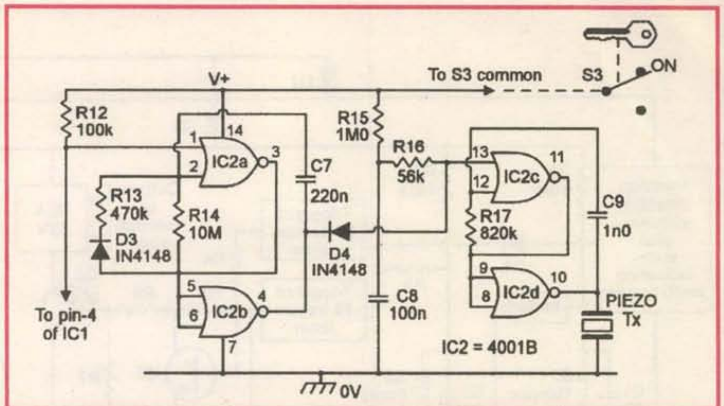


Figure 8. State-indicating sounder, for use with the Figure 7 circuit.

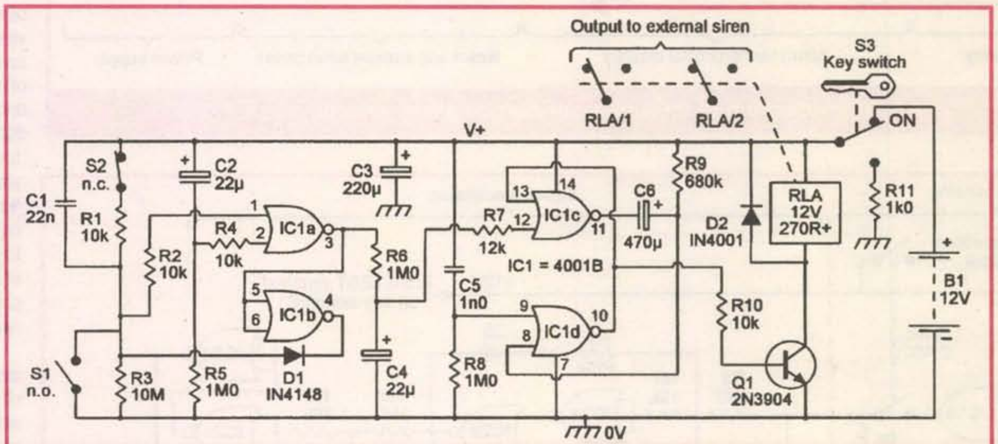


Figure 7. Shed/garage burglar alarm, with internal on/off switch.

house, and burglars often make a quick search for such a key when they enter the porch area of a house. 'False key' booby trap units take advantage of this fact by activating a semi-latching siren if an object such as a flower pot is briefly moved, or if someone grabs a key that is tied to a short length of string, etc. *Figure 4* shows the practical circuit of such a unit.

In *Figure 4*, two gates of the 4001B CMOS IC are wired as a simple monostable multivibrator that gives a low pin 4 output when a positive voltage is fed to pin 5, but — if pin 5 is low — produces a positive pin 4 output pulse if a positive-going transition is applied to pin 2 by opening sensor switch S1.

This output pulse has a duration of about two minutes with the R4-C4 values shown, and is used to activate an inexpensive commercial siren unit via R5 and transistor Q1.

Note that the monostable can only be triggered by a positive-going transition of its pin 2 voltage; its action is not influenced by 'standing' high or low voltages applied to pin 2 via R1-S1. Thus, the action of this booby trap circuit — which may typically be housed in an inverted flower pot — is as follows:

When power is switched to the circuit via S2, C3-R3 apply a decaying positive voltage to pin 5 that disables the monostable for at least 12 seconds, thus giving the user time to safely 'prime' the circuit (position it so that S1 is held in the closed position) without activating the siren.

At the end of this period, the monostable becomes enabled. If sensor switch S1 subsequently opens for a period in excess of 200mS (determined by R1-C2), the monostable fires and activates the siren for a continuous period of about two minutes (which is long enough to scare off most burglars).

At the end of this two minute period, the siren turns off, irrespective of the state of S1, and can only be retriggered by closing and then opening S1 again.

Note that R6 discharges the circuit's timing capacitors when control switch S2 is turned off, that most of the unit's circuitry must be weatherproofed and protected with varnish, and that the unit can be powered by any 6V to 14.5V battery supply and the unit consumes a quiescent current of only a few µA (mainly via R1 and via C1's leakage currents).

The circuit's S1 switch can take various forms: in a flower pot unit it may be an n.o. keypad switch that is normally held closed by the weight of the pot, but opens when the pot is lifted; in another case, it may be an n.c. type that opens when someone tugs on a piece of string, and so on.

SHED/GARAGE BURGLAR ALARM CIRCUITS

Domestic workshops and garages that are fitted with AC power lines are best defended by simple AC-powered 'house/flat' types of burglar alarms that can activate powerful siren/light-strobe units for several minutes. A versatile alarm unit of this type is shown later in this article.

Most garden sheds and many domestic garages (and also caravans and small boats, etc.) are, however, devoid of AC power lines, and are best defended by battery-powered burglar alarms that, when activated, sound a siren for only a few minutes. This section looks at some practical circuits of this type.

Figures 5 to *8* show alternative versions of battery-powered shed/garage burglar alarms, which should ideally be powered by rechargeable batteries that are kept fully energized by solar-powered charger units. The *Figure 5-6* unit is meant to be turned on and off by a key switch that is operated from outside the building; the *Figure 7-8* unit is meant to be turned on and off from within the building, and incorporates exit/entry time delays that let the key holder leave and enter the building without sounding its

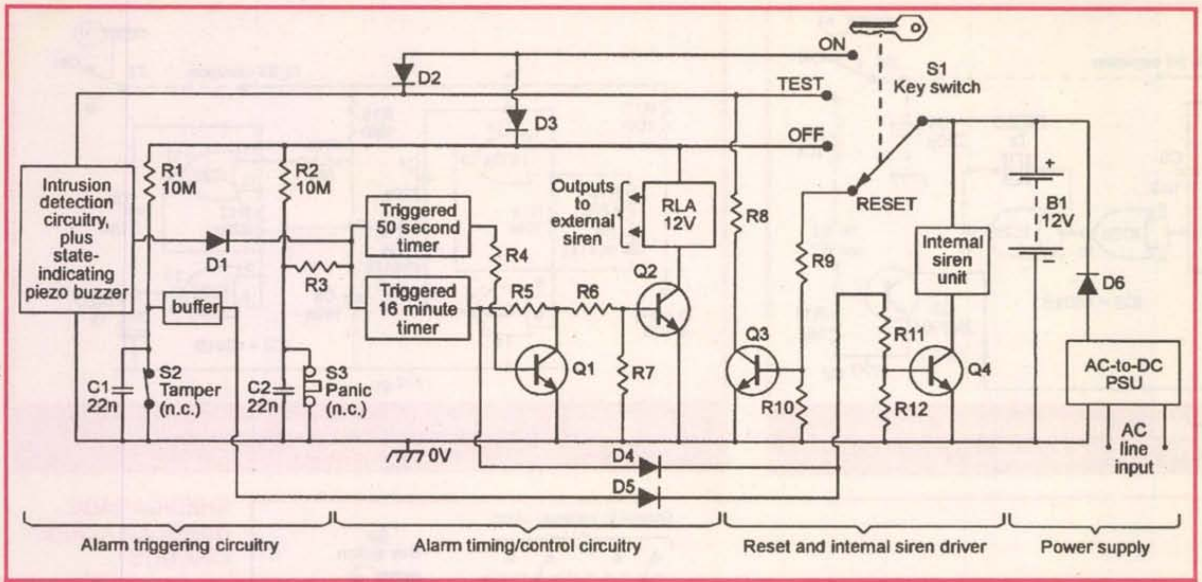


Figure 9. Block diagram of the 'universal' burglar alarm system.

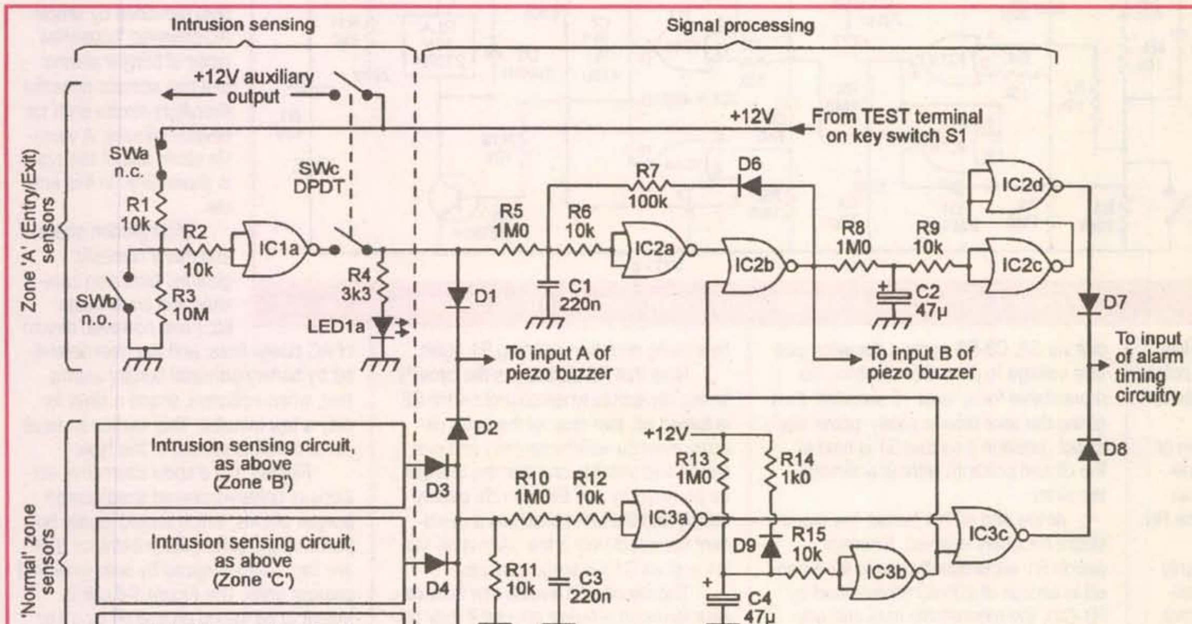


Figure 10. Basic circuit diagram of the intrusion sensing/signal processing circuitry.

alarms.

Each unit consumes a typical ON ('standby') current of 1-2µA, can use any desired number of n.o. (S1) and/or n.c. (S2) sensor switches, and has a pair of c.o. relay output contacts that latch on for about five minutes under the 'alarm' condition and can be used to activate any type of external siren, which may be self-powered or may be powered from the burglar alarm's battery via the relay contacts.

Note in the *Figure 5* and *7* diagrams that S1 can consist of any desired number of n.o. switches (including 'tilt' switches of the type used on up-and-over types of garage doors) wired in parallel, and S2 can consist of any desired number of n.c. switches (such as reed-and-magnet switches on shed doors and opening windows, anti-tamper switches built into alarm and siren boxes, wire 'loops' formed inside easily-cut cables, and cable loops used to protect tools, etc.) all wired in series. If S1 is not needed, simply omit it. If S2 is not needed, replace it with a short.

The *Figure 5* burglar alarm circuit is turned on and off via key-operated switch S3, which is mounted in a position where it can be operated from *outside* of the building's main entrance. Thus, S3 is used to enable the alarm after leaving the building, and to disable it before entering the building.

The circuit is basically similar to that of *Figure 4*, which uses two gates of a 4001B IC as a triggered monostable pulse generator. In this case, however, the monostable output has a period of about five minutes and activates relay RLA via transistor Q1, and can be triggered by closing n.o. switch S1 or by opening n.c. switch S2.

Figure 6 shows an optional audible-output 'system-state' indicator that can be added to the *Figure 5* alarm circuit and emits a brief 'bleep' when the alarm circuit is first switched on, confirming that it is receiving power, and emits a longer 'decaying' bleep as the alarm circuit is switched off, confirming that its power has been removed (if you do not use this add-on circuit, change the R7 value to 1K0 and wire its low end to the 0V line).

In *Figure 6*, IC2 is wired as a gated astable that — when gated on by a 'low' voltage on pin 1 — generates an audible tone signal in a low-cost piezo sounder. The action is such that the astable is briefly driven on via R8-C5 as S3 is switched to the ON position, thus generating a brief 'bleep' in the sounder. When S3 is switched to the OFF position, C1's stored charge drives the astable on via R7-Q1 and supplies the astable with limited operating power, thus producing a decaying 'bleep' in the sounder.

The *Figure 7* burglar alarm circuit is turned on and off via key-operated switch S3, which is mounted *inside* the shed/garage; when S3 is first turned ON, an 'exit delay' comes into operation, giving the key holder about 18 seconds to leave the building, after which all S1/S2 sensor switches become fully active.

When the building is re-entered after this period, the sensor switches trigger an 'entry delay' timer that — if S3 is not switched OFF within 18 seconds — triggers a five-minute monostable that drives an external siren via the contacts of relay RLA. The basic circuit is similar to that of *Figure 5*, except that exit/entry time-delay logic is interposed between the outputs of S1/S2 and the input trigger point of the five-minute monostable (IC1c-IC1d). The circuit operates as follows:

In *Figure 7*, IC1a is used as a NOR gate that gives a low (logic-0) pin 3 output if either input is high, and gives a high output only if both inputs are low. The pin 1 input of IC1a is normally high, but goes low if S1 closes or S2 opens. The pin 2 input of IC1a is normally low, but is held high by the C2-R5 'exit delay' network for about 18 seconds when power is first applied to the circuit via S3. Thus, IC1a's output is locked low during the 'exit delay' period, but can subsequently switch high if S1 closes or S2 opens.

If this latter action occurs, the output of inverter IC1b pulls IC1a's pin 1 input low via D1, thus locking its output into the high state, irrespective of subsequent S1/S2 actions. This 'high' output is fed to the pin 12 'trigger' input pin of the IC1c-IC1d relay-driving five-minute monostable via the R6-C4 'entry delay' timing network, which triggers the monostable about 18 seconds after pin 3 goes high.

Figure 8 shows an optional audible-output 'system-state' indicator that can be added to the *Figure 7* alarm circuit and emits a brief 'bleep' when the alarm circuit is first switched on prior to leaving the building, and emits a series of 50mS 'bleeps' at roughly one second intervals when anyone re-enters the building, reminding them to turn S3 OFF before the siren-activating finish of the 'entry delay' period.

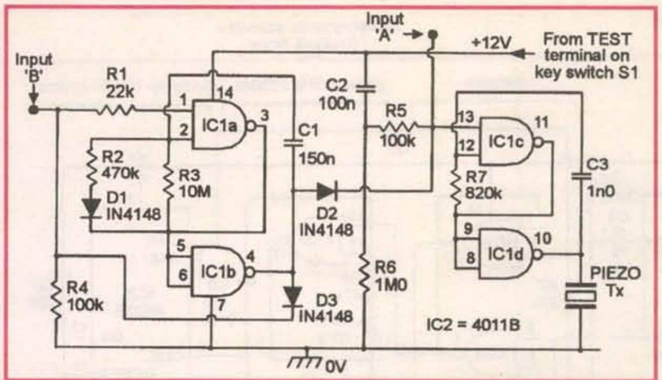


Figure 11. Circuit of the 'universal' burglar alarm's state-indicating piezo buzzer unit.

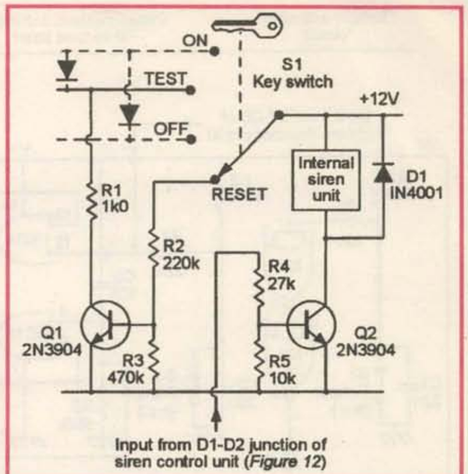


Figure 13. The alarm's 'reset' and internal siren driver circuitry.

In *Figure 8*, IC2c-IC2d are wired as a gated astable that — when gated on by a 'low' voltage on pin 13 — generates an audible tone signal in a low-cost piezo sounder, and IC2a-IC2b are wired as a gated asymmetrical astable that gates the IC2c-IC2d astable via D4 and activates automatically when anyone re-enters the building.

The action is such that the IC2c-IC2d astable is briefly driven on via R15-C8 as S3 is switched to the ON position, thus generating a brief 'bleep' in the sounder, and is activated via the IC2a-IC2b astable whenever the main unit's 'entry delay' circuitry becomes active, thus generating a series of 50mS 'bleeps' that are repeated at one second intervals until the main alarm unit is turned off via S3.

HOUSE/FLAT BURGLAR ALARM CIRCUITS

Shed/garage burglar alarms of the *Figure 5* to *8* types are simple battery-powered single-zone units. Modern burglar alarms suitable for use in houses, flats, and apartments are moderately complex AC-powered multi-zone units with built-in 'panic' and 'tamper' facilities.

They usually have an internal trickle-charged battery that provides power in the event of an AC power-line failure, and have auxiliary 12V DC outputs suitable for powering external PIR movement detectors, etc.

Figures 9 to *13* show the block diagram and practical circuit details of a sophisticated modular 'universal' burglar alarm unit of the latter type that can quite easily be built to suit the precise needs of the individual user.

Figure 9 shows the basic block diagram of the 'universal' burglar alarm unit, which can be fitted with one exit/entry zone plus any desired number of 'normal' defense zones, all of which are individually switch-selectable.

Each zone is provided with its own audio/visual 'state' indicator (not shown in this diagram) and activates internal and external alarm sirens when an intrusion is detected. The unit can also be fitted with any desired number of n.c. 'panic' switches (S3) wired in series, and with any number of n.c. tamper switches or loops (S2) wired in series.

The unit comprises the four major sections shown in the diagram, and offers the following modes of operation, which are selectable via four-way key-switch S1:

ON. When S1 is in the ON position, all four major sections of the unit are energized, and the 'alarm timing/control' circuitry's 50 second and 16 minute timers are immediately triggered if an intrusion is detected by the 'alarm triggering' circuitry, or if PANIC switch S3 is opened for more than 200mS.

Under this condition, the internal siren is immediately driven on via D4 and Q4, but the external siren (which is activated via Q2 and RLA) is held off for 50 seconds via R4-Q1, thus minimizing the chances of *accidentally* sounding the external alarm. Both alarms switch off when S1 is moved to the RESET position, or turn off automatically at the end of the 16 minute timing period. The intrusion detector's piezo buzzer also sounds if an intrusion is detected and operates for the duration of the intrusion condition. The internal siren is driven on (via D5) if TAMPER switch S2 opens, and sounds for the duration of the o.c. condition.

TEST. When S1 is in the TEST position, the 'alarm timing/control' circuitry and the TAMPER and PANIC switches are disabled, but the intrusion detection circuitry is fully active; if an intrusion state is detected under this condition, only the internal piezo buzzer is activated. This mode is useful when testing or checking sensor switches, PIR units, or sensor wiring, etc.

OFF. When S1 is in the OFF position, the intrusion detection circuitry is disabled, but the TAMPER and PANIC circuitry is fully active. If TAMPER switch S2 opens, the internal siren is driven on (via D5-Q4) for the duration of the o.c. condition. If PANIC switch S3 opens, the internal siren is driven on immediately (via D4-Q4) and the external siren activates 50 seconds later. Both sirens turn off when S1 is moved to RESET, or turn off automatically at the end of the 16 minute timing period.

RESET. When S1 is in the RESET position, the entire circuit (except the power supply circuitry) is effectively disabled, and Q3 rapidly resets the intrusion detector circuit's 'exit delay' timer.

Figure 10 shows the basic circuitry of the 'universal' alarm unit's intrusion sensing/signal processing circuitry, specifically applied to a unit with one entry/exit zone (Zone 'A') and three 'normal' zones (Zones 'B' to 'D').

Additional 'normal' zones can be added by simply duplicating the Zone 'D' and D5 circuitry for each extra zone. All zones use the same intrusion sensing circuit design as shown for Zone 'A.' Each zone can use any desired number of series-connected n.c. (SWa) and/or parallel-connected n.o. (SWb) sensor switches, and is selected by a DPDT switch (SWc) that — when closed — connects the output of inverting buffer IC1a to a state-indicating LED (LED1a) and also connects the +12V supply to any auxiliary units (PIRs, etc.) that are associated with the zone.

When a zone is selected by SWc and key switch S1, its action is such that the output of IC1a goes high and illuminates the LED and activates a piezo buzzer (via D1 or D2) if any of the zone's intrusion-detecting sensor switches are activated. This 'high' signal is also passed through the unit's signal processing circuitry, as described in the next two paragraphs.

In *Figure 10*, the output signals from the sensing circuits of all selected 'normal' defense zones are ORed via D3-D4-D5 and are then fed to input A (monotone sound) of the piezo buzzer via D2, and also through transient suppressor R10-C3 (which only passes signals that switch high for at least 200mS).

The output of R10-C3 is then inverted by IC3a and passed to one input of NOR-gate IC3c, which has its other input derived from 30 second switch-on delay generator R13-C4-IC3b, which disables IC3c for 30 seconds when power is first connected to the circuit via S1.

The net result is that the circuit gives an instant audio-visual indication if the output of any selected zone switches high but, under this condition, IC3b's output only generates a siren-activating signal (via D8) if the circuitry has been energized via S1 for at least 30 seconds.

In *Figure 10*, the output signals from the entry/exit zone are (when SWc is closed) fed to input A of the piezo buzzer via D1, and also passed — via transient suppressor R5-C1 — to the

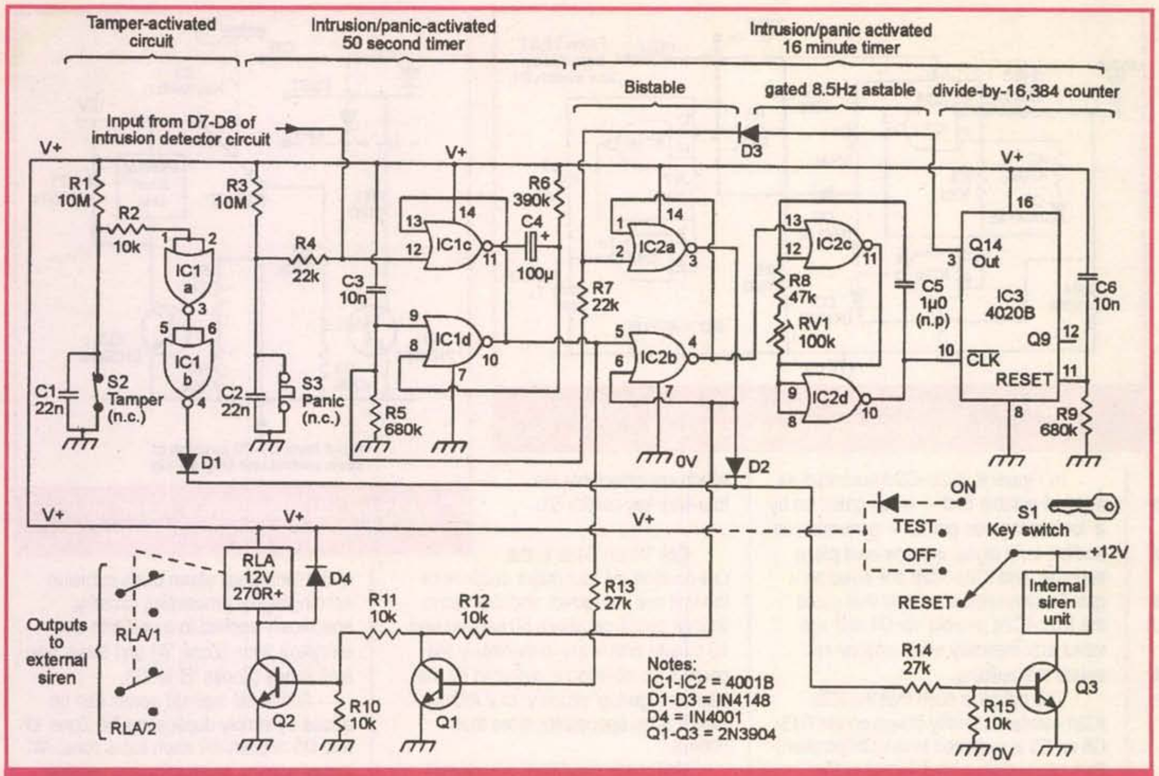


Figure 12. Circuit of the alarm's siren control unit.

input of a gated self-latching, non-inverting buffer formed by 1C2a-IC2b, which is gated by the R13-C4-IC3b 30 second switch-on delay generator, which provides the zone with its 'exit' delay.

If the zone's output switches high *during* the 30 second exit delay period (as, for example, when someone exits the zone), the circuit gives an instant audio-visual indication of the fact but produces no other effects.

If the zone's output switches high *after* the end of the 30 second exit delay period (as, for example, when someone re-enters the zone), the circuit again gives an instant audio-visual indication of the fact but, in this case, the output of IC2b switches high and is latched into that state via D6-R7.

This action drives input B (timing-beat sound) of the piezo buzzer high and also initiates a 30 second entry delay timing period (controlled via R8-C2 and non-inverting buffer IC2c-IC2d). If the complete circuit is not switched off (via S1) by the end of this 30 second 'entry' period, IC2d's output switches high and activates the unit's sirens via D7.

Note in *Figure 10* that D9-R14 are used to rapidly discharge C4 via the positive supply rail and *Figure 9's* transistor Q3 when S1 is moved to the RESET position. Also note, when building the *Figure 10* circuit, that pin 14 of all 4001B ICs must be wired to the +ve supply rail, pin 7 to the 0V rail, and that all unused gate input pins must be tied to the 0V rail. All LEDs must be high-brightness types.

Figure 11 shows the circuit of the unit's state-indicating piezo buzzer unit, which is powered from the supply rails of the intrusion sensing/signal processing circuitry and consists of two gated astables that are activated by high (logic 1) gate voltages.

IC1c-IC1d are wired as a simple 'tone' astable that — when gated on via pin 13 — generates a 680Hz tone in the piezo sounder, and IC1a-IC1b are wired as a gated semi-latching asymmetrical astable that — when gated on via the alarm's 'entry delay' timer (see *Figure 10*) — produces one-per-second 50mS output pulses that gate the tone astable via D2.

The action is such that the tone astable is briefly driven on via C2-R6 when power is first switched to the circuit, thus generating a brief 'switch-on' bleep in the sounder, and is activated via the input 'A' terminal whenever a sensor switch is activated in any of the alarm's active zone areas, and is also activated via the IC1a-IC1b astable and D2 whenever the alarm's 'entry delay' circuitry becomes active, thus generating a series of 50mS 'bleeps' at roughly one second intervals when anyone re-enters the building, reminding them to turn keyswitch S1 OFF before the siren-activating finish of the 'entry delay' period.

Figure 12 shows the circuit of the alarm's siren control unit, which is based on the block diagram of *Figure 9* but uses its own component numbering system and is energized when S1 is in the ON and OFF positions.

Here, IC1a-IC1b are wired as a non-inverting buffer that drives the internal siren on (via D1-Q3) if Tamper switch S2 opens, and the remaining ICs act as triggered 50 second and 16 minute timers that activate the internal and external sirens if Panic switch S3 is opened or if a 'high' input is received from the output of the alarm's intrusion detector circuitry. These timing circuits operate as follows:

In *Figure 12*, IC1c-IC1d are wired as a simple monostable timer that controls the external siren's 'hold-off' period; it is automatically reset at S1-switch-on via C3-R5 and is triggered by a positive-going transition on pin 12 (derived from the intrusion detector, or by opening S3).

When triggered, the monostable's pin 10 output switches high and activates the IC2-IC3 16 minute timer and turns Q1 on, but switches low again at the end of its 50 second (nominal) timing period, which is controlled by R6-C4.

In practice, this timing period also depends on the 'threshold' voltage value of the individual IC, and may vary substantially from the 50 second value. If it does, make the timing roughly correct by changing the R6 value.

The output of the 50 second timer triggers the 16 minute timer, which is a semi-precision design built around a bistable latch (IC2a-IC2b), a gated 8.5Hz astable (IC2c-IC2d), and a 14-stage (divide-by-16,384) ripple counter (IC3). The action is such that, at switch-on, the bistable is automatically reset (with its pin 3 output low and pin 4 high) via C3-R5-R7, thus gating the astable off, and the counter is reset via C6-R9.

As soon as the 50 second timer (IC1c-IC1d) is triggered, its pin 10 output flips the IC2a-IC2b bistable, driving the internal siren on via D2-Q3 and feeding a drive current towards the base of relay-driving transistor Q2 via R12-R11, and also gating on the astable, which immediately starts feeding clock pulses into the IC3 counter at a 8.5Hz rate.

Note that, in the early stages of this 16 minute timing sequence, Q1 is driven on by the monostable timer, thus preventing the bistable's drive current from reaching the base of Q2, but that Q1 turns off after 50 seconds, thus enabling Q2 to turn on and activate the external siren via relay contacts RLA/1-RLA/2.

Meanwhile, the astable keeps feeding clock pulses into the counter until, after 16 minutes, on the arrival of the 8192nd pulse, the pin 3 output flips high and resets the bistable via D3, thus terminating the timing process and turning both the internal and external sirens off.

The circuit's timing period can easily be set to precisely 16 minutes by connecting a LED and 4k7 series resistor between pins 12 and 8 of IC3 and — with the timer triggered — carefully trimming RV1 so that the LED operates with precise 30 second on and off periods.

Figure 13 shows the circuit of the alarm's 'reset' and internal siren driver circuitry, together with its connections to S1; this diagram is based on those of *Figures 9* and *12*, but uses its own component numbering system. Here, Q1 is driven on whenever S1 is in the RESET position, and rapidly resets the alarm's intrusion detector 'exit delay' timer by discharging its timing capacitor (C4 in *Figure 10*).

Q2 is driven on (via the output of the alarm timing/control unit) and activates the internal siren unit (a low-cost multi-tone medium power commercial unit) whenever an intrusion is detected or a tamper or panic switch is operated; the specified Q2 transistor has a maximum current rating of 200mA, which is adequate for driving most medium-power 12V sirens.

Regarding the 'universal' burglar alarm's power supply, note that the basic unit consumes a typical standby current of only a few microamps and can, if desired, simply be powered by a rechargeable 12V battery. In practice, however, modern burglar alarms are usually used in conjunction with PIR detector units, each of which typically consume a quiescent current of 20mA.

Thus, a system that uses three PIRs consumes a quiescent operating current of about 60mA, which can — if desired — be supplied by a 12V rechargeable 1.2AH battery that is fed — via a protective diode — via the output current of a line-powered 60mA trickle charger.

In a unit of this type, the charger supplies the full operating current when the alarm is in its ON but untriggered mode; the battery supplies all excess power if the alarm is triggered, and receives a safe 60mA (1/20th of its 1.2AH capacity) trickle charge when the alarm is not in the ON state.

Finally, note that the 'universal' burglar alarm is very simple to operate, and is normally used in the ON mode when required to respond to an intrusion, and in the OFF mode (in which its Panic and Tamper switches are still active) when it is not required to detect an intrusion.

The TEST mode is only used when setting up or testing the system. The RESET mode is only used to reset the alarm timing/control circuitry once an alarm siren has activated, or to rapidly reset the intrusion detector's exit delay timer when an unexpected repeat of the full 'exit delay' time is needed. **NV**

News Bytes:

The Greatest Crisis In The History Of The Information Age Is Ready To Strike. Are *YOU* Ready?

The Year 2000 compliance problem threatens to be the greatest crisis in the history of computing. It may indeed be one of the most influential factors on business profitability in the year 2000 and beyond. Here are a few estimates compiled by research organizations:

* Five to seven percent of mid-size companies will go bankrupt because of Year 2000 problems.
* Between 50% and 80% of currently installed PCs are not fully Year 2000 compliant.
* Many of the "off-the-shelf" software applications are not Year 2000 compliant.
* Most customized PC applications are not Year 2000 compliant.
* According to "Law and Technology," officers and business owners may be personally liable for financial damages caused by Year 2000 problems to shareholders.
* Lloyds of London predicts Year 2000 litigation costs to top 1.5 trillion dollars.

Most information technology (IT) managers have been focusing their Year 2000 conversion efforts on mission critical host applications primarily located on mainframes. But an even greater threat to Year 2000 compliance may be sitting quietly on the other half of the IT world – the desktop. Outdated PC BIOSes and non-compliant desktop applications could undermine an organization's Year 2000 readiness plans. Small and mid-size organizations without an IT structure or budget are particularly vulnerable.

Here are the three steps that SystemLink (www.systemlinkinc.com) uses to determine desktop compliance:

1. Discover
Discovery is the analysis of desktop hardware and software to determine which systems have Year 2000-compliant (or non-compliant) BIOSes, which software is loaded on each PC, including operating systems, off-the-shelf applications, and custom applications, and which of these software systems are (or are not) Year 2000 compliant.

2. Prioritize
Prioritization is the process of determining which PC systems and applications are the most critical to fix and allocating resources to fix these applications first. Most organizations will not have the resources available to fix everything. The goal therefore, is to identify those critical applications (those being used most) and work to make certain that these applications are Year 2000 compliant.

3. Control
Even if you have addressed all of your desktop Year 2000 issues, your users could download non-compliant applications at any time. Companies must be vigilant in tracking what applications are being loaded to their systems to ensure their compliance. For even tighter control, companies can lock out usage of applications known not to be Year 2000 compliant.

There is a tremendous amount of information on Year 2000 Compliance located on the Internet. SystemLink, a global provider of ACCPAC for Windows and SQL Accounting Solutions, have developed a blueprint for companies searching to bring their company's desktop environment into Year 2000 compliance. This free report can be downloaded from their web site located at www.systemlinkinc.com. Also located on their site is a free application that will test whether your PC is Year 2000 compliant. SystemLink also offers more extensive software that helps to automate the above outlined steps. For more information, SystemLink can be contacted either through their web site or at **1-888-344-7770.**

Will your company be ready when the clock clicks 12 on January 1, 2000?

SystemLink Offers Free Year 2000 Compliance Software

SystemLink, a global provider of ACCPAC for Windows and SQL Accounting Solutions, is providing free-of-charge a program that will test your computer for Year 2000 Compliance. Also available for free is our report "Issues and Solutions for Year 2000 Compliance" which steps companies through the process of verifying Year 2000 Compliance. Both are available on their web site located at www.systemlinkinc.com.

Contact: Mark T. Snidero
VP Marketing & Business Development
SystemLink
1122 Kenilworth Dr., Suite 301
Baltimore, MD 21204

Phone: **1-888-344-7770** Fax: **410-825-2073**
E-Mail: **msnidero@systemlinkinc.com**
Website: **www.systemlinkinc.com**

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MasterCard

DISTORTION ANALYZERS

HP 339A Distortion Analyzer, built-in low distortion osc. $1,500.00
HP 8903A-001 Audio Analyzer, ... $2,600.00
20 Hz-100 kHz; rear panel input
HP 8903B-001,013,051 Audio $3,750.00
Analyzer, 20 Hz-100 kHz; C-message, CCITT
TEK DA4084 Programmable Distortion Analyzer $1,000.00

RMS VOLTMETERS

FLUKE 8920A True RMS Voltmeter, ... $500.00
180 uV-700 V, 10 Hz-20 MHz
FLUKE 8922A True RMS Voltmeter, ... $500.00
180 uV-700 V, 2 Hz-11 MHz

OSCILLATORS

HP 204C Oscillator, 5 Hz-1.2 MHz, 5 VRMS $150.00
HP 209A Sine/Square Wave $225.00
Generator, 4 Hz-2 MHz, 5 VRMS max.
TEK SG5010 Programmable $2,750.00
Oscillator, 10 Hz-163.8 kHz
TEK SG502 Sine/Square Osc., ... $200.00
5 Hz-500 kHz, 70 dB step atten.,TM500

MISCELLANEOUS

HP 3575A-001 Phase-Gain Meter, ... $850.00
1 Hz-13 MHz, dual display option
HP 4437A Step Attenuator, 0-119.9 dB, ... $175.00
DC-1 MHz, 600 ohms unbal.
HP 461A Amplifier, 20/40 dB, ... $125.00
1 kHz-150 MHz, 0.5 V/50 Ohms
KROHN-HITE 3103 High/Low Pass $400.00
Filter, 10 Hz-3 MHz, 24 dB/octave
KROHN-HITE 3202 Dual HP/LP/BP/BR $500.00
Filter, 20 Hz-2 MHz, 24 dB/octave
KROHN-HITE 3342R Dual HP/LP Filter, ... $1,100.00
0.001 Hz-99.9 kHz, 48 dB/octave
KROHN-HITE 3750 LP/HP/BP/BR Filter, ... $700.00
0.02 Hz-20 kHz, 6/12/18/24 dB/oct.
ROCKLAND 852 Dual $1,000.00
Highpass/Lowpass Filter, 0.1 Hz-111 kHz
TEK AF501 Tunable Bandpass $300.00
Filter / Amplifier, 3 Hz-35 kHz
TEK AM502 Differential Amplifier, ... $475.00
0.1 Hz-1 MHz, TM500 series

RF & MICROWAVE

SPECTRUM ANALYZERS

HP 11517A/19A/20A Mixer Set, ... $600.00
18.0-40.0 GHz, for HP 8555A/8569A
HP 11970A WR28 Harmonic Mixer, 26.5-40 GHz $1,100.00
HP 11970K WR42 Harmonic Mixer, 18.0-26.5 GHz $1,100.00
HP 11970Q WR22 Harmonic Mixer, 33-50 GHz $1,400.00
HP 11970U WR19 Harmonic Mixer, 40-60 GHz $1,400.00
HP 8444A-059 Tracking Generator, ... $1,250.00
0.5-1500 MHz, for 8554,8568,etc.
HP 8445B Preselector, 1.8-18.0 GHz, for HP 8555A $650.00
HP 8565A-100 Spectrum Analyzer, ... $4,500.00
10 MHz-22 GHz, 100 Hz min. res.
HP 8566B Spectrum An., ... $37,500.00
100 Hz-22 GHz, HP calibration certificate
HP 8569B Spectrum Analyzer, ... $8,500.00
10 MHz-22 GHz, 100 Hz min.res.bw.
TEK TR503 Tracking Generator, ... $1,375.00
0.1-1800 MHz, for 492/4/5/6
TEK WM782V WR15 Harmonic Mixer, 50-75 GHz $2,000.00

NETWORK ANALYZERS

HP 3577A/35677A/35678A $12,500.00
Network Analyzer, 5 Hz-200 MHz, w/S-Parameter & Cal.Kit
HP 85021C Directional Bridge, ... $1,000.00
0.01-18 GHz, 33 dB dir,for 8755/6/7

SIGNAL GENERATORS

FLUKE 6060A Synthesized Signal Gen., ... $2,750.00
0.1-1050 MHz, 10 Hz res., GPIB
FLUKE 6060A/AN Synthesized Signal Gen., res,GPIB $2,000.00
10 kHz-520 MHz, 10 Hz
GIGATRONICS 600/10-18 Synthesized Source, ... $3,000.00
10-18 GHz, 1 kHz res., GPIB
GIGATRONICS 875/50 Levelled Multiplier, ... $3,500.00
x4, 50.0-75.0 GHz output, -3 dBm
GIGATRONICS 875/86 Levelled $5,000.00
Multiplier, 26.5-40.0 & 50.0-75.0 GHz outputs
GIGATRONICS 910/12-18,opt6,14,16 .... $3,500.00
Synthesized Source/Sweeper, 12-18 GHz, 1 Hz res., OCXO
HP 11720A Pulse Modulator, 2-18 GHz, 80 dB on/off ratio $750.00
HP 85100V Frequency Mult., ... $4,250.00
10-15 GHz in / 50-75 GHz out >0 dBm
HP 8640B-001,002 Signal Gen., 0.5-1024 MHz, ... $1,750.00
AM, FM, var. audio osc.
HP 8660C/86602B-002 Synth. Sig. Gen., 1-1300 MHz, ... $3,250.00
FM / Phase mod. w/86635A
HP 8660C/86603A/86633B Synthesizer, ... $3,750.00
1-2600 MHz, AM, FM

SWEEP GENERATORS

HP 8350B/83592B-002 Sweep $18,500.00
Generator, 10 MHz-20 GHz, 70 dB step attenuator
HP 8350B/83592C-004 Sweep $17,500.00
Oscillator, 10 MHz-20 GHz, +10 dBm levelled
HP 8601A Generator/Sweeper, ... $400.00
0.1-110 MHz, +20 dBm levelled
HP 8620C Sweep Oscillator Frame $550.00
HP 8620C-011 Sweep Oscillator Frame, ... $675.00
HPIB programmable
HP 86222B-002 RF Plug-in, ... $1,750.00
10-2400 MHz, +13 dBm levelled, 70 dB atten.
HP 86230B RF Plug-in, 1.8-4.2 GHz, +10 dBm unlevelled $675.00
HP 86235A-001,002 RF Plug-in, ... $700.00
1.7-4.3 GHz, +14 dBm levelled, 70 dB atten.
HP 86240C RF Plug-in, 3.6-8.6 GHz, +16 dBm levelled $750.00
HP 86241A-001 RF Plug-in, 3.2-6.5 GHz, +8 dBm levelled $400.00
HP 86242D-004,008 RF Plug-in, ... $400.00
5.9-9.0 GHz, +10 dBm levelled
HP 86250D RF Plug-in, 8.0-12.4 GHz, +10 dBm levelled $600.00
HP 86260A RF Plug-in, 12.0-18.0 GHz, ... $700.00
+10 dBm unlevelled
HP 86260A-H04 RF Plug-in, ... $700.00
10.0-15.0 GHz, +10 dBm unlevelled
HP 86290A RF Plug-in, 2.0-18.0 GHz, +7 dBm levelled $1,750.00
HP 86290B RF Plug-in, 2.0-18.6 GHz, +10 dBm levelled $2,000.00
WAVETEK 962 Sweep Generator, ... $1,500.00
1.0-4.0 GHz, markers, +12 dBm unlvld.
WILTRON 6619A Sweep Generator, ... $1,500.00
2-8 GHz, +10 dBm levelled

POWER METERS

ANRITSU MA72B Power Sensor, ... $300.00
-20 to +20 dBm, 0.01-18 GHz
ANRITSU MP-81B/ML-83A Power Meter, ... $2,500.00
75-110 GHz (WR10), -20 to +20 dBm
BOONTON 4200-01A,03/8-4A x2 Dual $1,500.00
Channel Microwattmeter, w/(2) 1 MHz-7 GHz sensors
BOONTON 42B/41-4B Analog Power $375.00
Meter, with 1 MHz-12 GHz sensor
BOONTON 42B/41-4E Analog Power Meter, ... $500.00
with 1 MHz-18 GHz sensor
GENERAL MICROWAVE 476/4240A $300.00
Power Meter & Sensor, 0.01-18 GHz, -35 to +10 dBm
HP 435A/8481A Power Meter, ... $900.00
10 MHz-18 GHz, -30 to +20 dBm
HP 435A/8482H Power Meter, ... $950.00
0.1-4200 MHz, -10 to +34 dBm
HP 435B-001/8482H Power Meter, ... $1,200.00
0.1-4200 MHz, AC or battery power
HP 8477A Power Meter Calibrator, for HP 432 series $500.00
HP Q8486A Power Sensor, ... $1,500.00
33.0-50.0 GHz, WR22, for 435/6/7/8
HP R486A WR28 Thermistor Mount, ... $350.00
26.5-40 GHz, for 432 series
HP R8486A WR28 Power Sensor, ... $1,500.00
-30 to +20 dBm, 26.5-40 GHz

RF MILLIVOLTMETERS

BOONTON 92BD 3-1/2 digit $600.00
RF Millivoltmeter, 10 kHz-1.2 GHz
BOONTON 92B-opt.05 RF Millivoltmeter, ... $500.00
10 kHz-1.2 GHz, 75 Ohm dB & mV scale
RACAL 9303 TRMS Level Meter, ... $875.00
10 kHz-2 GHz, -77 to +23 dBm, GPIB

AMPLIFIERS, MISCELLANEOUS

BOONTON 82AD-opt.01A Modulation Meter, ... $900.00
AM, FM, 10-1200 MHz, GPIB
HP 11715A AM/FM Test Source $1,600.00
HP 415E SWR Meter $300.00
HP 465A Amplifier, 20/40 dB, ... $125.00
5 Hz-1 MHz, 1/2 Watt/50 Ohms
HP 8447A-001 Dual Amplifier, 0.1-400 MHz $450.00
HP 8447E Amplifier, 22 dB, 0.1-1300 MHz, +13 dBm output $750.00
HP 8447F Preamplifier / Power Amplifier, 0.1-1300 MHz $1,200.00
HP 8901A Modulation Analyzer, 150 kHz-1300 MHz $3,000.00
HP 8901B-1,2,3 Modulation An., ... $4,500.00
0.15-1300 MHz, rear input, OCXO, ext.LO
HP 8970A Noise Figure Meter $6,000.00
HUGHES 1177H01F000 TWT Amplifier, ... $1,500.00
2.0-4.0 GHz, 10 Watts output
HUGHES 1177H02F000 TWT Amplifier, ... $1,500.00
4.0-8.0 GHz, 10 Watts output
HUGHES 1277H02F000 TWT Amplifier, ... $2,500.00
4.0-8.0 GHz, 20 Watts output
HUGHES 8020H02F000 TWT Amplifier, ... $2,750.00
4.0-8.0 GHz, 20 Watts output
MICROWAVE SEMI.CORP. MC5112 Noise $275.00
Source, 25.5 dB ENR, 1.0-12.4 GHz, N(m), +28 VDC
ROHDE & SCHWARTZ ESH2 .... $6,000.00
Test Receiver, 9 kHz-30 MHz

COAXIAL & WAVEGUIDE

AMERICAN NUCLEONICS AM-432 Cavity $95.00
Backed Spiral Antenna,LHC, 2-18 GHz,TNC(f) *NEW*
BIRD 8329-310 30 dB Attenuator, ... $650.00
2000 Watts, DC-1 GHz, LC(f)/N(f)
FXR/MICROLAB S3-02N Triple Stub Tuner, ... $125.00
200-1000 MHz, 100 Watts max., N(m/f)
GR 874-LTL Constant Impedance $400.00
Trombone Line, 0-44 cm, DC-2 GHz
GR 900-Q GR900 14mm Interseries Adapters $125.00
HP 11590A-001 Bias Network, 1.0-18.0 GHz, APC7 .... $450.00
HP 11612A Bias Network, 45 MHz-26.5 GHz, APC3.5 .... $550.00
HP 11691D Directional Coupler, 22 dB, 2-18 GHz $450.00
HP 774D Dual Directional Coupler, 20 dB, 215-450 MHz $275.00
HP 777D Dual Directional Coupler, 20 dB, 1.9-4.1 GHz $275.00
HP 778D-011 Dual Dir. Coupler, 20 dB, ... $450.00
100-2000 MHz, APC7 test port
HP 8470B Crystal Detector, 10 MHz-18 GHz, neg. pol., APC7 .... $250.00
HP 8472A Crystal Detector, 10 MHz-18 GHz, neg. pol., SMA $150.00
HP 8494G-002 Programmable Step $350.00
Attenuator, 0-11 dB, DC-4 GHz, SMA
HP 8495G-002 Programmable Step Attenuator, ... $300.00
0-70 dB, DC-4 GHz, SMA
HP 8495H-002 Programmable Step Attenuator, ... $400.00
0-70 dB, DC-18 GHz, SMA
HP 8497K-004 Programmable Step Attenuator, ... $750.00
0-90 dB, DC-26.5 GHz
HP K422A WR42 Flat Broadband Detector, 18.0-26.5 GHz $350.00
HP K532A WR42 Frequency Meter, 18.0-26.5 GHz $450.00
HP K870A WR42 Slide Screw Tuner, 18.0-26.5 GHz $275.00
HP K914B WR42 Moving Load, 18.0-26.5 GHz $350.00
HP Q752D WR22 Directional Coupler, 20 dB, 33-50 GHz $650.00
HP R375A WR28 Variable Attenuator, 0-20 dB, 26.5-40 GHz $375.00
HP R422A WR28 Flat Broadband Detector, 26.5-40 GHz $400.00
HP R532A WR28 Frequency Meter, 26.5-40 GHz $500.00
HP R752A WR28 Directional Coupler, 3 dB, 26.5-40 GHz $450.00
HP R914B WR28 Moving Load, 26.5-40 GHz $300.00
HP V365A WR15 Isolator, 25 dB, 50-75 GHz $900.00
HP V752D WR15 Directional Coupler, 20 dB, 50-75 GHz $650.00
HP X870A WR90 Slide Screw Tuner $150.00
HUGHES 45111H-2000 WR28 Isolator, 25 dB, 26.5-40 GHz $450.00
HUGHES 45712H-1000 WR22 Frequency Meter, 33-50 GHz $900.00
HUGHES 45721H-2000 WR28 Precision $1,200.00
Rotary Vane Atten., 0-50 dB, 26.5-40 GHz
HUGHES 45732H-1200 WR22 Level Set Attenuator, ... $250.00
0-25 dB, 33-50 GHz
HUGHES 47316H-1111 WR10 Tuneable Detector, ... $600.00
75-110 GHz, positive polarity
HUGHES 47323H-1211 WR19 Flat Broadband $650.00
Detector, negative, 40-60 GHz
HUGHES 47974H-1000 WR15 SPST PIN Switch, ... $375.00
250 MHz speed, 60-62 GHz response
KAY 442D Step Attenuator, 0-101 dB, 75 ohms, BNC $100.00
KRYTAR 1818 Directional Coupler, 16 dB, 2-18 GHz, SMA(f) $200.00
M/A-COM 3-19-300/10 WR19 Directional $450.00
Coupler, 10 dB, 40-60 GHz
MIDWEST MICROWAVE 3537 DC Block, ... $40.00
0.1-12.4 GHz, SMA(m/f) *NEW*
MINI-CIRCUITS ZFDC-20-4 Directional $25.00
Coupler, 19.5 dB, 1-1000 MHz, SMA(f)
NARDA 25171 Level Set Attenuator, ... $100.00
0-17 dB, 2-8 GHz, SMA(f)
NARDA 26298 20 dB Attenuator, ... $200.00
150 Watts, DC-1 GHz, N(f/f)
NARDA 3000-SERIES Directional Couplers $150.00
NARDA 3024 Bi-Directional Coupler, 20 dB, 4-8 GHz $300.00
NARDA 3090-SERIES Precision High Directivity Couplers $225.00
NARDA 368NM Coaxial High Power Load, ... $400.00
500 Watts, 2.0-12.4 GHz, N(m)
NARDA 369BNF High Power Termination, ... $325.00
175 Watts, 0.7-18 GHz, N(f)
NARDA 3753B Coaxial Phase Shifter, ... $1,250.00
0-55 deg./GHz, 3.5-12.4 GHz
NARDA 4000-SERIES SMA Miniature Directional Couplers $75.00
NARDA 4245-10 Directional Coupler, ... $100.00
10 dB, 4-12 GHz, SMA(f)
NARDA 4799 Level Set Attenuator, ... $135.00
0-15 dB, 4-18 GHz, SMA(f)
NARDA 5070-SERIES Precision Reflectometer Couplers $300.00
NARDA 765-10 10 dB Attenuator, 50 Watts, ... $135.00
DC-5 GHz, N(m/f)
NARDA 766-10 10 dB Attenuator, 20 Watts, ... $100.00
DC-4 GHz, N(m/f)
NARDA 792FF Variable Attenuator, ... $375.00
0-20 dB, 2.0-12.4 GHz
NARDA 794FM Direct Reading Variable $375.00
Attenuator, 0-40 dB, 4-8 GHz
OMNI-SPECTRA 2085-6010-00 Crystal Detector, ... $50.00
1-18 GHz, negative polarity, SMA(m/f)
PAMTECH KYG1014 WR42 Junction $250.00
Circulator, 18.0-26.5 GHz
SONOMA ENG. S-4901 WR15 Junction $125.00
Isolator, 57-59 GHz, 30 dB isolation
SONOMA ENG. S-4906 WR15 Junction $125.00
Isolator, 60-62 GHz, 30 dB isolation
SONOMA ENG. S-4907 WR15 Junction Isolator, ... $125.00
62-64 GHz, 30 dB isolation
SONOMA SCIENTIFIC 21A3 WR42 Circulator, ... $75.00
20 dB, 20.6-24.8 GHz
SPACEK LABS DQ-1 WR22 Flat $400.00
Broadband Detector, 33-50 GHz
SPACEK LABS K-2X Frequency Doubler, ... $350.00
9.0-13.25 GHz in/ 18.0-26.5 GHz out
SPACEK LABS KA-3X Frequency Tripler, ... $350.00
8.83-13.33 GHz in/ 26.5-40.0 GHz out
TRG B528 WR22 Direct Reading Phase $1,250.00
Shifter, 0-360 deg.,33-50 GHz
TRG V551 WR15 Frequency Meter, 50-75 GHz $600.00
TRG W551 WR10 Frequency Meter, 75-110 GHz $750.00
WAVELINE 100080 WR28 Terminated $200.00
Crossguide Coupler, 30 dB
WEINSCHEL 1515 Power Divider, 2-Way, ... $125.00
DC-18 GHz, SMA(m/f/f)
WEINSCHEL DS109 Double Stub Tuner, ... $150.00
1-13 GHz, N(m/f)
WEINSCHEL DS109LL Double Stub Tuner, ... $150.00
0.2-2.0 GHz, N(m/f)

COMMUNICATIONS

HP 59401A HPIB Bus Analyzer $700.00
TEK 1410R NTSC Gen., w/SPG2 sync. $800.00
generator, TSG7 color bars
TEK 1411R PAL Gen.,w/SPG12 sync;TSG11 .... $750.00
color bars;TSG13 linearity
TEK 1411R PAL Test Gen., w/SPG12, ... $1,000.00
TSG11,TSG13,TSG15,TSG16
TEK 1411R PAL Test Gen., w/SPG12, ... $1,100.00
TSG11,TSG12,TSG13,TSG15,TSG16
TEK 1411R-opt.04 PAL Test Gen., ... $1,400.00
w/SPG12,TSG11,TSP11,TSG13,TSG15,TSG16
TEK 1420 NTSC Vectorscope $600.00
TEK 147A NTSC Test Signal Generator, ... $800.00
with noise test signal
TEK 148 PAL Insertion Test Signal Generator $700.00
TEK 520A NTSC Vectorscope $750.00
TEK 521A PAL Vectorscope $750.00

MISCELLANEOUS

P.A.R. 5206-95,98 Two-Phase Lock-in Amp., ... $1,500.00
2 Hz-100 kHz, GPIB
P.A.R. 5209 Lock-in Amp., 0.5 Hz-120 kHz, ... $2,500.00
130 dB dynamic reserve
TEK TM5006 5000-series 6-slot $600.00
Programmable Power Module
TEK TM504 500-series 4-slot Power Module $175.00
TEK TM506 500-series 6-slot Power Module $250.00
TEK TM515 500-series 5-slot Traveller Power Module $275.00

Write in 151 on Reader Service Card.

Questions & Answers

TECH FORUM

This is a READER TO READER Column. All questions AND answers will be provided by *Nuts & Volts readers* and are intended to promote the exchange of ideas and provide assistance for solving problems of a technical nature. All questions submitted are subject to editing and will be published on a space available basis if deemed suitable to the publisher. All answers are submitted by readers and *NO GUARANTEES WHATSOEVER* are made by the publisher. The implementation of any answer printed in this column may require varying degrees of technical experience and should only be attempted by qualified individuals. Always use common sense and good judgement!

QUESTIONS

Send all material to **Nuts & Volts Magazine**, 430 Princeland Court, Corona, CA 91719, OR fax to (909) 371-3052, OR E-Mail to **forum@nutsvolts.com**

I am looking for schematics and/or service manuals for a DEC VRT19 DA fixed frequency monitor, also known as Sony GDM-1960. Sony sent me to DEC, DEC only had user manuals.

I need to do convergence adjustments, but otherwise the monitor works.

8981 **Dave via Internet**

I want to use my Sony 900 line big screen TV as an alternate display for my Compaq Armada 1130T laptop. My computer will support VGA (1024x768) resolution and 256 colors. The current laptop display operates at 800x600.

Is there a product that will give me better resolution than 600x800 on the TV from the laptop?

8982 **C. Wagner via Internet**

I have a couple of S148 servo motors (the kind used in model R/C vehicles) that I'd like to use in a robotics project. Using an article I found in an earlier issue of *Nuts & Volts*, I was able to modify the motors to operate within the full 360 degrees of motion.

Now, I'd like to further adjust the servos to decrease the rotation speed of the output shaft. Is there an easy way to modify the servo to decrease the speed by about a factor of 2?

8983 **K. A. Delahoussaye via Internet**

I need a schematic for a simple, inexpensive, stable wide band FM receiver to recieve 137.85 MHz.

I would also like to know if anyone can tell me the proper way to modify a Radio Shack Pro 51 scanner from narrow band FM to wide band FM?

8984 **Gary Gretzinger Salem, OR**

I have adapted a bicycle speedo to the drive shaft of my boat and calibrated it in knots. This arrangement works well, but could be better.

I would like to see speed to two decimal places. Presently, I get one decimal and jitter ±.05 KN. The jitter may be because of the long (30') twisted pair signal wire to the sensor.

Also, I would like to get RPM. The shaft is on a reduction of 2.7:1 and I am near the limit that the speedo has for adapting various wheel sizes.

Also, the reed switch cannot be safely secured in the area of the belts, and the "click" frequency would be too high for stable operation of the mag switch/sensor.

Do you have a suggestion for interfacing the standard Velo-10, which is expecting input from the mag sensor attached to the bicycle forks with, say, an optical sensor which would work off reflective paint on the belt drive pulley on the crankshaft end?

Do you know anything about the pinouts of the chips that are used by the typical bicycle speedos?

Is it possible for the amateur to successfully solder the wires on the pads of digital devices like the bicycle speedo, electronic stopwatches, etc?

You may be wondering how I calibrated the Velo-10 into a knotmeter.

Just experiment with the constant you load for wheel diameter against known boat speed on a carefully measured charted distance. The trick is in replicating that exact RPM because alternator driven tachs just don't have the necessary accuracy even if they are digital.

8985 **Richard via Internet**

We just bought an HP 410C voltmeter, and need an HP 11036A probe. Can we make one, or can you guide us to a source for used probes?

8986 **Paul H. Jamison Sutter Creek, CA**

How can I disable the horrible sound alert in a Uniden BCT-2 permanently? I would prefer to save the light and normal audio.

8987 **Louis Phelps Tempe, AZ**

I have a few related questions on coils: If more than one layer must be wound on a core, should each layer be wound in "from end-to-end and then back again," or should the wire be "returned" to the starting point and start the second layer there?

It seems to me that winding from end-to-end, and then continuing to wind back again would cause the second layer to reverse the current's direction and cancel the field of the first. Is this so?

8988 **Michael Keller Lancaster, PA**

I'm entering Robot Wars and need a motor controller. It must have two inputs, one for forward and one for backward, and it needs to be able to handle 100 amps.

How could I build one to handle that much current?

8989 **James Mead Owego, NY**

I have a Sharp laptop PC, model 3010, with a 486 DX 2/66 processor, a Glidepoint Trackpad, and Windows 3.1.

I tried disabling the Glidepoint and installing several kinds of mice in Serial Port Com 1. None worked, even though I tried to follow recommended installation procedures.

What have I overlooked?

89810 **J. Gentile Lawrence, MA**

I wish to obtain a Philips or Signetic NE 5520N for operation of a linear variable differential transformer. Use of this IC was described in the March '90 *Radio Electronics* magazine.

Is there a substitute available? Could someone suggest a circuit using a combination of ICs to do the same LVDT operation?

89811 **John Ekparian Reseda, CA**

I have an '82 "Stargate" video arcade machine by Williams' manufacturer brand. It is intermittantly inoperable, and reports a "RAM error 31, 34, and 37." Also, the onboard LED reports an error address of 131 (or IEI?). Sometimes after warming up for 10 minutes it begins to operate correctly.

I need repair advice, the type of RAM chips used, and preferably a technical repair manual, or where to get one.

89812 **Gary Triestman Shady, NY**

What happened to the 2.88 floppy drives? I haven't even seen 2.88 disks for sale for quite some time.

Are 1.44 disks useable as 2.88?

89813 **Anonymous**

I have a 72 VDC battery bank in my electric car that is made up of 12, six-volt deep cycle batteries. I'd like to convert the car to a hybrid, using a gas or diesel powered engine to operate an alternator(s) which, in turn, could charge the batteries while I am driving to extend my range.

Does anyone have an alternator and regulator circuit I can construct? I can use two alternators/regulators, each providing 36 volts DC

ANSWER INFO

- Include the question number that appears directly below the question you are responding to.
- Payment of $25.00 will be sent if your answer is printed.
- In most cases, only one answer per question will be printed.
- Your name, city, state, and E-Mail address, (if submitted by E-Mail), will be printed in the magazine, unless you notify us otherwise with your submission.
- Due to space limitations, we can not reprint the original questions with the answer. The question number and the issue it appeared in are printed above the answer.
- Unanswered questions from a past issue may still be responded to.
- Comments regarding answers printed in this column may be printed in the Reader Feedback section if space allows.

QUESTION INFO

TO BE CONSIDERED FOR PUBLICATION

All questions should relate to one or more of the following:

1) Circuit Design 3) Problem Solving
2) Electronic Theory 4) Other Similar Topics

INFORMATION/RESTRICTIONS

- No questions will be accepted that offer equipment for sale or equipment wanted to buy.
- Selected questions will be printed one time on a space available basis.
- Questions may be subject to editing.

HELPFUL HINTS

- Be brief but include all pertinent information. If no one knows what you're asking, you won't get any response (and we probably won't print it either).
- Write legibly (or type). If we can't read it, we'll throw it away.
- Include your Name, Address and Phone Number. Only your name will be published with the question, but we may need to contact you.

across two, 36-volt battery banks in series or I can use one 72-volt DC alternator/regulator across the entire 72-volt battery bank.

I would like the charger to put out around 80 to 100 amps. If possible, I'd like to use high current (100 amp) automobile alternators since they are so readily available, but this is not mandatory.

My biggest obstacle has been designing a regulator circuit for my application (i.e., 36 volts or 72 volts). All I can seem to locate are 24- and 32-volt alternator/regulator set-ups.

Can someone assist me? If special parts are needed, can someone provide sources?

89814 **Alan Turof**
Rochester, NY

I'm looking for a suitable substitute for a Signetics NE561. It doesn't have to be an exact pin-for-pin replacement, just a functional equal.

89815 **Pete Haas**
Kent, OH

I have been searching for years to find a source of Sperry SP-352 plasma displays such as used in Heathkit clocks. I still see these readouts in all type of avionics and pinball machines, but have been unable to find them anywhere. All Electronics has not been able to help me. I'm also looking for a suitable replacement for a TIL-78 phototransistor, which is used as an IR detector in an Heath weather station. No one seems to be able to cross this device, either.

89816 **Dave Wood**
W4EJ@coastalnet.com
Wilson, NC

ANSWERS

ANSWER TO #7981 - JULY 1998

When daylight savings changes the time here in Washington, I take the opportunity to synchronize all the clocks so I never have to remember whether that egg has been cooking for three minutes bedroom time or VCR time.

In answer to your question: yes, your microwave should be using the expected 60 Hz frequency of the AC power-line to regulate its clock, because the power companies have excellent long-term stability.

To isolate the problem, I'd have many more questions as to the conditions under which the time slippage occurs. I've seen problems of this kind in other products that were design flaws, like the seconds not incrementing during the actual sounding of any particular beep. This could become 20 seconds every couple days depending on use.

Regardless of the many possibilities, there's only one that would be practical to fix. If there is a connector that feeds a 60 Hz signal (through a large value resistor) to the control board to stabilize its clock, and that connector is loose, your time could slip in very unpredictable ways. You should try to check that all the connectors are well seated.

The only really dangerous thing in your oven is a big-ol high-voltage capacitor that's probably near the back. If you'd like pictures of what they look like, *Practical Microwave Oven Repair*, published by TAB books, shows pictures and makes recommendations, but you're pretty safe to pull the cover and push any connectors that appear loose back on with a non-conductive object (a wooden spoon comes to mind).

Failing that, sell it, and buy a new one. Most people that you warn of its annoying behavior won't even consider it a problem.

Art Popp
Blaine, WA

ANSWER TO #7986 - JULY 1998

The 40-pin digital alarm clock chip with Heathkit house number 443-848 is the National Semiconductor part number MM53113. This info is from Tom Anthony at **Heathkit Educational Systems**. Their fax number is **616-925-4488**.

From comparison of data sheets in National Semiconductor's 1980 MOS data book, it appears that the MM5316 is an almost identical part. The pinouts and power requirements are the same.

First thing to do is check the power supply. VSS on pin 28 should have a fairly clean DC voltage, +21 to +29 volts above VDD at pin 29. That looks backwards, but this is an MOS part from the "negative rail" days.

Make sure pin 36 — the 50 Hz/60 Hz select pin — is open, that is, not connected, to select 60 Hz input. Then check the 60 Hz input going to pin 35. It should be a fairly clean sinewave swinging almost rail-to-rail. If the kit has a power transformer, check the voltages out of the secondary. There should be about 18 volts RMS upstream of the rectifier, and also there should be a 6.3 volt winding providing power to the cathode heaters. If you are lucky, the problem will be at the power supply or 60 Hz reference end of the circuit, as those parts will be easier to find.

Documentation for the clock kit is still available from the **Heath** parts department at **616-925-5899**.

Jack Dennon
via Internet

ANSWER TO #7988 - JULY 1998

Connecting two mobile antennas back-to-back is not reasonable, but here's how to do it: you need to make the antennas be mirror images. The center is the two antenna grounds, so connect them together, but don't connect them to ground (the antenna will float). The two signal connections must be driven by a balanced input, so connect a 50 ohm unbalanced to 100 ohm balanced balun. You could cheat with a 1:1 balun if you use the antenna tuner to drive the balun input.

The back-to-back configuration is unreasonable because a wire dipole is a better architecture for a horizontal antenna. People have strung dipoles in their attics and under the eaves.

A mobile antenna is usually a center-loaded whip antenna. The whip antenna must be stiff because it is supported at one end. If you are going to make a horizontal antenna, you can support it from both ends, and that means you can make it out of wire and insulators. I would suggest building a center-loaded dipole. (A dipole antenna with a loading inductor halfway out on each side of the dipole.) The loading inductor cuts down on the length.

The *ARRL Handbook* tells how to make one. Use a balun at the dipole to convert the coax feed to balanced drive at the dipole center. There are some multi-band designs that use parallel LC networks as loading coils and traps, so if you are interested in multi-band antennas, build one of those — they are only a little more difficult than a center-loaded dipole.

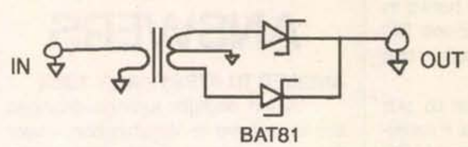
Since you have the antenna tuner, use it. The AT 180 should work with a simple random wire antenna (the tuner specs. will tell you the minimum length), but you will get better results with a dipole designed for the band you use.

BTW, I believe the courts have held that communities cannot outlaw outdoor amateur antennas.

Gerald Roylance
Mountain View, CA

ANSWER TO #7989 - JULY 1998

You are correct about a doubler being a full-wave rectifier. The circuit is a transformer with a center-tapped secondary and two Schottky diodes. The problem is making every-



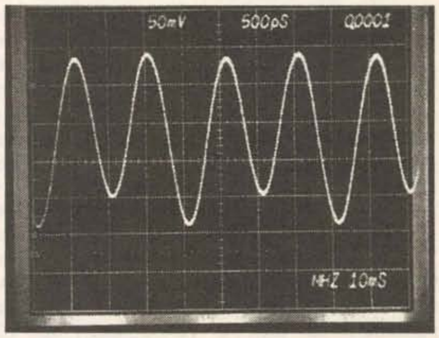
thing work at 1 GHz.

The wavelength is about 30 cm, so 7.5 cm of wire turns an open into a short and vice-versa. Your RF construction practices must be very good.

Commercial RF transformers, such as the Minicircuits T4-1, are only rated to a couple hundred MHz. Schottky diodes must be used because conventional diodes such as the 1N4148 are an order of magnitude too slow. Furthermore, the doubler must be driven hard — at least 0 dBm — to turn the diodes on and off. The conversion loss of the doubler will be about 15 dB. A scope photo shows my results at 1.0 GHz output.

Making a doubler work takes a lot of effort, and the result is not guaranteed. If you consider your time, the cost of getting the connectors, the housing, the diodes, and building a suitable RF transformer, you are much better off buying a doubler. A used HP 11690A would probably set you back $150.00 (ouch!), but a new FD-2 from **Minicircuits (1-800-654-7949)** costs about $45.00.

The FD-2 will perform better and be a lot more rugged than something built at home.



Gerald Roylance
Mountain View, CA

ANSWER TO #79812 - JULY 1998

I am not familiar with your Toshiba laptop, but I have seen a similar problem with a Compaq laptop docking station.

Does your laptop have a built-in Ethernet interface? If so, you have

Continued on page 78

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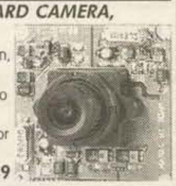

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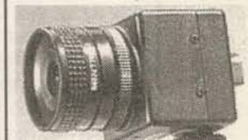

The GM-412 specs: B&W, size 1.5"sq. X 2.4"L, 250,000 Pixels, **380** Lines Resolution, Sensitivity **0.3** Lux, The GM410 specs: size only 1.5" SQ. x 1.6"L, >270,000 Pixels, **410** Lines Res., Sens. **0.05 LUX.**, Both cameras are 1/3" CCD with AGC & Electronic shutter. 12V @110mA power. NTSC out. IR SENSITIVE, GM 410 has RCA video connector, GM-412 has a BNC. Both use std. DC pwr. jack. Aluminum housings with dual threaded top and bottom mounting. True performance not hype! These cameras will outperform ***ANY*** camera in this magazine. Multi- lens options are available to exploit their superior performance.
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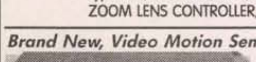

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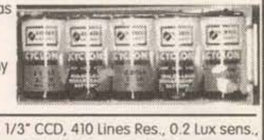

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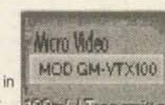

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AMATEUR ROBOTICS NOTEBOOK

by Robert Nansel

Last time, I showed an example program in Parallax BASIC for Breadbot. The program made Breadbot move in a squared-off figure eight pattern – one counterclockwise square followed by a clockwise square.

Since there is no speed feedback, how close your Breadbot actually comes to describing these two back-to-back squares is dependent on how well the open-loop speeds of your two servos are matched.

I noted last month that the servos used for Breadbot's drive motors must be individually calibrated to determine the control pulse length required to stop the servo.

Since these vary from servo to servo, the Breadbot you build will need different calibration constants, and you must determine these calibration values experimentally.

Calibrating the Servos

Listing 1 is a simple program to let you do just that, one servo at a time. To set up, put Breadbot on a block so the wheels are free to turn without touching the tabletop. Plug the servo to be calibrated into what would normally be the connector for the right servo, and leave the other servo unplugged.

When you download the program to Breadbot, it displays the current values of the calibration constants fstop and rstop. This first time through they will be zero. The program then waits for you to press the right whisker to start the calibration procedure. It then pauses for one second then steps the servo from full reverse through full forward. Each step, 10 equal length control pulses are sent to the servo under test so you have enough time to see the speed at which the servo is turning.

About half way through the run the servo will slow to a crawl. When it stops, pressing the right whisker will log the stop pulse length threshold for the reverse-stop-forward transition; this is fstop. The servo then is commanded to full forward and is stepped back toward full reverse. When you press the whisker the second time, the servo stops, and the forward-stop-reverse transition threshold is logged; this is rstop. The program then displays the new values of fstop and rstop.

In general, fstop and rstop will not be equal because servos are designed with a certain amount of deadband centered around neutral. Servos are designed to be used as a positioner, and this deadband is there to keep the servos from constantly hunting about zero position when they should be motionless. For our purposes, we average rstop and fstop together to get one number for the servo's stop constant.

Run the calibration routine for each servo, write down the calibration constants on stickers on the servos for future reference, then plug the values of these constants into your software. You will still have to experiment to match the open-loop speeds of the servos, but at least the servos will both stop when commanded to do so.

The real answer to this problem would be to provide some sort of speed feedback from each servo. The BS1-IC isn't really up to the task of closed-loop control of servo speed since it is taxed pretty heavily already just to run two servos open loop, not to mention monitoring the whiskers and bumper switches. What to do?

More Power

When in doubt, it's often easiest to just throw more computational horsepower at the problem. One obvious solution might be to use a BASIC Stamp 2.

The BS-2 has 16 general-purpose input/output lines, 25 bytes of general-purpose RAM, 2048 bytes of EEPROM program and data space – up to about 500 PBASIC instructions on average, eight times more than the BS1-IC. It uses a 20 MHz clock vs. 4 MHz for the BS1-IC. You might suppose that because the BS-2 clock is five times faster than the 4-MHz clock of the BS-1 that it would also execute PBASIC instructions five times faster. This would be wonderful if true, but, alas, it's not.

It turns out the serial EEPROM is the real bottleneck, so the BS-2 will execute only 4000 PBASIC instructions/second. Still, this is

Table 1. BASIC Stamp 2 pinout.

Pin	Name	Function	Description	
1	SOUT	Serial Out	Temporarily connects to PC's RXD	After programming, these pins may be left unconnected
2	SIN	Serial In	Temporarily connects to PC's TXD	
3	ATN	Attention	Temporarily connects to PC's DTR	
4	VSS	Ground	Temporarily connects to PC's GND	
5	P0	User I/O	User port pins than can be programmed as inputs or outputs.	
6	P1	User I/O	In output doe: Pins will source from VDD or sink to VSS. Pins should not be allowed to source more than 20 mA or sink more than 25 mA each. As groups, P0-P7 and P8-P15 should not be allowed to source more than 40 mA or sink more than 50 mA each.	
7	P2	User I/O		
8	P3	User I/O		
9	P4	User I/O		
10	P5	User I/O		
11	P6	User I/O		
12	P7	User I/O		
13	P8	User I/O	In input mode: Pins are floating (less than 1 µA leakage). The 0/1 logic threshold is about 1.4V.	
14	P9	User I/O		
15	P10	User I/O		
16	P11	User I/O		
17	P12	User I/O	NOTE: To realize low power during sleep, make sure that no pins are floating, causing erratic power drain. Either drive them to VSS or VDD, or program them as outputs that don't have to source current.	
18	P13	User I/O		
19	P14	User I/O		
20	P15	User I/O		
21	VDD	Regulator Out	Output from 5V regulator (VIN powered). Should not be allowed to source more than 50 mA, including P0-P15 loads.	
		Power In	Power input (VIN not powered). Accepts 4.5-5.5V. Current consumption is dependent on run/sleep mode and I/Os.	
22	RES	Reset I/O	When low, all I/Os are inputs and program execution is suspended. When high, program executes from start. Goes low when VDD is less than 4V or ATN is greater than 1.4V. Pulled to VDD by a 4.7K resistor. May be pulled low externally (i.e. with a switch to VSS) to force a reset. Do not drive high.	
23	VSS	Ground	Ground. Located next to VIN for easy battery hookup	
24	VIN	Regulator In	Input to 5V regulator. Accepts 5V to 15V. If power is applied directly to VDD, pin may be left unconnected.	

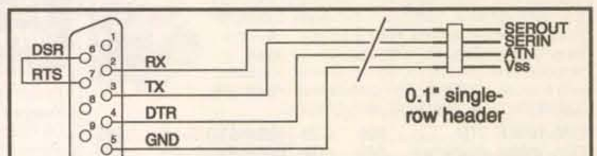

Figure 1. PC to BS2-IC programming cable.

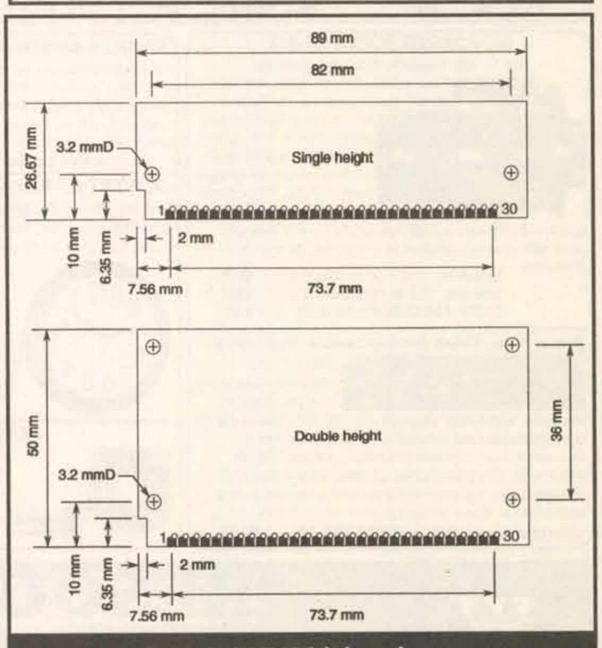

Figure 2. SIMMStick form factors.

twice the execution rate of the BS1-IC, and most BS-2 PBASIC instructions do more or are more flexible in modes of operation than their BS-1 equivalents. Communications zing along at up to 50K baud, the BS-2 also can generate DTMF tones, arbitrary dual sinewaves, and X-10 control codes. Size: 1.2" x .6" x .375", a 24-pin DIP on 600 mil centers (see Table 1 and Figure 3 for the BS-2 pinout).

The BS2-IC also offers more efficient RAM use since you can declare not just bit, byte, and word variables, but also nybbles. These come in handy when you just need a loop counter for less than 16 counts because they take up half the space of a byte variable.

One big difference between the BS-1 and the BS-2 is that you program the BS-2 through the PC serial port. Because the BS-2 uses the serial port instead of the printer port, a different program editor/downloader is also used — BSTAMP2.EXE — available for free download from Parallax.

As with the BS-1, you can order a starter kit for the BS2-IC which comes with all the software and manuals you need plus one BS2-IC, a carrier board with prototyping area, 9V battery clip, and serial port connector — all for $149.00. You don't really need all that stuff, though. Breadbot functions as the carrier board and all the software and manuals are available online. Make your own $2.00 cable (Figure 1) and save yourself $100.00.

SIMMSticks

What if you want to build your own controller? One possibility that's intrigued me is something called a "SIMMStick." These are much larger (about 1" by 3.5") than the boards from either Parallax or Micromint. They are based on the 30-pin SIMM form factor of older PC memory modules, and use through-hole components rather than surface mount, so they are inherently easier for hackers to build (see Table 2 for pinout). Bare boards are available for most PIC chips, the Zilog Z-8, and Atmel AVR eight-bit RISC and 8051-derivative microcontrollers.

The first designs were done a couple years ago by Antti Lukats; he started with boards for PIC16Cxx chips (one of which also works with the Zilog Z-8). All of these boards have small prototyping areas, making them even more hacker-friendly.

In a truly international effort, Antti Lukats in Estonia (www.antti@sistudio.com) and Don McKenzie in Australia (www.dontronics.com) have expanded the original line to other microcontroller families such as the Atmel family of microcontrollers, with

Listing 1.

```
SYMBOL servo = pin0      ' p0 = servo under test
SYMBOL lwhisker = pin3   ' p3 = left whisker
SYMBOL fbumper = pin4    ' p4 = front bumper
SYMBOL rwhisker = pin5   ' p5 = right whisker

SYMBOL spd = b2
SYMBOL fmax = 200
SYMBOL rmax = 70
SYMBOL fstop = b3
SYMBOL rstop = b4
SYMBOL delay = b5
SYMBOL i = b6

SYMBOL bump = 0

delay = 20

' Set up I/O bits 3,4,& 5 as inputs; 0 as output

        INPUT lwhisker
        INPUT rwhisker
        INPUT fbumper
        OUTPUT servo

' Initialize speed vars

init1:
        fstop = 0
        rstop = 0

init2:
        spd = rmax  'reverse maximum

DEBUG "Reverse stop = ",#rstop,"Forward stop = ",#fstop,cr

wait_bump:
        IF rwhisker<>bump THEN wait_bump

pause 1000

' Ramp speed from max reverse to max forward

ramp1:

        FOR i = 0 TO 10
                pulsout servo, spd
                pause delay

                IF rwhisker <> bump THEN skip
                fstop = spd
                GOTO ramp2

skip:   NEXT i

        spd = spd + 1
        IF spd > fmax THEN ramp2
        goto ramp1

' Ramp speeds from max forward through max reverse

ramp2:
        IF rwhisker = bump THEN ramp2      ' wait for whisker to be released
                spd = fmax                 'forward maximum

ramp3:

        FOR i = 0 TO 10
                pulsout servo, spd
                PAUSE delay

        IF rwhisker <> bump THEN skip2
                rstop = spd
                GOTO Init2

skip2:  NEXT i

        spd = spd - 1
        IF spd < rmax THEN init2
        GOTO ramp3
```

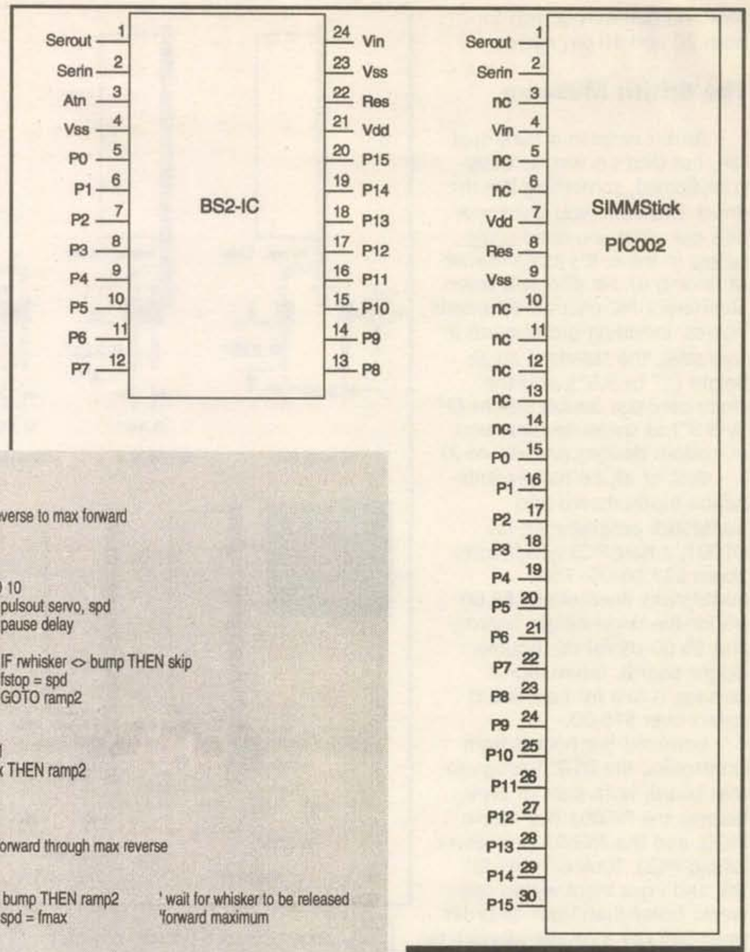

Figure 3. Pin arrangements for Parallax BASIC Stamp 2 vs. PIC002 SIMMStick configured for BS-2 operation.

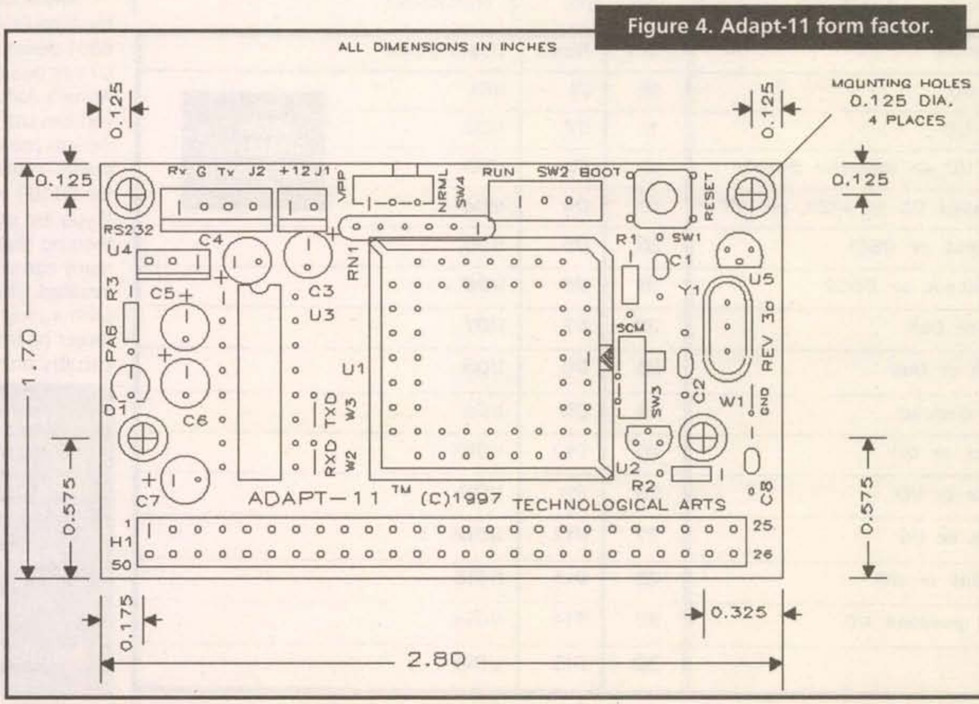

Figure 4. Adapt-11 form factor.

AVR and non-AVR boards for both 20 and 40 pin micros.

The British Museum

Antti's website is fairly spartan, but Don's is wonderously complicated, something like the British Museum (you just know he's got what you need somewhere in there, it's just a matter of finding it). He also sells several different PIC chip development boards, including protoboards in two sizes, the standard single height (1" by 3.5"), and the credit card-size double height (2" by 3.5") to speed development of custom designs (see Figure 2).

Best of all, he has a combination motherboard and SIMMStick programmer, his DT001, a bare PCB which costs about $27.00 US. The SIMMSticks themselves? $6.00 US for the single-height boards, and $9.00 US for the double-height boards. International postage is free for bare-board orders over $15.00.

I ordered five boards from Dontronics, the DT001 programmer board, both sizes of protoboards, the PIC001 (for 18-pin PICs), and the PIC003 (for newer 28-pin PICs). Total bill: $45.00 US, and I got them within one week, faster than I got an order from Digi-Key a couple weeks later.

For those of you who don't want to depend on delivery from the Antipodes, there is a US distributor, Wirz Electronics (http://www.wirz.com/). Ben Wirz stocks the full line of SIMMStick PC boards, as well as a couple good deals on parts kits. He also has a Serial LCD Interface (SLI) board that allows you to turn any standard parallel-interface LCD display into a serial display, a natural for a mobile robot console. (I'll have more to say about SLI in a future column.)

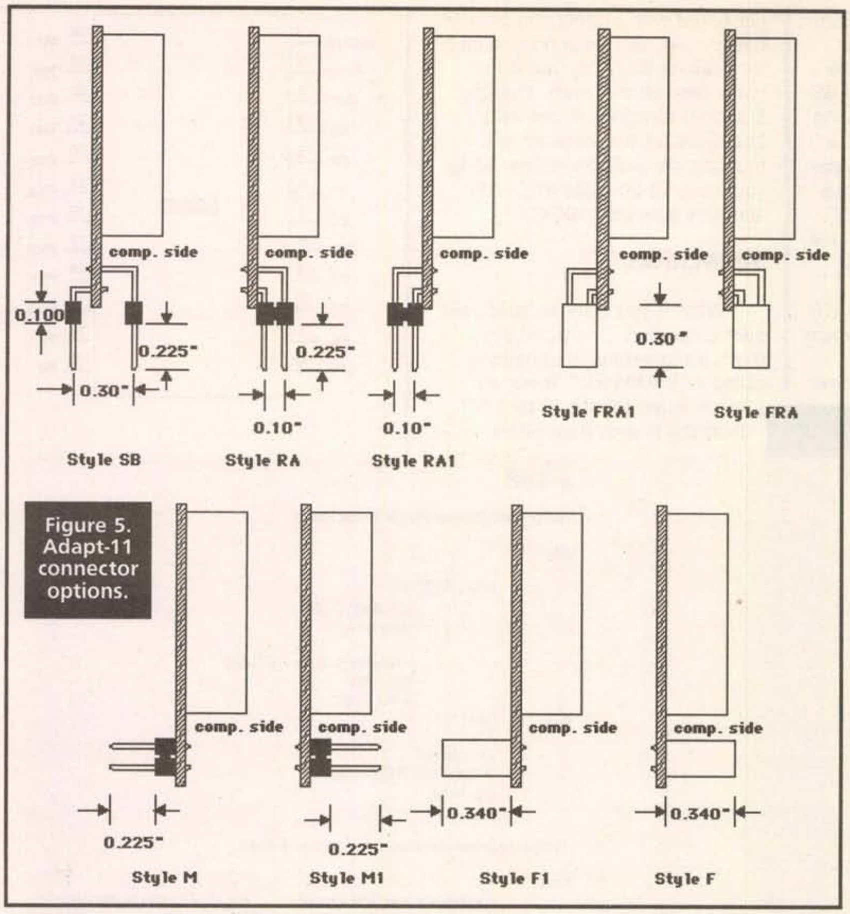

Figure 5. Adapt-11 connector options.

But what do SIMMSticks have to do with the world of BASIC Stamps? This is the kicker: you can make your own Stamp clones, fully PBASIC compatible, and fully expandable and customizable.

And there are other BASICs available, such as FED BASIC (www.ibmpcug.co.uk/~gmwarner/fed.htm), and the PBASIC-compatible MEL BASIC compiler (www.melabs.com/mel/home.htm). There are also C compilers, Forth, and many others available for PIC chips. Check out the "All About PIC" website (http://www.ormix.riga.lv/eng/mchip/mchip.htm) for a comprehensive list of software and hardware development tools available for PIC.

In case you can't tell, I'm very impressed with the whole SIMMStick concept. I like the price, the form factor, and — more importantly — I like the DIY spirit of the whole enterprise and its international character.

A Bunch of Bare Boards from Down Under

In the time since I first ordered from Dontronics, the PIC001 board has been obsolete. It's been replaced by the DT101 which supports all of the Microchip PIC 16CXX line of microcontrollers in 18-pin DIP packages: PIC16C52, 54, 56, 58A, 554, 556, 558, C61, 620, 621, 622, C710, 711, 71, C83, C84, and F84. It has an on-board RS-232 level converter, brown-out circuit protection, real-time clock, 1 to 64K Serial EEPROM 8- and 12-bit A/D converters, compatibility with the many SIMMStick prototyping and expansion boards.

The DT101 is also compatible with the DT.001 programmer for on-the-fly in-circuit programming. Unlike the PIC001 board which it replaces, it doesn't support a BASIC Stamp 1 mode.

The PIC002 supports the 28-pin 16C57 (both the 300 and 600 mil DIP versions), which means you can make a BASIC Stamp 2 compatible by combining the PBASIC2/P part from Parallax ($25.00) with a 24LC16 serial EEPROM; add a 20 MHz crystal, voltage regulator, a few capacitors and resistors, and you have a complete BS-2 work-alike. Or use a 20 MHz ceramic resonator and you can dispense with two capacitors.

The PIC003 supports the newer 28-pin PICs, the PIC16C62, 62A, 63, 72, and 73. Rounding out the PIC family, the PIC004 supports 40-pin PICs such as the PIC16C64, 64A, 65, 65A, 74, and 74A. The PIC004 is a double-height SIMMStick.

SIMMSticks are also available for Atmel's AVR eight-bit RISC and 8051-derivative MCU chips. The DT103 board was designed for Atmel's AVR 40-pin DIP MCUs, but you can use either AVR or non-AVR devices (minor changes need to be made — cutting a trace — to use the DT103 with a non-AVR micro). If you are using it with an AVR chip then no changes are required and many components don't need to be installed. This board can be used as both a programmer board and a target board with the programming circuitry on the board.

Table 2. SIMMStick bus pinout.

Pin #	Name	Description	Pin #	Name	Description
1	A1	Special I/O	16	D1	I/01
2	A2	Special I/O	17	D2	I/02
3	A3	Special I/O or Negative Supply	18	D3	I/03
4	PWR	Unregulated DC in, +12V, or VPP	19	D4	I/04
5	CI	Clock Input or OSC1	20	D5	I/05
6	CO	Clock Output or OSC2	21	D6	I/06
7	VDD	+5V In or Out	22	D7	I/07
8	RES	Reset In or Out	23	D8	I/08
9	GND	Digital Ground	24	D9	I/09
10	SCL	I2C Clock or I/O	25	D10	I/010
11	SDA	I2C Data or I/O	26	D11	I/011
12	SI	Serial In or I/O	27	D12	I/012
13	SO	Serial Out or I/O	28	D13	I/013
14	I/O	General purpose I/O	29	D14	I/014
15	DO	I/00	30	D15	I/015

If you have suggestions for improving Breadbot, or if you have questions or comments about amateur robotics topics, as usual you can reach me at:

Robert Nansel
69 S. Fremont Ave. #2
Pittsburgh, PA 15202
E-Mail:
bnansel@nauticom.net

The DT104 board was designed for Atmel AVR 20-pin DIP MCU (such as the AT90S1200), however, it also works with non-AVR devices. Again, minor changes need to be made if you choose to use the DT104 with a non-AVR micro such as the AT89C2051. If you are using it with the AT90S1200, then no changes are needed.

Did I say I like the SIMMStick concept? Well, I do. I have several projects in mind for them in upcoming months. But this month, another thing was on my mind ...

Wither Motorola?

There are currently no Motorola MCU chips such as the 68HC05 or 68HC11 supported by SIMMSticks. This is a shame since these seem like naturals for SIMMSticks, and they are certainly popular with us gearheads. If Antii or Don or Ben don't design an HC11 SIMMStick, I may have to do one myself (are you listening guys?).

Until then, the ADAPT-11 Modular Prototyping System from Technological Arts (http://www.interlog.com/~techart) looks to be a good candidate to fill this gap.

All of you fans of the popular Motorola 68HC11 MCU will be happy to find that ADAPT-11 boards contain all the elements common to every 68HC11 design: clock (8 MHz crystal), reset (including a pushbutton), a mode select switch, a 5-volt regulator, and an RS-232 interface. The system also has provisions for programming the 68HC711 EPROM with the addition of an external programming voltage. The boards themselves are a business card size (1.7" x 2.8" for the AD-11 and AD-11C75, 2.1" x 2.8" for the AD-11C75DX), close to the size of a SIMMStick double-height.

The real strength of the ADAPT-11 family, though, is that all of the microcontroller I/O and control lines are brought out to a 50-pin header pattern on the printed circuit board. This allows for several different connector options (Figure 5). The SB-style connector allows you to plug an AD-11 card directly into Breadbot.

There are three 68HC11-based boards available from Technological Arts: the AD-11, which fits somewhere between a Botboard and a Botboard II in terms of capability; the AD-11C75, which adds Xicor's X68C75 microperipheral chip with 8K EEPROM and two eight-bit I/O ports; and the AD-11C75DX with all the features of the AD-11C75 with the addition of 32K SRAM.

Pin	Signal Name	Pin	Signal Name
1	PD2	50	GROUND
2	PD3	49	GROUND
3	PD4	48	PDO/RXD
4	PD5	47	+5V
5	PD1/TXD	46	IRQ*
6	PA7	45	XIRQ*
7	PA6	44	RESET*
8	PA5	43	RESERVED
9	PA4	42	PC7 (AD7)
10	PA3	41	PC6 (AD6)
11	PA2	40	PC5 (AD5)
12	PA1	39	PC4 (AD4)
13	PAO	38	PC3 (AD3)
14	PB7 (A15)	37	PC2 (AD2)
15	PB6 (A14)	36	PC1 (AD1)
16	PB5 (A13)	35	PCO (ADO)
17	PB4 (A12)	34	R/W*
18	PB3 (A11)	33	E
19	PB2 (A10)	32	AS
20	PB1 (A9)	31	VRL
21	PBO (A8)	30	VRH
22	PEO (AnalogO)	29	PE7 (Analog7)
23	PE1 (Analog1)	28	PE6 (Analog6)
24	PE2 (Analog2)	27	PE5 (Analog5)
25	PE3 (Analog3)	26	PE4 (Analog4)

Table 3. Adapt-11 bus pinout.

But that's not all. Technological Arts has a series of low-cost PLCC-to-breadboard adaptors for PLCC chips ranging from 28-pin on up to 84-pin. Check them out.

Wrapping up

One suggested modification to the Breadbot design comes from a Seattle Robotics Society member who saw Breadbot at the May meeting when I was on a business trip to Seattle. This person — sorry! I didn't get your name — was captivated by Breadbot's simplicity and was so inspired he went out immediately after the meeting to build one of his own.

His specific suggestion was to use stick-on velcro to mount the servos and battery holder to the breadboard. This overcomes one of the objections to using a Radio Shack breadboard, namely that it doesn't come with double sticky foam on its underside. You can bet that future versions of Breadbot will incorporate this suggestion.

SIMMSticks and the ADAPT-11 line offer a plethora of paths to smarter Breadbots. I'll guide you down a couple of those paths next month. **NV**

INTERNET RESOURCES:

"All About PIC" website:
http://www.ormix.riga.lv/eng/mchip/mchip.htm

Atmel Flash AVR 8-bit RISC and 8051-derivatives:
http://www.atmel.com/atmel/products

Dallas Semiconductor RTC's: http://www.dalsemi.com/

DonTronics: http://dontronics.com

Linear Technology A/D's: http://www.linear.com/

Microchip PIC and EEPROM:
http://www.microchip.com/

National Semiconductor A/D's:
http://www.national.com/

Parallax, Inc. BASIC Stamp modules and chips:
http://www.parallaxinc.com

Silicon Studio SIMMSticks:
http://www.antti@sistudio.com

Wirz Electronics SIMMSticks: http://www.wirz.com/

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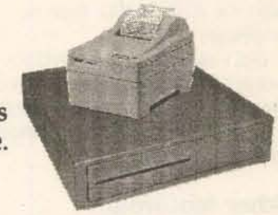

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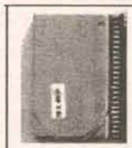

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Short Circuits ...

A REMOTE TELEPHONE ALARM

Did you ever miss an important telephone call because you were in your basement or garage and didn't hear the telephone ring? Or perhaps you heard it ring, but you heard it too late and, although you rushed as fast as you could, you couldn't get to the phone in time?

Even if the call is not important, missing it by a few seconds can be, to say the least, annoying.

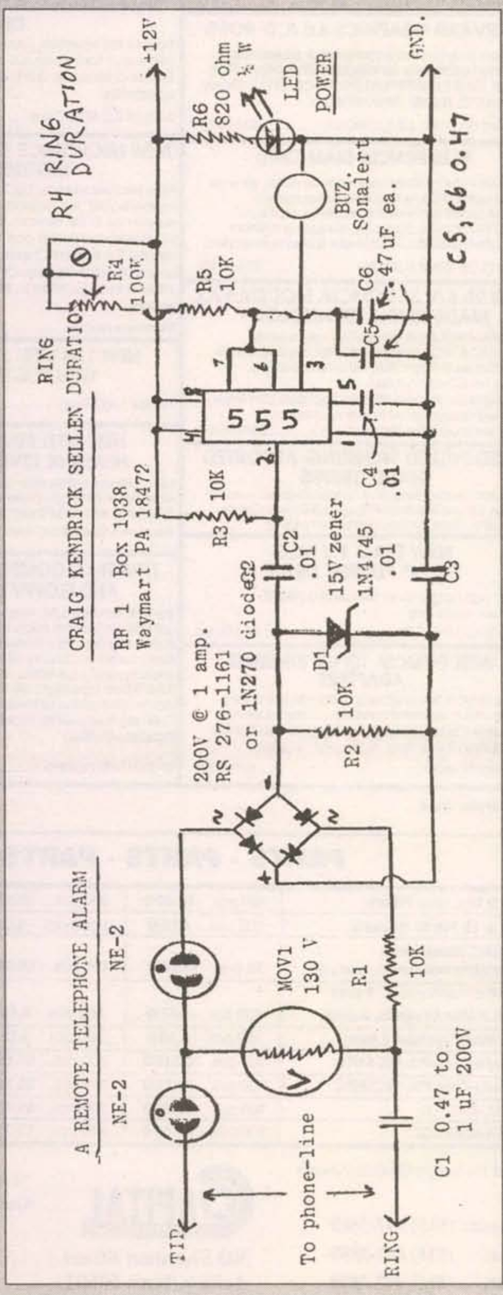
THE SOLUTION

The ring signal fires through the two NE-2 neon bulbs. Capacitor C1 blocks the DC line voltage but couples the AC ring signal to the full-wave bridge rectifier through limiting resistor R1.

The pulsating DC from the rectifier is coupled to C2 and C3. These capacitors isolate the circuit from the phone line.

While R2 is the load resistor for the bridge and D1 is the diode clamp, capacitor C2 couples negative-going pulses to trigger the 555 which acts as a monostable one-shot.

This, in turn, sounds a buzzer or sonalart. The sonalart can be replaced by a solid-state relay if some other alarm or indicator (such as a light in your workshop) is to be used.



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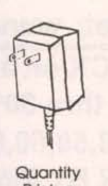

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by Fred Blechman

Part 1

Digital Frequency Counters

This two-part article on digital frequency counters covers typical low-cost counters and how they are used.

The accurate determination of operating frequency is very important in the design, servicing, and maintenance of electronic equipment. Experimenters, hobbyists, and professionals in the electronic field use many forms of signal generators or transmitters that require frequency verification. Although other means of measuring frequency are available, the frequency counter has become the instrument of choice. Small, pocket-size frequency counters can be used to determine the transmitting frequency of nearby handheld transmitters for surveillance or scanning purposes, or testing and calibration.

Digital frequency counters are growing in popularity for several reasons: greater availability, lower prices, and greater accuracy. They have become a status symbol for electronics technicians. Everybody wants one, even if they're not entirely sure why, or exactly when and where a frequency counter would be used.

If you work primarily in general TV servicing, you probably would not use a frequency counter very often. On those rare occasions when you need to measure a TV circuit frequency, you can use your oscilloscope for a fairly approximate frequency. You just count the number of cycles displayed and divide by the time base.

For example, if the oscilloscope time base is set to 1 millisecond (ms) per screen grid division, and a single cycle occupies one horizontal grid division, the frequency ($f=1/t$) is 1/.001, or 1000 Hz (cycles per second).

However, measurements of frequency using typical analog methods, such as an analog oscilloscope, crystal calibrator, or various forms of wave meters, are not particularly accurate.

The main advantages of a digital frequency counter (sometimes called a "frequency meter") are that it is simple to use, and its digital operation provides a direct numerical readout of frequency with a higher precision than using analog measurements. It is perhaps the most useful AC measuring instrument to emerge from the laboratory since the oscilloscope.

In some applications, a digital frequency counter can be extremely valuable, such as musical instrument servicing and working with RF (radio frequency) transmitters. Tuning a piano, for example, can be performed with a digital readout by relatively novice tuner technicians compared to the experience required for listening to beat frequencies using pitchforks. Most RF transmitters, by law, are required to operate on precise frequencies or within certain band limits; a frequency counter can verify that oscillators, multipliers, and frequency synthesizers are working properly and tuned correctly, and that dials are properly calibrated.

SOUND MASTER ELECTRONICS SM-100

Bench or Portable?

Frequency counters are available for bench or portable use. A bench 117VAC-powered frequency counter would most likely be used for adjustment, test, and repair of electronic clocks and watches, or to calibrate and adjust the frequencies of desktop radio receivers and transmitters, or laboratory equipment such as AF (audio frequency) and RF signal generators.

A portable battery-operated unit is much more convenient for off-site measurements, such as instrument tuning. Shirt-pocket or handheld portable frequency counters are used by professionals and amateurs alike for finding and identifying HT (handheld transceiver) communication frequencies, surveillance functions, repair and adjustment of equipment, monitoring RF transmitter output near the antenna, tuning antennas with antenna analyzers, field strength measurement, and much, much more.

Modern Frequency Counters

Part 1 describes typical frequency counters, with details on one that can be built from a kit or completely assembled. Part 2 will describe various units from different manufacturers, and include some actual uses.

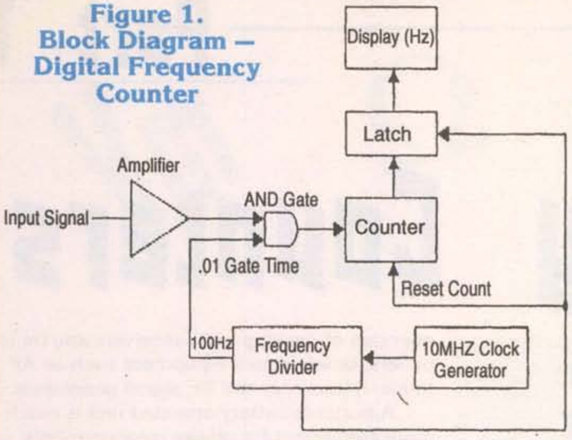
All modern frequency counters are digital devices, with the measured frequency displayed in numerical form on either an LCD (liquid crystal display) or LED (light-emitting diode) readout. Since the typical direct input impedance of a frequency counter used below 50MHz (megaHertz — million cycles per second) is about 1 megohm, the circuit being measured is not significantly affected. If an antenna or loop pickup is used to intercept signals, there is generally minimum effect on the frequency-producing circuit.

Most inexpensive frequency counters measure frequencies from a few Hertz (cycles per second) up to about 50MHz, which is sufficient for most servicing work. If you need to measure higher frequencies, built-in or accessory prescalers extend the upper range to over 1 GHz (gigaHertz) — that's over 1000MHz!

LED or LCD Readout?

There is no question that for a bench unit,

Figure 1.
Block Diagram — Digital Frequency Counter



an LED readout makes sense, since it can easily be seen indoors under typical workbench lighting, or even relative darkness. But some misunderstandings exist about the advantages of LCD readouts for portable battery-operated units. Since LCDs are generally considered to use less power than LEDs, the thoughts are that LCD readout frequency counters will use less battery power, and provide a readable display in sunlight.

However, only about 20% of the power used in a typical frequency counter is used by the display; the other 80% drives the sophisticated countdown and digital readout conversion circuitry. Furthermore, many LCD displays require backlighting power, deteriorate in high brightness like sunlight, and can be hard to see clearly in darkened conditions.

LED displays, on the other hand, are usually "multiplexed" with only one digit "on" at any moment, but scanned so fast that all digits appeared to be lighted. This saves considerably from the roughly 20% of battery life devoted to the display.

Principle of Operation

The basic principle of a digital frequency counter is that the number of cycles of the input signal occurring in a fixed time period is counted on a digital counter, and the result is then displayed as a frequency reading on a digital readout.

For example, if the fixed counting time is 1ms (one millisecond), then the displayed digital count will be the number of signal cycles in KHz (kiloHertz — thousands of cycles per second), often with up to eight decimal places!

The general arrangement for a digital frequency counter is shown in Figure 1. In this block diagram, an accurate 10MHz clock generator is digitally divided down to 100Hz, thus allowing the input "gate" to be open for 0.01 seconds. The input signal passes to the counter ONLY for that exact period of time — in this example, one hundredth of a second.

The counter accumulates the number of cycles occurring in the 0.01 seconds while the gate is open, then latches the gate closed and resets the counter to zero for the next count. The total count during the open gate time is displayed to show the frequency readout in Hz (cycles per second), with the decimal point pre-positioned. Most frequency counters allow you to set different gate times, perhaps for as long as 10 seconds to capture very slow cycles, or 0.001 seconds to read high frequencies.

Above 50MHz

For frequencies above 50MHz, time delays in the gates can produce errors in the frequency readout. The solution is to use a prescaler counter with a frequency division ratio of 10 or perhaps 100. If the prescaler has a division ratio of 10 and the input frequency is 500MHz, then the output frequency will be just 50MHz and this signal can be fed to a standard frequency counter circuit. Of course, the readout frequency must be multiplied by 10 in this case to give the proper input frequency.

Commercial frequency counters often have the prescaler built in, and the decimal point on the readout is shifted so that the correct frequency is displayed. It should also be noted that the input impedance — often 1 megohm below 50MHz — will probably be only 50 ohms when the prescaler is put into the circuit.

Most inexpensive digital frequency counters provide high precision readings to five or six digits. The more expensive frequency counters have a display of eight or more digits. The actual accuracy of the frequency readings depends upon the accuracy of the timing clock and the speed at which the input gate can operate. The timing oscillator is normally based on the use of a crystal-controlled primary oscillator so that the clock accuracy can be high and the clock frequency stable.

Frequency counters usually have an adjustable sensitivity control which sets up the level at which the input signal will trigger the counter. This control can be adjusted so that the meter does not respond to noise or other low-level interference. In laboratory instruments, the frequency measuring function is often combined with the ability to operate as an event counter or as a period timer.

Table 1.
Sound Master SM-100 Specifications

Frequency Range: 10 Hz-150 MHz
Display: 8-digit .5" LED (multiplexed)
Gate Time: .01, .1, 1, 10 seconds
Input Sensitivity: KHz Range: 10 Hz-10 MHz, 20 mV (min.)
MHz Range: 1 MHz-120 MHz, 20 mV (min.)
120 MHz-150 MHz, 35 mV (min.)
150 MHz-200 MHz, 40 mV (Typical)
Time Base: 10.00 MHz (crystal oscillator, ±10 ppm)
Accuracy: ±digit, ±time base
Input Impedance: KHz Range: 1 MΩ; MHz Range: 50Ω.
Response Time: 0.2 second
Resolution: 0.1 Hz (at 10 second gate time)
1 Hz (at 1 second gate time)
10 Hz (at 0.1 second gate time)
100 Hz (at 0.01 second gate time)
Hold: Holds the last input signal
Power: 9VDC power adapter or four 1.5V D-size batteries
Price: $79.00 kit; $99.00 assembled
Dimensions: 8.05" wide, 6.55" deep, 2.60" high

Many Manufacturers

Frequency counters are made by a number of different manufacturers at various price levels. Some specialize in pocket-size frequency counters for receiving nearby handheld transmitters, others make various bench-type units.

In Part 2 of this series, we'll cover some counters available from Startek International, Elenco Electronics, Weeder Technologies, Optoelectronics, EXTECH Instruments, and TechAmerica.

The SM-100 — Buy or Build?

For now, we'll describe in detail the Sound Master Electronics SM-100. Selling for $99.00 assembled, this is an accurate, easy-to-operate bench or portable frequency counter to measure frequencies from 10Hz to 150MHz. It can be powered from a

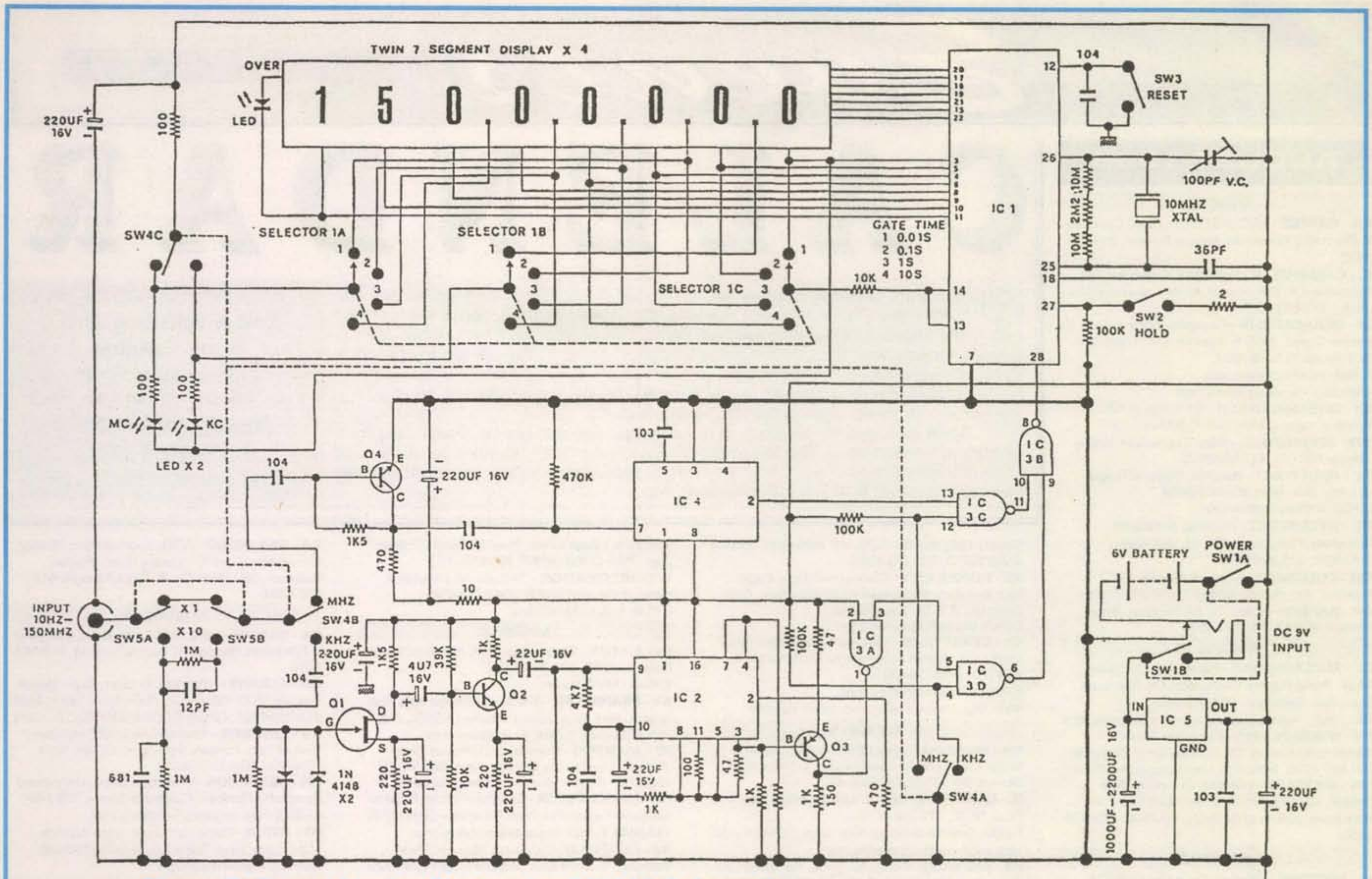


Figure 2. Sound Master Electronics SM-100 Schematic

wall-type 9VDC adapter or four "D" batteries, none of which are included with the unit.

The black plastic case with clear white markings measures 8.05 inches wide, 6.55 inches front-to-back, and 2.6 inches high. To use the SM-100, you'll need a typical oscilloscope probe or an antenna (neither included) to match the SM-100 BNC-type input connector.

Although it can be built from a complete kit of parts for $20.00 less than a fully-assembled unit, I do not recommend building the kit. The instructions are minimal, and there are many, many parts with at least 200 soldering points and some critical physical alignment. The assembled unit, on the other hand, is professional in appearance, construction, and operation.

The SM-100 display is composed of eight 0.5-inch-high bright seven-segment multiplexed LED digits, and will count a wide frequency in two ranges from 10Hz to 150MHz, with gate times of 0.01, 0.1, 1, and 10 seconds. The input impedance is 1 megohm for the lower range (up to 10MHz), and 50 ohms for the higher range, with a limiting AC input of 250 volts. It includes a manual "Hold" switch that displays the last input frequency for future reference and comparison. The SM-100 specifications are shown in Table 1.

Theory of Operation

The schematic of the SM-100 is shown in Figure 2. The signal to be measured is applied to the BNC input connector. Power switch SW1A/SW1B supplies internal or external DC power to the circuitry. If external power is used, it is regulated to 5 volts by IC5, a 7805. Signal attenuation switch SW5A selects X1 or X10 input signal, while range switch SW4B selects one of the two input amplifiers.

For input signals below 10MHz, the signal is applied to FET transistor Q1, with two diodes protecting its input from excessive signals. The drain load of Q1 consists of transistor Q2 connected as a common emitter amplifier, which drives integrated circuit IC2, an MC10116P triple-line receiver. The output of IC2 at pin 3 is a squarewave buffered by emitter follower transistor Q3.

For input frequencies above 10MHz, switch SW4B connects the signal to transistor amplifier Q4, which drives IC4, an SP8629 divide-by-10 prescaler. It is necessary to divide the input frequency because the counter used in IC1 (a 7216D) cannot handle frequencies much above 10MHz. This also drops the input impedance to 50 ohms.

The IC3C/IC3B or IC3A/IC3D NAND gates are configured as OR circuits to select the signal applied from either IC4 or IC2 as set by switch SW4A.

IC1 counts the frequency, performs decoding, and drives the eight seven-segment LED displays. The basic timing function is provided by a 10MHz crystal oscillator at pins 25 and 26. Pins 3 through 11 drive the digits, and pins 15 through 22 are the segment drivers. Switch SW3 grounds pin 12 of IC1 to reset the counter. Switch SW2 applies a high to pin 27 to hold the last readout count.

Band switch SW4C lights either the KC (kiloHertz) or MC (megaHertz) LED on the front panel, and enables the proper gate time/decimal point locator switch selector 1A/B/C. The gate time selected determines the counter frequency resolution and presets the decimal point. Resolution is increased by longer gate times, but results in slower updates.

Summary

A digital frequency counter can simplify troubleshooting and the accurate adjustment or calibration of all sorts of electronic equipment compared to using an oscilloscope or other frequency measuring device. As frequency counters have become less expensive, they have become more common, and as the technology has improved, so has the accuracy and range of these instruments.

In Part 2 of this series, we'll cover some counters available from Startek International, Elenco Electronics, Weeder Technologies, Optoelectronics, EXTECH Instruments, and TechAmerica. **NV**

SOURCE

The Sound Master SM-100 is available in kit form for $79.00, or assembled and tested for $99.00, from **Mark V Electronics, Inc.**, 8019 E. Slauson Ave., Montebello, CA 90640; 24-page illustrated catalog (almost 50 electronic kits or assembled units) and information: **(213) 888-6868**. Orders only: In California, **(800) 521-MARK**; outside California, **(800) 423-FIVE**. Call them for shipping, handling, and sales tax. Internet: www.mark5co.com; E-Mail: **mark5co@aol.com**.

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AUGUST 1998

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AUGUST 1

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

IL - CARLINVILLE - Hamfest & Computer Fair. Macoupin Co. Fairgrounds, Rt. 4. 7am-noon. Tim Jones, 217-627-2355

IN - INDIANAPOLIS - Computer Show & Sale. IN Events Center, 3655 E. Raymond St. 10am-4pm. AGI Shows 317-299-8827.
E-Mail: info@agishows.com
Web: http://www.agishows.com

KY - BOWLING GREEN - KY Colonels ARC Hamfest. Leon Garrett K4CIT, 502-842-5307

MO - SPRINGFIELD - State Convention. Karen Thorpe N0TDW, 417-889-6775

NC - HIGH POINT - Hamfest. National Guard Armory, 8am-1pm. 336-887-3039.
E-Mail: RAHam@infoave.net

NY - WEEDSPORT - Hamfest. Weedsport Speedway/Fairgrounds, Rt. 31. Joe Kahler WA2NGX, 315-364-5135

OH - COLUMBUS - Voice of Aladdin ARC Hamfest. Jim Morton KB8KPJ, 614-846-7790

OR - BANDON - Coos Co. RC Hamfest. Brian Howard W7MLT, 541-572-5623

AUGUST 1-2

FL - JACKSONVILLE - Hamfest & Computer Show. Prime Osborn Convention Ctr. Sat: 9am-5pm, Sun: 9am-3pm. 904-268-2302.
Web: http://www.pobox.com/~w4ue/hamfest.html

NY - WHITE PLAINS - Computer Show. Westchester County Ctr. 9:30am-4pm. MarketPro 201-825-2229. Web: http://www.marketpro.com

WA - SPOKANE - Hamfest. University High School, 10212 E. 9th Ave. Sat: 9am-5pm, Sun: 8am-noon. JoAnn L. Gemmrig KA7SUZ, 509-928-1808

AUGUST 2

IL - PEOTONE - Hamfest. Dave Brasel NF9N, 708-448-0580

IN - ANGOLA - Land of Lakes ARC Hamfest. Theresa J. Limestahl KB9NNR, 219-495-5403.
E-Mail: tjlimestahl@dmci.net

NH - PORTSMOUTH - Computer Show. Yoken's. Northern Computer Shows 978-744-8440.
E-Mail: inquiries@ncshows.com

OH - AKRON - Computer Show. Tadmor Shrine Temple. 10am-3pm. Peter Trapp Shows 603-272-5008. Web: www.petertrapp.com

OH - RANDOLPH - ARC Hamfair. Portage County Fairgrounds, St. Rt. 44. 8am-4pm. Joanne Solak KJ3O, 330-274-8240

PA - HOMER CITY - Computer & Ham Radio Fair. Red Barn Sportsman Club. 8am-4pm. Gary Robinson K3SJX, 724-459-8941.
E-Mail: axxon@microserve.net

VA - BERRYVILLE - Hamfest & Computer Show. Clarke Co. Ruritan Fairgrounds. Tom Martin KF4TNX, 540-539-4301.
E-Mail: hamfest@Vvalley.com
Web: http://www.Vvalley.com/svarc.hamfest

AUGUST 8

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves

IL - QUINCY - Western IL ARC Hamfest. Jim Funk N9JF, 217-336-4191.
E-Mail: jfunk@adams.net Web: http://scribers.midwest.net/bcrocket/swapfest.htm

NY - BUFFALO - Computer Show. Hamburg Fairgrounds. 9:30am-4pm. MarketPro 201-825-2229. Web: http://www.marketpro.com

NY - POUGHKEEPSIE - Computer Show. Mid-Hudson Civic Center. 9:30am-4pm. MarketPro 201-825-2229. Web: http://www.marketpro.com

PA - LEWISTOWN - Hamfest. Decatur Township Fire Company grounds. 8am-1pm. Rich Yingling WB3COB 717-242-1882

PA - YORK - Computer Show. Fairgrounds, Horticultural Hall. 10am-3pm. Peter Trapp Shows 603-272-5008. Web: www.petertrapp.com

WI - HILBERT - Ham Radio & Computerfest. Tommy's Village Lanes, Hwy. 57 North. 7:30am-2pm. Mike Ortlieb KN9P, 920-853-7073

WV - HUNTINGTON - Tri-State ARA Hamfest. Bernard Mays WB8ZER, 304-743-5459.
E-Mail: wb8zer@juno.com

AUGUST 9

IA - AMANA - Cedar Valley ARC Hamfest. Wayne Kolosik KI0FE, 319-393-4224.
E-Mail: ki0fe@usa.net

KY - FRANKFORT - Hamfest. Western Hills High School. 8am-4pm. John R. Barnes KS4GL, 606-253-1178 eves. E-Mail: ks4gl@juno.com

MI - JACKSON - Hamfest & Computer Show. Jackson Community College. Terry K8SMC, 517-768-1770. E-Mail: k8smc@modempool.com

NH - MANCHESTER - Computer Show. Holiday Inn Expo Center. Northern Computer Shows 978-744-8440. E-Mail: inquiries@ncshows.com

NJ - FAIRFIELD - Computer Show. Fairfield Radisson. 9:30am-4pm. MarketPro 201-825-2229. http://www.marketpro.com

NY - ROCHESTER - Computer Show. The Dome Ctr. 9:30am-4pm. MarketPro 201-825-2229. Web: http://www.marketpro.com

PA - ALLENTOWN - Computer Show. Days Inn Conference Ctr. 10am-3pm. Peter Trapp Shows 603-272-5008. Web: www.petertrapp.com

AUGUST 14-15

LA - NEW ORLEANS - Int'l DX Convention. Don Boudreau W5FKX, 504-737-9733

AUGUST 14-15-16

CA - SAN DIEGO - ARRL Southwestern Division Convention. Town & Country Hotel, Mission Ballroom, 500 Hotel Cir. N. Cybil Allbright 619-278-4284

AUGUST 15

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

GA - ALBANY - Computer & Elect. Expo. Hasan Temple, 1822 Palmyra Rd. 9am-5pm. Sandy Rabb 912-888-9393. E-Mail: GODS@SURFSOUTH.COM

KS - CHANUTE - Chanute Area ARC Hamfest. Central Park Pavilion. 9am-1pm. Charlie Ward WD0AKU, 316-431-6402

NH - SEABROOK - Computer Show. Greyhound Racetrack. Northern Computer Shows 978-744-8440. E-Mail: inquiries@ncshows.com

NY - UTICA - Computer Show. Utica Armory. 10am-3pm. Peter Trapp Shows 603-272-5008. Web: www.petertrapp.com

AUGUST 15-16

AL - HUNTSVILLE - Hamfest. Von Braun Civic Ctr. Sat: 9am-4:30pm, Sun: 9am-2:30pm. Art Davis WB4KKA, 256-883-0477
Web: www.hamfest.org

MN - WASECA - Hamfest & Craftfair. Waseca Co. Fairgrounds. Lloyd L. Schlaak 507-465-8619.
E-Mail: n0vfv@smig.net

NY - LAKE GROVE - Computer Show. Sports Plus. 9:30am-4pm. MarketPro 201-825-2229. Web: http://www.marketpro.com

NY - STONY BROOK - Computer Show. SUNY Stony Brook. 9:30am-4pm. MarketPro 201-825-2229. Web: http://www.marketpro.com

AUGUST 16

CO - GOLDEN - State Conv. & Hamfest. Jefferson Co. Fairgrounds, 15200 W. 6th Ave. 8:30am-2pm. Guy Reed W5GR, 303-674-5389

IN - LAFAYETTE - Tippecanoe ARA Hamfest. James Canarecci WA9TGO, 765-474-6570

KS - SALINA - Central KS ARC Hamfest. Ron Tremblay WA0PSF, 785-827-8149.
E-Mail: tremblay@midusa.net

MA - CAMBRIDGE - Flea Market. Kendall Square area. MIT. Nick Alternbernd KA1MQX, 617-253-3776 Web: http://web.mit.edu/w1mx/www/swapfest.html

MA - TAUNTON - Computer Show. Holiday Inn. Northern Computer Shows 978-744-8440.
E-Mail: inquiries@ncshows.com

MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988

NY - BINGHAMTON - Computer Show. The Showplace. 10am-3pm. Peter Trapp Shows 603-272-5008. Web: www.petertrapp.com

OH - WARREN - Hamfest. Trumbull Campus Kent State Univ., Rt. 45 (Mahoning Ave.) & Rts. 5/82 Bypass. Frank Fitzhugh KD8KJ, 330-652-0452.
E-Mail: kd8kj@onecom.com

AUGUST 21-22-23

CT - ENFIELD - Eastern VHF/UHF Conference. Harley Hotel. John DeNardo N1MUW, 413-562-8242 or 413-572-9072

MI - TAYLOR - Computer & Technology Show. Gibraltar Trade Center, 15525 Racho Rd. 734-287-2000

AUGUST 22

CANADA - MANITOBA - AUSTIN - Hamfest. Mani- toba Agricultural Museum. Dave Snydal VE4XN, 204-728-2463.
E-Mail: dsnydal@mb.sympatico.ca Web: http://www.mbnet.mb.ca/~donahue/austin.html

IN - INDIANAPOLIS - Computer Show & Sale. IN

Events Center, 3655 E. Raymond St. 10am-4pm. AGI Shows 317-299-8827.
E-Mail: info@agishows.com
Web: http://www.agishows.com
IN - WARSAW - Hamfest & Computer Show. Kosciusko County Fairgrounds, Bronson & Smith St. 8am-2pm. Loren Melton WB9OST, 219-858-9374 eves. after 6pm CDT
NJ - BRIDGEWATER - Hamfest. Somerset Co. 4H Ctr., Milltown Rd. 8am-1pm. Pat N2CQM, 732-873-3394. E-Mail: scars@qsl.net
Web: http://www.qsl.net/scars

AUGUST 22-23

NJ - SECAUCUS - Computer Show. Meadowlands Exposition Ctr. 9:30am-4pm. MarketPro 201-825-2229.
Web: http://www.marketpro.com

AUGUST 23

IL - GLEN ELLYN - Computer Show & Sale. College of DuPage. Main Arena of Phys Ed Bldg. Corner of Park Blvd. & College Rd. 9:30am-3pm. Computer Central Shows 847-940-7547
IN - KOKOMO - Computer Show & Sale. Johanning Civic Center, off US 31 near Big R. 10am-4pm. AGI Shows 317-299-8827.
E-Mail: info@agishows.com
Web: http://www.agishows.com
MO - BLANCHETTE PARK - Hamfest. 6:30am-2:30pm. Dirk Bremer KC0BZV, 314-750-3417.
E-Mail: dirkb@myself.com
Web: www.qth.com/wb0hsi/
NH - NASHUA - Computer Show. Sheraton Tara. Northern Computer Shows 978-744-8440.
E-Mail: inquiries@ncshows.com
NY - DEPEW - Hamfest & Computer Show. Hearthstone Manor, 333 Dick Rd., 8am-3pm. Luke 716-634-4667.
http://hamgate1.sunyerie.edu/~larc/greaterbuffalo hamfest.html
NY - YONKERS - Hamfest & Computerfest. Yonkers Municipal Parking Garage, Main St. 9am-3pm. John Costa WB2AUL, 914-963-1021.
E-Mail: maytan@juno.com

AUGUST 28-29-30

MI - MT. CLEMENS - Computer & Technology Show. Gibraltar Trade Center, 237 N. River Rd. 810-465-6440

AUGUST 29

IN - LA PORTE - Hamfest. La Porte Co. Fairgrounds. 7am-2pm. Rich Dugger WD9ARW, 219-326-6672. E-Mail: 1pcea@hotmail.com
ME - LEWISTON - Computer Show. Civic Center. Northern Computer Shows 978-744-8440.
E-Mail: inquiries@ncshows.com
NY - ALBANY - Computer Show. Polish Community Center. 9:30am-4pm. MarketPro 201-825-2229. http://www.marketpro.com
OH - TALLMADGE - Computer Show. Summit Co. Fair-grounds, 10am-3pm. Peter Trapp Shows 603-272-5008. Web: www.petertrapp.com

AUGUST 29-30

CO - WOODLAND PARK - Swapfest. Colorado Lions Camp. Don AA0NW, 719-687-3692
FL - SARASOTA - Computer Show. Sarasota Municipal Auditorium. Frank Cox 941-954-0202
GA - PEACHTREE - Computer Show. Peachtree Showcase Exhibition Hall & Conv. Ctr., I-75 Exit 71. Georgia Mountain Productions 706-838-4827.
E-Mail: gamtnpro@blrg.tds.net
MA - BOXBORO - Convention. Boxborough Woods Hotel & Conference Ctr. Anthony Penta W1ABC, 978-887-8887. Web: http://www.ultra net.com/~whd-inc/ham/boxboro/welcome.htm

AUGUST 30

CA - GOLETA - Hamfest. Santa Barbara Elks Lodge, 150 N. Kellogg. 8:30am-2:30pm. JoAnn 805-966-7060. E-Mail: hamfest@sbarc.org
IA - DUBUQUE - Hamfest, Radiofest & Computer Expo. County Fairgrounds. 8am-2pm. Jerry Ehlers W0SAT, 319-583-1016. E-Mail: kb0lcj @mwci.net Web: http://grarc.mwci.net/
IL - WOODSTOCK - Hamfest & Computer Extravaganza. McHenry Co. Fairgrounds. 6am-3pm. Bob Grosse 708-944-0500.
E-Mail: N9KXG@quality-enterprises.com
Web: http://quality-enterprises.com/TCRG/
IL - TILTON - Vermilion Co. ARA Hamfest. UAW, 579 Civic Center. Gary Denison KA9SKS, 217-759-7389. E-Mail: gdenison@danville.net
NH - DURHAM - Computer Show. Whittemore Center @ UNH. Northern Computer Shows 978-744-8440. E-Mail: inquiries@ncshows.com
NJ - PARSIPPANY - Computer Show. Parsippany Hilton. 9:30am-4pm. MarketPro 201-825-2229.
http://www.marketpro.com
NY - YONKERS - Hamfest. Yonkers Raceway. 8am-2pm. Bill Hertwig N2QZB, 914-741-6606. Web: WWW.WECA.ORG
OH - BEREA - Computer show. Cuyahoga Co. Fairgrounds. 10am-3pm. Peter Trapp Shows 603-272-5008. Web: www.petertrapp.com
TN - CEDARS OF LEBANON - Hamfest. Lee Hall NY4T, 615-849-9704. E-Mail: ny4t@qsl.net

SEPTEMBER

SEPTEMBER 5

AL - SOUTH PELL CITY - Hamfest. National Guard Armory, 405 19th St. Gordon K. Porter KF4HBB, 205-338-7091. E-Mail: k2@zebra.net
Web: http://www.qsl.net/k4scc/
CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
KY - CAVE CITY - Southern KY DX Assoc. Hamfest. Larry Brumett KN4IV, 502-651-2363.
E-Mail: lbrumett@glasgow-ky.com

SEPTEMBER 5-6

NC - SHELBY - Shelby ARC Hamfest. June Melvin WA4JNJ, 704-739-2583

SEPTEMBER 11-12-13

IL - PEORIA - Super Computer Sale. Peoria Civic Center, 201 S.W. Jefferson St. Blue Star Productions. 612-788-1901.
Web: http://www.supercomputersale.com

SEPTEMBER 12

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves
IL - ROLLING MEADOWS - Convention & Banquet. Holiday Inn. Bill Smith W9VA, 847-945-1564. E-Mail: w9va@aol.com
Web: http://www.qth.com/w9dxcc
IN - SPENCER - Owen Co. ARA Hamfest. Kathryn Smith KB9INU, 812-829-2140
MO - COLUMBIA - Central MO Radio Assoc. Hamfest. Perry Ogletree N0NMC, 573-445-2662.
E-Mail: cmra@qsl.net
Web: http://www.qsl.net/cmra
NE - LEXINGTON - Amateur & Antique Radio Auction. National Guard Armory, 302 Washington. Randy Gigliotti 308-987-2312.
Web: http://hara.simplenet.com
NY - BALLSTON SPA - Hamfest. Saratoga Co. Fairgrounds. 7am-3pm. Darlene Lake N2XQG,
E-Mail: lake@capital.net
PA - ERIE - RA of Erie Hamfest. Matthew Steger N3NTJ, 814-835-1566 or 814-864-3809
WV - WHEELING - Triple States RAC Hamfest. White Palace, Wheeling Park. 8am-3pm. William Maxwell WD8JIA, 304-242-2509.
E-Mail: BMAXWELL1@COMPUSERVE.COM

SEPTEMBER 12-13

FL - MELBOURNE - Platinum Coast ARC Hamfest. Joe Mitchell K4AW. E-Mail: k4aw@digi tal.net Web: http://www.ham.net/pcars/
GA - AUGUSTA - Computer Show. Regency Mall. Georgia Mountain Productions 706-838-4827.
E-Mail: gamtnpro@blrg.tds.net

SEPTEMBER 13

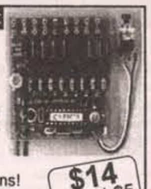
IL - GLEN ELLYN - Computer Show & Sale. College of DuPage. Main Arena of Phys Ed Bldg. Corner of Park Blvd. & College Rd. 9:30am-3pm. Computer Central Shows 847-940-7547
IL - JOLIET - Bolingbrook ARS Hamfest. Gary Hansen N9GH, 630-759-4955
MD - GAITHERSBURG - Hamfest. Montgomery Co. Fairgrounds. Al Brown KZ3AB, 301-490-3188.
E-Mail: Amateur_Radio@hotmail.com
MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988
NJ - TRENTON - Delaware Valley Radio Assoc. Hamfest. Darryl Foyuth N2JVP, 609-882-2240
NY - HICKSVILLE - Long Island Mobile ARC Hamfest. Richie Selzer N2WJL, 516-520-9311.
E-Mail: n2wjl@juno.com
PA - BUTLER - Butler Co. ARA Hamfest. Gerald Wetzel W3DMB, 724-282-6777.
E-Mail: k311@nauticom.net
Web: http://home.sprynet.com/sprynet/n3ppz/

SEPTEMBER 18-19-20

MI - TAYLOR - Computer & Technology Show. Gibraltar Trade Center, 15525 Racho Rd. 734-287-2000
WI - MADISON - Super Computer Sale. Dane Co.

Continued on page 82

Running Lights Kit



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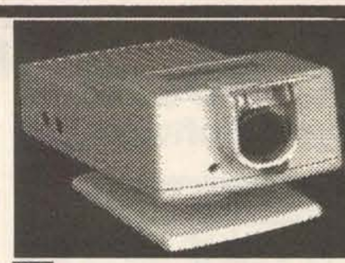

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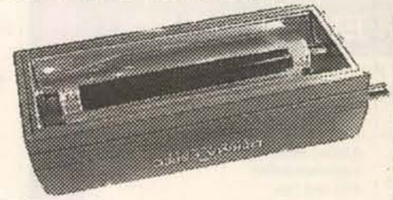

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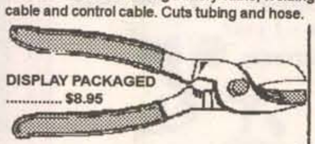

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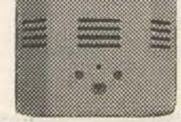

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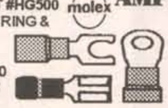

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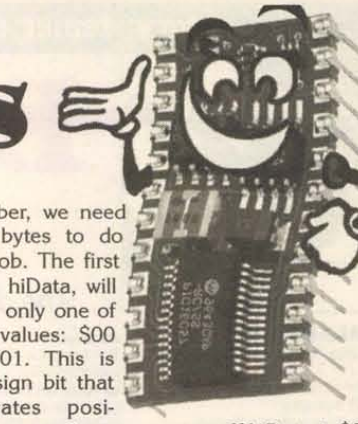
STAMP APPLICATIONS

by Jon Williams



Putting the Spotlight on BASIC Stamp Projects, Hints, and Tips

Remote Control Stamping: Part 2

Last month, we started a series of projects that we loosely referred to as "StampNet." This month, we'll continue our focus on software and communications to allow the PC and Stamp to work cooperatively. We'll also delve into a type of network control for which we don't have to build special hardware. Let's get started.

Freewheeling

During our discussion of Stamp-to-PC communications options, we decided to use event-driven communications to receive messages from the Stamp. We did this, you'll recall, because it works well in systems that specifically ask the Stamp for information, as well as those that just listen to what the Stamp has to say. Our first project fits into the latter category: it just listens to the Stamp and displays the information it receives.

It has been as hot as Hades in Texas lately, so I decided that my "freewheeling" project would monitor temperature. To do the measurement, we'll use the DS1620 from Dallas Semiconductor. Since the DS1620 has been covered by this column on more than one occasion, I'm not going to go into the details of using the chip. We'll limit our discussion to getting information to the PC and displaying it there.

Listing 1 is the BS2 code that reads the temperature from the DS1620. The DS1620 pin constants are set up for the Basic Stamp Activity Board (BSAC) *[Author's note: Last month, I incorrectly referred to the BASIC Stamp Activity Board as the BSAB. Parallax calls it the BSAC and I will stick with that acronym.]* You can see that the code is very straightforward. It configures the DS1620 for continuous operation, then reads the temperature and sends it (in its raw form) to the PC at one-second intervals.

Listing 2 shows the meat of the PC side of things, which is just as simple. After receiving a valid Stamp message string, the OnComm event handler passes program control to ProcessInput for data conversion.

The first thing we do is grab the raw temperature data. Since the DS1620 returns a nine-bit number, we need two bytes to do the job. The first byte, hiData, will have only one of two values: $00 or $01. This is the sign bit that indicates positive or negative temperature. If hiData is $00, the temperature is positive, and all we have to do is convert the hex string to decimal and divide it by two. You'll notice that the temperature is converted to a floating point number with the CSng (convert to single) function. The division by two is necessary since the DS1620 reports temperature in half-degree increments.

If hiData is $01, the temperature is negative and has been returned in 2's complement form. We convert from 2's complement by XORing with 255 and then adding 1. This time, we divide by -2 since our sign bit told us this was a negative temperature.

Here's the best part: conversion and display. The PC makes this task trivial. A couple of labels on the form and the VB Format function make for a nice display. You can see that the Celcius-to-Fahrenheit conversion is built right into the display code. Figure 1 shows the program in action. Obvious extensions of this program include multicolor graphing, long-term data storage, and

Listing 1

```
' Listing 1
' Nuts & Volts: Stamp Applications, August 1998

' -----[ Title ]-----------------------------------------------
'
' File...... PC1620.BS2
' Purpose... Dallas DS1620 <-> Stamp II -> PC (Visual Basic)
' Author.... Jon Williams
' E-mail.... jonwms@aol.com
' WWW....... http://members.aol.com/jonwms
' Started... 10 JUN 1998
' Updated... 10 JUN 1998


' -----[ Program Description ]---------------------------------
'
' This program reads the temperature from the Dallas DS1620 and sends it
' to the PC for conversion and display.


' -----[ Revision History ]------------------------------------
'
' 10 JUN 98 : Rev 1 complete


' -----[ Constants ]-------------------------------------------
'
True    CON     1
False   CON     0

' DS1620 pins
' -- setup for BSAC
'
Rst     CON     13                      ' DS1620.3
Clk     CON     14                      ' DS1620.2
DQ      CON     15                      ' DS1620.1

' DS1620 commands
'
RdTmp   CON     $AA                     ' read temperature
WrTHi   CON     $01                     ' write TH (high temp register)
WrTLo   CON     $02                     ' write TL (low temp register)
RdTHi   CON     $A1                     ' read TH
RdTLo   CON     $A2                     ' read TL
StartC  CON     $EE                     ' start conversion
StopC   CON     $22                     ' stop conversion
WrCfg   CON     $0C                     ' write configuration register
RdCfg   CON     $AC                     ' read configuration register
CPU     CON     %10
NoCPU   CON     %00
OneShot CON     %01
Cont    CON     %00

Baud96  CON     84                      ' serial baud rate (to PC)
SIOPin  CON     16                      ' use programming port


' -----[ Variables ]-------------------------------------------
'
tmpIn   VAR     Word                    ' 9-bit temp input from DS1620


' -----[ EEPROM Data ]-----------------------------------------
'


' -----[ Initialization ]--------------------------------------
'
Init:   LOW Rst
        HIGH Clk
        PAUSE 100

' Initialize the DS1620
' - use with CPU in free run mode
'
I_1620: HIGH Rst
        SHIFTOUT DQ,Clk,LSBFIRST,[WrCfg,CPU+Cont]
        LOW Rst
        PAUSE 10
        HIGH Rst
        SHIFTOUT DQ,Clk,LSBFIRST,[StartC]
        LOW Rst


' -----[ Main Code ]-------------------------------------------
'
Main:   ' get temp from DS1620
        HIGH Rst
        SHIFTOUT DQ,Clk,LSBFIRST,[RdTmp]
        SHIFTIN DQ,Clk,LSBPRE,[tmpIn\9]
        LOW Rst

        ' send to PC
        SEROUT SIOPin, Baud96, [hex2 $55, hex2 $01, hex4 tmpIn, 13]

        PAUSE 1000
        GOTO Main


' -----[ Subroutines ]-----------------------------------------
'
```

Listing 2

```
Public Sub ProcessInput()
  Dim hiData As String
  Dim loData As String
  Dim tempC As Single
  Dim rawNeg As Integer

  hiData = Mid$(buffer, 5, 2)
  loData = Mid$(buffer, 7)

  If hiData = "00" Then ' positive temp
    tempC = CSng(HexToDec(loData)) / 2
  Else ' negative temp
    ' two's compliment
    rawNeg = (HexToDec(loData) Xor 255) + 1
    tempC = CSng(rawNeg) / -2
  End If

  ' display
  lblTempC.Caption = Format(tempC, "##0.0°C")
  lblTempF.Caption = Format(tempC * 9# / 5# + 32#, "##0.0°F")
End Sub
```

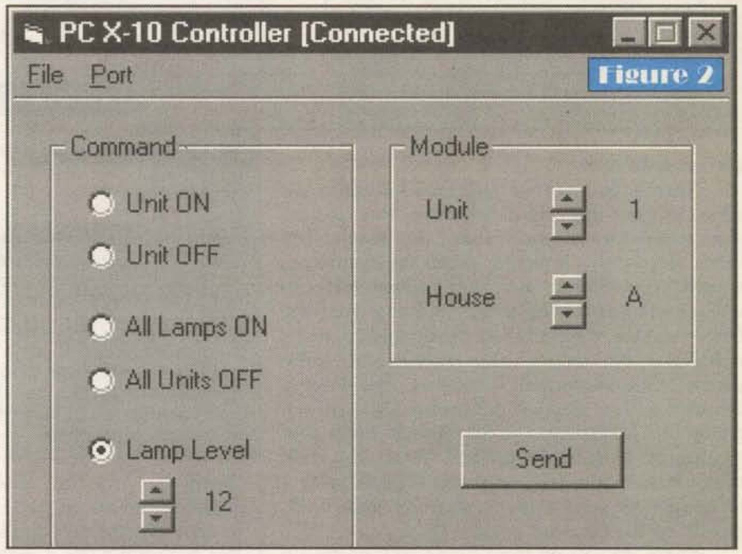


Figure 2

analysis.

The basic theme of this project is to let the Stamp gather raw data from your sensors and let the PC convert the data to the appropriate engineering units and provide a nice display. The Parallax application notes for the Stamp 1 show how to interface the Stamp to a thermistor — a good candidate for this kind of program due to its non-linear conversion requirements.

Stamp-Based Home Control

With the Stamp 2, Parallax introduced several new features to the PBASIC programming language. Among the BS2 features is XOUT, a command the sends control codes to X-10 appliance and lamp modules.

In application, the BS2 is connected to your home electrical system with a special interface called a PL-513 or the TW-523. The latter supports the reception of X-10 codes, but since the Stamp does not support this feature, there is no point in spending the extra money for the TW-523. Parallax carries the PL-513. You can get lamp and appliance modules at Radio Shack or your local home center.

X-10 modules use a two-digit addressing scheme: house code and unit code. On the X-10 units, house code is a letter between "A" and "P" (inclusive). The Stamp represents this range with a nibble value of zero to 15. The idea of the house code is that you would use one letter while your neighbor would use another. This would prevent you from creating problems for each other.

The unit code on the X-10 module is from one to 16. As with the house code, internally the Stamp represents the unit code with a value from zero to 15. We'll take advantage of this in our PC program by packing nibbles into a byte for transmission.

The BS2 supports six X-10 commands: Unit On, Unit Off, All Lamps On, All Units Off, Dim, and Bright. Not all commands work with all X-10 modules. All Lamps On, for example, will turn on all lamp modules with the same house code, but appliance modules are not affected. Likewise, with Dim and Bright: they only work with lamp modules. All Units Off, however, will shut down anything with the same house code.

Listing 3 is a BS2 program that accepts X-10 commands from the PC and sends the appropriate codes with XOUT. As with last month's project, I downloaded this to a BS2 that is plugged into the BSAC. (Of the many conveniences of the BSAC, it has a built-in RJ-11 jack for connecting the Stamp to the PL-513 or TW-523 with a telephone cable.) Structurally, this program is identical to last month's program with a couple of updates and the ability to handle the X-10 stuff.

The first thing you'll notice is that the variable pcData has been promoted from a byte to a word. We need the extra byte to send all the X-10 data and will use this next month when sending 12-bit data to a DAC. Interestingly, however, we split it up for receipt from the PC. The reason for this has to do with the Visual Basic integer type. It is a signed type, that is, bit 15 is a sign bit so we can't manipulate the VB integer in the same manner as a PBASIC word. It's not a big problem, though. With the ability to map variables, we can easily construct a word from the two bytes via our variables declaration section.

You'll also notice that I've mapped several variables having to do specifically with the X-10 stuff. For those of you that are new to PBASIC, this mapping does not use any more variable space in the Stamp 2. It simply gives my generic variables names that make the actual program code easier to read — almost self-commenting.

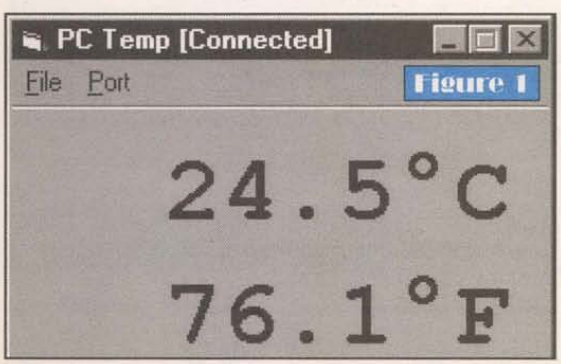


Figure 1

Working our way into the code, we see that the program waits for the data from the PC (prefaced with $55), then checks the address and command to make sure that the data string is intended for this node (the master node) and that the command is X-10 ($F). This may not all make sense now, particularly the addressing part. Next month, we will pass on information not intended for the master node to a remote Stamp. Since we've planned for this eventuality, designing the code to handle it now will make folding X-10 control into our fully-blown StampNet network that much easier.

The PC sends a code of one to five to indicate which X-10 function to execute. We use the BRANCH command to route the program to the proper subroutine. The first four are very straightforward; the dim command, however, requires a little bit of discussion.

Dim and Bright are relative to the current brightness of the lamp. Since it's not always possible to know the current state of a lamp dimmer, the Parallax manual suggests that the easiest implementation is to turn off the lamp, then dim it down to the desired level. That's right: turn off, then dim down. This seems a bit peculiar at first, and yet it works. I spent about a half hour experimenting and this is the easiest method. Valid dimming values are from one (brightest) to 19 (just barely on).

The last part of the code sends an acknowledgment to let the PC know that the command has been carried out. The PC expects this string and will alert the user if it doesn't show up within a reasonable amount of time.

Take a look at Figure 2. This is the PC side of our X-10 control project. The form is divided into two frames: Command and Module. Radio buttons are used to select the X-10 function and spin controls are used to set the lamp level, and house and unit codes. The nice thing about using the PC as our interface is the ability to make the controls organized and intuitive.

The lamp level, for example, has a range from 1 (dim) to 19 (bright) — what the user would expect (big number = bright light). Since we're using the dim function of the XOUT command, this value gets inverted before sending to the Stamp.

And note that the unit and house codes are physically laid out just as they are on an X-10 module. The associated spin controls have Stamp-compatible values, while their labels are converted to something the user expects (i.e., letters for house codes). These are simple things to do in code and will make your PC programs easier to use.

Listing 4 is the Visual Basic code that corresponds to clicking the "Send" button. You can see that the house code (updnHouse.Value) is embedded in the message part of our data string. The house code is added to $F0 (&HF0 in VB), the command for X-10 functions. The unit code (updnUnit.Value) is placed in the high nibble of the first data byte and the X-10 function (1-5) is embedded in the low nibble of this byte. Finally, the corrected lamp level is placed in the

```
Private Sub btnSend_Click()
  SendMsg 1, &HF0 + updnHouse.Value, updnUnit.Value * 16 + x10, lamp
  ' start the response timer
  Timer1.Interval = timeOut
  Timer1.Enabled = True
End Sub
```

Listing 4

second data byte.

The next two lines of code look harmless, yet serve a very important function. This project uses a timer to let you know if the Stamp isn't there. Here's how it works. When the command is sent to the Stamp, the timer interval value (in milliseconds) is loaded and the timer is enabled. Once enabled, the timer will count down until it's disabled or the interval value reaches zero. If the proper acknowledgment is received, the timer is disabled and no alarm is generated. Otherwise, a dialog box is displayed to let the user know that the Stamp is not talking back. When you look through the code, you'll see that it takes quite a bit longer to send dim commands than basic on/off, so the time-out value is larger.

Where do you go from here? Well, that's up to you. Sure, there's a lot of off-the-shelf X-10 control software available, but the ability to use the Stamp 2 as an interface gives you some serious advantages. You could, for example, use the Stamp to monitor environmental conditions (light, temperature, etc.) and use X-10 modules to adjust lamps and appliances accordingly. Give this program a try; it really is a lot of fun. Kind of like a blown-up version of a blinking LED program — it'll make you smile when you can control lights in another room from a PC program that you wrote yourself.

Next Time...

Next month, we'll wrap up StampNet and get back to custom hardware by adding RS-485 communications and remote Stamp modules. For those that want to get a jump on ordering parts for the project (a multipurpose I/O node), you'll need the following:

(2) LTC1487 RS-485 interface
(1) 74HC595 serial-parallel output shift register
(1) 74HC164 parallel-serial input shift register
(1) LTC1298 12-bit ADC
(2) LTC1257 12-bit DAC

The code for both of this month's projects, StampNet2.ZIP, can be downloaded from my ftp directory (ftp://members.aol.com/jonwms/stamps). Have fun and I'll see you next time. **NV**

SOURCES

For more information on the BASIC Stamp, contact:

Parallax, Inc.
3805 Atherton Road, #102
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phone **(916) 624-8333**
Internet
http://www.parallaxinc.com

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fax **520-459-0623**
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(903) 509-1691
jonwms@aol.com
Internet:
http://members.aol.com/jonwms
ftp://members.aol.com/jonwms/stamps

Listing 3

```
' Listing 3
' Nuts & Volts: Stamp Applications, August 1998


' -----[ Title ]-----------------------------------------------------------
-
'
' File...... PCX10.BS2
' Purpose... PC-based X-10 Control via the Stamp II
' Author.... Jon Williams
' E-mail.... jonwms@aol.com
' WWW....... http://members.aol.com/jonwms
' Started... 28 JUN 1998
' Updated... 28 JUN 1998


' -----[ Program Description ]---------------------------------------------
-
'
' This program X-10 commands from the pc using the StampNet communica-
tions
' protocol. Actual X-10 control is via the XOUT command.
'
' Message structure:
'
'       $55             header
'       addr            node address (must be 1 for X-10)
'       msg             HighNib = "F" for X-10, HowNib = house code
'       pcHigh          HighNib = unit code, LowNib = pc X-10 command
'       pcLow           lamp level for dimmer modules


' -----[ Revision History ]------------------------------------------------
-
'
' 28 JUN 98 : Rev 1


' -----[ Constants ]-------------------------------------------------------
-
'
Baud96  CON     84                      ' serial baud rate (to PC)
SIOPin  CON     16                      ' use programming port
                                        '  - couple ATN with capacitor
mPin    CON     0                       ' X-10 comm pin
zPin    CON     1                       ' X-10 zero-cross pin


' -----[ Variables ]-------------------------------------------------------
-
'
addr    VAR     Byte                    ' node address
msg     VAR     Byte                    ' message
cmd     VAR     msg.Nib1
channel VAR     msg.Nib0
pcData  VAR     Word                    ' data from pc
pcHigh  VAR     pcData.HighByte
pcLow   VAR     pcData.LowByte
sData   VAR     Word                    ' return data
sDHigh  VAR     sData.HighByte
sDLow   VAR     sData.LowByte

' X-10 variable mapping
hCode   VAR     msg.Nib0                ' X-10 house code (0-15)
uCode   VAR     pcHigh.HighNib                  ' X-10 unit code (0-15)
x10     VAR     pcHigh.LowNib                   ' X-10 command (1 - 5)
lmpLvl  VAR     pcLow                           ' lamp level (1-19)


' -----[ EEPROM Data ]-----------------------------------------------------
-
'


' -----[ Initialization ]--------------------------------------------------
-
'


' -----[ Main Code ]-------------------------------------------------------
-
'
Main:   ' wait for message from PC
        SERIN SIOPin, Baud96, [WAIT ($55), addr, msg, pcHigh, pcLow]

        ' ignore bad address or non X-10
        IF (addr <> 1) | (cmd <> $F) THEN Main

        BRANCH x10,[Main, Unit1, Unit0, All1, All0, SetLvl]
        ' ignore if invalid x-10 command
        ' zero is not valid
        GOTO Main


' -----[ Subroutines ]-----------------------------------------------------
-
'

' turn selected unit on
Unit1:  XOUT mPin, zPin, [hCode\uCode\2,hCode\unitOn]
        GOTO Rspnd

' turn selected unit off
Unit0:  XOUT mPin, zPin, [hCode\uCode\2,hCode\unitOff]
        GOTO Rspnd

' turn all lamps on
All1:   XOUT mPin, zPin, [hCode\uCode\2,hCode\lightsOn]
        GOTO Rspnd

' turn all units off
All0:   XOUT mPin, zPin, [hCode\uCode\2,hCode\unitsOff]
        GOTO Rspnd

' set light level
SetLvl: XOUT mPin, zPin, [hCode\uCode]
        XOUT mPin, zPin, [hCode\unitOff\2,hCode\dim\lmpLvl]
        GOTO Rspnd

Rspnd:  ' output to PC (x-10 signature)
        SEROUT SIOPin, Baud96, ["5501F000", 13]
        GOTO Main
```

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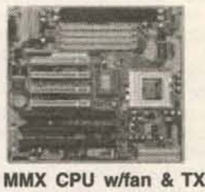

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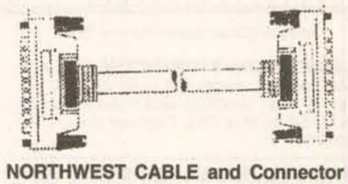

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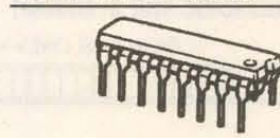

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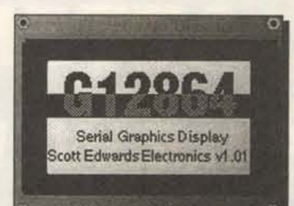

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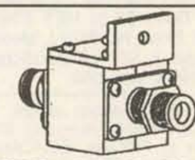

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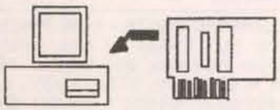

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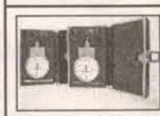

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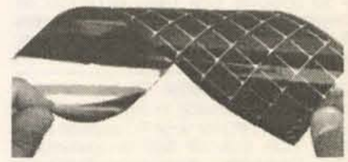

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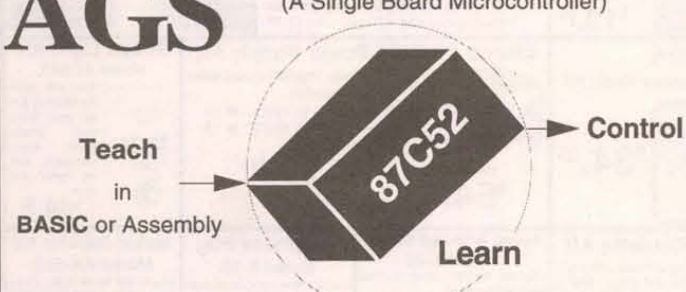

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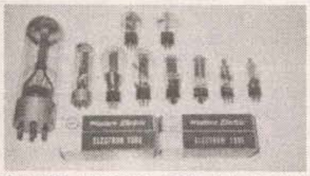

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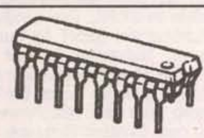

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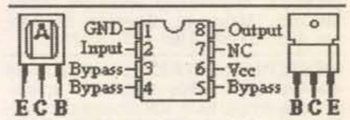

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Continued from page 17

itance, stray inductance, the external capacitance of test leads, and the calibration accuracy of the signal generators used.

However, for the home experimenter or the small repair shop or lab, which do not usually need extreme accuracy, Quick Henry will satisfy a need to measure inductance, resonance, and Q quickly and inexpensively.

I probably should have added the word "relative" before "Q" in that last phrase.

Fred Blechman

Dear Nuts & Volts:

I read with interest your article about ExpressPCB and the service they offer.

I have been using for several years now an alternative equivalent service (that advertises in your magazine), Alberta Printed Circuits.

They are slightly less expensive than ExpressPCB ($18.00 less set-up fee, $.05 less per board square inch), and give essentially the same services (one day turnaround, WEB transfer of files, etc.). They accept industry standard Gerber and Excellon Drill files, and provide very easy-to-use DOS based software (which runs fine in a 95 or NT window) if desired.

They can be reached at www.apcircuits.com if any of your readers are interested. I can vouch for their high quality.

Steve Bepko
Internet

Dear Nuts & Volts:

I have been meaning to comment on the automatic mail person's arrival project for some time. I was very much interested in it as I'd just completed my own design. I"m afraid it's not near as complex as the one in *Nuts & Volts*, but it was a lot cheaper and quicker to implement, and with no expendables (to speak of).

His has a transmitter, receiver, LED, battery (expendable), and a switching system. (With all that stuff in the mailbox, I'd be concerned about petty larceny!)

My advantage, and possibly a special case, is that I can see the rear of the mailbox from the house (optical transmitter and receiver).

I drilled a hole in the back near the top rear of the box and threaded a nylon string through it. I tied an old lead weight from a wheel balance to the end of the string on the outside of the box. The other end of the string goes through the box and is

Continued on page 81

ELECTRONICS Q & A

With TJ Byers

In this column, I answer questions about all aspects of electronics, including computer hardware and software. This column doesn't replace the Tech Forum that you've grown to love and support. Instead, it will supplement it, so feel free to participate as always with your questions and answers. You can send your questions to me by E-Mail at q&a@nutsvolts.com, or by snail mail at Nuts & Volts Magazine, 430 Princeland Ct., Corona, CA 91719.

What's Up:

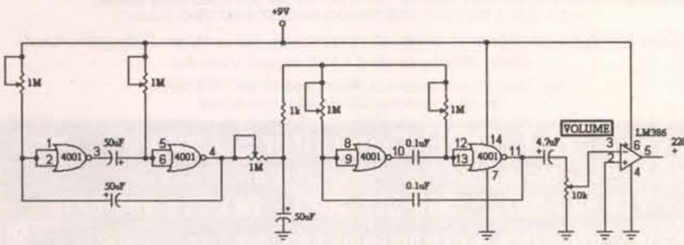
Fun stuff: sirens and more. How deep is the well and watts up (power factor). VolksLAN for the people and NiCd/NiMH side-by-side. Some PC oldie pinouts, and another phone tip. What happens to your PC in the year 2000? A great Reader's Tip on upgrading to Win 95. Enjoy!

Simple Sound Generator

Q. I would like to construct this old noisemaker circuit from the '70s, but the specified IC that it's built around is no longer available. Are there any equivalent logic ICs around today that can be used for a substitute?

Pete Haas
Kent, OH

A. *For the benefit of our readers, here's the circuit you sent me – with a couple of important changes.*



The original circuit called for an MC717P, which is a standard NOR gate times four (four NOR gates in one IC package). A suitable substitute is the 4001, which you can buy anywhere in town, including Radio Shack, for less than a buck. The circuit has been redrawn to reflect this chip. A careful look at the circuit, though, reveals a lot. Although the gates have two inputs, they're tied together so that the gate behaves like an inverter, not a Boolean decision maker. That's to say, when the input to the gate is high, the output is low; when the input is low, the output is high. Moreover, you can obtain this function using many types of logic gates, such as a 4011 NAND or a 4049 inverter chip. I built this circuit using a 4001 and found it to be quite interesting. The range of the 1-meg pots lets you change the sound from a warbling siren to that of a dripping faucet. The original circuit called for an external audio amplifier, like a hi-fi aux input (boy, does this date the circuit!), so I updated that section, too. What I did was add a simple LM386 IC amplifier that'll drive a small speaker loud enough to run you out of the house. Best of all, the circuit still runs off a nine-volt battery – just like the original.

NiCd vs. NiMH

Q. I read your response to Bob Jackowski's battery problem in the Oct. '97 issue, and wonder if you can do the same for me and my Altima laptop. The NiCd battery pack is rated 7.2 volts at 2500 mAh. The other day, at my local Radio Shack, I came across several NiMH battery packs rated 7.2 volts at 1200 mAh (they're used in RC models), and wondered if they would work in my laptop, too. Of course, I'd put two in parallel. Will this work? Would the capacity change? Will there be a problem using the NiMH in place of the original NiCd?

Chuck
via Internet

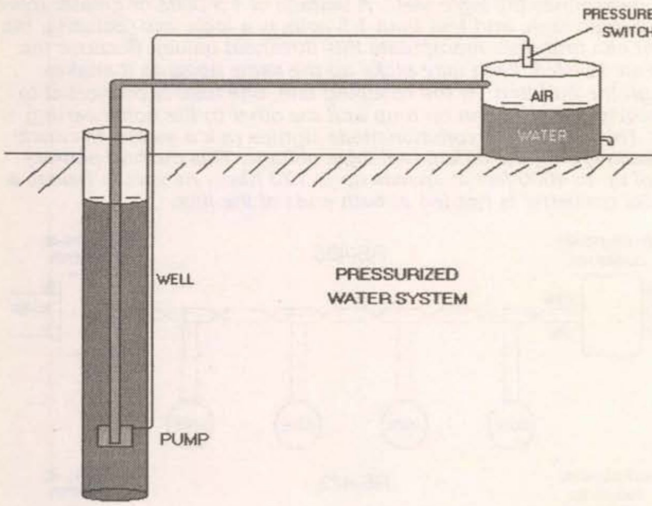
A. *The laptop doesn't care whether it's powered by NiCd, NiMH, or alkaline batteries – so long as the voltage is 7.2 volts, or thereabouts. The capacity will be lower by 100 mAh with the aforementioned NiMHs (2500 mAh versus 2400 mAh), but you'll never notice the shorter battery life under normal use. The only question is, how do you expect to recharge the NiMHs? Most laptop battery chargers have a two stage charge cycle: fast and trickle. Fast charging starts when the cells are connected and the ambient temperature is above a safe minimum. Fast charge terminates on one of three conditions: when a watchdog timer times-out, the cell temperature rises beyond a preset level, or the cell reaches a threshold voltage. The latter is the value the charger is looking for and is different for NiCd and NiMH cells. When a NiCd cell is fully charged, the cell voltage actually drops off with time as the charge continues; for a NiMH cell, the cell voltage flattens out and stays there. Essentially, a NiCd charger looks for negative dV/dt (decreasing battery voltage) and a NiMH charger looks for zero dV/dt (no voltage increase or decrease). After the fast charge finishes, a slow or "trickle" charge is applied. The trickle charge is just enough to replenish the internal discharge of a cell, and can remain connected indefinitely. So while two RC NiMH battery packs in parallel can be used in place of your present NiCd pack, you can't use your present charger. The best answer is to buy a cheap NiMH charger (you can buy them from RC hobby shops) and charge the cells outside the laptop.*

How Deep The Well

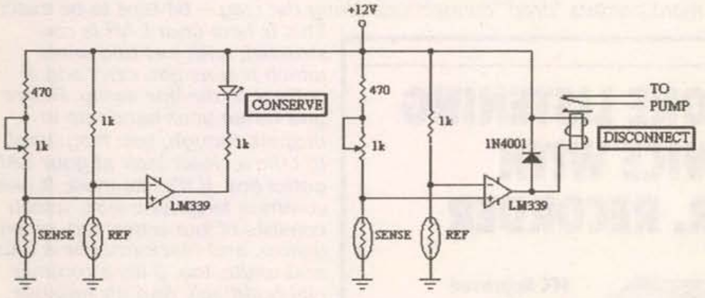
Q. I live in an area where water is derived from a well — that at times runs short of water. To prevent me from jumping in the swimming pool when the shower dries up, I'd like to monitor well depth and water consumption. The well is about 100 feet from the house and about 35 feet deep, give or take a foot. The pump is submerged in the well, but the pressure tank is in the basement. A pressure sensor in the tank closes when the tank calls for water, which, in turn, applies power to the pump in the well. It would be nice to know when the water level of the well has dropped below a certain level so that we can conserve water. At a deeper level, the water becomes undrinkable, at which point I don't want the pump to turn on at all. If I could monitor usage, it would be easier to predict when the well will run dry. Burying a wire would be a problem, but not an impossibility.

Stano
via Internet

A. *I used to have this exact arrangement, so I know your frustration when the well runs dry. Here's how the system works.*



Notice that the pressurized tank uses air to provide the water pressure. As the tank fills, the air compresses. When the pressure reaches about 70 PSI, the switch opens and the pump shuts off. As water is drained from the tank, the air pressure drops, and the switch closes. By controlling and monitoring this cycle we can measure water usage and prevent sucking the well dry. First, a well-depth gauge.



This circuit uses inexpensive thermistors to monitor the water level in the well. What we do is run enough current through the thermistor that it heats just slightly (as you know, all resistors dissipate heat, that's their job). This is heat that must be dissipated in some way — normally through air convection. However, each medium has its own heat transfer rate, which is why heatsinks are made of metal and not plastic. Water, too, is a better conductor of heat than air – a property that we'll use to monitor the well level. The circuit uses two thermistors: one connected to the inverting input and the other the non-inverting input of a comparator. The current through the thermistors is adjusted so that the output of the comparator is low when both the reference and sense are in still air. When the sense thermistor is plunged into water, the heat is removed more efficiently and its resistance decreases, which toggles the comparator output high. When the water recedes (the well goes down), the thermistor is left dangling in air and the output goes low. One thermistor lights an LED when the water level drops below the critical "gotta be careful" stage and the other triggers a relay that cuts off power to the pump when the water level is too low to use. Of course, you can add as many level monitors as you wish by adding more comparator stages. Two critical points. First, make sure you waterproof the thermistors and attached leads. Second, the values of the resistors are for reference only. The actual values depend on the thermistor you choose. The values shown are for a negative temperature coefficient, 1K thermistor – like the KC003G-ND glass encapsulated thermistor from ***Digi-Key (1-800-344-4539; http://www.digikey.com)****. For other resistance values, the 470 resistor and 1K pot needs to be changed accordingly; for positive temperature coefficient thermistors, reverse the inputs. Now for the usage rate. It's a simple matter of timing how long the pump runs, because the pump delivers a constant rate of flow. Lets say the pump delivers four GPM (gallons per minute) and it runs for 10 minutes. That means you've used 40 gallons of water. The simplest way to do this is wire a counting timer (or a dial-face alarm clock) across the pressure switch so that the timer runs when the contacts are closed, then multiply the reading by the GPM rate. I'm sorry, but I don't have room to show you how to make the level monitor wireless, but it's easily done using a small transmitter/receiver combination that you can buy from several of our advertisers; check out the* ***Abacom Technologies (416-236-3858)*** *ad on page 76.*

More About Thermistors

Q. I purchased a Radio Shack thermometer (63-869) to monitor the temperature of my hot tub. Recently, the sensor housing split and the sensor stopped reading. I believe the sensor housing wasn't designed to withstand continuous hot water (95-106 F). What I need to know is where to get a replacement sensor and how to make it hot tub proof.

Mark Hanslip
Dayton, OH

A. *Well, it should withstand hot tub use and a lot more. Remember, it has to be impervious to the elements, including snow, sleet, rain, summer heat, and a whole lot more. Maybe it split from physical abuse because you placed it too close to a water jet or leaned against it. Whatever, I doubt very much the sensor is damaged – probably just shorted out by the water. The sensor is a glass-encapsulated diode, so short of a whack with a hammer, you didn't hurt it. Simply wipe it clean and dry, and put it back in a suitable enclosure. The diode is polarity sensitive, so you may have to reverse the leads if they became unattached. BTW, all the sensors used in the Radio Shack line of indoor/outdoor thermometers are the same, which means you can take one from a different model and use it with yours. I mention this because I've seen these items in the "As Is" bin from time to time. If all else fails, you could try a 1N914 diode – I'm just not sure how to calibrate the temperature after this substitute. Look for a trimmer pot on the circuit board and go from there.*

Q & A or Tech Forum?

If you have questions about any aspect of electronics, from circuit design to theory explanations, or just need to be pointed in the right direction to get that project started (or finished), *WE CAN HELP!*

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PS/2 Floppy Interface Faces Off

Q. We have a "huge" EISA-based dual-Pentium server that runs under the SCU operating system. The problem is that we can't get all the necessary boot files to fit on a standard floppy disk — even when the files are pared down to the bare bones. This is a major pain in the you-know-what because the only reliable piece of hardware in the PC is the floppy drive. The BIOS says it will support a 2.88 MB floppy drive, so, in my infinite stupidity, I bought a refurbished 2.88 MB Toshiba floppy drive, thinking our boot problems would be solved. To my horror, when it arrived there was no power connector — just a 34-pin signal connector! So it was off to the Web, where I discovered that Big Blue, in an effort to coin yet another hardware standard to license, sends the +5 VDC power to the drive through the 34-pin controller cable. Do you have a pinout for this drive so that I can fabricate a functional cable and skin the cat?

Mike Irick
via Internet

A. *Actually, IBM did more than route power through the cable. That would be too easy to defeat. Instead, they very nearly redefined the whole cable. In the standard 34-pin connector, all odd-numbered pins are grounds. In the PS/2 cable, some of these pins are signal or power lines, and many of the other pins have been scrambled. Anyway, here are the pinouts for the 2.88 MB floppy drive. Good luck with your server! BTW, I haven't tested this cable, but the information comes from a PS/2 Technical Reference manual so it should work.*

PS/2 Floppy Disk Controller Cable

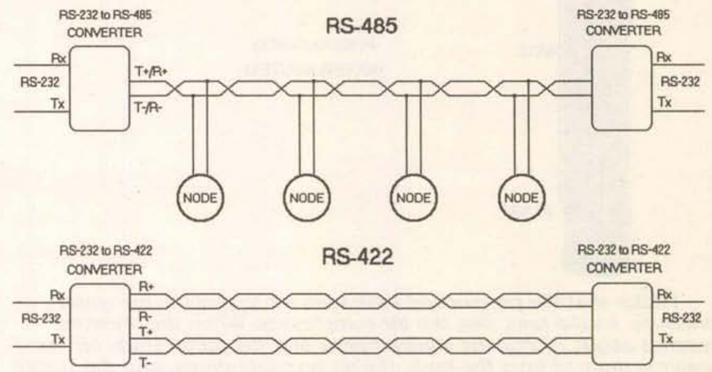
Pin	Function	Pin	Function
1	Signal return	2	Data rate select 1
3	+5 volts	4	Drive type ID 1
5	Signal return	6	+12 volts
7	Signal ground	8	Index
9	Drive type ID 0	10	Reserved
11	Signal ground	12	Drive select
13	Ground	14	Reserved
15	Signal ground	16	Motor enable
17	Media type ID 1	18	Direction in
19	Signal ground	20	Step
21	Signal ground	22	Write data
23	Signal ground	24	Write enable
25	Signal ground	26	Track 0
27	Media type ID 0	28	Write protect
29	Signal ground	30	Read data
31	Signal ground	32	Side 1 select
33	Data rate select 0	34	Diskette change

All About RS-485 ... almost

Q. I have four nodes on an RS-485 LAN running in the half duplex mode. The nodes, which are used to sense ambient light levels, are battery powered, and I was wondering if there is any way to run 12 volts along with the RS-485 cable to power the nodes and eliminate the batteries.

Doug Doane
via Internet

A. *That all depends on what you mean by "along with." To understand what I mean, we need to look at a typical RS-485 LAN. Let's start with the RS-232 port on the back of your PC. The RS-232 port is a single-ended, or unbalanced, line that represents data as defined voltage levels: logic low equals 0 volts and logic high equals 5 volts. The problem with unbalanced transmission lines is that they are very susceptible to outside noise – which can and does corrupt the data. Consequently, most RS-232 connections are limited to 50 feet and 19.2 Kbps. To increase the distance between stations, we can use a balanced transmission line, like the kind used in telephone networks. In this arrangement, the voltage difference between a twisted pair of wires determines the logic state. A voltage of 1.5 volts or greater represents a logic high, and less than 1.5 volts is a logic low (actually, the vendor can and does manipulate this threshold value). Because the wires are twisted, each wire picks up the same noise as it snakes through the building. At the receiving end, one wire is connected to the inverting input of an op amp and the other to the non-inverting input. This causes the common-mode signals (a.k.a. noise) to cancel out, leaving only the differential logic voltage. This method permits runs of up to 4000 feet at speeds up to 120 Kbps. As shown below, a protocol converter is needed at both ends of the link.*



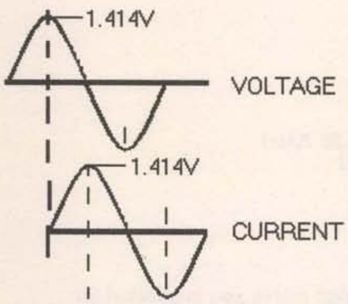
By definition, the RS-485 link is half-duplex. That is, both terminals can send and receive – just not at the same time, like you can with RS-232 or RS-422. Hence, only two wires are needed to link the two terminals, as opposed to four for RS-422. Better yet, this arrangement permits "drop" connections along the way – 64 taps to be exact. This is how your LAN is constructed, with just two wires, which means you can't add a voltage to the line easily. Before you throw your hands up in despair, though, you may want to take a closer look at your LAN outlet box. If it's like most, it uses common telephone wire, which consists of four wires: red, green, yellow, and black (maybe a blue and white, too, if it's a commercial building). And it's possible that one of the pair is unused. If that's the case, you can use the spare pair to power the nodes.

Save The Watts ... Power Factor Correction

Q. I'm trying to find information on and/or a schematic for a device that cuts the peak current usage of compressor-based motors, like that used in refrigeration devices. This controller is put in line between the AC line and load. I heard they were used in restaurants to lower the power bills by 20 to 30 percent.

C. Keeney
via Internet

A. *The specific device you're looking for no longer exists, though I'm sure one of our readers can dig up an old schematic* *from the pages of an original (Ziff-Davis) Popular Electronics magazine, circa. 1974. The circuit, originally developed by NASA, is really nothing more than a power factor correction circuit. Back in those days, we were well aware of power factor and its impact on utility cost, but could do little about it because of the changing parameters on the smaller scale, as is the case with a compressor motor, so this was a breakthrough: power factor correction on the fly. Today, power factor correction is built into many products, like PC power supplies, usually under the watchful eye of a microcontroller chip. Not every device is computer controlled, though. There's been a lot of advances in capacitors, too. Let me explain – very briefly. Power factor is defined as the true power consumption compared to the apparent power consumption. A resistor is the ultimate test. When 1 amp at 1 volt flows through a 1-ohm resistor, 1 watt of heat is dissipated. This happens whether the input is a DC voltage or an AC sinewave – because the current and voltage are in sync, or in phase with other. If we substitute an inductor for the resistor and apply the same AC voltage, things change. In a pure inductor, the voltage lags the current by 90 degrees.*



This happens because the inductor's magnetic field takes time to build up, and by the time the current starts catching up with the voltage, the voltage takes a nose dive, which cause the magnetic field to collapse. As you can see, it's a game of catch up, where the current is always one step behind the voltage. So what, you ask? Remember that wattage is the product of both current and voltage. With a resistive load, the voltage and current are in phase, and when the voltage is peaking, so is the current. If we have 1 volt at 1 amp, we dissipate 1 watt. Now look at the inductive waveform. When the voltage is at its peak, the current is zero, and when the current is at its peak, the voltage is zero. Zero amps times 1 volt is zero watts, as is 1 amp times zero volts. Unfortunately, the power utility doesn't charge you by the watt. How can they? There aren't any watts being produced, yet you're drawing current from their lines. Instead the unit is the "var," which is the product of peak voltage times peak current – regardless of time (different power companies calculate the var in different ways, so don't write). So while no work is getting done, you're still charged for a whole unit of power – power that's needed to get your inductive motor up and running. This discrepancy between apparent power and actual power is called the power factor. The closer the power factor is to unity, the less the var factor, and the less your electric bill. The best way to bring the voltage in phase with the current is to add capacitive reactance to the mix. In a pure capacitor, the voltage lags the current by 90 degrees – just the opposite of an inductor. By adding the right amount of capacitance to the circuit, often using a microcontroller to switch capacitors in and out of the circuit as needed, we can bring the current and voltage closer together. That's basically how it's done. I haven't seen a "breadbox" power factor correction device in a long time. Most of the units today are mounted at the main coming into the building, where they condition the lines for all plugged-in devices. You can read more about this from Energy Planning Services (http://www.energyplanning.com/products.htm), a vendor of power factor correction devices, and Microconsultants (http://www.microconsultants.com/tips/pwrfact/pfarticl.htm).

Reader's Tip

In the Mar. '98 issue you told the reader that he needed a Windows 3.1 diskette to upgrade to Windows 95. Here's a tip: Using the COPY CON command, create a NTLDR and a WIN.CN_ file in the C:\ (root) directory. The files don't have to contain anything but a carriage return. The Win95 upgrade will recognize these as a previous Windows install. I assume the trick will work for Windows 98, too.

Trailblazer
via Internet

Happy Millennium

Q. I know your readers don't want the magazine to concentrate on computer problems, but please seriously consider the following question. I've heard that all PCs that work with datelines need adjustment for the year 2000 (Y2K). There is software that diagnoses and corrects this problem, but sometimes a CMOS chip needs replacement. Is there any literature that identifies and sources these CMOS chips, and assists the novice attempting a replacement?

Pete Zizos
via Internet

A. *Let's begin with a little background. There are two clocks in the PC: a hardware CMOS/Real Time Clock (RTC) and the operating system clock. Over the years software writers have been able to choose between the two and get the same date – that is until the century changes. Most motherboards made before 1994 didn't foresee this problem, and in the rush to get products to market, the RTC and OS clocks didn't know the other existed. Since 1996, most motherboards and all Pentiums are Year 2000 compliant, with the two clocks in sync. There are three ways to fix a PC that isn't Y2K compliant.*

- *Software upgrade*
- *BIOS upgrade*
- *BIOS replacement*

To see which fix works with your PC, download one of the Y2K test programs from our Web site, DosCheck (DOSCHK.ZIP), or Year2000 (TEST2000.ZIP), and see what it has to say. If it recommends a new BIOS, you have three options.

- *Flash BIOS upgrade*
- *BIOS replacement*
- *BIOS adapter board*

The flash BIOS upgrade is the simplest because you can download the upgrade via a modem, or, at worst, from a floppy supplied by the PC's vendor. Most BIOSs made since 1996 are flash upgradable. Replacing a BIOS is more complicated – not because of the mechanics, which is a simple matter of unplugging the old and plugging in the new – but because you have to find one that works with your particular motherboard. Just because your motherboard sports an Award or AMI BIOS doesn't mean you can go to them and buy a new one, because you can't. Virtually every motherboard vendor has the BIOS tailor-made for them to incorporate special features that make their system different from the competition. In answer to your question: You have to go back to the original manufacturer for a replacement. There are a couple of compatibility lists posted on the Internet, but it's unlikely you'll find your motherboard/BIOS combination listed. My favorite is Mr. BIOS (800-800-2467; http://www.mrbios.com/instruct.htm). So what do you do if your motherboard isn't listed or out of business? Well, you can upgrade your old motherboard (highly *recommended) – or plug in a BIOS board. Available from a dwindling number of suppliers, like Fernlink 2000 (http://www.implement.co.uk/index.htm), this card simply plugs into an empty ISA slot on the motherboard. A BIOS board is designed to intercept the BIOS interrupts and redirect them to the BIOS card, which fixes the internal hardware (RTC) and firmware (operating system) clocks to work into the 21st century. Expect to pay about $80.00 for a replacement BIOS or BIOS board.*

Ring Me Up Sometime

Q. Years back when phone companies had party lines, you could dial your phone number and all the phones on that number would ring. I have a Telephone Co installed extension at a shop about 1/2 mile from my home. Both locations have the same number. Is there anyway to ring either line from the other extension or to tell when one extension is in use? A telephone installer said he didn't know of a way. I tried the Radio Shack phone line busy indicator, but it only works if the extension is in the same building and not with the distant extension. Do you know of anything I can use to improve my use between the two extension?

Fred
via Internet

A. *At the risk of incurring further wrath from Pa Bell, there is a way that uses a little-known phone service. When a repair technician goes on site, it's often necessary to check the phone link from the central office to the residence. The technician does this by dialing a call-back number then hanging up the phone. When the call is made to this special number, the central office logs in the number the tech is calling from and rings it back, thereby opening up the line. I've used this trick to use the phone as an intercom between remote industrial sites. You can use this trick to* ***1)*** *ring all extensions on that number,* ***2)*** *see if the extension is busy, or* ***3)*** *test your phone line. Now all you have to do is find someone willing to give you that number – it's top secret!*

VGA and EGA Don't Mix!

Q. In the June '98 issue, you have a very useful chart showing the pinouts for nine-pin and 15-pin VGA connectors. I'd like to use this adapter to have my VGA video card drive my EGA color monitor, but when I checked other reference books for the pinouts, I found that the nine-pin EGA pinouts are different than those published in your column. Ditto for MDA and CGA. I believe I can use a monochrome or EGA monitor with a VGA video card if I change the pinouts. Is this true?

Anonymous
via Internet

A. *No, it's not true. The MDA (monochrome), CGA and EGA monitors are digital displays. That is, they use binary bits, like 010100, to adjust the intensity of the color guns. VGA monitors, on the other hand, are analog displays. They use a voltage, in the range of 0 to 5 volts, to adjust the intensity of the color guns. As you can see, the two don't mix. Even if you could convert the voltage into digital bits, there's no way to sync the VGA controller to the EGA monitor. That's because VGA sweeps the face of the screen at 31.5 KHz, whereas the EGA monitor runs at 21.85 KHz, and trying to sync the two will result in a scrambled image. Sorry. For those interested, here's the pinout of an EGA connector. Just remember, it's not VGA compatible.*

Pin	*Function*
1	*Ground*
2	*Secondary red*
3	*Red*
4	*Green*
5	*Blue*
6	*Secondary green*
7	*Secondary blue*
8	*Horizontal sync (21.85 KHz)*
9	*Vertical sync (60 Hz)*

Mailbag

Dear Mr. Byers:

I was a little disappointed in the high prices you suggested for NTE130MP or equivalents for the audio output amplifier circuit on p. 29 of the Apr. '98 issue. (A similar but a little different circuit was used in many CB radios around 1975.) The NTE130MP has a suggested retail price of $15.00, with most distributors selling them to hobbyist at around $9.00 for the matched pair. Even with the $3.00 postage and handling that I charge, it is considerably less than the $30.00 to $50.00 you quoted! I keep these transistors in stock; they are part of the "top 1000" inventory that NTE distributors are expected to keep on hand. If your local distributor charges such high prices and has to special order them, maybe you should buy your parts from me! I will sell these transistors to any *Nuts & Volts Magazine* reader any day of the week for $12.00 (P & H included). You can order by phone or E-Mail (616-345-4609; http://www.kenselectronics.com).

Ken's Electronics
Kalamazoo, MI

Response:

What a deal! Where I live they don't carry NTE parts, and yes an equivalent goes for $30.00 – if you can find one in stock. As one jobber told me, "Why fix an antique like that when you can buy new for less?" Personally, I like my antiques. I also located another source of "obsolete" and popular semiconductors at low prices: tech America (1-800-813-0087; http://www.techam.com), a Tandy (Radio Shack) subsidiary. I wish I hadn't tossed my old stereo now.

Electronics Q & A

Dear Mr. Byers:

This is a follow-on to your answer to Oscar Rubio in Mexico City (June '98). We manufacture a line of over/under voltage mains protectors. The Original Protector used an ICL7665. Our later circuits use a PIC16C71 to do the voltage monitoring and relay control. Just thought you should know that such a unit is commercially available.

Ron Tipton
TDL Technologies, Inc.
Las Cruces, NM

Dear Mr. Byers:

The "bogus" lamp over my head flashed several times after reading your June '98 column. The last question related to MPG meters for cars. Your response was that your dad's Buick had such a meter. Maybe it did. My father-in-law's Pontiac had an alleged MPG meter that was nothing more than a regular vacuum gauge. Given Detroit's level of technology in the late 70s, I'd be REAL surprised if they had an actual MPG gauge. Obviously I'm nit-picking. You have an excellent column. Keep it up.

Jerry McCarty
Chief Engineer
Center for Professional Development College of Engineering
The University of Michigan
Ann Arbor, MI

TECH FORUM

Continued from page 30

come against the terrible "splitting of the eight-bit data lines!" This will let older printers receive data for printing, and using the other four data lines for the Ethernet interface.

Thus, when you try connecting a parallel port device (scanner, zip drive, CD-ROM, bi-directional printers) no go.

Here is a **Toshiba** support phone number **1-800-999-4273**.

If you have this type of set-up in your laptop, there isn't much you can do about it. But if you have two serial ports on your laptop, you could consider re-doing your PCR for one of those ports instead.

Here is the asynchronous communications adapter RS-232C 25-pin D connector serial port pin-out:

Pin 2 (TXD) Transmit Data
Pin 3 (RXD) Receive Data
Pin 4 (RTS) Request To Send
Pin 5 (CTS) Clear To Send
Pin 6 (DSR) Data Set Ready
Pin 7 Signal Ground
Pin 8 (CXD) Carrier Detect or (RLSD) Received Line Signal Detect
Pin 20 (DTR) Data Terminal Ready
Pin 22 (RI) Ring Indicator.

Terry Baker
St. Paul, MN

ANSWERS TO #79811 - JULY 1998

#1

Having built a sonar unit from scratch, I can direct you to a low-cost vendor who sells sonar units or sonar components.

If you want to build the unit from scratch (like I did, it's not too hard), you want to use ultrasonic units. This avoids the loud, annoying hum of audible transducers, as well as false triggers caused by noises (such as a slamming door or a barking dog).

I have gotten great results from a pair of ultrasonic transducers, ones that can serve as either a transmitter or a receiver. They have a range of about 50 feet. Their part no. is 251-1603, and are $5.80 each. (Available through the mail from **Mouser Electronics**, 958 North Main Street, Mansfield, TX 76063-4627. Voice: **1-800-346-6873**.)

A schematic isn't really necessary — these transducers act just like speakers. All the transmitter needs is a signal source that oscillates at about 40 KHz.

If you want, I'll send you a full schematic.

Thomas Ng
San Jose, CA

#2

The Polaroid 6500 Series Sonar Ranging module is based on the auto focus sensor from Polaroid cameras. It is available from Wirz Electronics for $50.00. It includes a sensor and controlling circuit board.

If you can find the sensor from an old camera you can buy the circuit board alone for $35.00. Some of the specs include a range of 6" to 35 ft.; absolute accuracy ± 1% TTL compatible; supply 4.5 to 6.8V; during transmit 2000 mA; after transmit 100 mA; operating temperature: 0 to 40 degrees C.

More information is available at http://wirz.com/sonar/index.html.

I'm not sure if that fits your idea of inexpensive, but if you factor in your time, it should.

Tom Tillander
Bay Village, OH

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#3

The article "An Experimenter's Cheap Robotic Sonar System" in the April '97 *Nuts & Volts* describes building a sonar system.

Andrei Boitor
Walnut Creek, CA

ANSWERS TO #79810 - JULY 1998

#1

The easiest method for finding buried power lines is to use an AM radio tuned slightly off between stations. As long as there is power running through the wires, you will receive a 60 Hz hum when the antenna is near.

If you are in control of the power running through these wires, then power a brush type motor to run from these wires, such as a blender or hair dryer, and the radio noise level will increase significantly.

If the wires don't have power running through them and they aren't buried too deep, then a coin/treasure finder should be able to find the wire up to seven feet, depending on who manufactured the device.

Controlling the power running through the wires will make finding them easier because you can induce "noise" that radios, frequency meters, or even oscilloscopes can pick up.

Chris
Bieber, CA

#2

I have successfully traced the routing of, and located short circuits in, underground 60 Hz power lines using a magnetic telephone pick-up device.

The one I used combined a pick-up coil, amplifier, and speaker in a plastic case, but an ordinary pick-up coil connected to a headphone amplifier should work as well. You will need a pair of headphones as well. Pick-up coils, amplifiers, and headphones are all available at Radio Shack.

There *must* be current flowing in the underground wire for the pickup to work. If the circuit is in operation, just connect the pick-up coil to the amplifier, plug in the phones, and move the pickup near the ground to a known location of the underground wire, such as near

TECH FORUM

the fuse box or near an above-ground load.

You will hear a 60 Hz hum in the headphones. As you move the pickup directly above the wire, the hum will grow much louder. Move along the wire, swinging the pickup from side to side as you go, noting the loudest point in the swing. This will keep you centered above the wire. If your object is to plot the path of the wire, someone can follow you with stakes or chalk to mark the path.

What if there is no current flowing? Then you must supply some. Several years ago, I needed to find a short in a 4800-volt underground feed. The fuse had blown, of course. I shut off the switch and removed the blown fuse. Then I rigged up a power cord with alligator clips and a light socket so that when it was plugged in, the cord supplied 110V through a series 100 watt light bulb.

So, connect the hot side of a 110V circuit to one side of a lamp socket with a bulb in place, the other side to an alligator clip. Connect the alligator clip to the load side of the fuse holder. The light should light. If it does not, reverse the 110V plug.

The reason for the lamp is that the load (the underground wire) is a short. By connecting a lamp in series, we can supply current through the short without overloading the 110V circuit. The total of the simple equipment described was under $10.00.

If there is a lot of 60 Hz underground wiring in a small area, you may find it impossible to trace the wire you want to locate. To locate the right wire, you can drive it with a different frequency. For about $50.00, you can buy a high-powered tone generator that is made to drive a short.

One example is the Progressive Electronics model 77HP. Progressive also makes a magnetic pickup with a built-in speaker, but it costs about $60.00. Progressive sells through electrical contractor supply stores and Frye's Electronics.

If you use a tone generator, you must first remove power to the circuit.

Robert Weil
San Diego, CA

reader FeedBack

Continued from page 71

secured only by the door being closed on it. Thus when the mailperson opens the mailbox door, he/she releases the string (detector circuit) and the weight drops about six inches (limited by a knot in the string which will not go through the drilled hole in the rear of the box).

This change in position of the lead weight is readily visible from the house (personal optical detector and interpreter); (binoculars might be used in mansions ...).

Upon retrieving the mail, the string is again jammed in the mailbox door, ready for the next delivery. This installation took about 15 minutes and was a junkbox project. I must say that either system is very handy during inclement weather.

John B. Miller
Norco, CA

Dear Nuts & Volts:

Although I enjoyed Mr. Carr's "Open Channel" about EMI, there are some minor problems.

The current in a lightning strike does not oscillate back and forth. Lightning strikes are a succession of DC discharges. A lightning strike consists of many (about 40) separate fast strikes. Each fast strike lasts about 200 microseconds, and the fast strikes occur at about two millisecond intervals. Subsequent strikes usually follow the same path, so the separate strikes look like one strike to us.

Most ground strikes (90 percent) are negative charges at the base of a cloud traveling to earth. [Microsoft Encarta.]

Television sets and monitors are significant sources of EMI, but VCRs are probably minor. The culprit in TV sets is the horizontal flyback: lots of power is needed to deflect the beam. VCRs, on the other hand, process the video signals at low power levels, so they are not significant EMI sources.

More disturbing is the statement, "a fault with the single-turn loop is that it is somewhat sensitive to magnetic fields ..." Loop antennas are supposed to be sensitive to magnetic fields! Furthermore, good loop antennas use electrostatic shields to reduce their sensitivity to electric fields.

The dual loop with half-twist antennas shown in Figure 7a and 7b are magnetic field probes. The half-twist reduces the sensitivity to far-away magnetic field sources but still allows near-field reception. When the magnetic source is far away, the field strength in both loops will be the same and the induced voltages will cancel. When the

reader FeedBack

magnetic source is close by, then the field will be higher in the closer loop, and the two loops will not cancel.

The book *EMC for Product Designers*, page 61, describes both an E-field probe (an insulated rod antenna) and an H-field probe (a shielded loop) to use for hunting EMI sources.

Gerald Roylance
Mountain View, CA

Response:

You may be right, but I will have to check it out. The lightning comment was based on a Discovery Channel interview during a series on lightning.

As to the TV/VCR comment you are simply in error. I can listen on the color burst frequency on any night where there is heavy TV usage and hear it. It sounds different from the TV horizontal (which appears every 15,734 Hz up the band due to harmonics). I can also notice a large increase in the signal level at 3.58 MHz when I turn my own VCR into the RECORD mode. This may be an anomaly with my particular machine, but the observation is made.

I also don't know whether it is conducted or radiated. But I intend to try a common mode choke in the power line to see if it affects it. The project does, however, have a relatively low priority because I don't usually use the VCR and shortwave band receiver at the same time.

Thanks for the tip on the book. Can you tell me where to buy a copy, or provide the citation so that I can ask the local tech bookshop for it? One of my major "sins" is collecting tech books, and I have enough to cause several hernias if I ever have to move!

Joe Carr

Events CALENDAR

Continued from page 43

Expo Center. 1881 Expo Hall E., Blue Star Productions. 612-788-1901.
Web: http://www.supercomputersale.com

SEPTEMBER 19

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

CA - SEBASTOPOL - Swapmeet. Holy Ghost Hall, 7960 Mill Station Rd. Colleen Dean KF6DHA, 707-578-4098. E-Mail: KF6DHA@cdsl.net
Web: http://www.cdsl.net/scra

GA - GAINESVILLE - Lanierland ARC Hamfest. Terry Jones K4FB, 770-967-6364.
E-Mail: K4FB@mindspring.com

KY - LOUISVILLE - Hamfest, Computer Show, & KY State Convention. KY Fair & Exposition Center. Herb Rowe W4WQD, 812-294-4905

MN - WARROAD - Banquet & Hamfest. Warroad Area Community Ctr., 222 Virginia Ave. N.E. William Landby W0DCM, 218-386-1654

NJ - MT. HOLLY - Hamfest & Computer Show. Mt. Holly Armory, Rt. 38. 8am-3pm. Joe Cramer N2XYZ, 609-268-2135. E-Mail: N2XYZ@juno.com or hamfest@SJRA.ORG

SEPTEMBER 19-20

AK - ANCHORAGE - State Convention. Kincaid Park Outdoor Center. Sat: 10am-5pm, Sun: 10am-3pm. Lillian Marvin NL7DL, 907-277-6741.
E-Mail: rlment@alaska.net

IL - PEORIA - Superfest. Exposition Gardens, Northmoor & University Streets. 309-692-FEST.
Web: WWW.W9UVI.org

VA - VIRGINIA BEACH - Hamfest. Virginia Beach Pavilion. 757-HAM-FEST. E-Mail: hamfest@exis.net

SEPTEMBER 20

MA - CAMBRIDGE - Flea Market. Kendall Square area. MIT. Nick Alternbernd KA1MQX, 617-253-3776 Web: http://web.mit.edu/w1mx/www/swap fest.html

MI - ADRIAN - Hamfest and Computer Show. Lenawee County Fairgrounds. Brian KG8CO, 517-265-1537. E-Mail: kg8co@lni.net
Web: http://www.lni.net/~w8tqe

MI - MT. CLEMENS - Hamfest. L'Anse Creuse High School. 8am-2pm. Richard Dzick N8MQU, 810-268-4671

NJ - HAZLET - Hamfest. Veteran's Park, Greenacre Rd. Jack Petro KB2GJI, 732-681-5994.
E-Mail: jpKB2GJU@aol.com

OH - CINCINNATI - GCARA Communications Expo. Kolping Center, 10235 Mill Rd. Jim Weaver 513-825-2868. E-Mail: JimWeaver@aol.com

SEPTEMBER 21

CT - NEWTOWN - Western CT Hamfest. Edmond Town Hall, Rt. 6. 9am-2pm. Ken Weith KD1DD, 203-743-9181.
Web: http://www.danbury.lib.ct.us/org/cara/

SEPTEMBER 25-26-27

MI - MT. CLEMENS - Computer & Technology Show. Gibraltar Trade Center, 237 N. River Rd. 810-465-6440

WI - GREEN BAY - Super Computer Sale. Brown County Veterans Memorial Arena & Expo. Hall, 1901 S. Oneida. Blue Star Productions. 612-788-1901. Web: http://www.supercomputersale.com

SEPTEMBER 26 -

FL - DAYTONA BEACH - Hamfest & Computer Show. Embry Riddle Aeronautical University Campus, Clyde Morris Blvd. 9am-5pm. John Munsey KB3GK, 904-677-8179.
E-Mail: munseyj@worldnet.att.net
Web: http://www.america.com/~dbara/

NJ - HAMILTON TWP - Hamfest. Tall Cedars of Lebanon Picnic Grove, Sawmill Rd. 609-882-2240.
Web: www.slac.com/w2zq

NY - HORSEHEADS - Hamfest and Computerfest. Chemung County Fairgrounds. 6am-3pm. Dave Lewis, 607-589-7495

SC - ANDERSON - Hamfest & Computer Fair.

Events CALENDAR

New Civic Ctr., near Anderson Mall, 9am-2pm. Anderson Radio Club 864-964-9097

SD - HURON - Swapfest. Women's Bldg., State Fairgrounds. 8am-3pm. Lloyd Timperley WB0ULX, 605-352-7896 eves.
E-Mail: wb0ulx@santel.net

SEPTEMBER 26-27

IL - GRAYSLAKE - Radio Expo. Lake County Fair-grounds, Rts. 45 & 120. Sat: 8am-4pm, Sun: 8am-3pm. 708-457-0966.
Web: http://www.chicagofmclub.org

SEPTEMBER 27

CA - SANTA ANA - Swapmeet. ACP parking lot. Mary Russo 714-558-8813

CO - BOULDER - BARCs Swapfest. Boulder County Fairgrounds. 8am-2pm. BARC 303-380-6540. E-Mail: N0NLS@aol.com
Web: http://www.thisistrue.com/barc.html

FL - NEW PORT RICHEY - Hamfest & Computer Show. 9am-3:30pm, Recreation Ctr. Chuck KU4EV, 813-937-2540.
E-Mail: cfowler995@aol.com

NY - YONKERS - Flea Market. Lincoln High School. Kneeland Ave. 9am-3pm. Otto Supliski WB2SLQ. 914-969-1053

OH- BEREA - Hamfest. Cuyahoga Co. Fairgrounds. 6am-noon. 1-800-CLE-FEST.
Web: info@hac.org

OH - SPRINGFIELD - Hamfest & Computer Show. Clark Co. Fairgrounds. 8am-3pm. Dave Ray KC8BVM, 937-325-3047

OCTOBER 1998

OCTOBER 3

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

TX - BELTON - Ham Expo. Bell Co. Expo Center. Mike LeFan WA5EQQ, 254-773-3590.
E-Mail: hamexpo@tarc.org
Web: http://www.tarc.org

OCTOBER 4

NY - QUEENS - Hamfest. NY Hall of Science Parking Lot, Flushing Meadow Corona Park, 47-01 111th St. Stephen Greenbaum WB2KDG, 718-898-5599 night only.
E-Mail: WB2KDG@bigfoot.com

OCTOBER 10

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves

GA - AUGUSTA - Hamfest & Computer Show. Evans Middle School @ Washington & Belair Rd. 9am-4pm. Terry KE4MHN, 706-796-7635.
E-Mail: ks4oc@bellsouth.net

OCTOBER 11

CT - WALLINGFORD - Nutmeg Hamfest & Computer Show. Mountainside Special Event Facility. 9am-3pm. Gordon Barker K1BIY, 860-342-3258. E-Mail: nutmeghamfest@qsl.net
Web: www.qsl.net/nutmeghamfest

MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988

MI - MASON - Hamfair. Ingham Co. Fairgrounds. 8am-1pm. Don Tillitson WB8NUS, 517-321-2004

OCTOBER 17

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

OCTOBER 18

IL - PALATINE - Computer Show & Sale. Harper College. Bldg. M (Phys Ed Bldg.). Roselle & Algonquin Rds. 9:30am-3pm. Computer Central Shows 847-940-7547

MA - CAMBRIDGE - Flea Market. Kendall Square area. MIT. Nick Alternbernd KA1MQX, 617-253-3776 Web: http://web.mit.edu/w1mx/www/swap fest.html

PA - SELLERSVILLE - Hamfest. Sellersville Fire House, Rt. 152. Linda Erdman KA3TJZ, 215-679-5764. Web: HTTP://WWW.RFHILL.AMPR.ORG

OCTOBER 23-24-25

WI - WEST ALLIS - Super Computer Sale. WI State Fairgrounds, 8100 W. Greenfield Ave. Fri: 12pm-8pm, Sat: 10am-7pm, Sun: 10am-4pm. Blue Star Productions 612-788-1901.
Web: http://www.supercomputersale.com

OCTOBER 24

NC - HICKORY - Hamfest & Computer Show. Catawba Valley Community College, 2550 Hwy 70 S.E. 8am-5pm. William B. Walker W4ZCV, 828-322-6180. E-Mail: N1PD@TWAVE.NET

OCTOBER 25

IL - GLEN ELLYN - Computer Show & Sale. College of DuPage. Main Arena of Phys Ed Bldg. Corner of Park Blvd. & College Rd. 9:30am-3pm. Computer Central Shows 847-940-7547

OCTOBER 31-NOVEMBER 1

GA - PEACHTREE - Computer Show. Peachtree Showcase Exhibition Hall & Conv. Ctr., I-75 Exit 71. Georgia Mountain Productions 706-838-4827.
E-Mail: gamtnpro@blrg.tds.net

NOVEMBER 1998

NOVEMBER 7

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

NOVEMBER 7-8

MO - ST. CHARLES - Computer Show & Sale. St. Charles Exposition Hall, St. Charles Center, I-70 & 5th St. Sat: 10am-4pm, Sun: 11am-3pm. Computer Central Shows 888-296-6066.
E-Mail: computershow.chicago@mcimail.com

NOVEMBER 14

AL - MONTGOMERY - Hamfest & Computer Show. Garrett Coliseum, S. AL State Fairgrounds. 9am-3pm. Phil 334-272-7980 after 5pm CST.
E-Mail: wb4ozn@worldnet.att.net
Web: http://jschool.troyst.edu/~w4ap/

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves

NOVEMBER 14-15

GA - AUGUSTA - Computer Show. Regency Mall. Georgia Mountain Productions 706-838-4827.
E-Mail: gamtnpro@blrg.tds.net

NOVEMBER 21

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

NOVEMBER 27-28

MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988

NOVEMBER 29

CA - SANTA ANA - Swapmeet. ACP parking lot. Mary Russo 714-558-8813

IL - GLEN ELLYN - Computer Show & Sale. College of DuPage. Main Arena of Phys Ed Bldg. Corner of Park Blvd. & College Rd. 9:30am-3pm. Computer Central Shows 847-940-7547

DECEMBER 1998

DECEMBER 5

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

DECEMBER 5-6

GA - PEACHTREE - Computer Show. Peachtree Showcase Exhibition Hall & Conv. Ctr., I-75 Exit 71. Georgia Mountain Productions 706-838-4827.
E-Mail: gamtnpro@blrg.tds.net

HOW TO PLACE A CLASSIFIED AD

TYPE or PRINT your **ELECTRONICALLY RELATED** ad copy **CLEARLY (not all caps)** on a separate piece of paper. Spell out words when submitting handwritten copy. Calculate the number of words and multiply it by the appropriate rate (see RATE PER WORD section). Include any charges for **bold** and/or CAPPED words, any artwork costs that would be applicable, and/or costs for boxing your ad (explained below). Choose the appropriate classification for your ad(s) to appear in (see below). If no classification is indicated, it will be placed in Misc. Electronics or wherever we deem most suitable. **Enclose your name, address, phone number, and *Nuts & Volts* account number from your mailing label** (if available) for identification purposes. Include full payment — **CLASSIFIEDS RUN ON A PRE-PAID BASIS ONLY** — and mail your completed order to:

NUTS & VOLTS MAGAZINE, 430 Princeland Ct., Corona, CA 91719.

RATE PER WORD

The ad rate for **current PAID subscribers** is **60¢** per word. All others pay **$1.20** per word. There is a **$9.00 minimum** charge per ad per insertion.

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Words to be set in **bold** or CAPS are each 10¢ extra PER WORD. **BOLD CAPS** are 20¢ extra per word. The first two words of each ad are bold capped at no charge. Indicate bold words by underlining. Words normally written in caps (e.g., IBM) and accepted abbreviations such as VAC or MHz are NOT charged as all cap words. Use a two-letter abbreviation for states.

PHOTOS, DRAWINGS, AND BOXES

A photo or drawing may be run at the top of your classified ad for an additional **$10.00** (1" depth max.) for camera-ready art. No wording is allowed in this area. Add a one-time charge of **$5.00** to enlarge, reduce, or duplicate line art, or **$8.00** for halftone of photographs. To **BOX** your ad, include an additional **$50.00** for copy-only ads, or **$75.00** for ads with art or photos.

FAXING IN AD COPY

You may fax in ad copy or changes before the closing date (5:00pm on the **5th**) at 909-371-3052 using MasterCard or Visa. Include credit card expiration date, the name that appears on the card, a daytime phone number, and your *Nuts & Volts* account number. Ads without credit card information will not be listed as received until payment is received in full. **WE DO NOT CALL OR FAX BACK VERIFICATION OR QUOTES OF FAXED-IN ADS.** For verification of faxed-in ads, please call 909-371-8497.

DEADLINE

Prepaid ads received by 5:00pm on the **closing date (5th of the month)** will appear in the following month's issue. Ads postmarked through the **5th**, but received after the closing date, will be placed in the next available issue. No cancellations or changes after the 5th. Cancellations and changes must be submitted in writing.

IMPORTANT INFORMATION

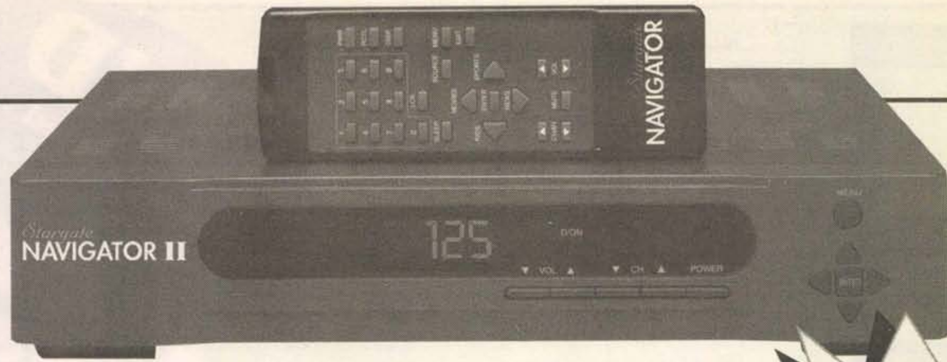
All classified ads are running copy only. No special positioning, centering, dot leaders, extra space, etc. is allowed. All advertising in *Nuts & Volts* is limited to **electronically related items ONLY**. All ads are subject to approval by the publisher. We reserve the right to reject or edit any ad submitted. We do not take ad copy or changes over the phone. We do not bill for classified ads. Repeat ads or ads run in multiple classifications within the same issue are allowed. Paid subscribers may run ads at the 60¢ rate only through their subscription expiration date. **NO REFUNDS**. Credit only. No credit for typesetting errors will be issued unless you *clearly* print or type your ad copy.

Choose a category for your ad from the classifications listed below.

10. Ham Gear For Sale
20. Ham Gear Wanted
30. CB/Scanners
40. Music & Accessories
50. Computer Hardware
60. Computer Software
70. Computer Equipment Wanted
80. Test Equipment
85. Security
90. Satellite Equipment
95. Military Surplus Electronics
100. Audio/Video/Lasers
110. Cable TV
115. Telephone/Fax
120. Components
125. Microcontrollers
130. Antique Electronics
135. Aviation Electronics
140. Publications
145. Robotics
150. Plans/Kits/Schematics
155. Manuals/Schematics Wanted
160. Misc. Electronics For Sale
170. Misc. Electronics Wanted
175. BBS & Online Services
180. Education
190. Business Opportunities
200. Repairs/Service

ADVERTISER'S INDEX

FIND what you need . . . FAST BY PRODUCT OR CATEGORY



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FEATURES

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- Addressable/Programmable
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- **Eliminates Complicated VCR Programming**
- **Current, Future or Series Recording**
- **Categorizes All Programming**
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- **Seven Day Programming Schedule**
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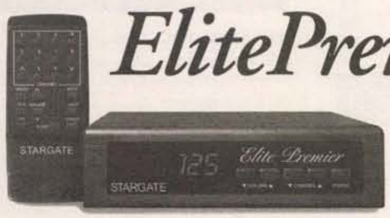

- Volume Control
- Audio/Video Out
- Slim Line Remote
- 800 MHz / 125 Channel
- Parental Control
- Unlimited Favorite Channel
- STD/HRC/IRC Switchable
- Automatic Fine Tuning

Elite 800

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- Dynamic Memory Recall
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Don Lancaster's

RESOURCE BIN

number seventy nine

Finding semiconductor and IC data.

Our usual reminder here that the *Resource Bin* is now a two-way column. You can get tech help, consultant referrals, and off-the-wall networking on nearly any electronic, *tinaja questing*, personal publishing, money machine, or computer topic by calling me at (520) 428-4073 weekdays 8-5 Mountain Standard Time.

I'm now in the process of setting up my new *Guru's Lair* web site you will find at (where else?) www.tinaja.com. You will get the best results if you have both *Netscape Communicator* and *Acrobat Reader 3.0* installed.

Finding Semiconductor Data

There's been some revolutionary changes in how and where you go to get info on both older and modern transistors and integrated circuits. So, I thought we'd do an update for this month. One key question is whether we are about to see ...

The End of Bingo Cards?

Most electronics suppliers seem to have made the stupendous discovery that their users would rather receive info on their products right now and hassle free. Rather than waiting for several weeks for catch-as-catch-can results. As a result, nearly everybody now has instant "real" data sheets and ap notes on the web. In the superb quality *Adobe Acrobat* .PDF format.

Your cost of delivering a catalog online approaches zero. Full color is virtually free. But the cost of a hard catalog by mail is a dollar or more. Possibly five for a fat data manual. (More details on "24-7" publishing are found in PUBL24-7.PDF.)

It also turns out that the real buyers are *much* more attracted to instant web availability than those literature collectors. This is creating a "death spiral" in which hard sales from bingo card responses are clearly heading south. In a very big hurry.

If it costs five cents per dollar sale to process bingo requests, then the cards can be a useful choice for the advertiser. If it costs five dollars per dollar sale, they obviously are not. *E.E. Times* is one of the earliest of the major electronics trade journals to drop bingo cards entirely.

I also personally no longer offer bingo cards because they have simply stopped being cost-effective.

The really big new development in getting semi info is ...

NEXT MONTH:
Don goes over the fundamentals of electronic test gear.

Questlink

Otherwise called *www.questlink.com* which is a more or less unbiased and independent site that has gathered together all of the major data sheets and ap notes from most of the major and minor manufacturers.

This free site is spectacularly good. Here is a brief summary of a few of the goodies you'll find ...

- Application note search
- Board level product index
- Company listings
- Discrete device index
- EDA design tools index
- EE news find
- Industry events
- Integrated circuit index
- Online media guide
- Product search
- Technology reports
- Wisdom web site links

Best of all, though, is their sample service. You can instantly order one or two parts by VISA at any time. A modest premium is charged for this service. But well worth it.

Chip Directory

Check out this free web site found at *www.hitex.com*. You can search for new integrated circuits six ways from Sunday. Plus find listings of pinouts, discover which manufacturers have many dozens of those free CD-ROMs available, view recommended books, and explore their external links.

More EE Web Sites

There are now many thousands of useful electronics engineering web sites. Many of which deal in one way or another with semiconductor info. I have got links to many of these at my *www.tinaja.com*. Here's a random sampling of a few of the more important ones ...

CMP Net at *www.techweb.com*. Industry news, ap notes, new products, much more. This one is sponsored by *E.E. Times* magazine and its stablemates. Sadly, their site is uselessly slow.

Ultimate List at *www.infinet.com/~fincato/electron.html*. A mind-boggling collection of linkings to everything electronic. Distributors, magazines, personal pages, references, directories, data sheets, PICs, and more.

An EE Toolbox at *www.eg3.com*. These folks do believe they are the largest online resource in electronics. And back it up with many thousands of useful online files and links. This one is very well done.

Dana's Source at *pw1.netcom.com/dwsmity/index.html* is an English version of a German site with an extensive listing of more than 1,100 electronics-related links. This site is often a very good starting point.

EE Compendium at *www.geocities.com/ResearchTriangle/1495/*. A personal collection of highly useful Electronic Engineering links. Includes bunches of publications, parts, PICs, and lots of assorted additional links.

Guru's Lair at *www.tinaja.com*. Hey, that's me. Large and fast loading site provides you an eclectic collection of computers and electronics tutorials, links, and resource access.

Electrical Engineering Links at *www.mindspring.com/~brucec/links3.htm*. Another labor-of-love guide that was designed for working engineers and hobbyists. Hundreds of links that are organized into broad categories.

Electronics Links and Resources at *207.34.139.253/users/sgl/html/jo4.htm*. Yet another well-arranged personal collection of useful sites, grouped by electronic circuits, distributors, parts and device manufacturers, electronic education, software, online resources, and other personal link pages.

Electronics Resources at *members.hom e.net/darrellg/html/electronics_re source s.html* is a personal page with scads of links to search engines, references, all of the newsgroups, microprocessors, repair sites, data sheets, standards orgs, and even the ee labs.

SEMICONDUCTOR AND IC INFO RESOURCES

Adobe Acrobat System
1585 Charleston Rd
Mountain View CA 94039
(800) 833-6687

Allied Electronics
PO Box 1544
Ft Worth TX 76101
(800) 433-5700

Audio Visions
E Hwy 70
Thatcher AZ 85552
(520) 428-7625

Books in Print
121 Chanlon Rd
New Providence NJ 07974
(908) 464-6800

Circuit Specialists
PO Box 3047
Scottsdale AZ 85271
(800) 811-5208

Compendex
1 Castle Point Terrace
Hoboken NJ 07030
(201) 216-8500

Dialog Information Svcs
3460 Hillview Ave
Palo Alto CA 94304
(415) 858-2700

Digi-Key
701 Brooks Ave S
Thief River Falls MN 56701
(800) 344-4539

EDN Magazine
275 Washington St
Newton MA 02158
(617) 964-3030

EE Times
600 Community Dr
Manhasset NY 11030
(516) 562-5000

EITD
1 Chilton Way
Radnor PA 19089
(610) 964-4137

Electronic Comp News
1 Chilton Way
Radnor PA 19089
(610) 964-4137

Electronic Design
611 Rt #46 W
Hasbrouck Heights NJ 07604
(201) 393-6060

Electronic Products
645 Stewart Ave
Garden City NY 11530
(516) 227-1300

Global Eng Documents
15 Inverness Way East
Englewood CO 80112
(800) 854-7179

IC Master
645 Stewart Ave
Garden City NY 11530
(516) 227-1300

IHS Group
15 Inverness Way E
Englewood CO 80112
(800) 525-7052

Inspec/IEEE
445 Hoes Ln
Piscataway NJ 08855
(800) 678-IEEE

Jameco Electronics
1355 Shoreway Rd
Belmont CA 94002
(415) 592-8097

Luke Systems Intl
27827 Via Amistosa #101
Agoura Hills CA 91301
(818) 991-9373

MathSci
Box 6248
Providence RI 02940
(401) 455-4000

MCM Electronics
650 Congress Pk Dr
Centerville OH 45459
(513) 434-0031

Mouser Electronics
11433 Woodside Ave
Santee CA 92071
(800) 346-6873

Newark Electronics
228 E Lake St
Addison IL 60101
(312) 941-7200

NTE Electronics
44 Farrand St
Bloomfield NJ 07003
(923) 748-5089

Oxbridge
150 5th Ave #202
New York NY 10011
(212) 741-0231

Philips/ECG
1001 Snapps Ferry Rd
Greeneville TN 77744
(423) 636-5693

Rochester Electronics
10 Malcolm Hoyt Dr
Newburyport MA 01950
(508) 462-9332

Sunset Silicon Prods
402A Ridgefield Cr
Clinton MA 01510
(508) 365-6108

Synergetics
Box 809
Thatcher AZ 85552
(520) 428-4073

Circuit Center at *www.dark-portal.com/index.htm*. Fancy graphics site with lots of links to pinouts, software, circuits, suppliers, components, magazines, up to usenet, basics, and tutorials.

ECG and NTE

Your pair of "best" directories to replacement semiconductors have long been from *Philips ECG* and *NTE Electronics*.

These competing sources both offer fat printed catalogs which vary from free to cheap depending on exactly who you are. Their respective web sites are at *www.ecgproducts.com* and *nteinc.com*.

Both offer easy and free online part number searches. Both outfits resell equivalent replacements for hundreds of thousands of transistors, integrated circuits, plus most other electronic goodies. They both sell direct, as well as providing carded and shelved ICs at leading distributors.

Both of these directories are "must haves" in any home or student lab.

Another useful directory is that *E.I.T.D. Electronic Industry Telephone Directory* from *Chilton Publishing*. The website is *www.ecnmag.com/eitd*. They have a free online search service. But these days, it's just as quick to get to the actual chip manufacturer's site than it is to look up a number to play telephone tag with.

Frequently overlooked is *Radio Shack*. They do have a cheap and fine *Semiconductor Reference Guide* that is really big on foreign semiconductors. Radio Shack also has a "behind the counter" service where you can get just about any electronic part, as well as detailed technical manuals and such. The usefulness and competence here will very much depend on the particular store you select. I've found Dave and Larry at *Audio Visions* here in Thatcher to be quite helpful.

I. C. Master

The people at *Electronic Products* magazine have long issued the pricey *I. C. Master* directory for integrated circuits. Historically, these annually updated printed indexes once were the industry standard place to go for chip reference info. Older copies were especially useful for finding dated and otherwise problem chip info.

These days, the list price is $195.00 for their printed version and $235.00 for a searchible CD-ROM version. That printed version also does score you password access to their web site, which lets you do online searches and linking to actual data sheets. Several *Nuts & Volts* advertisers now offer discounted versions.

I dunno. As I wander around the web, I do see bunches of one-time industry standard dominant winners who have not yet picked up on the key web rule of "Give a lot away to sell a little." I question why anybody would pay for a service that you can find elsewhere for free.

Other obvious "ain't got the faintest clue" examples are *Books in Print*, who clearly and utterly have been blown away by *Amazon* (check my search link www.tinaja.com/amlink01.html). Or else my one time recommended favorite *Ulrich's Periodicals Dictionary*, who seem to have gotten completely shot out of the saddle by that free *Oxbridge Media Finder*. Check my links on this and related research tools at *www.tinaja.com/webwb01.html*.

Yet some others have found great opportunities here. For instance, a number of sites now offer free *Medline* to everybody. Medline is *the* super expensive research source which the doctors themselves use. You can find a number of freebie Medline links at my *www.tinaja.com/beewb01.html*.

A second collection of fee-based services is offered by the *IHS Group* in their *D.A.T.A.* series of parametric info for electronics components. These CD-ROMs are quite expensive. But their *Replacement Series and Discontinued Devices Data* is apparently a definitive source for older semiconductors and integrated circuits. Cost is $135.00.

These same people also apparently operate *Global Engineering Documents*, who can find you reprints on nearly any standard or technical paper.

Some of their related products now include ...

- Digest Discrete Semiconductors Library
- Digest Integrated Circuits Library
- Parametric Access Library
- Specialty References Library
- Surface-Mounted Devices Set
- Replacement & Discontinued Devices Library
- Edward's Encyclopedia of Connectors

Yet another fee-based device info service is *Webstir* that you'll find at *www.info-quick.com*. These people are purportedly a quality content service for larger electronics outfits. Yearly group memberships here can run as high as $12,500.00. Private memberships are a steal at $750.00.

Again, its going to be interesting to see if these fee-based services can survive the freebie web sites. New times take new methods.

Obsolete Semi Sources

Several firms specialize in stocking older and out-of-date semiconductors. The leader here seems to be *Rochester Electronics*, while *Luke Systems* is also a big player. There's also a *Sunset Silicon* who will build your ancient integrated circuits from the ground up, starting with the original masks or a reasonable clone of them.

A nearby firm is *Circuit Specialists*. They seem to have a long term stock of once popular experimenter and homebrew circuits that are quite hard to find elsewhere.

Most of these chips are low in cost. Your quantity one orders are welcome. Their website is found at www.cir.com.

Distributor Catalogs

Most of those old line distributors (such as *Allied* or *Newark*) or the new age ones (such as *Jameco*, *Mouser*, or *Digi-Key*) have lots of semiconductor and integrated circuit listings in their catalogs. These tend to be catch-as-catch-can as they are pretty much limited to current production of only those vendors that the distributor represents. But these catalogs are certainly highly useful for info on at least some newer parts.

I've noticed that *MCM Electronics* has a pretty extensive stocking for foreign and replacement ICs and discrete semiconductors.

Let me know your favorites here.

Trade Journals

Those electronic trade journals are your first source of info on upcoming and newer products. These are often free to qualified subscribers. They are easily reached through many of the previously mentioned links. Or you can get a nearly complete list via the *Oxbridge Media Finder* link you'll find at *www.tinaja.com/webwb01.html*.

My favorites here are *E.E. Times*, *Electronic Design*, *EDN*, *Electronic Products*, and the *Electronic Component News*. Plus a large handful of more specialized titles.

We saw a lot more on these back in RESBN62.PDF, RESBN57.PDF, and in RESBN49.PDF. All can be downloaded at *www.tinaja.com/resbn01.html*.

Newsgroups

Often you can pick up info on an oddball chip by asking for help in one of the Usenet newsgroups. You might start off with one of these ...

- misc.industry.electronics
- sci.electronics
- sci.electronics.components
- sci.electronics.equipment
- sci.electronics.misc
- sci.electronics.repair
- sci.electronics.design

This Month's Contest

Lots of additional links to related sites are in my *Electrical Engineering* library at *www.tinaja.com/eeweb01.html*. You can also pin down most anything on any technical subject by using my *InfoPack* service you'll newly find at *www.tinaja.com/info01.html*.

Let's have us several contests for this month. Firstoff, tell me about an old line "ain't got a clue" fee-based service that now has one or more free web replacements.

Or newly useful substitutes. Especially needed is the freebie *Dialog* stuff, such as *Inspec*, *MathSci*, *Compendex*, and all the rest of the serious research gang.

What have you found so far?

So much is happening so fast on the web, that the chances are good I've missed a biggie or two here. So, as our second contest, please tell me about any of your favorite sources for semiconductor info that I may have missed here.

There should be a largish pile of my new *Incredible Secret Money Machine* books going to the dozen or so better entries, plus an all-expense-paid (FOB Thatcher, AZ) *tinaja quest* for two that will go to the very best of all.

To be fair to everyone, all entries must be written and submitted via snail mail. Send all your *written* entries to me here at *Synergetics*, rather than to *Nuts & Volts* editorial.

Let's hear from you. **NV**

Microcomputer pioneer and guru Don Lancaster is the author of 35 books and countless tech articles. Don maintains his no-charge US tech helpline found at ***(520) 428-4073****, besides offering all of his own books, reprints, and consulting services. Don also offers a free catalog full of his unique products and resource secrets. The best calling times are 8-5 on weekdays, Mountain Standard Time*

Don is the webmaster of his Guru's Lair found at ***http://www.tinaja.com/tinaja****. Full reprints and preprints of all Don's columns and ongoing tech support appear here. You can reach Don at Synergetics, Box 809, Thatcher, AZ 85552. Or send any messages to* ***don@tinaja.com****.*

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Write in 65 on Reader Service Card.

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NEW PRODUCT EDITOR,
430 PRINCELAND CT., CORONA, CA 91719

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Novatech Instruments, Inc. announces three new versions of its 2950AR rubidium frequency standard. Dubbed the 2950AR/01, 02, and 03. These versions provide additional output frequency combinations while maintaining the ± 5 x 10^{-11} monthly stability of the 2950AR. The 2950AR/01 provides three 10 MHz outputs; the 2950AR/02 provides 10 MHz, 5 MHz, and 100 KHz; while the 2950AR/03 provides three outputs of any customer specified combination of 10 MHz, 5MHz, 1 MHz, and 100 KHz.

The 2950AR/01 is $4,145.00; 2950AR/02 is $4,245.00, and the 2950AR/03 is $4,495.00.

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SEATTLE, WA 98133
206-301-8986 FAX: 206-363-4367
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MFJ-295Y MINISPEAKERMIC™

MFJ Enterprises, Inc. announces the new MFJ-295Y Yaesu MiniSpeakerMic™ for Yaesu FT-10R, FT-40R, FT-50R, and VX-1R ... only $15.95 each!

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P.O. BOX 494, DEPT. NV
MISSISSIPPI STATE, MS 39762
601-323-5869 FAX: 601-323-6551
1-800-647-1800
E-MAIL:
mfj@mfjenterprises.com
WEB:
http://www.mfjenterprises.com

ICOM's IC-746 ALL-MODE TRANSCEIVER

ICOM announces its newest HF through two-meter all-mode transceiver — the IC-746. The IC-746 is a DSP, high-performance radio in a compact package.

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205-837-4587
E-MAIL: cstanley@airnet.net
WEB:
http://www.airnet.net/cstanley

NEW CG-951 NTSC COLOR PATTERN GENERATOR

Products Intl., Inc. introduces the new CG-951 NTSC Color Pattern Generator from Kenwood. It incorporates a 10-step staircase signal generator featuring variation of the luminance level of each step, in addition to the generation of color bar, crosshatch, raster, and other patterns required for adjustments and inspections of video equipment and color TV.

Based on the CG-930 Series of color pattern generators, the CG-951 features many new functions such as a variable 10-step staircase signal generator, RGB output, and Y/C separate outputs.

With its improved resolution, the CG-951 is also compatible with a wide range of modified patterns.

Features include: Variable 10-step staircase generator for easy adjustment of the gamma-corrector circuit of LCD displays; RGB output and Y/C separate outputs provided as standard in addition to composite video output; burst signal ON/OFF with any pattern; selection of nine raster patterns; two color bar patterns; setup 0%; EEPROM memory; and composite sync and vertical sync outputs standard.

The CG-951 is available now with a suggested list price of $2,899.00.

For more information, contact:

PRODUCTS INTL., INC.
8931 BROOKVILLE RD.
DEPT. NV
SILVER SPRING, MD 20910
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FAX: 1-800-545-0058
E-MAIL:
SMPRODINTL@aol.com
http://www.kenwoodtmi.co.jp

The Computer Controlled World: RS-232 Network Control Methods and Applications

ANALOG-TO-DIGITAL -TO-WINDOWS

by Ryan Sheldon, National Control Devices (404) 244-2432 http://members.aol.com/ncdcat

I have written many articles in the preceding months concentrating on low-cost ways of getting data into and out of your desktop computer via RS-232 communications under Visual Basic. All of these methods have worked well if you're working strictly with logic-level data. But in the real world, data is not always digital. So this month, I want to spend some time showing you how to build an RS-232 networkable dual channel analog-to-digital (A/D) converter. Up to 16 A/D interface processors can share a single serial port, providing up to 32 analog inputs.

RS-232 Networking

RS-232 networking allows up to 16 devices to share a single RS-232 serial port in any combination. In previous articles, I have written about RS-232 controlled relays, digital inputs and outputs, and LCD character display controllers. And I have provided explicit directions on using these networkable devices under Windows via Visual Basic 4 and 5. Now with A/D conversion, you can add real-world analog measurements to digital control systems using VB5, but this is just where the power begins ...

Reactive Programming

Here, you will also learn how to build the hardware and software program capable of responding to real-world conditions. So if the temperature gets too cold, you can trigger a relay to turn on a heater. Similarly, if the light level falls too low, you can trigger a different relay to turn on a light. I call this type of program a "reactive program" because you can set the levels in software that define the temperature or light level that will trigger a reaction.

This power can be extended to any user by building a simple Visual Basic 5 application allowing any user to control the level of the reaction. After all, a Windows 98 program can be as intuitive as your imagination permits. And when you provide an intuitive interface for the user, you can quickly and easily empower anyone with world control at any skill level.

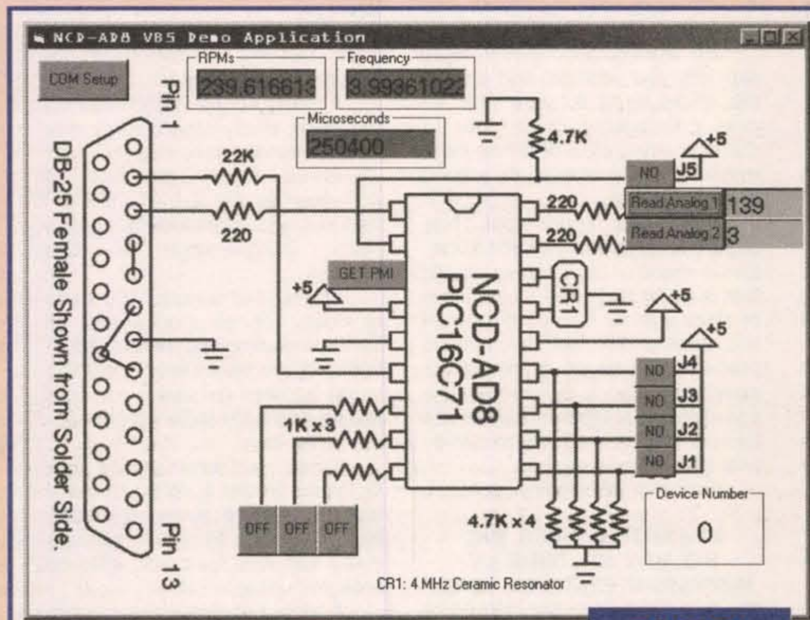


FIGURE 1

FIGURE 2

Project1 - Form1 (Code)

DeviceSet | Click

```
Private Sub DeviceSet_Click(Index As Integer)
    If DeviceSet(Index).Caption = "NO" Then
        DeviceSet(Index).Caption = "YES"
        If Index = 0 Then Device = Device + 1
        If Index = 1 Then Device = Device + 2
        If Index = 2 Then Device = Device + 4
        If Index = 3 Then Device = Device + 8
    Else
        DeviceSet(Index).Caption = "NO"
        If Index = 0 Then Device = Device - 1
        If Index = 1 Then Device = Device - 2
        If Index = 2 Then Device = Device - 4
        If Index = 3 Then Device = Device - 8
    End If
    DevicesLabel.Caption = Device
End Sub
```

Technicalities ... Technicalities ...

The technicalities of using the RS-232 control network are simple. I will briefly overview the concept of operation by saying that 16 devices can be chained together using only three wires on the RS-232 port of your computer. One wire provides a ground, another provides data from the computer to all devices, and a third (and sometimes optional) wire provides data from a device back to the computer.

Each device has a set of four jumpers that defines its device number on the network. Removing all four jumpers sets the device number to 0. When the device number is set to 0, the device

THE COMPUTER CONTROLLED WORLD

```
Project1 - Form1 (Code)
Analog    Click

Private Sub Analog_Click(Index As Integer)
    'Compute a Device Number
    Dev = Device * 16
    'Ask the AD8 for an A/D Reading
    MSComm1.Output = Chr$(Dev + 7 + Index)
    'Wait for a Reply
    LoopCounter = 0
    Do
        LoopCounter = LoopCounter + 1
        'Do Not Allow an Infinite Loop
        If LoopCounter > 200 Then Exit Sub
    Loop Until MSComm1.InBufferCount = 1
    'Display the Reading using a Label
    Label2(Index) = Asc(MSComm1.Input)
    'Note that Index is used to distinguish between the
    'two "Read Analog" buttons.  An Index Value of 0
    'Reads Analog Input 1 while an Index Value of 1
    'Reads Analog Input 2.
End Sub
```

FIGURE 3

```
Project1 - Form1 (Code)
AUX    Click

Private Sub AUX_Click(Index As Integer)
    'Compute a Device Number
    Dev = Device * 16
    'Toggle Buttons and Set Status
    'Note that if STATUS = 0 then LINE is ON
    'When STATUS = 1 then LINE = OFF
    If AUX(Index).Caption = "OFF" Then
        AUX(Index).Caption = "ON"
        Status = 0
    Else
        AUX(Index).Caption = "OFF"
        Status = 1
    End If
    'Compute a the AUX Line that Should Be Toggled
    AuxDat = Index * 2
    'Send Data Out the Serial Port
    'To Write Data to the AUX Outputs
    MSComm1.Output = Chr$(Dev + AuxDat + Status)
End Sub
```

FIGURE 4

responds ONLY to ASCII characters 0 to 15. When a device is set to address 1, the device only responds to ASCII characters 16 to 31. Since RS-232 allows 256 possible ASCII character transmissions, and each device can be set to listen to a specific range of 16 characters, 16 devices may be shared (256 ÷ 16 = 16).

Applications Unlimited

The RS-232 network was designed to be just as modular as a well-written subroutine. You can mix 16 devices in any combination. You can connect a relay driver, a LCD display driver, an input board, an output board, and an A/D board to the same set of RS-232 communication wires (and a lot of other stuff that I plan on talking about in future articles).

You can ask the input board for the status of the inputs. You can then send data to the LCD display providing valuable information based on the status of these inputs. You can also ask the A/D board what the current analog value is on one of the two input channels. You can make a relay respond to this analog value, and even display another message on a second LCD display. All of these things can be accomplished with only three wires from the RS-232 port of your computer over a distance of about 1,000 feet.

And later on, when your needs grow, so can your network. You can add another relay driver, another A/D, a video switcher, graphic LCD displays, and a host of other devices.

Getting Started

I will continue in my traditional method by talking about the software and how it works. I will highlight a few subroutines and how they work, but I think it's time to move on from the baby steps of RS-232 communications under VB5, so you won't find explicit directions for building this application. But if you need to take these first steps, please consider reading some of my previous articles in *Nuts & Volts*. Some of my earlier articles walk you through VB5 from the point of first loading the program to building your first computer control application. You can always download the software for this and other articles by visiting http://members.aol.com/ncdcat/.

Figure 1 shows a screen-shot of the NCD-AD8 attached to the serial port of a computer. This application is unique in that it combines a schematic overlaid with buttons and numbers. This "tutorial" type program allows you to send commands to the chip and display the results. Note that the chip MUST be attached to the serial port of the computer for this program to return data.

This program is very easy to use. When you click a command button, data is transmitted to the chip. Some command buttons wait for a reply from the chip. In these cases, the program will wait for a short period of time for data to return from the chip.

The computer will make several attempts at reading data from the serial port. If data is not received, the subroutine exits and no data will be updated. So, in these cases, check to make sure your wiring is correct.

```
Project1 - Form1 (Code)
PMI    Click

Private Sub PMI_Click()
    'Period Measurement Input
    'This subroutines samples pulse rates and converts them
    'to Rounds Per Minute (RPM).
    'Compute a Device Number
    Dev = Device * 16
    'Send Command the AD8 to Read the RPMs.
    MSComm1.Output = Chr$(Dev + 15)
    'Wait for a Reply
    LoopCounter = 0
    Do
        LoopCounter = LoopCounter + 1
        'Do Not Allow an Infinite Loop
        If LoopCounter > 99999 Then Exit Sub
    Loop Until MSComm1.InBufferCount = 2
    MSComm1.InputLen = 1
    'Read Most Significant Byte of 16-Bit Return
    MSB = Asc(MSComm1.Input)
    'Read Least Significant Byte of 16-Bit Return
    LSB = Asc(MSComm1.Input)
    'Compute Microsecond Duration
    Microseconds = 8 * ((MSB * 256) + LSB)
    'Microseconds = MSB
    If Microseconds <> 0 Then
        'Compute Frequency
        Frequency = 1 / (Microseconds / 1000000)
        'Compute RMPs
        RPMs = Frequency * 60
    Else
        Frequency = 0
        RPMs = 0
    End If
    'Process Invalid Return
    If (MSB = 255 And LSB = 255) Then
        Frequency = 0
        RPM = 0
    End If
    'Display the Reading using a Label
    'Display RPMs
    RPMLabel.Caption = RPMs
    'Display Frequency
    FrequencyLabel.Caption = Frequency
    'Display Microseconds
    MSLabel.Caption = Microseconds
End Sub
```

FIGURE 5

Addressing

As I mentioned before, you can attach up to 16 devices to a single serial port. A set of four jumpers labeled J1 to J4 control the address setting of each individual device. Installing and removing jumpers changes the address.

Note that if you change the jumper settings, you MUST click the on/off jumper buttons on the AD8 demo application program. This will change the device number in software. So make sure the jumper settings in software match the jumper settings in hardware.

Figure 2 shows how these jumper buttons work. Each button is assigned a weight of 1, 2, 4, or 8. If all jumpers are installed, the Device variable is set to 15 because the weight of all on buttons is 1 + 2 + 4 + 8 = 15.

Turning off all buttons consequently sets the weight (or Device number) to 0. Turning on buttons J1 and J4 only sets the Device variable to 9 because the weight of J1 is 1 and the weight of J4 is 8, so J1 + J4 = 1 to 8 = 9.

If Figure 2 and my little explanation confused you, then skip it. It's not really all that important. The only thing you really need to get out of this section of the program is that by turning on/off jumpers J1 to J4 on the application (and in hardware), you are changing the Device variable by setting it to a value from 0 to 15. Run the program and watch the numbers change when you click the jumper buttons, you'll figure it out ...

Hot Jumpers

The NCD-AD8 supports "hot" jumpering. This simply means you can change the jumper settings at any time without rebooting or powering down the processor. Jumper J5 controls the baud rate. Installing a jumper at J5 sets the device to 1200 baud. Otherwise, the default communication is 9600 baud. Baud rate is also "hot" jumpered.

Command Set

The NCD-AD8 has a very powerful command set, capable of setting the on/off status of three outputs, reading two analog inputs, and is also capable of taking period measurement on another input (which is used for converting incoming pulses to RPMs and frequency).

The first command I want to talk about is sent to the NCD-AD8 by clicking one of the "Read Analog" buttons (see Figure 1 for a picture of the buttons). Figure 3 shows the exact sequence of instructions for reading an analog input when this button is pressed.

Here is a breakdown of how the command is sent to the NCD-AD8, and how the program should handle the data sent back to the computer. First, this subroutine determines which device number the AD8 is configured to.

Note that the device number is displayed in the lower right corner of the application program. The first line of the program reads:

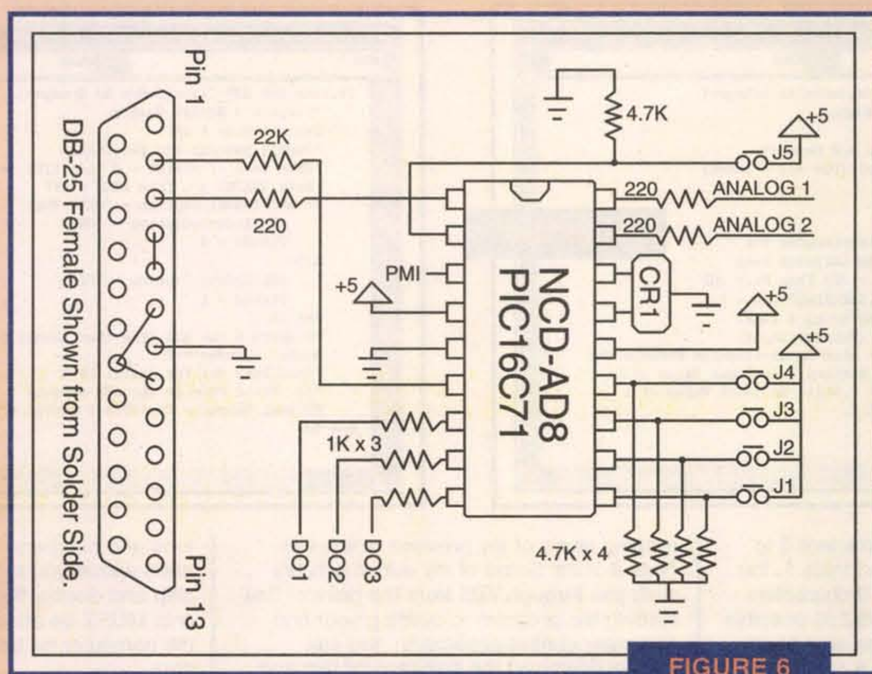
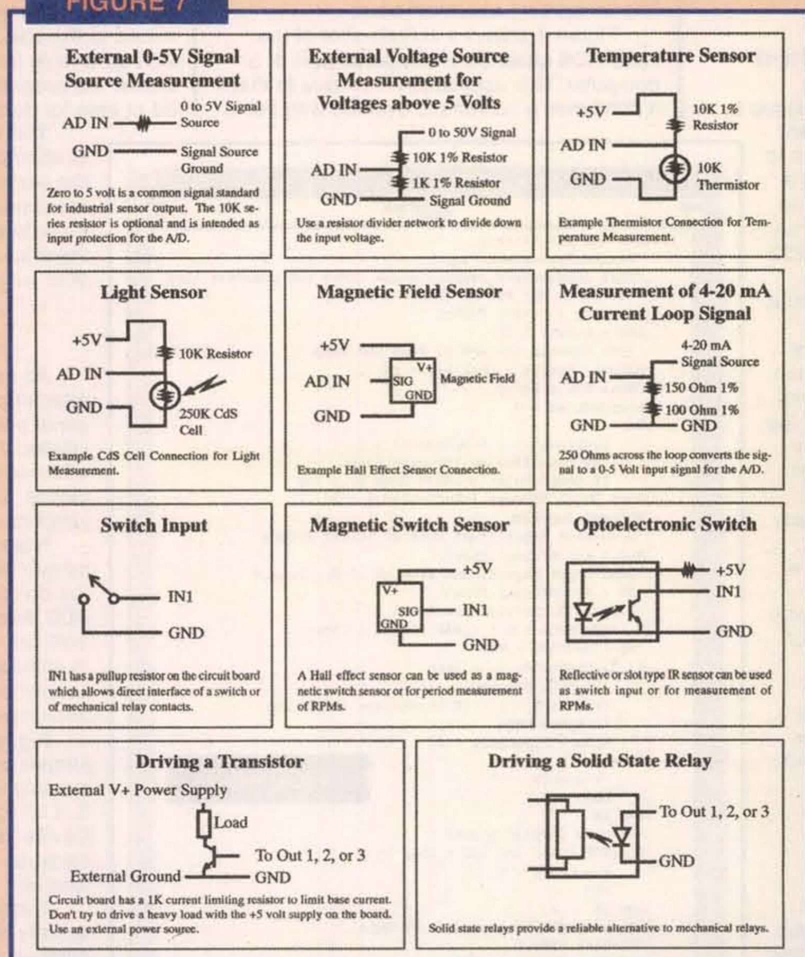


FIGURE 6

FIGURE 7



Dev = Device * 16

Dev is used to compute the beginning of a range of ASCII characters. This range of ASCII characters will be sent to the NCD-AD8 and interpreted as commands. When the Device variable is set to 0, Dev = 0. So commands will be sent to the NCD-AD8 using ASCII characters 0 to 15. Similarly, when the Device variable is set to 1, Dev = 16. So commands will be sent to the NCD-AD8 using ASCII characters 16 to 31.

Once the device number has been computed, it's time to send the command that will ask for an A/D measurement. The following line sends the command to the NCD-AD8 processor:

```
MSComm1.Output =
Chr$(Dev + 7+ Index)
```

The MSComm control is used in VB5 for RS-232 communications. The Output command is used for sending data out the RS-232 port. CHR$(N) means character. N has a value of 0 to 255 for sending an ASCII character out the serial port. Dev holds the device number we are speaking to. 7 is the command for reading analog channel 1. Index has a value of 0 or 1 depending on whether you clicked the "Read Analog 1" or "Read Analog 2" button. So sending command 7 + 0 reads analog channel 1 and sending command 7 + 1 reads analog channel 2.

The Do/Loop function is used to wait for data from the serial port. The LoopCounter variable will increment to a value of 200, meaning the loop will read the serial port 200 times waiting for a reply from the AD8 processor. If this loop never sees a reply from the chip, the subroutine will be exited, avoiding an infinite loop. The "Loop Until MSComm1.InBufferCount=1" tells the loop to wait for 1 byte to be sent from the AD8 processor.

Once data has been returned, the value is displayed using a Label. This value will always be a number from 0 to 255. If the analog input is at zero volts during conversion, the returned value would equal 0. If the analog input is at five volts during conversion, the returned value would be 255. Each number (from 0 to 255) is equal to .0195 volts (five volts divided by 256 possible values for an eight-bit A/D). So a returned value of 139 would equal 2.71 volts (139 * .0195).

Figure 4 shows an example subroutine

used for turning the three auxiliary outputs on or off. Note that the Status variable controls the on/off state. When Status = 0, the data line will be turned on (+5 volts). A Status of 1 turns the data line off.

Period Measurement is another feature of the NCD-AD8 network interface processor. Figure 5 demonstrates a programming example for reading period measurement and displaying the output. When the period measurement command is sent to the NCD-AD8, the processor counts the number of pulses received on the PMI pin. These pulses can be easily converted to RPMs, frequency, and microsecond duration values between pulses.

The PMI command is issued to the NCDAD8 by the following command:

```
MSComm1.Output = Chr$(Dev + 15)
```

Once the sample command is issued, the NCD-AD8 processor counts the number of pulses received. Once sampling is complete (allow about 1/2 second), the NCD-AD8 returns a 16-bit value in the form of two bytes (MSB and LSB). This 16-bit word represents the duration between pulses received on the PMI input pin. The following conversions provide other useful information about the received data:

```
Microseconds = 8 * ((MSB * 256) +
 LSB)
Frequency = 1/(Microseconds/1000000)
RPMs = Frequency * 60
```

The NCD-AD8 returns 255 for MSB and LSB if no pulses were detected on the PMI pin during sampling.

Circuit Assembly Notes

Figure 6 shows a schematic of the NCD-AD8 processor. All parts are commonly available from Ryan Sheldon of National Control Devices (http://members.aol.com/ncdcat/ or E-Mail ncdryan@aol.com). CR1 is a 4-MHz ceramic resonator. I would highly recommend the use of a power supply rated at exactly 5.00 volts for accurate A/D readings.

CR1 should be replaced with a 4-MHz crystal and two 15pF caps for more accurate PMI readings. Note that hardware handshaking is not used in this application. The NCD-AD8 only requires an RS-232 ground shared with the logic ground of the NCD-AD8 processor, a data input, and a data output line. Optoisolation is highly recommended in applications where voltages above five volts may be present. Please contact me for details at (404) 244-2432.

Application Schematics

All types of devices may be connected to the NCD-AD8. Figure 7 demonstrates how to connect a few different types of sensors to the various inputs and outputs of the NCD-AD8.

Reactions to Analog Actions

I briefly talked about reactive programming earlier in this article. Now, I would like to finish the article by controlling a few simple relays from the same serial port. So for now, set the address of the NCD-AD8 to 0 (remove jumpers J1 to J4). This will tell the NCD-AD8 to only listen to ASCII characters 0 to 15. An eight-relay driver can now be attached to the same serial port and set to address 1, forcing it to only listen to ASCII characters 16 to 31. ASCII characters 16 to 23 will turn off each of the eight relays while ASCII characters 24 to 31 will turn them on.

The data output of the RS-232 serial (pin 2 of the DB25) needs to be fed into the data input of the NCD-AD8 and the relay driver (see March '98 issue of *Nuts and Volts*). The ground of the RS-232 connector (pin 7 on the DB25) should also be shared with the logic ground of the NCD-AD8 and the relay driver.

Controlling the relays is now just a simple matter of sending ASCII characters out the serial port. The following program should control the relays under VB5:

```
'Turn Off all eight Relays
For n = 16 to 23
    MSComm1.Output = Chr$(n)
Next n

'Turn On all eight Relays
For n = 24 to 31
    MSComm1.Output = Chr$(n)
Next n
```

Now to make the relays reactive, you only need to read data into the serial port from device 0 and write data out the serial port at device 1 to control the relays. Please see Figure 3 for an example of reading data at device 0 into the computer. Note that at the bottom of the program example, a Label is used to write these values to the screen of your computer. Add the following code to the bottom of the subroutine (just before the "End Sub" statement) to make a relay "react" to various analog levels:

```
'If Input 0 is less than .64 volts
'(33*.0195)
If Label2(0) < 33 Then
    'Turn On Relay Number 8
    MSComm1.Output = Chr$(31)
Else
    'Otherwise, make sure relay 8 is
    'turned off
    MSComm1.Output = Chr$(23)
End If
```

You can expand this idea a little further by adding scalable relay control. In this next example, relays 1 to 7 will turn on as the voltage increases on analog input number 2.

```
'If voltage on Analog Input 2 is greater
'than .7 volts then
If Label2(1) > 36 Then
    'Turn On Relay 1
    MSComm1.Output = Chr$(24)
Else
    'Otherwise, Turn Off Relay 1
    MSComm1.Output = Chr$(16)
End If
'If voltage on Analog Input 2 is greater
'than 1.4 volts then
If Label2(1) > 72 Then
    'Turn On Relay 2
    MSComm1.Output = Chr$(25)
Else
    'Otherwise, Turn Off Relay 2
    MSComm1.Output = Chr$(17)
End If
'If voltage on Analog Input 2 is greater
'than 2.1 volts then
If Label2(1) > 108 Then
    'Turn On Relay 3
    MSComm1.Output = Chr$(26)
Else
    'Otherwise, Turn Off Relay 3
    MSComm1.Output = Chr$(18)
End If
'If voltage on Analog Input 2 is greater
'than 2.8 volts then
If Label2(1) > 144 Then
    'Turn On Relay 4
    MSComm1.Output = Chr$(27)
Else
    'Otherwise, Turn Off Relay 4
    MSComm1.Output = Chr$(19)
End If
'If voltage on Analog Input 2 is greater
'than 3.5 volts then
If Label2(1) > 180 Then
    'Turn On Relay 5
    MSComm1.Output = Chr$(28)
Else
    'Otherwise, Turn Off Relay 5
    MSComm1.Output = Chr$(20)
End If
'If voltage on Analog Input 2 is greater
' than 4.2 volts then
If Label2(1) > 216 Then
    'Turn On Relay 6
    MSComm1.Output = Chr$(29)
Else
    'Otherwise, Turn Off Relay 6
    MSComm1.Output = Chr$(21)
End If
'If voltage on Analog Input 2 is greater
'than 4.9 volts then
If Label2(1) > 252 Then
    'Turn On Relay 7
    MSComm1.Output = Chr$(30)
Else
    'Otherwise, Turn Off Relay 7
    MSComm1.Output = Chr$(22)
End If
```

I hope you enjoyed this month's "**COMPUTER CONTROLLED WORLD**." As usual, feel free to contact me with your questions, comments, suggestions, or ideas. Please contact:

Ryan Sheldon, at **(404) 244-2432** or E-Mail **NCDRyan@aol.com**. NV

TROPO TIME IN AUGUST ON THE VHF/UHF AIRWAVES

by Gordon West

August is the yearly peak of a weather condition called tropospheric ducting.

And, during periods of intense atmospheric subsidence, a tropospheric duct may open up a path several thousand miles long between stations running as little as 10 watts of output power.

You already know about the effects of tropospheric ducting. The outside temperature hovers around 90, and there is absolutely no breathe of fresh air. But television weather personnel show a high-pressure system settling in, and the forecast is "hot and muggy" with an elevated pollution index. Out here on the Pacific Coast, that brown stuff seen hanging on the horizon is just called smog. In other parts of the country, they may call it smoke — or haze. But whatever you call it, your eyes and lungs can feel it, and the condition will normally last for about three days until the stable high-pressure system decides to head east.

A high-pressure weather system contains a CELL of extra heavy air that may extend for hundreds, and sometimes thousands, of miles over us, or adjacent to us, in North America. Some of the most regular highs are the West Coast Pacific High centered between California and Hawaii, the Bermuda High, the Atlantic High, and transient, slow-moving, high-pressure cells that sometimes bog down right in the middle of the United States.

A cell of high-pressure air is heavier than the normal air below. Once a high-pressure system forms up with little jet stream activity around it, it begins to sink. Sinking air is called subsidence. And as the subsidence falls into higher pressure down below, it begins to heat up. Remember that tire pump? Give it one minute of tire pumping, and the cylinder is mighty warm. This is what happens when you compress air.

In the presence of stable air conditions below, the high-pressure cell begins to fan out for hundreds, and sometimes thousands, of miles over a region. It STRATIFIES in an area about 1,000 feet up from our average terrain. You can see this stratification by watching smoke rise from the local power plant, and about 1,000 feet up, the smoke abruptly goes horizontal in the extremely gentle wind. It is at this elevation where the effects of high-pressure stratification take place.

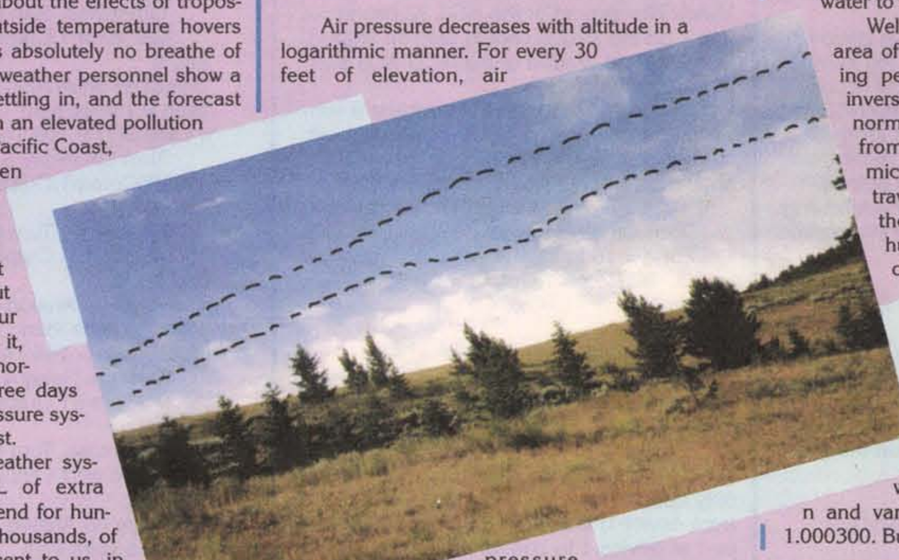
Within this stratified layer of air that has descended from a high-pressure cell, three "normals" take a sharp change.

TEMPERATURE

Temperature normally (n) decreases by 20 degrees Fahrenheit for every mile in increasing altitude. But within a stratified layer of sinking air, temperature may sometimes INCREASE by as much as 10 degrees below and 10 degrees above.

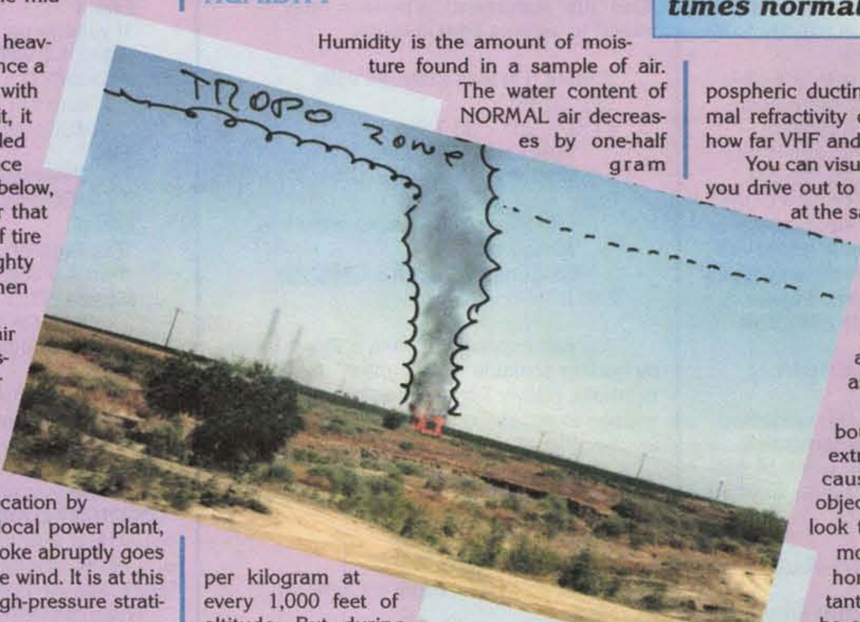
AIR PRESSURE

Air pressure decreases with altitude in a logarithmic manner. For every 30 feet of elevation, air pressure drops approximately one millibar. But within the stratified layer, air pressure is squeezed by subsidence, and may increase by several millibars.



HUMIDITY

Humidity is the amount of moisture found in a sample of air. The water content of NORMAL air decreases by one-half gram per kilogram at every 1,000 feet of altitude. But during periods of high-pressure air stratification, warm moist air feeding into this system from the south will many times increase water content within the stratified inversion layer.



When temperature, water content, and pressure all abruptly change from their normal (n) values with ascending height above earth, a tropospheric duct is created by the sharp change in refractivity. A change in refraction may bend both radio waves, as well as light waves. Stick a pencil into a glass of water, and see what happens when there is a sharp change in the refractive index of water to air. It looks bent, doesn't it?

Well the same thing happens in that thin area of stagnant, stratified air above us during periods of a widespread temperature inversion — VHF and UHF radio waves that normally slightly bend over the horizon from normal refraction (the 4/3 microwave radio horizon theory) now travel along the upper or lower edge of the temperature inversion, and may go hundreds, and sometimes thousands, of miles faithfully following the curvature of the earth along their DUCTED radio path.

And thus we have the name "VHF/UHF TROPOSPHERIC DUCTING," thanks to a warm air inversion in the presence of a high-pressure system. The normal radio refractivity within air is represented by the symbol n and varies normally (n) from 1.000345 to 1.000300. But during periods of above normal tropospheric ducting, the sharp change to the normal refractivity of air can influence dramatically how far VHF and UHF radio waves may travel.

This atmospheric phenomena is predictable and can regularly extend a VHF or UHF communications path by as much as 10 times normal line-of-sight range.

You can visualize this phenomena easily when you drive out to the desert. When you look down at the sand, it looks like blue water, doesn't it? What you're seeing is a mirage. What you are ACTUALLY seeing is blue sky being REFRACTED back up to your eyes by the super-heated warm air lying just above the sand or asphalt road.

On hot, windless days, sharp boundaries between normal air and extremely warm air may sometimes cause optical illusions. Distant objects well off on the horizon may look taller than they actually are. The moon coming up just above the horizon looks enormous. That distant airport revolving green light can be seen flashing on the horizon well beyond what you normally could see. And, during periods of intense super-refractivity of air, distant objects may have a mirror image of themselves, hanging upside down on the horizon. And sometimes the horizon of distant hills astonishingly disappears into clear blue sky. What was a line of hills now becomes peaks and valleys. Absolutely amazing, huh!

THE RADIO PATH

Tropospheric ducting of radio waves spans between a low of 50 MHz to a high of 10,000 MHz. The most popular ham bands influenced by tropospheric ducting are the VHF, UHF, and microwave bands. Tropo ducting is one of the few atmospheric phenomenas that actually becomes more pronounced as we go higher in frequency.

The amateur radio two-meter and 70 cm bands (144 MHz and 432 MHz) are the most popular for summer tropo DXing. These are the bands where hams can really get a taste of how far VHF and UHF radio waves can travel within the tropospheric duct.

- California to Hawaii for over five continuous days
- Nova Scotia to Florida for over a week
- Texas to Florida for over a week
- Chicago to Denver
- Washington to Memphis
- Maybe soon East Coast to Europe?

"As I was descending out of 5,000 feet to Tokyo Airport, I entered a band of smog hanging over the coastline, and all of a sudden could hear my AM VHF aeronautical radio crackle with talk from a controller in San Francisco," comments Bill Alber WA6CAX. "I had a few seconds to spin the dial on my NAV receiver, and it was wall-to-wall radio signals from all over the Pacific," adds Alber. He also reports that the freak reception only lasted for a couple of hundred feet within the visible tropospheric duct.

If your television is still wired into an outside antenna, tropospheric ducting can be seen on the unused TV channels. When Channel 3 usually gives you nothing but snow, all of a sudden it pops to life with television reception in clear color coming in from a station over 800 miles away. If the condition lasts for only a minute or so, chances are it's skywaves — not to be confused with atmospheric tropospheric ducting. However, if the condition prevails for hours on end, it is unmistakably tropo ducting.

Two-way radio companies are troubled by periods of tropo ducting. Business band radio users on VHF and UHF begin hearing signals coming in from other land and mobile stations, 600 and 700 miles away. Sometimes the incoming signals are actually stronger than their local mobile units.

Tropo ducting can also affect cellular phone frequencies at 900 MHz, and PCS at 1700 MHz. Many times you can make phone calls in areas that you had absolutely no reception from before. Your "in range" indicator may stay locked on for hundreds of additional miles when you're well outside of your normal cellular phone service area. And sometimes you receive double signals coming in from a local and a distant cell phone site on the same frequency — again, caused by a temperature inversion creating UHF tropospheric ducting.

But it is probably the amateur radio operator that most appreciates what the VHF super-range can do. Ham operators have established constant transmitting CW beacons at the bottom of all VHF and UHF band allocations specifically for studying the effects of tropo ducting. The Hawaiian KH6HME beacon has probably been received by more ham radio operators throughout the world than any other beacon installation. Every July and August, the 10-watt beacon — traveling over a VHF and UHF path more than 2,400 miles — comes in loud and clear for days on end.

"I know we're going to have an opening when I check with my national weather sources who tell me a strong inversion layer is forming over the big island of Hawaii," comments Paul Lieb KH6HME. "The first sign that we are going to have a California to Hawaii VHF/UHF tropo opening is when I begin to hear an elevated noise level on my receiver when I aim my directional antennas toward the West Coast," adds Lieb. "Then I begin to see the telltale band of warm air hanging out on the horizon, and that tells me it's time to pack my gear and head for the hill," adds Lieb.

He will drive to an 8,900 foot site on the slopes of Mauna Loa volcano, and transmit VHF and UHF messages on ham frequencies for as long as the duct remains open. If it stays open a week, Lieb will stay camped out at the remote radio relay site and give West Coast hams a radio experience they will never forget.

PREDICTING THE PATH

A simple way to recognize that tropospheric ducting conditions are settling in for a few days is to watch your local television station channels off of rabbit ears or an outside antenna. If you are picking up stations on unused channels, the duct has formed. If you have a little weather receiver, take it out for a drive, and head for the hills to see how far away you can pick up other transmitting stations on alternate frequencies. If you're into scanning, take your scanner out to an area where you might expect some good tropospheric conditions.

"I just look for the smog level and drive in it," comments Ben Hathaway of Santa Cruz, CA, call sign N6FM. "I can actually smell and see the effects of the temperature inversion when I'm within the duct — and once inside, my ham sets jump to life," adds Hathaway. "But if I go too high, or don't get high enough, the tropo duct is barely received on my radio. I must be at just the right position to get the maximum signal strengths," adds Hathaway.

And it's not uncommon for the tropospheric duct to regularly shift within a region. For two hours you might be receiving signals coming in from a station 800 miles away. Then the signal slowly fades out, and another radio operator across town says that they have great reception, and you have next to nothing. But in about two more hours, the tables will turn, and now they lose the station on receive, and you pick it up stronger than ever!

So, this month, give VHF and UHF tropospheric ducting a try. If you are on a microwave computer network, and one-half mile from your building is the expected range of your new wireless PC system, see what happens on a hot August night when there is absolutely no wind, and you are able to take your computer all the way across town, and get a line-of-sight shot at the distant horizon. You may find that you're back on the air again with astonishing results and little dropouts.

Most radio experts are prepared for the extra benefit that El Nino may bring when it comes to warm moist air circulation coming up from the south, mixing with a high-pressure system to create a long-haul tropospheric duct. Ham operators are scanning the bands, looking for distant beacon signals. Business radio users are bracing for a month of interference from stations hundreds of miles away. Police departments may be responding to a burglary in progress, only to find out they have the right street, but the wrong city 400 miles down stream!

So watch your weather maps, and when you see that high pressure system settle in and you spot the band of smoke just hanging on the horizon, take your VHF/UHF equipment out and see how far away you can begin to pick up those distant signals coming in from the effects of tropospheric ducting. NV

NEXT MONTH: Horizontal mobile loops for working long-range tropo.

Continued from page 91

New Product News

NEW PIONEER-AT ROBOT

ActivMedia Robotics introduces the Pioneer All Terrain (AT) Intelligent Mobile Robot, cousin of the popular Pioneer 1 mobile platform.

The Pioneer AT has four 16cm diameter deep chevron tires, each powered by an independent, reversible DC motor.

Lightweight (under 12 KGs inluding battery), the Pioneer AT is backpackable, yet its solid, aluminum body construction and single-board microcontroller lets the robot rough it out in some very tough places. Hinged backplate latches for hot swapping batteries and easy access to interior components.

With the Pioneer-standard suite of Saphira, PAI, and P-LOGO robotics application development software, navigational, mapping, and other core robotics problems arrive pre-solved.

The complete Pioneer AT package includes the pre-assembled and tested intelligent mobile robot with Pioneer server operating system-based controller (RS-232 interface for connection with user-supplied client computer), 7 A-hr @ 12 VDC battery charger, software, set of manuals, one-year warranty and lifetime support, including free software updates/upgrades at our 24x7 website, Pioneer-support E-Mail-based technical solutions team, and a robust Pioneer-users newsgroup. ($4,795.00 suggested retail price.)

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APP-1

AWC, announces the APP-1 add-on kit for their ASP-1 solderless prototyping system.

The APP-1 allows ASP-1 users to connect a BASIC Stamp to their ASP-1 board and tum it into a Windows-based PIC programmer for 16C84, 16F84 PICs, and PICStics.

Using a few simple parts supplied with the kit and a BASIC Stamp I or II (not included), the kit turns the ASP-1 into a complete PIC prototyping system and programmer. Using this system, designers can easily try circuits, tear them apart, and try something different. There is no soldering or wirewrapping required.

The APP-1 is perfect for professional designers, hobbyists, and it is ideal for educational use, too.

The parts are easily removed, allowing the ASP-1 to return to its original function as a BASIC Stamp prototyping system.

For more information, contact:

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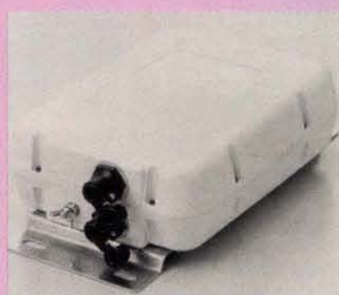
LEAGUE CITY, TX 77573
281-334-4341
http://www.al-williams.com/awce.htm

THE AH-4 ANTENNA TUNER



ICOM announces a new automatic antenna tuner — the AH-4. Compact in size, the AH-4 is weather-resistant, including rubber gasket seals. The AH-4 will tune a 23' long wire on the ham bands from 3.5 through 54 MHz.

When used with the optional AH-2G mobile antenna element, the AH-4 will tune from 7 through 54 MHz.

The AH-4 stores SWR minimum setting and tuning information in 45 memories for quick returning — average tuning time is 2.5 seconds or less. It is capable of handling up to 120 watts of transmitter power, yet only emits 300 mW during tune up.

Powered by 13.8V DC, the connections are simple. A control cable connects the tuner to a compatible ICOM transceiver, such as the IC-706MKII and IC-756 models.

The ICOM AH-4 automatic tuner is ideal for portable, mobile, and field day use, as well as for apartment, condominium, and other "stealth" istallations.

For more information, contact your ICOM dealer or ICOM America, Inc.

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http://www.icomamerica.com

NEW VA-2230 AUDIO ANALYZER

Products Intl., Inc. introduces the new VA-2230 Audio Analyzer from Kenwood. Its applications include audio/video, communications, and telephone equipment manufacturers, engineers, and designers. Manufacturers who require automated measurements and those monitoring production lines and PC boards will also find it useful.

The Kenwood VA-2230 is a high-performance, multi-function audio analyzer featuring a measuring signal generator with fast response, high stability, and 10 measuring functions.

It consists of a measuring signal generation block incorporating a programmable (DDS) oscillator and high-speed measurement block which processes signals using a notch filter, HPF, LPF, and applies DSP computations.

The 10 measuring functions include: Frequency measurement, AC level measurement with a wide bandwidth up to 210 KHz, wattage measurement, total distortion measurement, total harmonic distortion measurement, high order harmonic analysis, S/N ratio measurement, L/R ratio measurement, SINAD measurement, and DC level measurement.

These functions can be used independently or can also be combined with the signal generation block to build audio measuring systems with low noise, high accuracy, and high speed.

With digital technology invested everywhere, the VA-2230 makes possible fully automated measurements including automatic range switching and automatically synchronized measurement data output.

In addition, it is packed with many versatile functions including a preset memory for storing and recalling up to 100 measurement condition settings, a limiting function using zone display with GO/NO-GO judgement of the measurement results, an auto sequencing function which recalls the preset memory settings in sequence, a printer output, an EXT/ I/O for remote control, and GP-IB as standard.

The VA-2230 is available now with a suggested list price of $6,805.00.

For more information, contact:

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