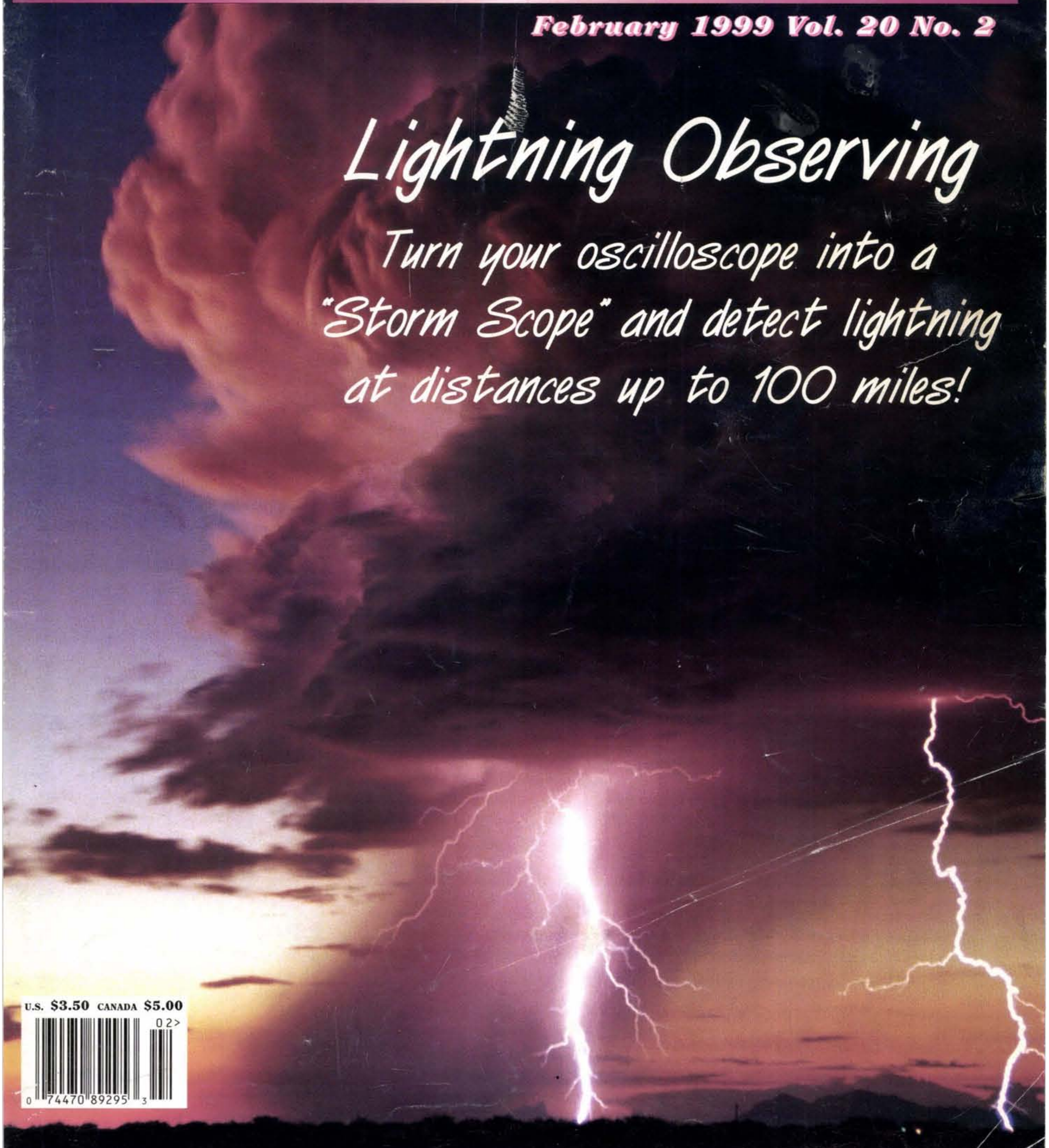
Nuts & Volts

Exploring Electronics And Technology For The Hobbyist And Professional

February 1999 Vol. 20 No. 2



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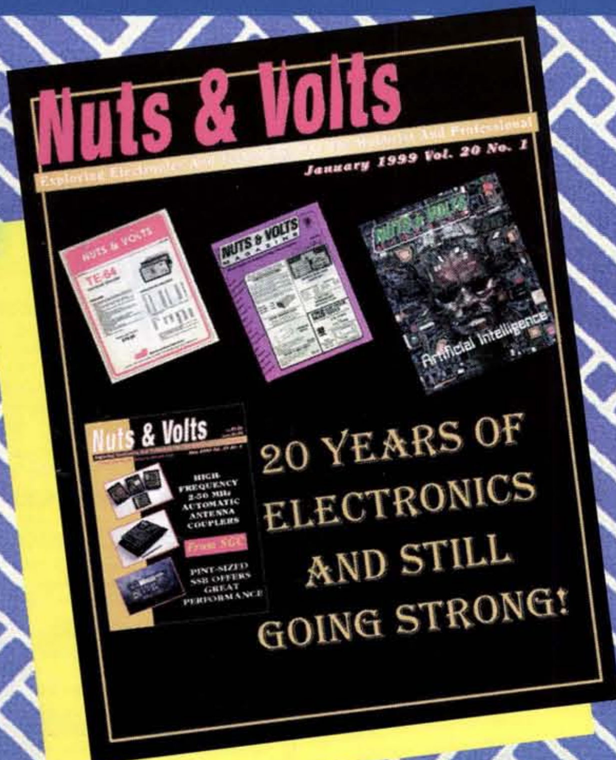

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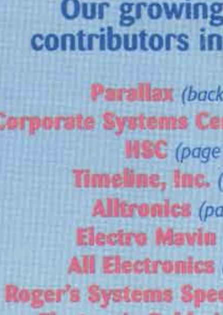

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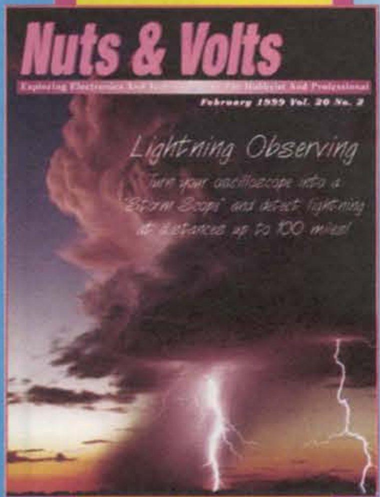

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Columns ...

DEPARTMENTS

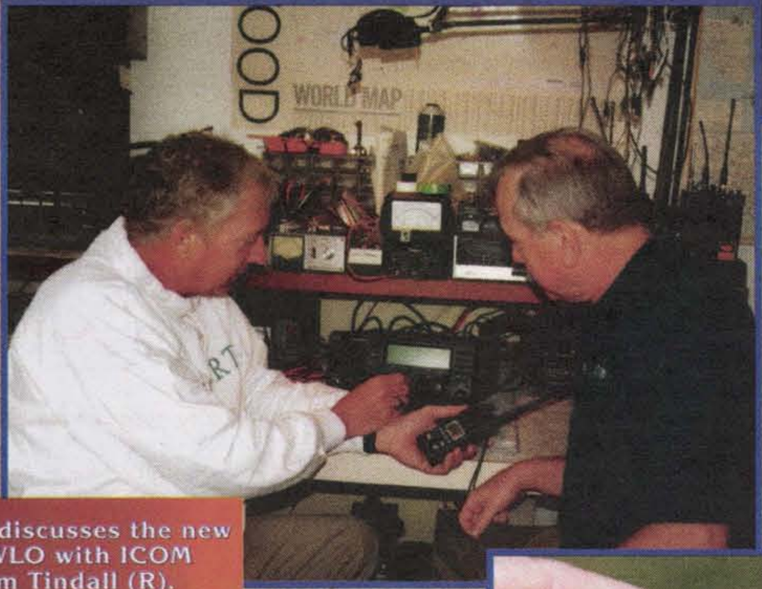
CLASSIFIED AD INDEX

BOATERS AND ROVERS UPSET WITH HF SSB PHONE SERVICE SHUTDOWN

by Gordon West

Sometime in the late afternoon on February 28th, AT&T station KMI in San Francisco, AT&T station WOO in New Jersey, and AT&T station WOM in Miami go off the air. Thousands of boaters, missionary stations, RVers, backpackers, and isolated stations depending on them for powerful high-frequency telephone coverage won't even get a friendly operator to tell them there is no more service. All they will hear on the 50 channels on high frequency between 2 MHz to 26 MHz is white noise.

For decades, the AT&T high seas radiotelephone service has provided powerful global high-frequency connections to the AT&T land-line system in the United States. Their three stations each ran thousands of watts of power into phased-array towers, giving mariners out on the high seas almost global coverage to their stations manned by helpful technical and telephone operators. Ship station equipment could be a simple 10-watt marine single sideband, or an elaborate full-duplex commercial kilowatt originally found aboard cruise ships. The AT&T channels were duplex, so bigger equipment could allow full duplex — talk and listen — so either party could interrupt each other during the phone call.



Gordon West (L) discusses the new channels for WLO with ICOM America's Jim Tindall (R).

Full duplex on marine single sideband high frequencies is actually more desirable for a phone call than the new satellite systems. The satellite systems, including new digital cellular systems, have a delay in a full-duplex conversation, so interrupting a fast-paced phone call is sometimes a problem. For satellite calls to the geostationary relay space stations, the delay is due to the 22,500-mile radio path. On local digital cellular networks, the delay is the analog-to-dialogue-to-analog conversion. The delay will sometimes cause an echo, but will usually make a fast-paced conversation almost impossible when both parties are trying to speak at the same time.

But on marine single sideband over high frequency, there was no delay — and this made HF phone calls from a relatively simple piece of high-frequency equipment a great way to go. Prices were also cheap through the AT&T high seas service, who charged no monthly fee to be registered, and the only time you paid $5.00 a minute was when you were actually speaking with a party you were calling or the party that had called you in the remote area. You would not be charged for a busy number, nor would you be charged for radio checks, calls to the Coast Guard, or calls to the operator just to double-check for messages holding.

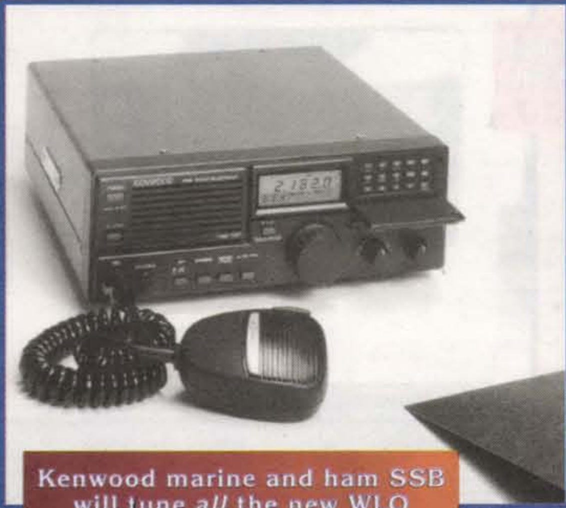
February 28, 1999, is the final day that AT&T will handle telephone calls over high-frequency single sideband.

Electronic techs will have good business programming old SSB with new WLO channels.

"AT&T's high seas radiotelephone service has played an integral role in the development of maritime communications. However significant the accomplishment, time and technology have steadily advanced commercial mobile satellite communications. So much, in fact, that demand from seafarers for more sophisticated and cost-effective methods of communications has outpaced the needs for terrestrial radio services. As a result, AT&T will close its three radio coast stations as of February 28, 1999," comments Vince Zuza, Mobile Satellite Service Manager of AT&T.

This SGC direct entry SSB will easily tune in the new telephone channels.

Not only will boaters be off the air with single sideband phone calls to AT&T, but also the thousands of users who use the AT&T station to their SSB equipment SOMEWHERE out there in radio land. Although the high seas ser-



Kenwood marine and ham SSB will tune *all* the new WLO telephone channels.

vice is specifically for boats, there are thousands of users who may be sailing in jungles, mountain peaks, remote deserts, remote campsites in Alaska, remote valleys in Canada, remote villages in Mexico, and just about anywhere else that is not presently served by cellular telephone service. The AT&T operators were only concerned about your signal strength, not the fact that you were necessarily beside the ocean, on the ocean, or under the ocean. As long as you appeared as a registered ship station, that was fine with them.

"To help insure that customers migrate to substitute services in a smooth manner, we are introducing an INMARSAT satellite service for AT&T radiotelephone customers with a special rate of $2.50 per minute," comments Zuza. He is expecting that mariners will chuck their SSB equipment overboard and buy a "discount priced" $5,000.00 INMARSAT marine mini-M terminal through Mackay Communications. I see no mention about the steep monthly service fees for INMARSAT, so for the mariner that doesn't make many phone calls, this might NOT be a viable way to go.

Does this shutdown of AT&T high-frequency service mean the demise of high-frequency single sideband? Absolutely not! Ham operators can run phone calls, called phone patch, through state-side ham stations. And the ham license for General class worldwide operation will be easier than ever to obtain next fall when the code requirements drop from 13 wpm to 5 wpm. The only thing that ham radio cannot do is handle business traffic.

SSB equipment can also contact "private coast stations" that may offer phone patch capabilities to their member stations. There is a fine line here before that private coast station becomes a public coast station, so we'll have to wait and see what happens.

There is also single sideband E-Mail. E-Mail could be run on ham frequencies if the operator was a ham, and may also be run on public coast E-Mail stations if out on the water or roaming in a water region. There is also Sail Mail where a single sideband set can work through private coast stations to access E-Mail services on line. It takes an additional radio modem to go along with the SSB, plus the computer, but nonetheless, E-Mail over high frequency is another good way to get the very last drop of signal out of your SSB radio investment. (Next month, high-frequency SSB E-Mail will be explained.)

GOOD NEWS FROM STATION WLO

AT&T is not the only FCC-licensed, public coast, single sideband radiotelephone station. Down in Mobile, AL, a company called Mobile Marine Radio offers 24-hour-a-day voice single sideband radiotelephone service, and they have a powerful antenna system that can reach out up to 10,000 miles away. They have been licensed to operate on specific ITU channels between 2 MHz to 25 MHz, and this allows 15 channels of half-duplex or full-duplex SSB communications to registered stations anywhere in the world. You could even register a dingy, using temporary FCC call signs made up of the dingy bow state registration number and the letter "K" preceding the two-letter, four-number combination.

The call sign of the high seas radio service is WLO — Whiskey, Lima, Oscar — and their signals come in loud and clear on the following frequencies:

ITU Channel	Receive Frequency	Transmit Frequency
2XX	2672 KHz	2430 KHz
405	4369 KHz	4077 KHz
414	4396 KHz	4104 KHz
419	4411 KHz	4119 KHz
607	6519 KHz	6218 KHz
824	8788 KHz	8264 KHz
829	8803 KHz	8279 KHz

830	8806 KHz	8282 KHz
836	8713 KHz	8113 KHz
1212	13110 KHz	12263 KHz
1225	13149 KHz	12302 KHz
1226	13152 KHz	12305 KHz
1607	17260 KHz	16378 KHz
1641	17362 KHz	16480 KHz
1647	17380 KHz	16498 KHz
2237	22804 KHz	22108 KHz

Both transmit and receive are all operated upper sideband. Equipment as small as the portable SGC-2020 at 20 watts output is capable of reaching this station thousands of miles away. Just be sure to give your receive and transmit frequencies correctly — the received frequency is always higher in kilohertz than the transmit frequency.

If you plan to use their radiotelephone service for both sending phone calls, as well as receiving them from shore, you need to register ahead of time. While you could do it on the radio, it's best NOT to give out a credit card number on transmit. Even though other stations may be listening duplex, you don't want a shortwave listener tuning into the transmit side of your duplex conversation and grabbing your credit card number.

Rates are similar to what AT&T had before they signed off — $4.99 a minute anywhere in the USA with no land line charges. Three-minute minimum. If you can get through on 2 and 4 MHz frequencies, you can save money and make phone calls for $2.99 a minute without land line charges. Pay a buck more and you can place phone calls through WLO to anywhere in the world, and they again pick up the land line charges.

The ICOM SSB (below VHF) will dial in all new telephone channels from ITU memory.

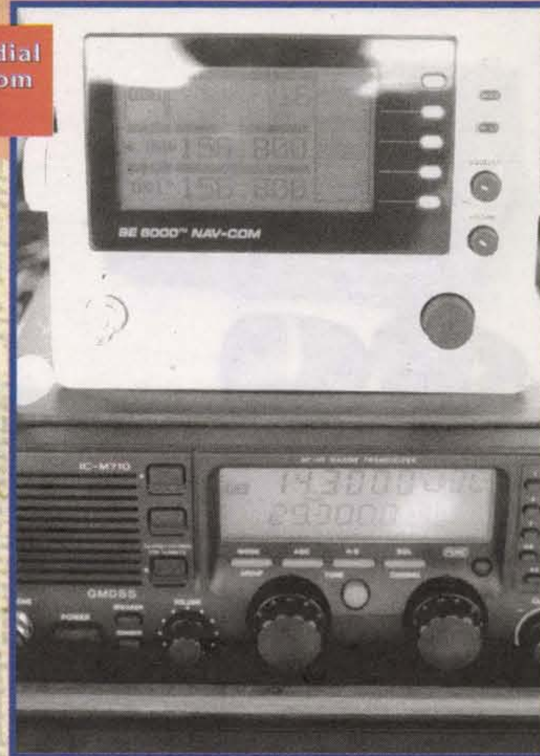
Here's how to register:

TELEPHONE: 334-666-5110
FAX: 334-666-8339
E-MAIL: wloemail-@-aol.com
(-@- in place of ASCII "atsign")
E-MAIL DIRECT: rene@shipcom.com

"Oh yeah, you can hear our signal just about anywhere in the world," comments K.C. Robinson, the lead radio technician at WLO, holding ham call sign KQ4ZL. "We are loud, and we have a very low-noise floor to sniff out weak signals coming in, too," adds Robinson.

"And we are looking for customers," comments Rene Stiegler of WLO. "We are capable of handling the registration of those mariners who may be leaving any other turned-off service," adds Stiegler.

But we will miss the friendly sounds of the AT&T high seas operators. These men and women were there to handle Mayday emergency calls, rescue calls to the Coast Guard Rescue Coordination Center, and just radio checks and "I'm lonely, anyone there?" calls in the middle of the night. We are disappointed that these operators won't be heard on the airwaves anymore — they have done a fabulous job over the years past for AT&T.



So don't throw out your marine SSB yet — and if you're looking for an inexpensive way of making phone calls from an SSB, contact WLO and get registered with no monthly registration charge.

Remember, next month — all about high-frequency SSB E-Mail. **NV**

Looking Inside a Power Splitter

What's inside a TV power splitter?

by Gerald Roylance

Ever wonder what's inside a TV power splitter? Several events made me curious about how they worked and their performance, so I opened some up and made some measurements. Power splitters have an input port S and two output ports, A and B. Ideally, the signal power going into port S splits equally between the coupled ports.

Some important criteria for power splitters are:

- Port Impedance Matching
- Port Isolation
- DC Power Distribution

TV power splitters for 75-ohm cable should look like 75 ohms at each port. Mismatched ports cause reflections and power losses, and that hurts the signal-to-noise performance. Except for weak signal environments, the losses won't mean much (a two-way splitter has an intrinsic 3dB loss already), but the reflections can cause ghosts.

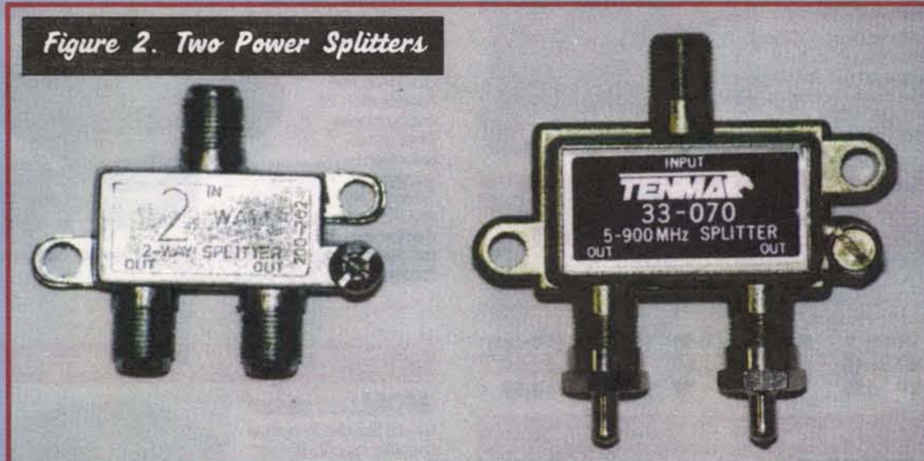


Figure 2. Two Power Splitters

The second criteria — port isolation — helps to keep signals clean even when there are reflections. A signal going into port A of a power splitter should not appear on port B. Port isolation prevents reflections and noise on port A from causing ghosts and interference on port B and vice versa.

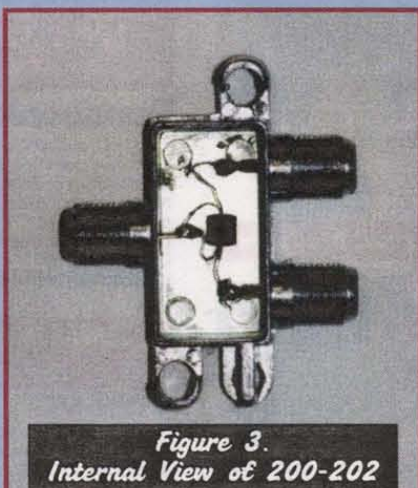


Figure 3. Internal View of 200-202

DC power distribution is important when a power splitter sits between an inline amplifier and its power source. In low signal strength areas, placing an amplifier at the antenna will eliminate feed line losses and improve reception. To simplify installation, these amplifiers often get their power over the coaxial cable from a power insertion module located inside the house. A power splitter that shorts DC to ground prevents power from getting to the amplifier; a splitter that blocks DC cannot be used between the amplifier and the power source. Three of the four splitters I looked at would pass DC.

Power Splitters

In his book *Introduction to Radio Frequency Design*, American Radio Relay League, 1994, Wes Hayward describes the basic power splitter as seen in Figure 1. The circuit — also called a zero degree hybrid — consists of a center-tapped ideal transformer and a balancing resistor. The circuit operation is clever, but its basic operation follows from a few observations.

Ignore the resistor for the moment and focus on how the transformer splits the power to the outputs. The transformer forces the two output currents to be the same ($i_A = i_B$). If the output currents are the same and they both flow into the same output impedance (Z_0), then the output voltages (V_A and V_B) will be the same. Thus, the transformer enforces the basic divider operation by forcing the input current to divide equally between the two output ports.

The transformer is also a voltage divider, so the center-tap voltage is at the midpoint of the two output voltages, $(V_A+V_B)/2$. If the output port impedances are similar, then the output voltages are equal. Consequently, the center-tap voltage also equals the output voltages, and there would be zero volts across the transformer.

The operation of the balancing resistor is subtle. If the output ports are matched, then the output voltages are equal and no current flows through the balancing resistor — it's as if the balancing resistor weren't there. If the output voltages are different, then a current will flow through the resistor. The value of the balancing resistor is chosen so that all of the unbalanced current flows through the resistor and none enters the transformer.

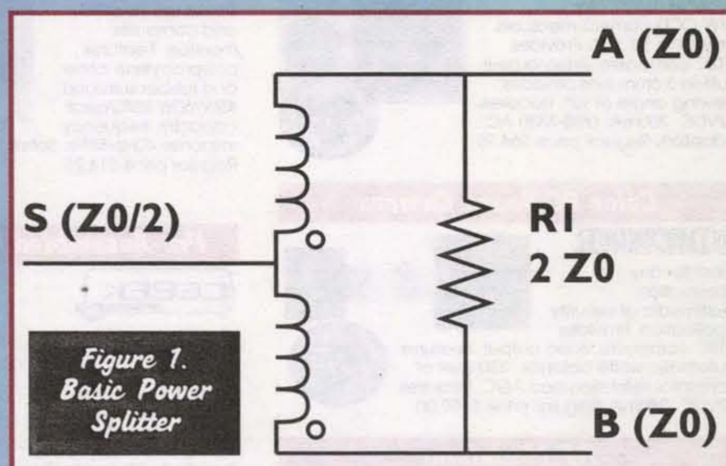


Figure 1. Basic Power Splitter

The basic power splitter has unequal port impedances: $Z_S = 0.5\ Z_A$ because the two output ports are essentially connected in parallel (when the loads are balanced, all the port voltages are the same). To make the impedances match, the splitter needs an impedance matching network. For broadband performance, that network is a 2:1 matching transformer.

The Power Splitters

Four different power splitters were tested. The first two are shown in Figure 2, and their internal parts are shown later. In addition to these two splitters, two other splitters were electrically tested.

Power Splitter Number One

The first power splitter of the group has model number 200-202 molded on its case. Black Point Products distributes the splitter as a BV-017, Two-Way Splitter, but other companies distribute the same part.

Figure 3 reveals the inside of the 200-202 power splitter — only the center-tapped transformer of the basic splitter design. This splitter design omits the matching transformer and the balancing resistor. Consequently, the match at the input port and the isolation should be poor. The design easily passes DC current among all ports because the transformer appears as a wire at DC.

Since the design does not have an impedance transformer, the input impedance will be 75 ohms divided by 2, or 37.5 ohms. The mismatch causes reflections at the input port, and the reflection coefficient is $\rho = (75 - 37.5)/(75 + 37.5) = 1/3$. One ninth (i.e., ρ^2) of the input signal power will be reflected and lost. The input mismatch causes a loss of 0.5 dB.

The missing balancing resistor will not affect the power split if the output ports are matched, but it will affect the isolation.

Power Splitter Number Two

The second power splitter is a Tenma model 33-070, 5-900 MHz splitter. The insides are shown in Figure 5, and its schematic is shown in Figure 6. This splitter has a matching transformer, but does not have a balancing resistor. The matching 4:3 autotransformer has a 16:9 impedance ratio, so the transformer converts the 37.5 ohms of the power splitter section to 67 ohms at the input port. The resulting ρ is 0.06 and the mismatch loss is 0.01 dB.

The matching transformer returns to ground through a 1nF blocking capacitor that prevents a DC short. Consequently, this splitter will pass DC power to all ports. The 2pF shunt capacitor tunes out the lead inductance to make the splitter have a broader bandwidth.

Other Power Splitters

Two other power splitters were electrically tested. Power splitter number three is a Gemini Industries, Inc., model number CV60. This model looks similar to the Tenma splitter. The fourth splitter is a Tru-Spec DSV-2, 5-450MHz, and is a splitter that my cable TV company installed.

Electrical Testing

Clearly, all power splitters are not created equal. Some are missing elements such as matching transformers and balancing resistors. Do these omissions affect performance a lot, or are there some subtler design tricks hidden in their design? Running some electrical tests will verify their performance.

To that end, a return loss bridge (RLB) was made for reflection testing, and some isolation measurements were made.

Return Loss Bridge

Reflection measurements can be made with a return loss bridge (Figure 7). The basic bridge looks like five resistors — four resistors for the bridge and one resistor (Rmeter) across the bridge that represents the

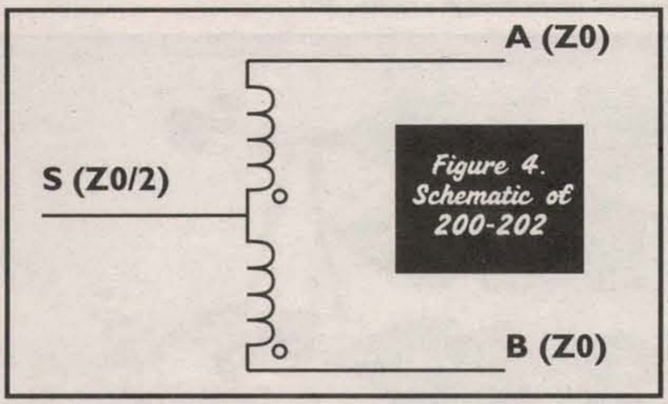


Figure 4. Schematic of 200-202

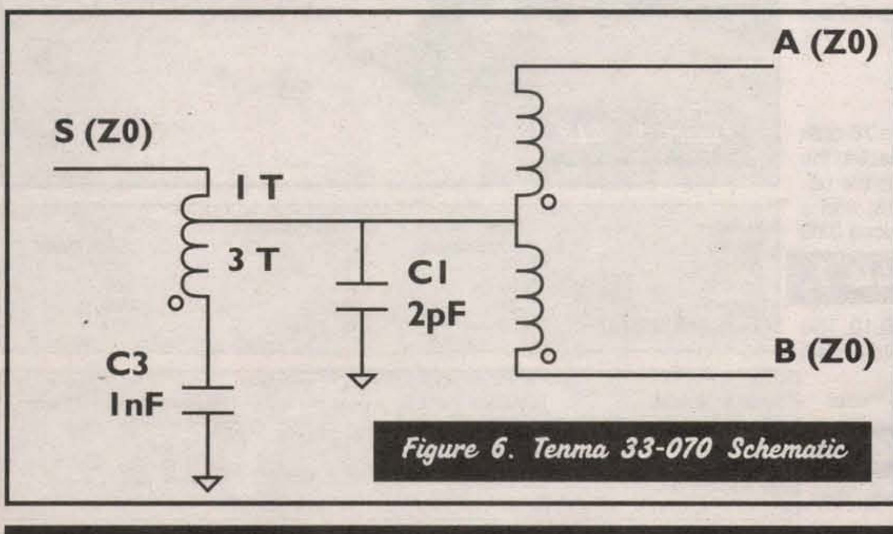


Figure 6. Tenma 33-070 Schematic

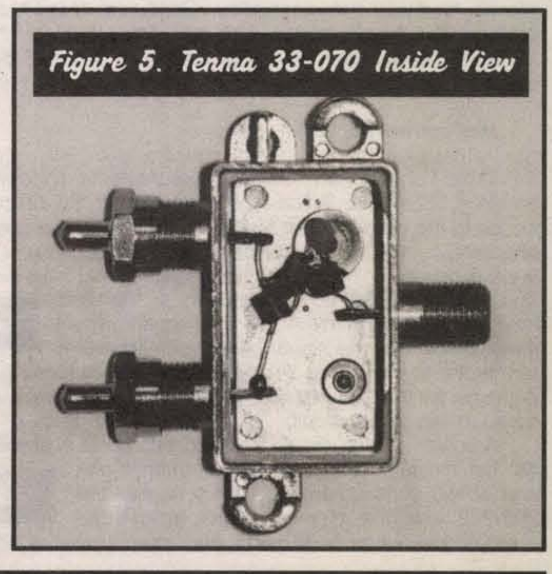


Figure 5. Tenma 33-070 Inside View

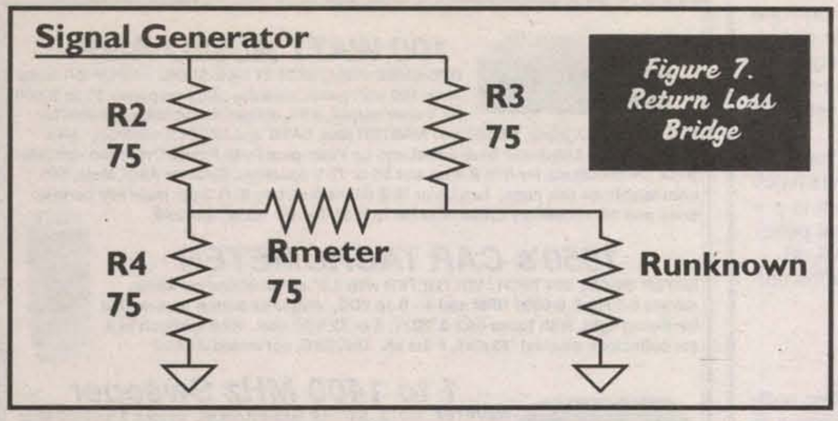


Figure 7. Return Loss Bridge

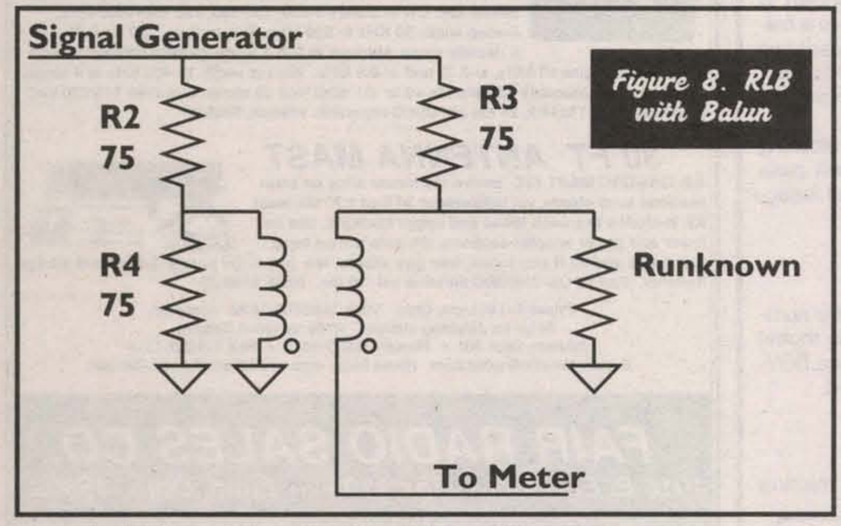


Figure 8. RLB with Balun

measuring instrument. One of the four bridge resistors (Runknown) is the transmission line that we are trying to measure. If the bridge is balanced, then the voltage across the bridge (between V2 and V1) will be zero and the measuring instrument will read zero. Hayward (c.f. page 151) describes how V2 - V1 is proportional to the reflection coefficient $\rho = (1 - y)/(1 + y) = (z - 1)/(z + 1)$.

Unfortunately, the voltage between VA and VB is floating, so it is difficult to measure with a grounded instrument. A balun transformer (see Figure 8) converts the balanced bridge voltage to an unbalanced signal that drives a terminated detector (I used my oscilloscope). The actual bridge is shown in Figure 9.

When making measurements, all ports and lines must be properly terminated. Most of my test equipment is 50 ohm, so I used some 75-ohm to 50-ohm min-loss attenuators in some crucial places, so my 50-ohm generator, cables, and scope would not compromise the measurement. The min-loss attenuator has a series 43.3-ohm resistor on the 75-ohm side and a shunt 86.6-ohm resistor on the 50-ohm side.

Reflection Testing

Table 1 shows the reflection measurements made with a 75-ohm bridge at 138.6 MHz. A two-foot length of foam RG-59 connected the bridge to the device under test. An open circuit was used as the reference ($\rho = 1.0$). A 75-ohm terminator produced $\rho = 0.18$, and a short produced $\rho = 0.89$. The terminator should have produced 0.00 and the short 1.00, so the numbers in the table have some uncertainty. A $\rho = 0.18$ means about three percent of the signal power is reflected. A terminator at the bridge (no RG-59 cable) produced $\rho = 0.10$. The numbers for the 200-202 and the Tenma are what we would expect from looking at the circuit.

A power splitter should be used with ports A and B terminated, but the table includes measurements with one or two ports unterminated. Notice that the 200-202 and the Gemini reflect almost the entire signal when both ports are unterminated. Curiously, the Tenma splitter reflection coefficient is not close to one when A and B are open — apparently the splitter consumes about 1/3 of the incident signal power.

Transmission/Isolation Testing

The isolation between ports A and B is tested by injecting a signal into port A while looking at port B. Port S is terminated in 75 ohms. The 200-202 splitter should have poor isolation because its S port is mismatched (remember it is 37.5 ohms). Here is how the S port mismatch hurts isolation. The test signal from port A travels to the S port, where some of it is reflected by the 37.5- to 75-ohm mismatch. The reflected portion travels back through the power splitter, where it divides equally between the A and B ports. Good input match is required for good isolation.

Although the Tenma splitter should have poor isolation because it does not have a balancing resistor, its isolation figure is reasonable. The transmission numbers agree with the reflection coefficients above: Those units with high reflection coefficients show more transmission loss (see Table 2).

Summary

Sadly, some power splitters have mismatched ports. TV splitters do not cost much, so some manufacturers have omitted the matching transformer and/or balancing resistor.

Although the Tenma and the Gemini splitters look almost identical on the outside, the Gemini's poor reflection coefficient suggests the inside is closer to the 200-202. Curiosity got the better of me just now, and my can opener reveals the Gemini is the same design as the 200-202. Maybe the Tru-Spec has all the right components, but it is not mine, so the can opener goes back to the kitchen.

All but the Tru-Spec splitter pass DC power among the three ports. The three Tru-Spec ports are DC shorts to ground, so the design is probably similar to the Tenma splitter without the 1nF DC blocking capacitor. Get out your ohmmeter before you apply power through a splitter. **NV**

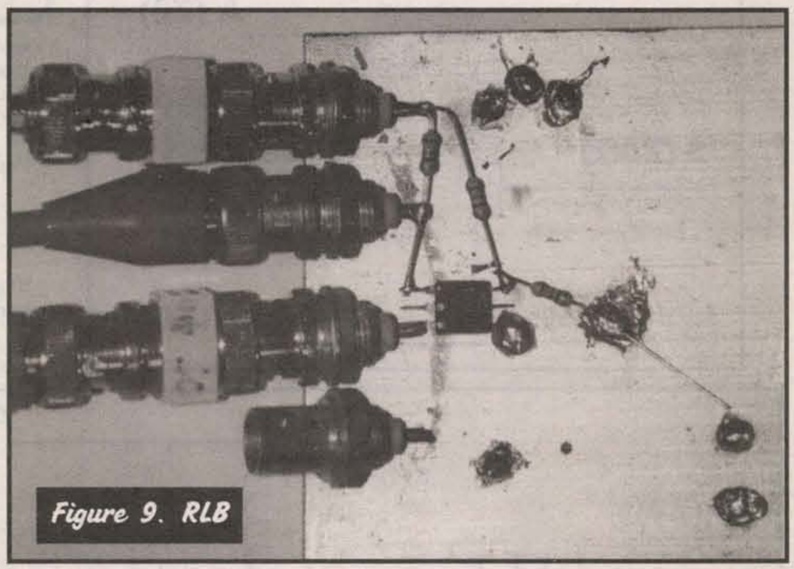


Figure 9. RLB

Table 1

Splitter Model	A&B Terminated	A Terminated, B Open	A&B Open
200-202	.34	.25	.95
Tenma	.13	.36	.80
Gemini	.32	.48	.98
Tru-Spec DSV-2	.15	.55	.90

Table 2

Splitter Model	Isolation port A -> port B	Transmission — Term
200-202	.17 = 15dB	.68 = -3.4dB
Tenma	.05 = 26dB	.69 = -3.2dB
Gemini	.08 = 22dB	.65 = -3.7dB
Tru-Spec DSV-2	.03 = 30dB	.70 = -3.1dB

reader FeedBack

Dear Nuts & Volts:

I am a long-time subscriber having paid $25.00 for a lifetime subscription when *Nuts and Volts* was an infant. I saw what I thought was a good opportunity to get a good subscription to a good magazine, and I have never been disappointed with your magazine.

Nuts and Volts has really grown, not just in size, but in quality as well, and rates tops with me!

I have been a ham and experimenter since 1950 and you are "right down my alley."

Jim Waits
Bruce, FL

Dear Nuts & Volts:

I have the following comments regarding question #11986 which was posted in your Nov. '98 issue of *Nuts & Volts* magazine, and its corresponding answer which was posted in your Dec. '98 issue.

I also have a RadioShack multi-meter — a Micronta 22-168 — and encountered the same serial communication problems that Grant Fair had with his meter, when I wrote a Windows95/DOS application in Basic to read the meter from my Compaq Pentium laptop.

I wanted to be able to automatically sort various resistors and capacitors that I had obtained at the surplus stores by using the application to read the meter and find the closest standard value to the actual reading.

I read the response given to Grant's question by Roger Omori, in your Dec. '98 issue and tried some of his suggestions which were very helpful in getting my application running.

First, I tried the various serial protocol changes suggested by Roger, using the Procom communications package, but I could not get a reading from the meter.

Next, I coded versions of the example in GW-Basic, Stamp BS2 BASIC, and Borland C++ and could not get any of them to work.

Finally in desperation, I found the number for the RadioShack customer support on the web and contacted them. Their response was to let me know that the Basic program listed in their manual was just an "example" and as such they could not provide me with any information or support. This included questions I asked them regarding what kind of Basic was used for developing the example, and who the actual meter manufacturer was, so that I could contact them for information.

I tried once more to code the example, this time with Quick Basic, making sure that there were no other Windows 95 applications using the COM1 serial port.

I also checked the serial device driver for COM1 using the Windows 95 control icon under the settings menu, and double-checked all cables.

I specified the serial communications protocol using the following Quick Basic statement:
OPEN
"com1:1200,n,7,2,rs,cs,ds,cd"
FOR RANDOM AS #2 (see attached
listing for more details).

When I turned on the meter, to my surprise, I was able at last to obtain the resistance readings.

To this day, I still don't know why the application did not work. The root cause of the problem could have been due to the fact that the meter may be using hardware handshaking, because the serial cable provided for the meter has five pins instead of the customary three pins used for most serial RS-232 communications. This would certainly explain why the communications software did not work, if it was not setup to use handshaking.

Unfortunately, the manual does not describe the handshaking protocol used. If any of your readers have more information on this subject, I would appreciate hearing from them.

Daniel F. Ramirez
Amherst, NH

Dear Nuts & Volts:

Congratulations on 20 years! Great stuff for newbies and old timers in every issue.

John Capron
Newark, CA

Dear Nuts & Volts:

Mr. Roylance delivered a great article. I was gratified to read history that escaped me in 50 years of electronics!

Jon

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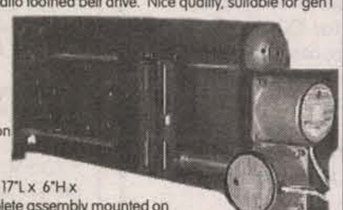

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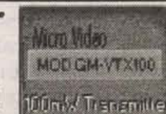

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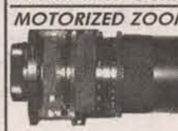

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by Joseph J. Carr

Lightning Observing

Lightning is a familiar and often feared natural phenomenon. Although lightning is seen in all areas of the country, southern Arizona and central Florida are areas of extremely high flash density (i.e., the number of cloud-to-ground strikes per square mile per year). When lightning strikes, property can be damaged, fires started, trees can be split in two (or, oddly, the bark can come off leaving the tree core intact), and, sadly, sometimes people are killed. It's not surprising that the electrical power industry is a leader in lightning research because of the damage done to their power lines by lightning.

Human casualties are common. The daughter of a former governor of Virginia was struck at the National Guard Camp at Pendleton (Virginia) beach in southeast Virginia. Florida saw 298 confirmed lightning deaths in the 30-year period 1959 to 1989. Between 1940 and 1989, there were 8,103 confirmed lightning deaths in the United States (SIRS 1990, Earth Science, Article 67). According to the National Oceanic and Atmospheric Administration (NOAA), lightning killed 88 people in 1995.

About 30 percent of the people struck each year are killed. I would have guessed that nearly all of them would have been killed, with only a few survivors. But the statistics apparently suggest otherwise. Those people who are killed usually succumb to cardiac arrest. The survivors frequently suffer serious heart problems thereafter, and most have to be treated for severe burns. One source claimed that there are cases on record where lightning did not even break the skin, but traveled the wet surface of their body to ground. The skin was said to be severely burned, after the manner of scalding.

It is estimated that the earth is struck by lightning 20 million times per year. And if you believe the old myth about "lightning never strikes the same place twice," then consider the fact that the Empire State Building in New York City takes about 12 strikes per year. Radio and television antenna towers are also struck frequently, although I hasten to add that they do not "attract" lightning that would not have come anyway (they tend to act as lightning rods).

The lightning is generated under up to 15,000,000 volts of electrical potential. According to one source, there is normally an atmospheric potential cloud-to-ground of 200,000 to 500,000 volts, and a constant but miniscule current of 10^{-12} amperes. The temperature inside the lightning bolt is 15,000 to 60,000 degrees Centigrade, which is several times the temperature on the sun. The lightning bolt travels at speeds up to 100,000,000 feet per second. A lightning bolt is actually a series of strokes, averaging about four. Durations vary from a few nanoseconds upward, but about 30 microseconds (30 µS) is said to be average. The average peak power per stroke is 10^{12} watts.

Many people struck by lightning were in unsafe situations. For example, on an open beach or in an open field such as a golf course. It is also not smart to be in a boat on the water. Standing next to a tree or other tall object (e.g., radio tower) is also rather dangerous, as the lightning may easily be attracted to that tree. In one case, a group of golfers in Massachusetts were struck when lightning struck a nearby tree, then traveled underground to a covered pavilion where they had taken refuge from the storm. Carrying an umbrella with a metal tip above the canopy has caused lightning injuries, presumably because it looks to the lightning like a lightning rod ... and you look like a ground wire!

As a general (but not absolute) rule, as long as you can hear thunder, the danger of strike is small. Lightning travels at the speed of light (3×10^8 meters/second), while sound travels at 331.3 meters per second at 0°C (sound velocity changes a bit with air temperature), or 1,087 feet per second. As a result, the flash of light arrives instantaneously, while the sound of thunder arrives a short time later (measured in seconds).

A "rule of thumb" is to count the seconds between the flash and thunder clap, and then divide by five, to find the number of miles to the lightning bolt. One reason why I doubt validity of the "can hear thunder" advice is that I've been under thunderstorms where the lightning flash and thunder were very nearly simultaneous, indicating it was right overhead.

More precise measurements of distance can be done using a good stopwatch to measure the time of arrival of the thunderclap. From that data, you can calculate the distance from D = VT, where D is the distance and V is the velocity (if you use m/s for T, then D is in meters, but if ft/s is used, T is in feet). You can further refine your measurements by consulting a table of sound velocity related to temperature and atmospheric pressures.

Some Lightning Detection History

Before we talk about early lightning research, let me hasten to add a caution: **DON'T EVEN THINK ABOUT DOING THESE EXPERIMENTS YOURSELF!** People who've tried to duplicate these experiments *have been killed* in the attempt.

Electrical phenomenon was researched starting in the early eighteenth century. It was noticed that certain substances, when rubbed, produced static electricity arcs. It was also found that a type of capacitor called a Leyden Jar could store an electrical charge. It was believed — correctly, of course — that these sparks looked enough like lightning to suggest a connection.

In May 1752, Thomas Francois D'Alibard in France performed an experiment that Benjamin Franklin had failed at the year before. The experimenter stood on an electrical stand, holding an iron rod in one hand. The idea was to produce an electrical arc between that rod and another rod in the other hand connected to a grounded iron wire. In an attempt to repeat the experiment in July 1753, Swedish physicist G.W. Richmann, working in Russia, was killed by the lightning.

Benjamin Franklin conducted his famous kite experiment in 1752. He used a rain-damped kite string connected to a key at the bottom. The lightning traveled down the string, and jumped from the key to a dry silk ribbon tied to Franklin's knuckles, and then through his grounded body. Others who attempted this experiment were killed. It's interesting to wonder what the American republic would look like if Franklin, having been killed in 1752, was not alive to provide wisdom to the Constitutional Convention (his compromise suggestion, which reconciled the "large states vs. small states" controversy, is supposedly how we got the bicameral Congress).

When photography and spectroscopy were invented in the nineteenth century, additional facts were learned about lightning. Time-resolved photography was used to count the number of strokes per lightning strike. Current measurements were made by Pockels in Germany during 1897-1900. He analyzed the magnetic fields induced by the lightning currents to estimate the current level from basic electrical fundamentals. C.T.R. Wilson (ca. 1920s), who also invented the cloud chamber, used electric field measurements to study lightning. Wilson hypothesized that the electrical fields cause such great ionization, that it's

Most Common Activities Leading to Lightning Strikes on Humans

(derived from NASA web site http://www.thunder.msfc.nasa.gov/primer.html)

1. Working, playing, or walking in open fields.
2. Boating, fishing, swimming.
3. Working on heavy farm or road construction equipment.
4. Playing golf (!!!).
5. Talking on the telephone.
6. Using electrical appliances.

possible for discharges to occur between the clouds and the upper atmosphere. Seeming confirmation of the 1925 theory was provided on April 28, 1990 when Shuttle mission STS-32 videotaped a single luminous discharge in the stratosphere.

Modern lightning research still measures electrical and magnetic fields, but adds other techniques to their armamentarium. Cameras with electrically-triggered shutters can be used with photosensors to make photographs of lightning strikes. High-speed movie cameras are also used, although the invention of charge coupled device (CCD) sensors (which are used in video cameras) has allowed a number of new instruments to emerge.

Other researchers rely on radiowaves, especially the whistlers, spherics, and broadband RF noise generated in the ELF/VLF/LF portions of the radio spectrum. This type of research is also easily conducted by amateur scientists.

At a site in Florida, researchers fire three-foot high solid fuel rockets into thunderclouds. The rocket trails a grounded wire that conducts the stroke to earth (**AMATEUR ROCKETEERS: DON'T DO THIS!**). The Space Shuttle and satellites are also being used for lightning research. Some hauntingly beautiful video clips of space shuttle lightning are available from NASA web sites. High altitude aircraft lightning research revealed newly discovered phenomenon called sprites and jets.

Types of Lightning

Cloud-to-ground lightning passes from a cloud overhead to the earth beneath. Most cloud-to-ground strikes occur in the higher latitudes, although recent research indicates a more important variable is cloud top height. Cloud-to-ground ligthning is what causes injury and damages. Cloud-to-cloud or "inter-cloud" lightning passes from one cloud to another. Intra-cloud lightning appears within a single cloud. The "jagged" lightning that we see so often is called chain lightning, while sheet lightning is a generalized bright flash.

Other types of lightning may or may not be little more than myths, poor observations (e.g., optical illusions), variations on other types, or real, depending on who you consult. These include ball lightning, tubular lightning, bead lightning, silent lightning, cloud-to-air lightning (as opposed to cloud-to-cloud), and heat lightning.

Storm Scope

Lightning research can be terribly dangerous, especially if it puts you out in the open or if you are foolish enough to mimic professional methods such as ground wire tethered rockets. There are, however, some instruments that are easily built and relatively safe to use. The storm scope is one such instrument.

Figure 1 shows the basic configuration. This project was originally published by Thomas P. Leary in the June 1964 *QST* magazine (although his implementation used vacuum tube amplifiers). The storm scope consists of a pair of orthogonal small loop antennas; one oriented North-South (N-S loop) and the other East-West (E-W loop). Keep in mind that a small loop antenna (e.g., < 0.18λ wire length) shows a figure-8 pattern with nulls broadside to the loop plane, and maxima off the ends. Align the ends of the loop (maximum sensitivity direction) in E-W and N-S directions. A compass will make the accuracy better.

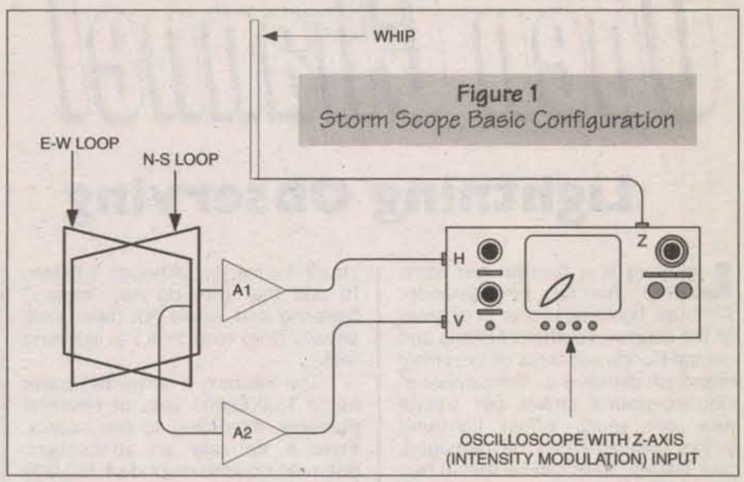


Figure 1
Storm Scope Basic Configuration

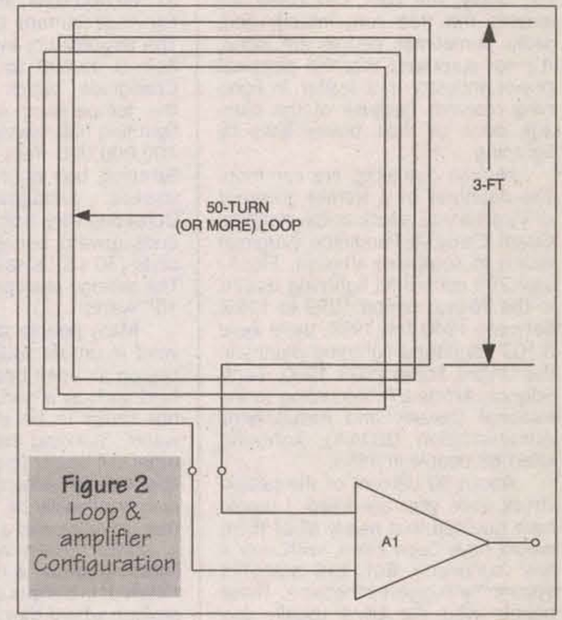


Figure 2
Loop & amplifier Configuration

The loops are fed through differential amplifiers, with gains in the 20 to 80 dB range, to the vertical and horizontal plates of the oscilloscope. The reason for the wide gain scale is that oscilloscopes vary. The original project connected the amplifier outputs directly to the oscilloscope deflection plates. Modern two-channel oscilloscopes can be used in the X-Y to form a vectorscope, of which the storm scope is a variation on the theme.

Although any two-channel 'scope with an X-Y mode is usable, a directional ambiguity exists unless the 'scope also has a Z-axis (a.k.a., intensity modulation) input. This input is often present, but hidden on the rear panel of the 'scope. The Z-axis is used to intensity-modulate the screen with a signal from a sense whip or vertical antenna near the two-X loop. It may be necessary to amplify the Z-axis input signal, but in that case a single-ended rather than differential amplifier is used.

Figure 2 shows the loop and amplifier configuration. The loop consists of at least 50 turns (50-t.) of small gauge insulated wire in a three-foot (3-ft.) loop. Either square or circular loops can be used, although it appears to me that the square is more easily constructed. The loop is untuned. The output of the loop is applied to the input terminals of the differential or push-pull amplifier.

It is critical to shield the loops. Wrap either copper foil or aluminum foil (or tape) over the entire loop, except for a small quarter inch or so gap along the top edge (this prevents the shield from acting like a single-turn shorted loop itself). The shielded loop will be less prone to pattern distortions from capacitive coupling. In addition, it responds largely to the magnetic component of the lightning electromagnetic field. It is less sensitive to electrical fields, so will not pick up as much locally-generated

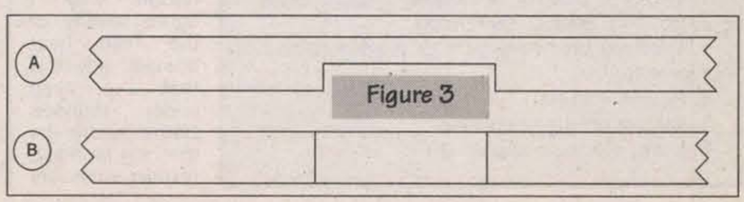


Figure 3

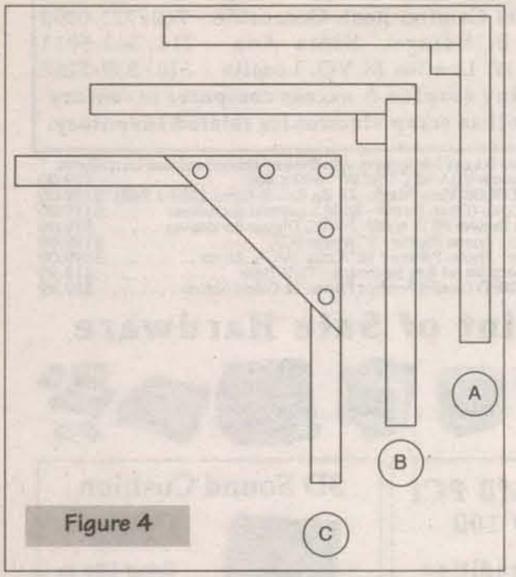


Figure 4

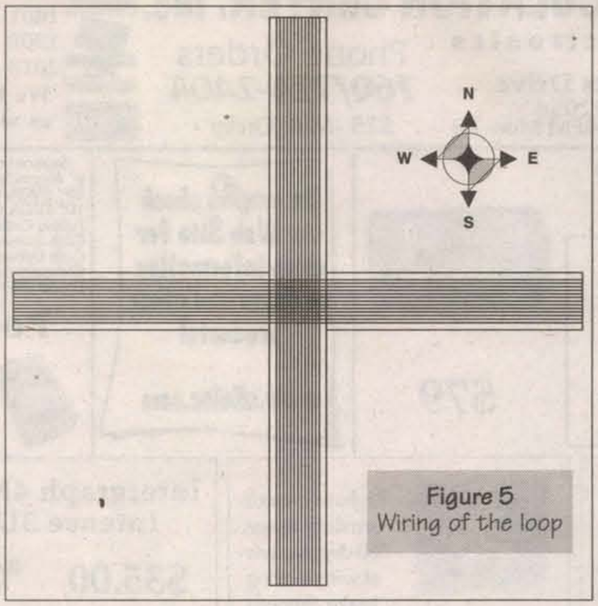


Figure 5
Wiring of the loop

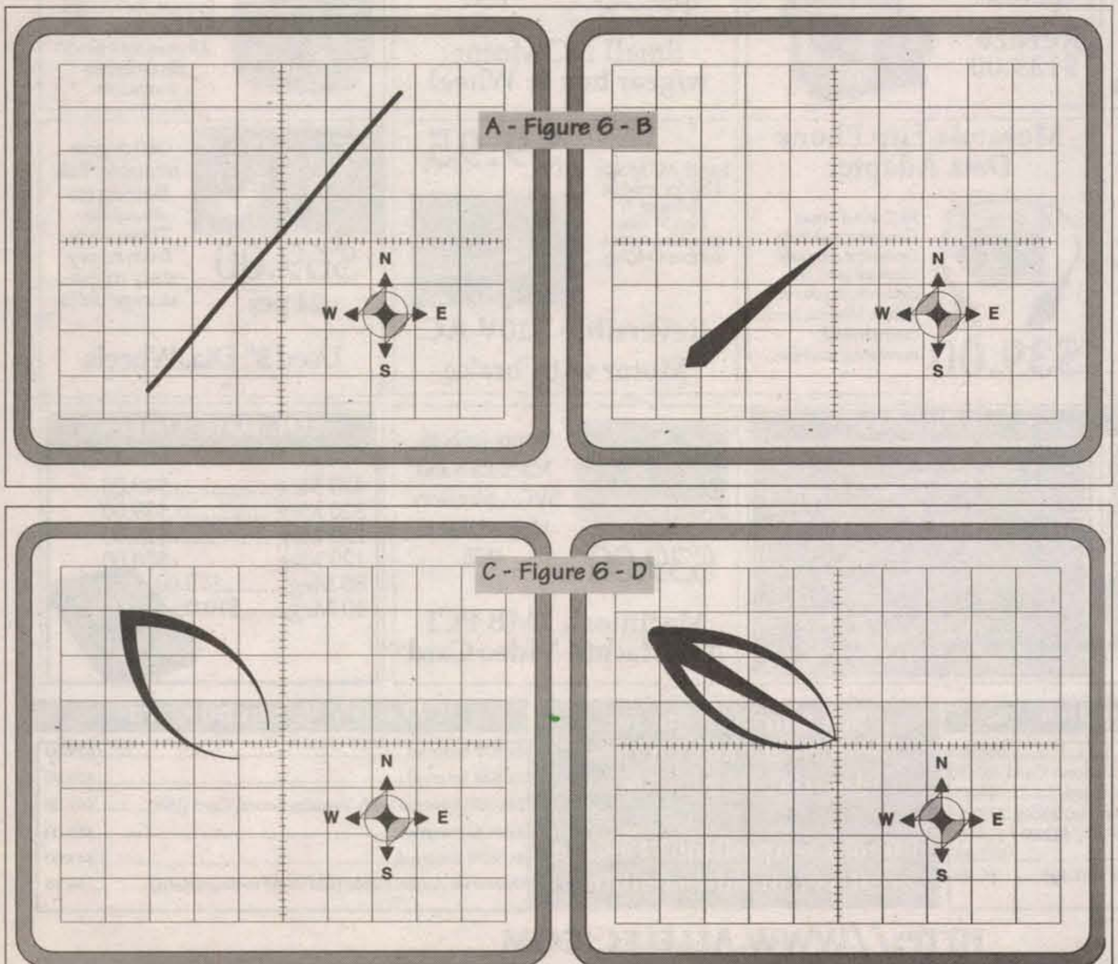
power line and appliance noise.

I constructed a loop pair using 0.75" x 4" x 36" lumber. Although my own woodworking skills leave something to be desired (polite for "atrocious"), others are able to make a better job of the method shown in Figure 3. A notch (Figure 3A) is cut at the center of the top and bottom members of each loop. The depth of the notch is the thickness of the lumber, while the width is sufficient to snug-fit the other piece of wood in it (Figure 3B).

The square loop will tend to "trapazoid" out of shape if left to its own devices. As a result, some or all of the methods of Figure 4 are used at the four corners of each loop. In Figure 4A, the wood elements are butted together, glued, and nailed (or screw fastened). A small block, about 0.5 inch square and as wide as the loop arm, is glued in the corner to give strength. In Figure 4B, the same method is used, but the joint between the wood members is a bit different. I am told this method is stronger, even though it is more difficult. Finally, a triangular gusset plate cut from a thin sheet of plywood or spruce modeling lumber is shown in Figure 4C.

Figure 5 shows the wiring of the loop. I used 50 conductor ribbon cable, although one continuous loop of #26 (or so) enameled wire could be used as well (it takes more than 600 feet of wire per loop for this approach!). You can also use 60 or 64 conductor cable. The sensitivity of the loop is improved with more turns or a larger length per side. You can, for example, build a four-foot or five-foot loop, or use multiple runs of 50 conductor ribbon cable. In one case, a whistler/spheric hunter used 126 conductors made from intercom cable.

If you opt for the simpler ribbon cable method, then cross connect adjacent turns so that one continuous loop is formed. This is a tedious chore, but it's made a lot easier if you use printed circuit perf-board (or some of the project boards from RadioShack) to make the connections. It is okay to lay the N-S and E-W loops over one another because their orthogonal geometry makes them minimally interactive.



Results to Expect

The original article claimed detection to distances of 500 miles, but I doubt that figure is practical. I would more likely guess tens of miles, or 100 miles, but further experimentation is needed to confirm the longer distance claim. Figure 6 shows typical patterns. These patterns are representations of what is observed, but are a bit more distinct and less ragged than actual 'scope photos (I am no longer able to photograph 'scope screens ... until I find a new hand-held Polaroid 'scope camera). I was able to create the patterns in Figures 6A and 6B, but those of Figures 6C and 6D are cribbed from the Leary article cited earlier.

The pattern in Figure 6A is what to expect when there is no Z-axis input to receive the vertical sense antenna signal. It shows the line of the storm, but has the directional ambiguity found on loop antennas. In other words, the storm could be in either direction from the loop. Figure 6B shows the pattern to expect when the sense antenna is used, and the Z-axis intensity is correctly adjusted. This is essentially the same concept as a sense antenna producing a cardioid pattern on a radio direction finding (RDF) antenna. The actual pattern will be a lot more ragged than shown here.

Leary claims that patterns like Figure 6C are produced with horizontally polarized cloud-to-cloud discharges (the others were essentially groundwave signals). The pattern in Figure 6D represents what might be seen when a groundwave and cloud-to-cloud pattern co-exist. I was not able to confirm these patterns, but that might be the particular thunderstorm I observed several years ago when I was active in building loops while researching a forthcoming book (Joe Carr's *Loop Antenna Handbook*, Universal Radio Research, Reynoldsburg, OH). **NV**

Connections ...

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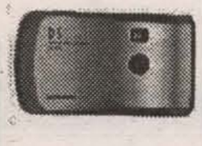

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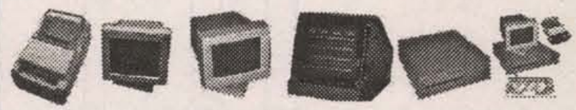

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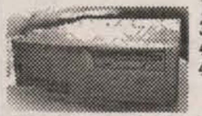

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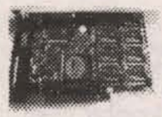

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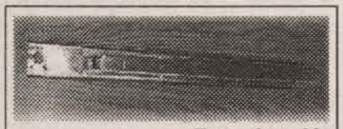

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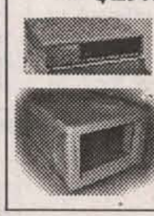

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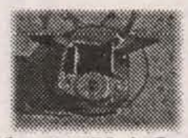

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Automotive Navigation

Where It's At and Where It's Going

by Jeff Stefan

This article explains the inner workings of automotive navigation systems.

Help! I'm Lost!

Being lost is frustrating. It happens to most of us; lost in the country, driving for miles through endless grids of farmland, or lost in an unfamiliar big city, wandering through deserted, and possibly dangerous, city blocks. All the time being low on gas. Being lost may soon become an unpleasant memory with the emerging availability of automotive navigation systems.

Automotive navigation systems require sophisticated hardware and software and are somewhat expensive, but I believe they'll be as common as air conditioning in the vehicles of the near future. This article examines and explains the major software components of a typical automotive navigation system.

Navigation System Components

There are six major components in a automotive navigation system. These components include a vehicle positioning module, a map matching module, a digital map database, a dynamic route guidance module, a static route planning module, and a user interface. These components are listed in more detail in Figure 1.

Automotive navigation systems do a lot of work when they're running. Global Positioning System (GPS) receivers intercept and condition GPS satellite signals, A/D converters digitize analog signals from gyroscopes or accelerometers, and buffers hold direct digital speed pulse data. On-board digital map databases and route guidance software prompt the driver to stay on course, and route planning engines calculate a route from a vehicle's starting position to a destination address. Figure 2 illustrates the basic software components and their interaction in a typical system.

Vehicle Positioning

Data comes in from various vehicle motion sensors to a Vehicle Positioning module. Within the Vehicle Positioning module, software reads the conditioned signals, keeps track of time, and performs a form a navigation called dead reckoning. The output of the Vehicle Positioning module is the current position of the vehicle, along with the rate of speed and heading. In the simplest case, dead reckoning can be accomplished with a watch, a compass, and a known speed. Time, speed, and direction are recorded at periodic intervals. With a known speed, direction, and starting point, it's easy to determine the distance traveled and make a crude correlation to a set of map coordinates.

There are several common vehicle speed and direction sensors used for position calculation. The most common of these are gyroscopes, wheel speed sensors, odometer pulse indicators, and GPS receivers. Gyroscopes, or turn rate sensors, are classed as inertial sensors, as are accelerometers. A quartz resonance gyro outputs a tiny voltage proportional to its input axis rotation. If a vehicle is making a sharp, fast turn, then the output is higher than when the vehicle is making a slow, widely arcing turn. Gyroscopes are great for dead reckoning, but have a few flaws.

The major problem with inexpensive quartz resonance gyros is temperature sensitivity. The output varies fairly dramatically with temperature. This drift translates directly into positioning error produced by the vehicle positioning module, since the gyro is used primarily to determine vehicle direction. The gyro output, to be accurate, needs to be frequently calibrated. GPS data is used for correcting the accumulated dead reckoning error.

Just knowing when and how fast a vehicle is turning isn't enough to determine position. The vehicle positioning module needs to know the distance traveled over a period of time. That's where wheel pulse sensors and odometer pulses come in. Wheel pulses come from one or two wheels, and are usually the output of Hall-Effect switches. The incoming pulse rate is proportional to wheel speed, which is proportional to vehicle speed.

Wheel pulses can even be used to detect turns. If the vehicle is making a left turn, then a right wheel travels a greater distance than a left wheel. Wheel pulses vary with tire pressure and slippage which, in turn, create positioning errors. Odometer pulses generally come from an existing in-vehicle computer. There are typically a fixed number of pulses per mile or kilometer, so the distance traveled is simply a matter of counting pulses. Error is still accumulated with slippage, but not as severely as with wheel pulses.

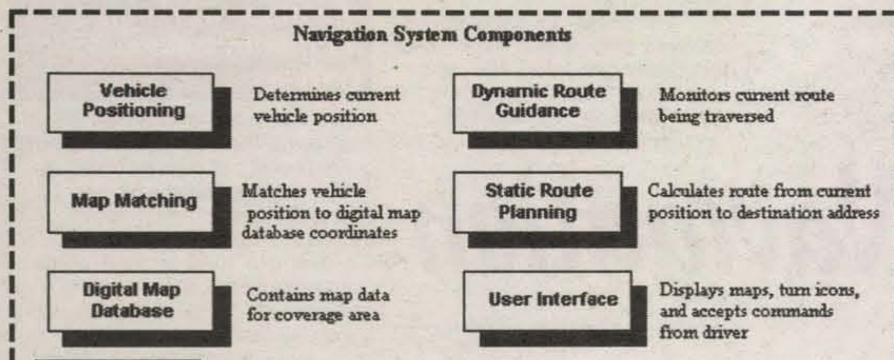

Figure 1

GPS has opened the door to highly accurate vehicle positioning systems, but GPS all by itself isn't really reliable for accurate, full time turn-by-turn navigation. There are two levels of positioning accuracy built into GPS, called SPS and PPS.

SPS stands for Standard Positioning Service and PPS stands for Precise Positioning Service. PPS is used primarily by the military, where SPS is used for civilian applications. Originally, SPS turned out to be very close to the positional accuracy of PPS, so to widen the performance gap, SA, or Selective Availability, was introduced. SA intentionally degrades the GPS positioning accuracy to 100 meters horizontally and 160 meters vertically. This means that in a vehicle, there is an inherent 300 foot error in any GPS positional reading, and that makes map matching a lot tougher.

GPS signals are also often blocked by trees and foliage. In a city with tall buildings, GPS may be blocked, or the signals may bounce around the buildings then enter the receiver, giving erroneous position readings. This is called multipath error. As it stands now, for robust and consistent navigation, GPS is used as a calibration source for dead reckoning and is not the central source of vehicle position information.

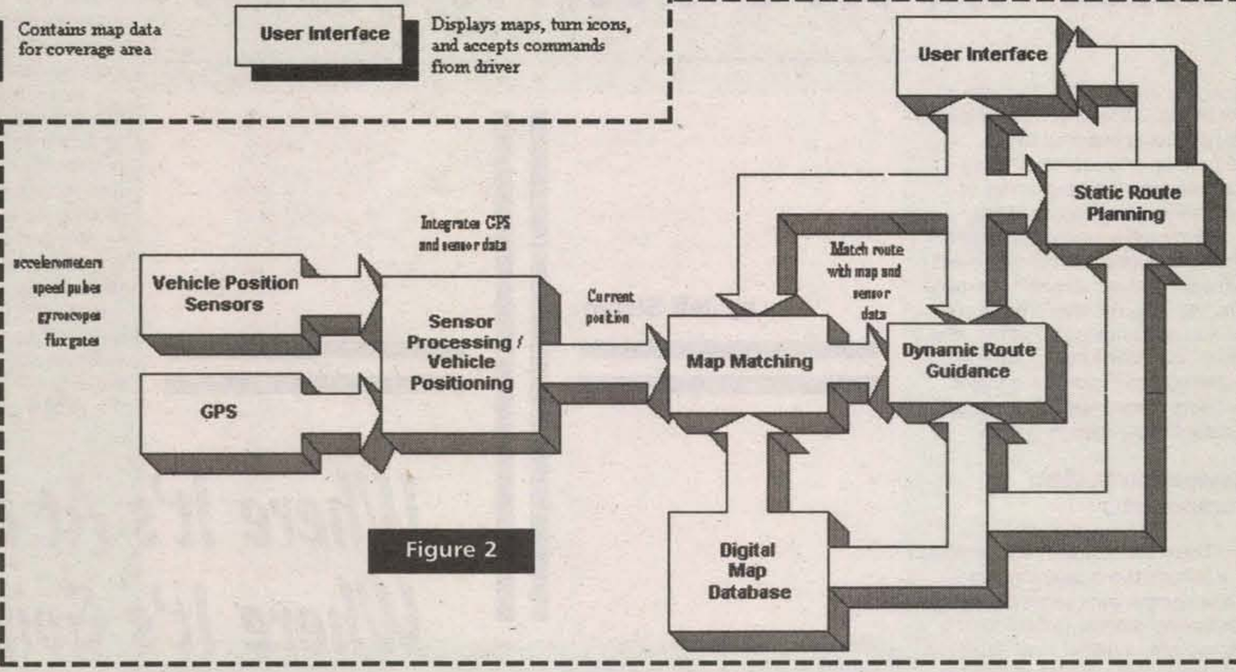

Figure 2

Map Matching

The next major component is the map matching module. Map matching consists of matching the position received by the positioning module to a road segment position from a digitized map database. The digitized map database contains road segment information, such as the latitude and longitude, the type of road, the shape of the road segment, and speed and direction attributes. An automotive navigation system is essentially worthless without a good digital map database.

Map matching itself is a form of positioning. If the positioning module reports a position that is reasonably close to a road segment, then the position is corrected to the digital map position, and not to the position reported by the positioning module.

There are four "truths" regarding position, and only one of them is really true. The vehicle speed and direction sensors report one positional truth, GPS reports another, and the map matching module reports yet another. All of them are inaccurate to a certain degree with respect to where the vehicle is at any given moment, which is the real positional truth.

Route Guidance

The next module is Route Guidance. Route Guidance monitors the vehicle and map matched position and determines if the vehicle is correctly traversing a pre-planned route. It does this by checking whether the current road segment being traversed matches the current segment in the pre-calculated route. Figure 3 illustrates the output of a typical automotive navigation system map display. The triangle icon indicates the vehicle.

The actual reported position may not be exactly on the current road segment of Normandy Road, but it is close enough to snap the vehicle icon onto the road display. It's annoying to a driver to see the icon travel along a route next to the road, but not on the road. Many navigation systems allow the driver to manually adjust the icon.

The Route Guidance module's main responsibility is to present upcoming maneuver data to the User Interface. The next maneuver — such as a right turn or left turn — is presented to the User Interface at a threshold distance from the maneuver. If the maneuver is missed, then at another threshold distance, an error is announced. The driver then has the option of canceling the route, or calculating a new route from the vehicle's current position.

Route Planning

The Route Planning module is responsible for generating a list of road segments to traverse from the vehicle's current position to a destination. The driver enters a destination address using optional criteria, such as least use of freeways, shortest distance, or shortest time, among others. The Route Planning software links together the road segments into a list based on the driver's preferences and makes this list available to the Route Guidance module.

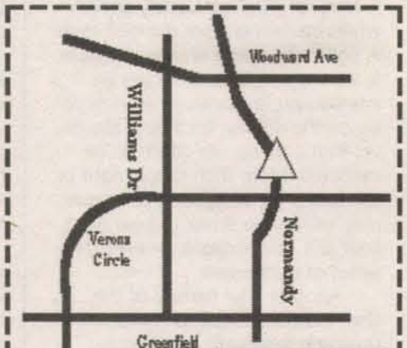

Figure 3

Route planning, which is essentially a search problem, has its roots in classical computer science and artificial intelligence. Roads and intersections can easily be modeled as graphs, which are commonly used in computer science.

Graph theory is used to illustrate and solve many computer science related problems, from network development to operating system deadlock detection. A typical graph is shown in Figure 4. The nodes, or circles, are called vertices, and the lines that connect them are called edges. The words node and vertice are used interchangeably.

A method called Dijkstra's Algorithm systematically determines the least-cost path in any graph, given a source and destination node. It can reliably calculate the least-cost path from any node to any other node. It's not a giant leap to translate vertices to intersections and edges to roads.

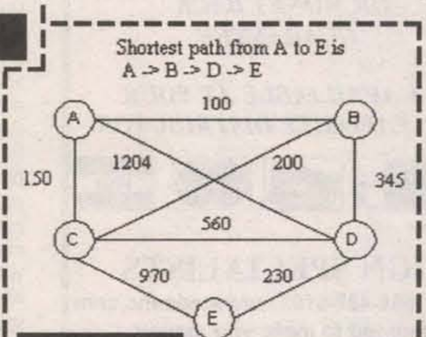

Figure 4

Note that in Figure 4, the least-cost path from vertice A to vertice E is through the path A to B to D to E, and not from A to C to E. Geometry has nothing to do with it; everything is dependent on the cost value, or weight, assigned to the edges. In a road network, the cost value can be based on speed limit, type of road, or some other criteria that would affect traveling down the road.

Figure 5

Dijkstra's Algorithm blindly and systematically searches for the least-cost path from any source node to any destination node. What if the search could be sped up if additional information was known ahead of time? This is called a heuristic search, and falls within the domain of artificial intelligence. A heuristic — or rule-of-thumb — helps in making a decision. A simple example of a heuristic is deciding which checkout line to go to in a store. A short line at a checkout usually equates to getting through the line faster. This isn't necessarily true if someone in a short line has a lot of items to buy but, in general, a shorter line means a faster exit.

Heuristics are used with the best-first search algorithm. Best first searches revolve around searching nodes that are estimated to be close to the destination node. In the case of the checkout line, using the heuristic that a shorter line means a faster exit, we would scan all of the lines to determine which line was shorter.

We're looking for the shortest, least-cost distance to our goal, which is getting out of the store in the minimal amount of time. There's no guarantee that the decision will be correct, but it will be correct most of the time.

The heuristic applied to route planning estimates the distance from a source node to a destination node. What best-first search really does is restrict the search space. Where Dijkstra's Algorithm is able to search a complete network, best-first search restricts the search to a single source and destination.

This translates into less processing time and returning a route to the driver much faster.

User Interface

Finally, the User Interface accepts commands and presents the navigation data to driver. Maps are displayed with a vehicle icon, as shown in Figure 3, and turn-by-turn maneuver icons are usually shown when traversing a pre-planned route. A right turn icon is shown in Figure 5. As the vehicle approaches an intersection, a maneuver icon pops up on the display, informing the driver that a maneuver needs to be executed. More than simply right or left turns, the navigation computer may inform the driver to bear right, bear left, stay straight, or execute a series of maneuvers.

Another vital feature of the User Interface is speech output. Driving is inherently hazardous, especially when a driver is continually looking at the navigation system and not at the road ahead. Speech output helps to minimize this potentially dangerous and litigious situation. In the simplest case, canned phrases are enunciated. Canned phrases do not recognize road names. To announce the maneuver in Figure 5, canned phrase software will say something like "right turn ahead." More sophisticated text-to-speech software will actually announce the road name. A text-to-speech module will actually say "turn right onto Woodward Avenue."

There are some inherent difficulties with text-to-speech. One major problem is storing the road name in the form that a text-to-speech module understands. It generally can't be simply the English spelling of the road name. Chances are the road name will be mispronounced. The road name needs to stored as a phoneme.

A phoneme is not so much the way a name is spelled, but how it sounds. This adds more data to an already dense database. Pronunciation is also difficult, since road names are predominately proper nouns. Canned phrases simply involve comparing a key word, such as "right" or "left," and indexing into a ROM location to extract the phrase.

Driver input needs to be minimized so the driver isn't too distracted from keeping his or her eyes on the road. Speech recognition is ideal, but very expensive. Touch screens are good, as are a simple and intuitive button layout.

The Future of Intelligent Transportation Systems

What happens when an accident occurs somewhere on the route you're traveling? Even if you know about the accident, how do you re-route around it? This is where real-time traffic information and server based navigation comes into play. Similar to an Internet service provider, a vehicle information service provider can monitor traffic and provide real-time traffic updates to the subscribers. If an accident occurs on your route, the service provider can alert your vehicle and download a new route, avoiding the obstacle or accident. Vehicles can even be used as traffic probes. A service provider can call your vehicle, determine its position, and compare the vehicle's speed to the speed on the road segment it's currently on.

If the road segment speed is supposed to be 65 mph, and the vehicle is only going 5 mph, then there is a possibility of traffic incident or construction. If many vehicles on the same road segment are stopped or moving slowly, then the probability of an incident is extremely high, and real-time traffic notifications can be broadcast to other vehicles. If your vehicle is involved in a traffic incident or simply breaks down, then the information service provider can provide emergency and breakdown services, ranging from calling an ambulance or tow truck. These features and services fall under the umbrella of Intelligent Transportation Systems, or ITS.

Think of the early days of aviation. You would pull an old plane out of the hanger, gas it up, check the wind direction, and look up to see if any other air traffic was around. If the sky was clear, you'd take off. No flight plan, very few instruments, and a compass and a map in your lap. There's a certain glamour and appeal to the unrestrained freedom that early aviation offered. That's the way driving is today, without a supporting information infrastructure, and essentially autonomous and unrestrained.

Traffic information systems of the future will offer important driver information, but at a cost. With the increased security and convenience comes a loss of autonomy. Opening a vehicle to allow two-way communications with the outside world opens the door to malevolent hacking. If an information service provider can remotely unlock your car doors, so can a hacker. Hacker proofing a vehicle requires data encryption technology which increases cost and complexity, and there are always back doors to everything.

The road to the future via ITS is bright, but there are a few technological potholes along the way. Being aware of the problems and benefits — both potential and real — can help designers and drivers develop and use reliable, practical, and safe intelligent transportation systems. **NV**

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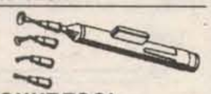

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92U034 **50 Lbs. for $49.95**

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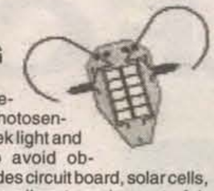
Unused unit from cable TV box takes channel 3, 4 or 5 signal and demodulates the audio. Comes with documentation and schematics, plus additional schematics to build add-on video demodulator board.

92A028 **$9.95 each**



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No batteries required! It uses photosensitive eyes to seek light and dual feelers to avoid obstacles. Kit includes circuit board, solar cells, miniature motors, all parts and easy-to-follow instructions. Body approx. 3"L x 2"W.

98K001 **$59.00 each**

CRYSTAL SET PROJECTS: 15 Radio Projects You Can Build

Crystal Set Projects is a collection of radio projects that won a recent building contest run by the Xtal Set Society. Included are step-by-step instructions so you can buiild and design your own Xtal sets no matter what your background in electronics. The projects are of various designs and difficulty so that everyone can learn something. 6x9 paperback, 160pp.

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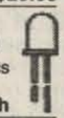
This flashlight is the newest in portable lighting technology. Three "AA" batteries will give 30 hours of light when you use the PL-W1 with one LED. There's no bulb to replace. This is a great light for cavers, backpackers, boaters and anyone who doesn't want to carry a lot of batteries and wants a dependable light. Put one into your Y2K "survival kit."

PL-W1 (1 LED)	**$22.95**
PL-W2 (2 LEDs)	**$26.95**
PL-W3 (3 LEDs)	**$29.95**



ULTRABRIGHT WHITE LED

T1-3/4, water clear, 1600 mCd. Docs included.

SE5082H **$4.95 each**

1MB 80nS 30-Pin SIMMs

Three-chip type; matched sets.

97C052 **4/$9.95**

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Primary: 208 or 240 VAC, 50-60Hz, 3A. Secondary: 2 x 30 or 24VCT @ 5A each, and 24V @ 3A. Mounted on 6-3/4" x 6-7/8" backing.

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98V013 **$19.95/pr.**

ATARI 1020 COLOR PRINTER

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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 reach me on America Online at TJBYERS, on the Internet at TJBYERS@aol.com, or by snail mail at Nuts & Volts Magazine, 430 Princeland Ct., Corona, CA 91719.

What's Up: Two different 12V DC-to-DC voltage converters, two new alarm circuits, and two battery monitor/testers. A reliable fixed-frequency, variable duty cycle pulse generator. And many more web sites to visit, including an interesting look at GeoWorks. Finally, our readers talk back about hard disk fixes and noisy A/D converters. Enjoy!

More Solar Stuff

Q. In your Dec. '98 column, you showed how to trickle-charge a battery from a solar panel using nothing but a diode. What size diode should I use for my solar panel which has a 1-amp output?

Carl Zajac
via Internet

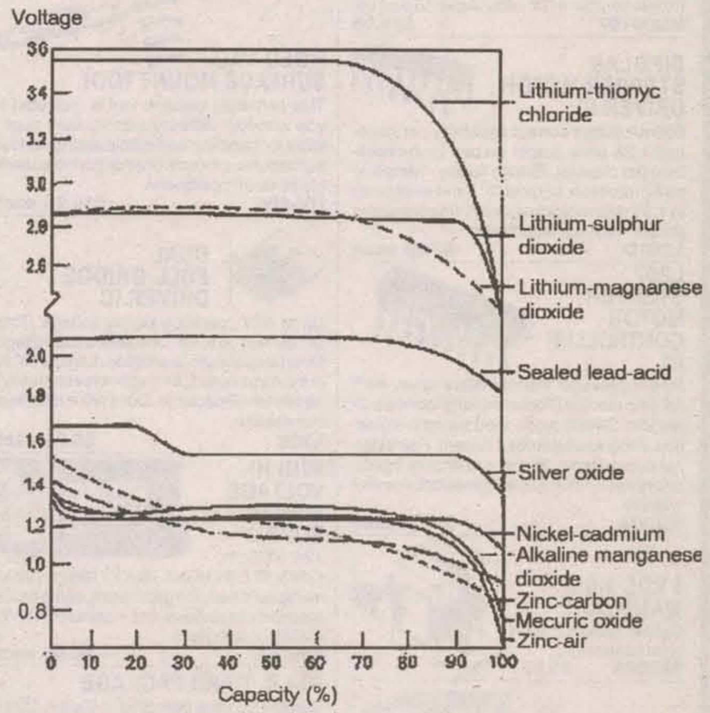
A. *Let me reiterate my Dec. '98 answer first: If the charging current is less than 1/10 the capacity of the battery under charge, a charge controller isn't needed. Translated, that means that your 1A solar panel can trickle-charge any battery of 10 AH (amp-hours) or bigger using a simple diode to prevent discharge when the sun doesn't shine. How big is the diode? If you have a 1-amp solar panel, a 1-amp diode like a 1N4001 works. If you have a 3-amp solar array, then the answer is a 1N5400. Both are available from RadioShack for under a buck.*

Battery Testing

Q. I'd like to use a voltmeter to check the condition of my 'AA' batteries, but I feel the need to put a load on them while testing. Can I just put a resistor across the battery when I test it? If so, what value of resistor should be used? Also, if I want to discharge NiCd batteries before recharging them, can I put a resistor across them to discharge them completely? What value should I use?

Thomas Wallenmaier
Southfield, MI

A. *You're quite right. Measuring the open-circuit voltage (OCV) of a battery to determine the amount of service life will yield but a rough estimate. A more accurate method is to measure the closed-circuit voltage (CCV) of the battery. This is accomplished by putting the battery under load for one to two seconds, then measuring the CCV. The load is determined by the size and type of battery. In the case of a 'AA' cell, the load should be approximately 8 ohms. A 'D' cell needs a 4-ohm load, and a 9-volt battery is best tested with a 50-ohm load. For an alkaline or carbon-zinc single cell, the cutoff point is 0.9 volts. For example, if the battery voltage is 1.1 volts, the battery has approximately 20% of life left. Different batteries have different discharge profiles, as shown below.*



Battery Size	Lamp
AAA	222
AA	PR5
C	PR5
D	PR2
6V lantern	1888
9V	1892

Personally, I prefer to use a flashlight bulb for the load when I test my batteries. In addition to getting a voltage reading of remaining capacity, you get a visual look-see that strikes closer to home. Here's a list of the bulbs that I use for the various batteries – and to drain a NiCd battery for recharging.

Cracking The BIOS Code

Q. I recently acquired a working Gateway 2000 with a 486 motherboard. The trouble is that it didn't come with a manual, and I'm not able to access the BIOS settings with key press(es) on Power-Up. I've tried pressing the keys that usually work, like <Del>, F2, and <Esc>/<Enter>, with no luck. The only way I've been able to access the BIOS settings is to unplug the hard drive and then power-up. I would really rather do it via the keyboard. Do you know the secret code?

John McMichael
via Internet

A. *It's no secret. The combination is pressing <F1> (sometimes repeatedly) when you see the first boot screen. You may have to turn on the monitor before you boot to make sure you don't miss your window of opportunity. Need a manual? No problem! Download it from Gateway's Web site at http://www.gateway2000.com/support/techdocs/manuals/index.html*

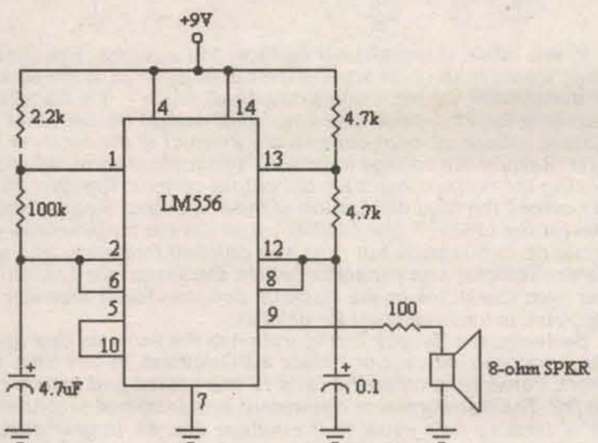
By the way (BTW), this is a message to any reader who is having a problem accessing the PC's BIOS. The answer is to unplug the (bootable) hard disk's power plug and take it from there. Been there done that often; it brings up the BIOS screen virtually every time.

Beep Me

Q. I'm working on a project for a restaurant that requires an audio alarm that will have a sound similar to that of a beeper (or the chimes of a door-ajar auto alarm). I don't want to use the high-pitched piezo buzzers available everywhere, because they would be very annoying to both employees and customers, but my efforts to find a beeper sound module or even surplus damaged beepers that I can use for this project have hit a stone wall. There are transducers available that would probably work, but I have no idea how to build a suitable driver circuit. Please help!

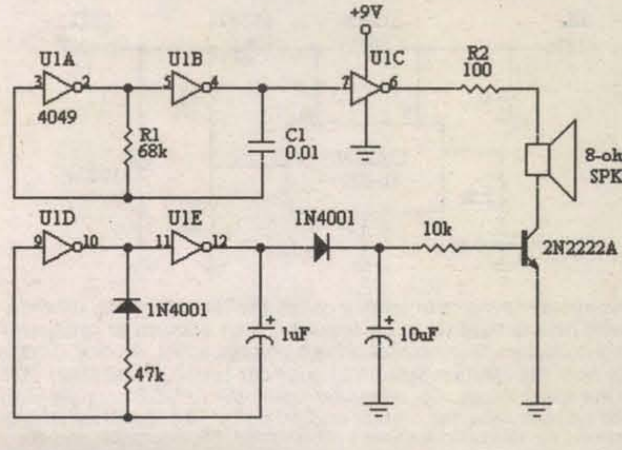
Thomas
via Internet

A. *For a beeper sound, I'd use this circuit.*



It uses a 556 chip, which houses two 555 timers. The second 555 timer (right side of the chip) is a 1-KHz, squarewave oscillator. This oscillator is controlled by the first 555 timer, which is basically an astable pulse generator that connects to the reset pin (pin 10) of the 1-KHz oscillator. When this pin goes high, the speaker sounds for a short time every couple of seconds. The frequency of the tone can be adjusted by the size of the 0.1uF capacitor: a higher value lowers the tone, and a smaller value raises it. Likewise, the 2.2K resistor and 5uF capacitor can be changed to generate different on/off times for the beeper. The volume is controlled by the 100-ohm resistor; to increase the volume reduce the resistance to 47 ohms, to make it softer, use a 330-ohm resistor. A piezo transducer will work in place of the speaker.

For a chime sound, this circuit is cheap and easy to build.



As in the beeper circuit above, it takes two oscillators to produce the sound. U1A and U1B generate the basic tone, while resistor R1 and capacitor C1 determine the frequency of this squarewave oscillator. U1C is a buffer/amplifier that drives the speaker (or piezo device). The volume is determined by R2 – with a lot of help from U1D and U1E. When power is applied, this duo oscillates and slowly charges the 10uF capacitor on the base of the 2N2222A transistor. As the voltage across the capacitor increases, the volume decreases, producing the chime tone. Unlike the beeper circuit above, which produces a continuous beeping after power is applied, this a one-time event. To make repeated chimes, you need to interrupt the power source with a momentary-ON push-button switch.

If this sounds too ambitious, check the ads in our pages under "Kits." Gateway Electronics (1-800-669-6810; http://www.gatewayelex.com), for example, sells all kinds of sound boards ranging in price from $7.95 to $29.95.

DC to DC Conversion ...

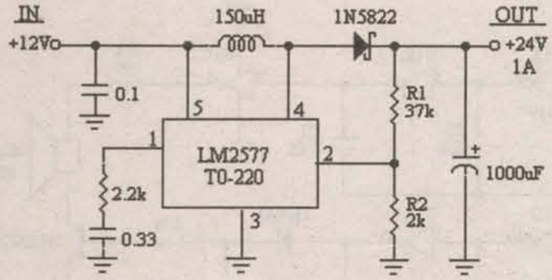
Q. While most people wish to convert 12-volts DC to 115-volts AC, I would like to raise a 12-volt car battery to the following higher DC voltages.

1 – 13 volts, 2.5 amps
2 – 19 volts, 2 amps
3 – 24 volts, 1 amp

I need to select any one of the voltages with a switch. Can this be done with a simple conversion circuit?

Fred Batin
via Internet

A. *What you ask for is easily done using an LM2577 step-up voltage* *regulator, which you can buy from Digi-Key (1-800-344-4539; http://www.digikey.com) or QuestLink (http://www.questlink.com) for under $10.00. (I recommend the LM2577T-ADJ version in a TO-220 package for ease of use.) This regulator is unique in that it has an input voltage range of 3.5 volts to 40 volts, an adjustable voltage output of up to 60 volts at up to 3 amps (at the lower voltages), current limiting, thermal shutdown (in case it gets too hot), and requires only eight external components. Here's the 24-volt version of the DC-to-DC converter you asked for.*



The circuit operates in what's called the "boost" mode, where a magnetic field is built up in an inductor, then allowed to collapse. As the field collapses, it generates a high voltage spike, or kick. This is exactly how the ignition system in your car turns 12 volts into 50KV to fire the spark plugs. On a smaller scale, the LM2577 regulates the boosted voltage between 5 volts and 60 volts. The regulated voltage is determined by the ratio between R1 and R2. Resistors R1 and R2 divide down the output voltage so that it can be compared to the internal 1.23-volt reference. For a given output voltage select the ratio so that

$$\frac{R1}{R2} = \frac{Vout}{1.23V} - 1$$

That is, the voltage drop across R2 at the desired output voltage must equal 1.23 volts. Here's how the values of R1 and R2 for a 24-volt output were calculated. Set R2 at 2.0K, then calculate the current needed to produce a 1.23-volt drop.

$$I = \frac{E}{R2} = \frac{1.23}{2000} = 0.615\ mA$$

Next, calculate the total resistance needed to generate a 0.6-mA current across a 24-volt source.

$$R = \frac{E}{I} = \frac{24}{.000615} = 39K$$

Finally, subtract for R2 to get the value of R1.

$$R1 = R - R2 = 37K$$

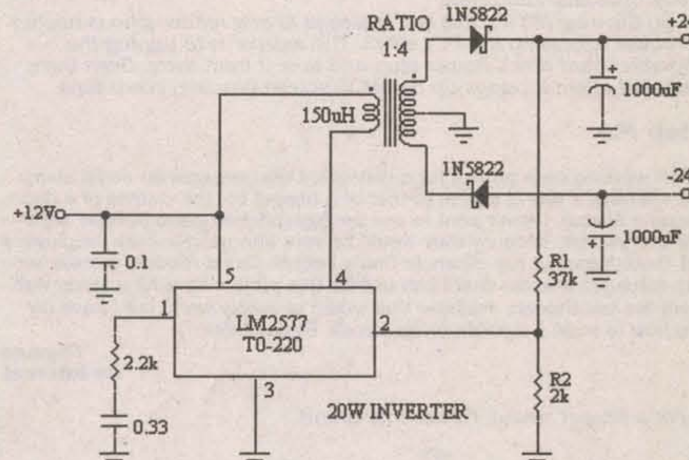
You can follow the same procedure for the 19-volt source, or 15 volts, and whatever. The important thing is that R2 has to generate 1.23 volts across it to output the desired voltage. You may have to juggle the values of R1 and R2 to achieve a ratio that equals a standard resistor value, but don't knock yourself out. A 37.4K resistor is plenty close enough for this example. Finally, the input voltage (Vin) can't exceed the boosted output voltage (Vout) – this is a step-up regulator remember? It can't reduce 12 volts to 5 volts, which is why you should get the 13-volt source directly from the 12-volt battery. With a full charge a car battery will measure 12.6 volts; when charging, the voltage is 13.1 volts. A simple rotary switch will let you select between the sources. For detailed information on designing DC/DC converters with the LM2577, download its data sheet from the National Semiconductor Web site at http://www.national.com/pf/LM/LM2577.html.

... DC to DC Conversion, Again

Q. I'd like to use an LM1875 20W IC power amp in an auto audio amplifier. How can I make a bipolar +24VDC/-24VDC power supply from the car's 12-volt power source?

William Silvis
via Internet

A. *Like the query above, you, too, can use an LM2577 step-up voltage regulator. For this application we'll use the LM2577 in the flyback mode, as shown below.*



In this mode, a transformer replaces the inductor. This time, the energy stored in the primary inductor is transferred to the secondary of a transformer, where – unlike the boost mode – it is transformed to a higher or lower voltage. The amount of energy transfer, that is the resultant voltage at what current, is a product of the two – or total power. Raising the voltage lowers the available current, whereas reducing the voltage increases the output current. Together, the two can't exceed the total dissipation of the IC's output stage – about 30 watts for the LM2577. (An LM2587, a pin-for-pin replacement, can operate up to 60 watts, but runs at a different frequency and uses different inductor and capacitor values. Download the LM2587 data sheet from QuestLink or the National Semiconductor web site (http://www.national.com) for details).

Basically, the flyback configuration is the same as that used in your monitor to increase or reduce a DC voltage. In this case, the flyback transformer takes the car's 12-volt source and increases it to ±24VDC. The transformer is a standard center-tapped secondary type with a winding ratio equal to the voltage desired. In your case, you need 48 volts total (24V + 24V) from a 12-volt source, a 1:4 ratio. Should you want to change the voltage to ±5 volts, the ratio would be

1:0.8 (10V/12V; quiz later).

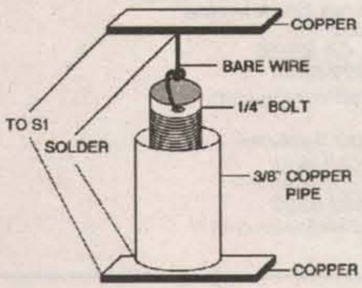
As before, resistors R1 and R2 set the output voltage. The output voltage for the bipolar output is derived from the positive leg of the output, which means the outputs aren't tracking. In other words, only the positive output is regulated. If there is a heavier, or lighter, load on the negative supply, its voltage may go above or below the positive. In your case, where you're using a symmetrical Class-B op amp, I wouldn't worry about it. However, if you plan to add single-supply devices, like indicator lamps or a preamp, make sure you hang them on the positive side – the regulated line – to keep the LM1875 in balance. Better yet, use the +12-volt source if you can. (BTW, are you aware that you can operate the LM1875 from a single-polarity (+32V to +60V) power supply)?

Don't Tread On Me Alarm

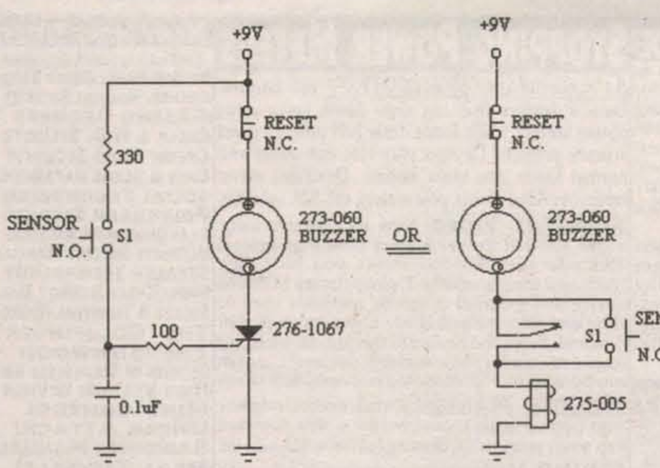
Q. I have a theft problem that I think could be solved with an inexpensive motion-activated alarm, somewhat like the alarms that go off when you bump into a car. Do you have any advice on appropriate sensors/circuits/sounders?

Steve Scott
via Internet

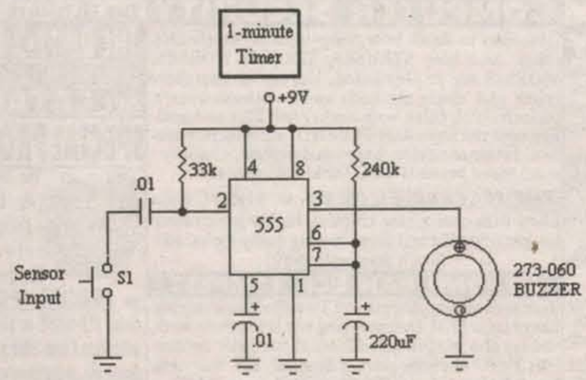
A. *What you want is a vibration detector, like RadioShack's 49-406 ($12.99). This is a 120dB siren that attaches to a door or window and screams its head off when it detects an abrupt shock or vibration. Want to make one yourself? Follow me. It begins with a plumb device, like a 1/4-inch bolt, suspended inside a 3/8-inch copper water pipe, as shown below.*



This device is identical to those used in pinball machines to trigger the "tilt" alarm. Bump it too hard, and the pendulum hits against the metal guard and sounds the alarm. The sensitivity is adjusted by the size of the pipe, the length of the bare (copper) wire, and the weight of the bolt. The heavier the bolt, the more force it takes to trigger the circuit, which is shown below.



I made it simple, on purpose. Once triggered, you have to get your butt out of bed and reset the alarm. If you only want it to scare the thief away and keep warm under the blankets while the alarm does its job, you need an automatic turn-off timer circuit like this.

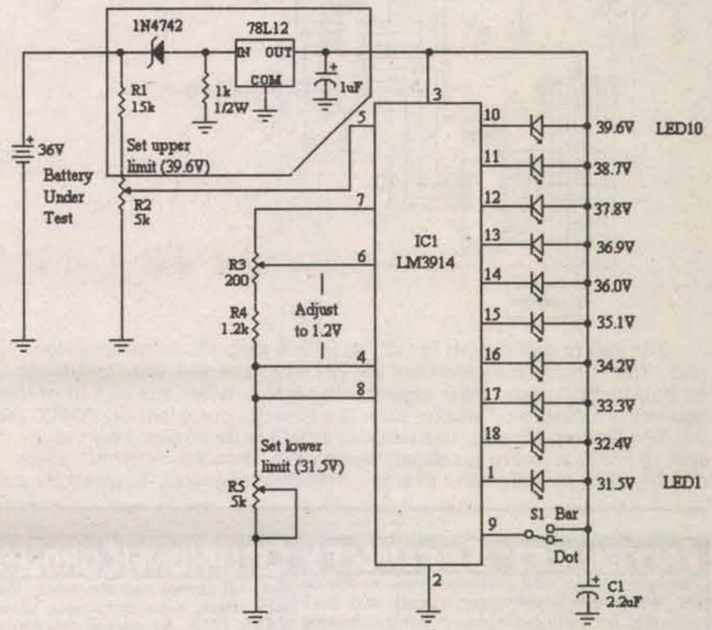


Battery Gas Gauge Does 36 Volts

Q. I have purchased all of the necessary components, including the printed-circuit board, needed to build the "Battery Gas Gauge" that you described in the July '97 issue. It's my intention to use the gas gauge across two of the 6-volt batteries in the golf cart, which is used as mobility for the disabled, to get a general idea of the charge on battery pack. The thought has come to mind that it may be possible to reconfigure this schematic so that the gauge could be used across the entire bank, which contains six batteries for a total of 36 volts. Can it be done easily?

Joe Dunnett
via Internet

A. *This is an easy order to fill. All you have to do is separate the power source from the battery under test. Because it's been a while since we published this circuit, and there still seems to be a great deal of interest in it, here it is again with the modification for 36-volt operation.*



The changes are highlighted in gray. Basically, you need to change the value of R1 and reduce the 36-volt input to 12 volts via the new 78L12 voltage regulator and its related components. Other than that, it's the same circuit. Make sure that you cut the copper trace on the PC board to pin 3 of the LM3914 and reroute it to the LM78L12 "out" when making this modification. Here's a new table showing the 36-volt battery voltage and charge levels.

Battery Voltage	LED Color	Description
39.6	Green	About 100% of charge remains
38.7	Green	About 80% of charge remains
37.7	Green	About 70% of charge remains
36.9	Green	About 55% of charge remains
36.0	Green	About 40% of charge remains
35.1	Yellow	About 25% of charge remains
34.2	Yellow	About 10% of charge remains
33.3	Red	Caution!
32.4	Red	Danger!
31.5	Red	Dead!

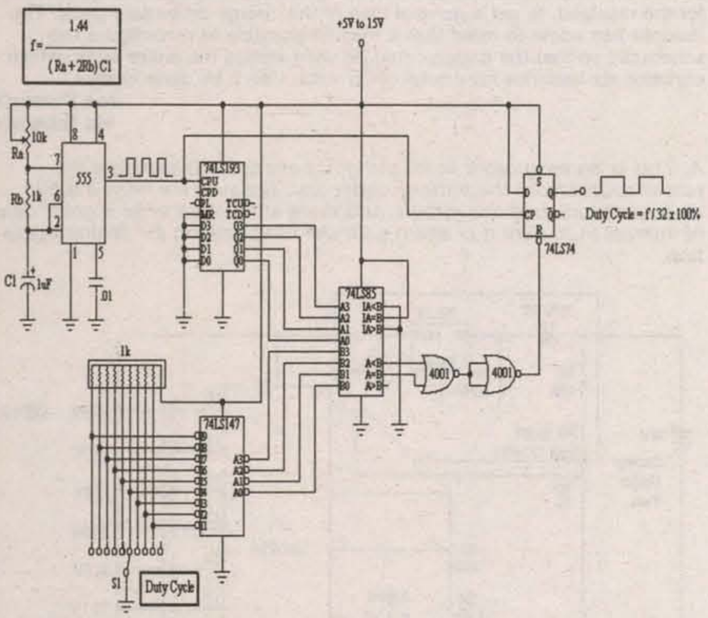
To calibrate the battery monitor, first set the voltage across pins 4 and 6 to 1.2 volts using R3. Apply 31.5 volts to the input and adjust R5 so that LED1 lights. If you don't have a 31.5-volt source, you can measure the battery-under-test voltage with a DMM (digital multimeter) and rotate R5 until that lamp lights with S1 in the dot mode. Now your ambulatory-impaired friends can get to the mall and shop 'til they drop before the golf cart drops dead.

Fixed-Duty Cycle Pulse Generator

Q. Please reference your Sept. '98 article about the LM558: Forrest Mims in his *Engineer's Notebook* shows a variable-pulse generator with a fixed duty cycle that uses two of these timers and a control voltage. This is a very useful circuit, but myself and others find it difficult to start. Would a 556 with a paralleling of the control inputs work better?

S. Chris Early
via Internet

A. You, too? I've never been able to make that circuit work short of a swift kick in the rear. Here's a design that I ran across (and slightly modified to include S1), but have never tried. It looks very solid because it uses digital logic to vary the duty cycle, which should make it quite stable.



The key to this design is the 74LS85, a magnitude comparator chip. The 555 clock increments the 74LS193 counter, which outputs its binary BCD code to the digital comparator. When the output of the counter is equal to or greater than the binary equivalent on B0-B3, the 74LS74 flip-flop is reset. The value of B0-B3 is determined by the setting of S1, a rotary (or slider) switch that encodes decimal values of 10%, 20%, etc. into BCD that the 74LS85 recognizes. To generate a squarewave; for example, simply set S1 to 50% (middle position). While the circuit looks complex, most of the lines are just wires going from one IC pin to another. Total cost is under $10.00. Like I say, I've never tried this and would appreciate your feedback. In particular, I'm not sure the IA<B and A<B blocks are properly placed; you may have to exchange the two blocks (six pins in all) to make it work. I recently ran across a single IC function generator, the MAX038 from Maxim (408-737-7600; http://www.maxim-ic.com), that claims to have a variable duty cycle pulse generator that's independent of frequency. I haven't looked at it closely, but I suspect it's an upgrade of the venerable Exar XR-2206. Stay tuned for more on this chip.

More POWER!

Q. I plan to build one of your 25-watt inverters shown in the Dec. '98 column, but would like more power, too. Do you have any circuits for 3-4 KW?

Jim Rudholm
via Internet

A. Sure, but not anything you want to tackle unarmed. Once you exceed a couple hundred watts, you can't use a simple squarewave output. You have to use a modified (staircase) wave or a pure sinewave, which needs at least eight power FETs, which generate a lot of heat, which require special heatsinks, which means you need a drill press, which ... (sorry, sometimes I like playing with words as much as wires) ... makes it cheaper to buy than build. My suggestion? Check out the following retailers.

Alternative Energy Engineering
P.O. Box 339
Redway, CA 95560
1-800-777-6609
http://www.alt-energy.com

Sierra Solar Systems
109 Argall Way
Nevada City, CA 95959
1-888-667-6527
http://www.sierrasolar.com

GeoWorks Still Lives

Q. In his article "Secrets of Making Attractive Rack Panels" in the Dec. '98 issue, Thomas Henry mentions GeoDraw (Geoworks Ensemble package) as his favorite drafting program software. After checking around the Internet, CompuUSA, and local computer shops, I still haven't found a source for GeoDraw. Any suggestions?

Lee Markmann
San Antonio, Texas

A. *First, let me say that GeoDraw runs under the GeoWorks operating system, and isn't a Windows, DOS, or Mac program. GeoWorks, formerly known as GEOS is now sold under the name NewDeal, is like Windows 3.1 in many respects. It's an object-oriented operating system which today we call a GUI (Graphics User Interface) – or Windows. And like Windows, it runs under DOS, and the applications – like GeoDraw – are GEOS specific. In other words, the application programs for GEOS work only with GEOS. Now that you're thoroughly confused, let me say that NewDeal can be installed over Windows, Atari, Commodore, and Apple operating systems. To sort all this out, I suggest you look at James D. Bearden's FAQ (frequently asked questions) on this subject. You can find it at http://www.cis.ohio-state.edu/hypertext/faq/usenet-faqs/html/pcgeos-faq/part1_/faq.html or on our web site (http://www.nutsvolts.com) under the name GEOS.TXT. Where can you buy GeoDraw? From New Deal under the name NewDraw.*

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MAILBAG

Dear TJ Byers:

I just read your item in the Nov. '98 issue concerning "Hard Disk Fixes." In my business, I have run into these problems you stated on many occasions, and while you are right on target with the "stickism" problem (we call it "sticktion"), I thought I would share my two cents with you on the third possibility you mentioned.

You stated "... the controller board has died. Unfortunately, there are no fuses to replace." Actually, I have fixed a large number of drives (read many dozens) which have a pico fuse on the controller board. They look like resistors, either standard leads or surface mount, but they are there —most near the power connectors — and they're often totally open.

John Hoyt
South Carolina

Response:

Yep, they are there, indeed, and I knew it. I guess what I should have said is: "If you hear the motor running but can't access the data, then use a DMM to probe the controller board for a voltage – any voltage. If absent, suspect the input fuse, if you can find it. If the voltage is there, then the board is dead." I'm happy to hear that you have repaired dozens of hard disks this way, but I've never been that lucky (sigh ... not even one). Thanks a lot for the input!

TJ Byers
Q & A Editor

The advice in Oct. '98 Electronics Q & A about quiet 2-MHz clocks misses the mark in several places. First, dithering the clock oscillator for a 20-bit ADC is a mistake because it introduces errors into the conversion. To maintain 20-bit (1 ppm) resolution in amplitude, you must also maintain about 1 ppm resolution in time. For a 50-KHz sample rate, the clock should be stable to 20 picoseconds.

Second, the original question is misleading. There are a couple of interpretations. The literal interpretation is the 20-bit ADC is working fine except that the 2-MHz clock causes a lot of radio interference to other equipment. In this interpretation the column's advice about quieter clocks makes sense, but lacks some better advice. Shielding is very effective at killing 2-MHz radiated noise — a 1/16 inch aluminum shield provides more that 150dB of absorption loss. Filtering the power supply and using bypass capacitors are also important.

A second (and more reasonable) interpretation is the 20-bit ADC outputs a lot of noise and the analog signals show a lot of sharp edges that coincide with the 2-MHz clock. In other words, Steve's project doesn't have the performance he wants. This interpretation is more likely, and it means there is nothing wrong with the 2-MHz clock. The clock and its harmonics are out of the ADC's input band. In this interpretation, the problem is inadequate isolation between the digital an analog parts of the circuit.

For good performance, the analog and digital circuits must be isolated. Otherwise digital currents flowing in the analog parts of the circuit will create IR voltage drops that look like noise. The circuit design needs separate analog and digital supplies, separate analog and digital ground planes, and a single point ground connection between the two systems. The ground plane cuts need careful thought. In addition to isolating the supplies, the designer must also minimize electrostatic and electromagnetic coupling.

In particular, you must keep the digital signals away from the analog signals. Assume that an output bit of the ADC toggles at 16 KHz. If that bit is close to an analog node (say close enough to have 1pF of coupling capacitance), then the capacitive impedance between the two nodes is 10 megohms. Finally, if the analog node impedance is 10K, then the 5-volt digital signal will couple 5mV of noise to the analog node. That 20-bit ADC (whose LSB is about 5 microvolts) just became a 10-bit ADC. To kill the noise, separate the analog and digital traces and use guard rings or other shields to minimize coupling capacitance. Use low impedance circuits (10K is too large).

Gerald Roylance
Mountain View, CA

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RF & MICROWAVE

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HP calibration certificate
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TEK TR502 Tracking Generator, ... $950.00
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TEK TR503 Tracking Generator, 0.1-1800 MHz, for 492/4/5/6 .... $850.00
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HP 35676A Reflection/Transmission $1,000.00
Test Kit, 5 Hz-200 MHz
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HP 85021C Directional Bridge, ... $1,000.00
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HP 8502A-H26 Reflection/ $600.00
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Transmission Test Set, 300 kHz-3 GHz
HP 85046A S-Parameter Test Set, ... $3,500.00
300 kHz-3 GHz, for 8753 series
HP 8756A Scalar Network Analyzer $2,500.00
HP R85026A WR28 Detector, ... $1,200.00
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SIGNAL GENERATORS

FLUKE 6060A Synthesized Signal Gen., ... $2,500.00
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FLUKE 6060A/AN Synthesized Signal Gen., ... $1,500.00
10 kHz-520 MHz, 10 Hz res.,GPIB
FLUKE 6062A Synthesized Signal Gen., ... $5,000.00
0.1-2100 MHz, 10 Hz res., GPIB
GIGATRONICS 1018 Synthesized $4,500.00
Signal Gen., 50 MHz-18 GHz, 1 MHz res.
GIGATRONICS 600/10-18 Synthesized $2,500.00
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26.5-40.0 & 50.0-75.0 GHz outputs
GIGATRONICS 900/2-8 Synthesized $2,500.00
Signal/Sweep Gen., 2-8 GHz, 1 MHz res.,GPIB
HP 11720A Pulse Modulator, 2-18 GHz, 80 dB on/off ratio $450.00
HP 85100V Frequency Mult., ... $3,750.00
10-15 GHz in / 50-75 GHz out >0 dBm
HP 8640B-001 Signal Generator, ... $1,000.00
0.5-512 MHz, AM, FM, var. audio osc.
HP 8640B-002,003 Signal Gen., ... $1,750.00
0.5-1024 MHz, AM, FM, reverse power prot.
HP 8656B-001 Synth. Signal Gen., ... $2,500.00
0.1-990 MHz, 10 Hz res., OCXO ref.
HP 8657A-002 Signal Generator, ... $3,250.00
0.1-1040 MHz, 10 Hz res., HPIB
HP 8660C/86602B-002 Synth. Sig. $2,750.00
Gen., 1-1300 MHz, FM / Phase mod. w/86635A
HP 8660C/86603A-002 Synthesizer, ... $3,750.00
1-2600 MHz, FM / Phase Mod., w/86635A
HP 8672A Synthesized Signal Generator, 2-18 GHz $6,000.00
HP 8673C Synthesized Signal $16,500.00
Generator, 50 MHz-18.6 GHz
HP 8673G-004,008 Synth. CW Signal $12,500.00
Generator, 2-26 GHz, >+8 dBm output
HP 8684B Signal Generator, ... $3,500.00
5.4-12.5 GHz, AM, WBFM, Pulse

SWEEP GENERATORS

HP 8350A/83545A-002 Sweep Oscillator, ... $4,000.00
5.9-12.4 GHz, 70 dB step attenuator
HP 83545A RF Plug-in, 5.9-12.4 GHz, +17 dBm levelled $1,750.00
HP 8601A Generator/Sweeper, ... $400.00
0.1-110 MHz, +20 dBm levelled
HP 8620C Sweep Oscillator Frame $550.00
HP 86222B-002 RF Plug-in, ... $1,500.00
10-2400 MHz, +13 dBm levelled, 70 dB atten.
HP 86230B RF Plug-in, 1.8-4.2 GHz, +10 dBm unlevelled $400.00
HP 86240C RF Plug-in, 3.6-8.6 GHz, +16 dBm levelled $700.00
HP 86241A-001 RF Plug-in, 3.2-6.5 GHz, +8 dBm levelled $300.00
HP 86242D-004,008 RF Plug-In, ... $300.00
5.9-9.0 GHz, +10 dBm levelled
HP 86250D RF Plug-in, 8.0-12.4 GHz, +10 dBm levelled $500.00
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HP 86260A-H04 RF Plug-in, ... $500.00
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HP 86290A RF Plug-in, 2.0-18.0 GHz, +7 dBm levelled $1,750.00
HP 86290C RF Plug-in, 2.0-18.6 GHz, +13 dBm levelled $2,250.00
WAVETEK 962 Sweep Generator, ... $1,250.00
1.0-4.0 GHz, markers, +12 dBm unlvld.
WILTRON 6619A Sweep Generator, ... $1,500.00
2-8 GHz, +10 dBm levelled

POWER METERS

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Channel Microwattmeter, w/(2) 1 MHz-7 GHz sensors
BOONTON 42B/41-4B Analog $375.00
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GENERAL MICROWAVE 476/4240A $300.00
Power Meter & Sensor, 0.01-18 GHz, -35 to +10 dBm
HP 435B/8481A Power Meter, ... $900.00
-30 to +20 dBm, 10 MHz-18 GHz
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HP 435B/8482H Power Meter, ... $900.00
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HP 436A-002,022/8481A Power Meter, ... $1,250.00
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HP K486A WR42 Thermistor Mount, ... $350.00
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HP Q8486A Power Sensor, ... $1,500.00
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HP R486A WR28 Thermistor Mount, ... $350.00
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26.5-40 GHz, for HP 435/6/7/8

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HP 33327L-006 Programmable $1,200.00
Step Attenuator, 0-70 dB, DC-40 GHz, 2.9mm
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 Dual Dir. Coupler, 20 dB, 100-2000 MHz, N test port $450.00
HP 778D-011 Dual Dir. Coupler, ... $450.00
20 dB, 100-2000 MHz, APC7 test port
HP 8431A 2-4 GHz Band Pass Filter, N(m/f) $150.00
HP 8470B Crystal Detector, ... $250.00
10 MHz-18 GHz, neg. pol., APC7
HP 8472A Crystal Detector, ... $150.00
10 MHz-18 GHz, neg. pol., SMA
HP 8472B Low Barrier Schottky Det., ... $200.00
10 MHz-18 GHz, neg.pol., SMA
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HP 8494B-002 Step Attenuator, 0-11 dB, DC-18 GHz, SMA(f/f) $450.00
HP 8494G-002 Programmable $350.00
Step Attenuator, 0-11 dB, DC-4 GHz, SMA
HP 8495G-002 Programmable $300.00
Step Attenuator, 0-70 dB, DC-4 GHz, SMA
HP 8495H-002 Programmable $400.00
Step Attenuator, 0-70 dB, DC-18 GHz, SMA
HP 8497K-004 Programmable $750.00
Step Attenuator, 0-90 dB, DC-26.5 GHz
HP K281C-012 WR42 x APC3.5(m) Adapter $300.00
HP K382A WR42 Direct Reading $2,900.00
Attenuator, 0-50 dB, 18-26.5 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 $300.00
HP Q752D WR22 Directional Coupler, 20 dB, 33-50 GHz $650.00
HP R382A WR28 Direct Reading $2,000.00
Attenuator, 0-50 dB, 26.5-40 GHz
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 $250.00
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 45712H-1000 WR22 Frequency Meter, 33-50 GHz $900.00
HUGHES 45721H-1000 WR28 .... $900.00
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HUGHES 45732H-1200 WR22 Level $250.00
Set Attenuator, 0-25 dB, 33-50 GHz
HUGHES 45772H-1100 WR22 .... $400.00
Thermistor Mount, -20 to +10 dBm, 33-50 GHz
HUGHES 45775H-1100 WR12 .... $800.00
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HUGHES 47974H-1000 WR15 SPST PIN $375.00
Switch, 250 MHz speed, 60-62 GHz response
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Directional Coupler, 10 dB, 40-60 GHz
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0.1-12.4 GHz, SMA(m/f) *NEW*
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Coupler, 19.5 dB, 1-1000 MHz, SMA(f)
MINI-CIRCUITS ZHL-42 Amplifier, ... $400.00
30 dB gain, 0.7-4.2 GHz, +28 dBm, 15V, SMA
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 368BNM Coaxial High $500.00
Power Load, 500 Watts, 2.0-18 GHz, N(m)
NARDA 3752 Coaxial Phase Shifter, ... $1,000.00
0-180 deg./GHz, 1-5 GHz
NARDA 3753B Coaxial Phase Shifter, ... $1,000.00
0-55 deg./GHz, 3.5-12.4 GHz
NARDA 4000-SERIES SMA Miniature Directional Couplers $75.00
NARDA 4245-10 Directional Coupler, 10 dB, 4-12 GHz, SMA(f) $100.00
NARDA 4799 Level Set Attenuator, 0-15 dB, 4-18 GHz, SMA(f) $135.00
NARDA 5070-SERIES Precision Reflectometer Couplers $300.00
NARDA 765-10 10 dB Attenuator, 50 Watts, DC-5 GHz, N(m/f) $135.00
NARDA 769-30 30 dB Attenuator, 150 Watts, DC-6 GHz, N $275.00
NARDA 792FF Variable Attenuator, 0-20 dB, 2.0-12.4 GHz $375.00
NARDA 794FM Direct Reading $375.00
Variable Attenuator, 0-40 dB, 4-8 GHz
OMNI-SPECTRA 2085-6010-00 Crystal $50.00
Detector, 1-18 GHz, negative polarity, SMA(m/f)
PAMTECH KYG1014 WR42 Junction $250.00
Circulator, 18.0-26.5 GHz
SONOMA SCIENTIFIC 21A3 WR42 .... $75.00
Circulator, 20 dB, 20.6-24.8 GHz
SPACEK LABS K-2X Frequency $350.00
Doubler, 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
TRANSCO 705C90100 Latching $150.00
DPDT Transfer Switch, DC-26.5 GHz, 28 V
TRG B528 WR22 Direct Reading $1,250.00
Phase 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, ... $125.00
2-Way, DC-18 GHz, SMA(m/f/f)
WEINSCHEL DS109 Double $150.00
Stub Tuner, 1-13 GHz, N(m/f)
WEINSCHEL DS109LL Double $150.00
Stub Tuner, 0.2-2.0 GHz, N(m/f)

COMMUNICATIONS

HP 3762A/3763A BER Test System, 1 kHz-150 MHz $1,250.00
HP 4935A-003 Transmission $600.00
Test Set, 20 Hz-110 kHz, battery power
HP 59401A HPIB Bus Analyzer $700.00
TEK 1410R NTSC Gen., w/SPG2 .... $800.00
sync. generator, TSG7 color bars
TEK 1411R PAL Gen.,w/SPG12 sync; $750.00
TSG11 color bars;TSG13 linearity
TEK 1411R PAL Test Gen., ... $1,000.00
w/SPG12,TSG11,TSG13,TSG15,TSG16
TEK 1411R PAL Test Gen., ... $1,100.00
w/SPG12,TSG11,TSG12,TSG13,TSG15,TSG16
TEK 1411R-opt.04 PAL Test Gen.,w/
SPG12,TSG11,TSP11,TSG13,TSG15,TSG16 .... $1,400.00
TEK 1420 NTSC Vectorscope $600.00
TEK 147A NTSC Test Signal Generator, with noise test signal $800.00
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., ... $2,000.00
0.5 Hz-120 kHz, 130 dB dynamic reserve
TEK TM5006 5000-series $600.00
6-slot 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 80 on Reader Service Card.

Newsbytes

Listen to Your E-Mail Instead of Reading It!

Sunnyvale, CA – 4Developers LLC has released Talking E-Mail v. 1.2, a Windows 98/95/NT4 program that notifies you when you've received an E-Mail, and reads it to you. Using nothing more than your e-mail account and sound card, Talking E-Mail's easy-to-understand voice will read aloud your incoming E-Mails, whether they're in plain text, HTML, or RTF formats.

While there are a number of programs that let computers multi-task, Talking E-mail lets people multi-task. Without interfering with your other work, Talking E-Mail will talk to you, letting you know who is trying to contact you, and what they have to say. You'll hear immediately if your incoming E-Mail is important enough for you to interrupt what you're doing, or if you can respond to it routinely later.

When an E-Mail message arrives, an animated cartoon character pops up on the screen and starts reading the message. Talking E-Mail is highly customizable, allowing you to specify if you want to hear who sent the message, its subject, and how many lines of the message should be read. You can stop the cartoon character at any time, or keep listening while you are working. You can even launch your default e-mail program and reply to the message.

Talking E-Mail's rules system allows you to specify the behavior of the character and what he will say when a message arrives from a specific individual. A variety of animations, sounds, and other settings are available, adding fun and practicality. Talking E-Mail uses Microsoft Agent technology ™ to achieve its natural-sounding, understandable voice quality.

In addition to its entertainment value, Talking E-Mail has some very practical uses. You can schedule Talking E-Mail to check your inbox at any time interval, and have the program read your messages aloud, ensuring that critical E-Mails are brought to your attention immediately. It automatically checks for your incoming mail, and makes it easy to hear from your friends and colleagues, without having to stop other activities.

Talking E-Mail costs $14.95 and can be ordered online from http://www.4developers.com/talkmail/. Site licenses are available. You can also download a trial version of Talking E-Mail from http://www.4developers.com/talkmail/.

For more information, contact:

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Sunnyvale, CA 94086
E-Mail: **sales@4developers.com**

Mainstay Releases JustEdit™ Browser-Based Text Editor Speeds Up Web Page Edits

Camarillo, CA – Mainstay today began shipping JustEdit™, a quick and painless way to edit web pages anytime, anywhere, using only a web browser. JustEdit is a Java applet that need only be included in a single web page of a site. A user simply brings up the JustEdit page, enters the path to any web page to edit and clicks "Open." A text editor window opens – displaying HTML code, ready for editing. After making changes, the user clicks "Save" and their web page is modified. JustEdit works on any website and requires no server-side applications, scripts, CGIs, or plug-ins.

JustEdit enables the user to correct a typo, update a headline, price, or date, and even correct a broken or changed link, on the fly, right in a browser. Using JustEdit, there's no need to start an FTP application, find a source file, or download the file from the web, start a web page editor, make the changes, save the changes, then re-upload the file.

Web pages can be changed from anywhere in the world using nothing more than a web browser. JustEdit eliminates the time wasted "round-tripping" web files back and forth to the web server, or needlessly searching for HTML files on a local hard disk. It also eliminates the frantic call back to the office, trying to talk someone through making a simple change.

JustEdit maintains the same level of security enjoyed by web pages today. In fact, JustEdit can be thought of as a transparent FTP client embedded in a web page. Like all FTP clients, both a name and a password are necessary for read/write access to web pages.

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Camarillo, CA 93012
http://www.mstay.com

Build an Inexpensive Whole-House Temperature/Humidity Monitoring System

Part 1

by Mike Keryan

Transmit data from up to eight monitoring stations on your house's power line, and receive the information on your PC.

In this article, you will see how to build an inexpensive circuit that measures temperatures and humidities. The sensor circuitry is unique in that it requires no calibration whatsoever. It is controlled by a PIC CPU chip that spends most of its time sleeping. Once every five minutes or so, it wakes up and samples the air, and transmits the data onto the house power line using an inexpensive X10 interface. You can place up to eight of these monitoring systems throughout your house, even in your attic and on your screened porch. Somewhere in your house, a PC — connected to an X10 receiver via RS-232 — collects and reports the data. The monitoring software can be extended to make decisions based on the data.

The THX10 remote monitoring system described in this article is inexpensive, accurate, and flexible. You can buy sensors that sample and report accurate temperature and humidity data, but they will probably set you back over $100.00 apiece. And even if you had the money to buy enough of them to monitor most of the rooms in your house, and to purchase an expensive master monitoring station, you would still have to run a bunch of wires around your house to connect everything.

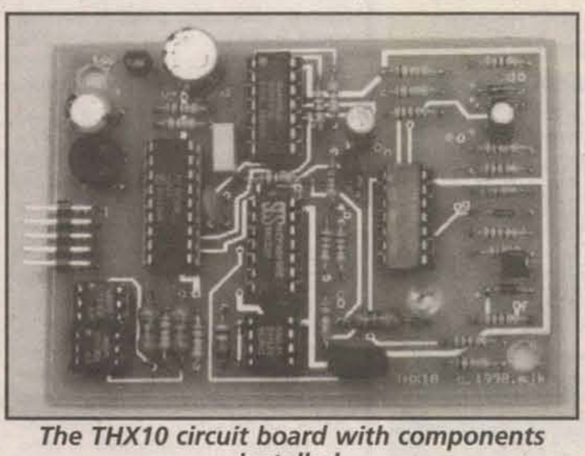
Or, you can build one or more of the sensor units described in this article. You can pick up the X10 interface equipment at your local RadioShack. With THX10, you won't have to calibrate anything or string up any wires between rooms. And you can customize the monitor software yourself, because it is written in BASIC.

In Part 1 of this two-part article, we'll talk a little about humidity, describe how the circuit works, and how to build the sensor circuitry. In Part 2, we'll show you how to connect the sensor circuitry to an X10 interface, and how the X10 receiver and software works.

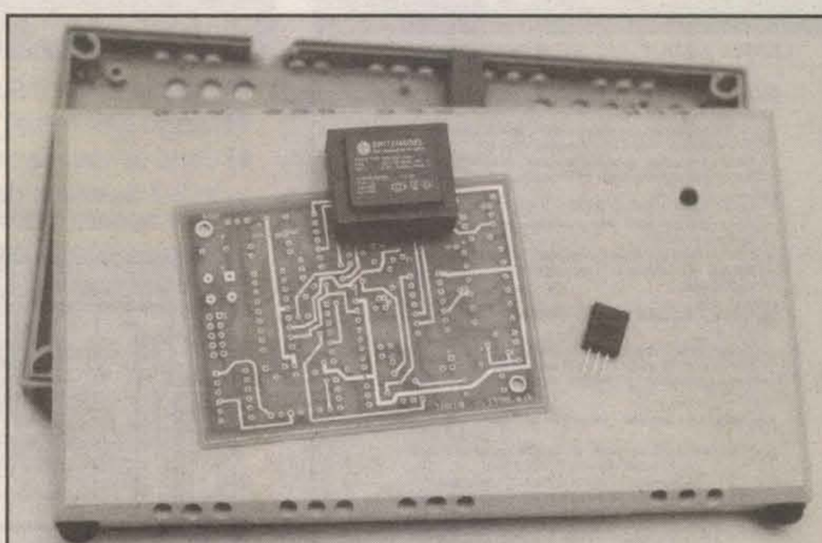
Why Bother to Measure Humidity?

Ever since we moved from up North to South Carolina several years ago, my family and I have not been able to adjust to the temperature. Not outside; the temperature outside is nearly always warm to hot and your body seems to become accustomed to that. The problem is inside, where the windows and doors are kept closed and the environment is supposedly controlled. Temperature fluctuations are kept to a minimum thanks to the heating and air-conditioning systems and programmable thermostats. However, it almost never feels ideal. Most of the time, it feels either too warm or too cool, even though the thermostats both upstairs and downstairs swear that the temperature hasn't changed. What they don't tell us anything about is the humidity.

Our HVAC systems work very hard to maintain a constant temperature, because our bodies are greatly affected by the temperature. However, human bodies, as well as many other living and non-living things, are also greatly affected by the humidity. Our natural cooling system is dependent on our sweat



The THX10 circuit board with components installed.



The compact 12-volt transformer, THX10 circuit board, humidity sensor, and plastic enclosure. Note the many holes drilled into the enclosure for ventilation.

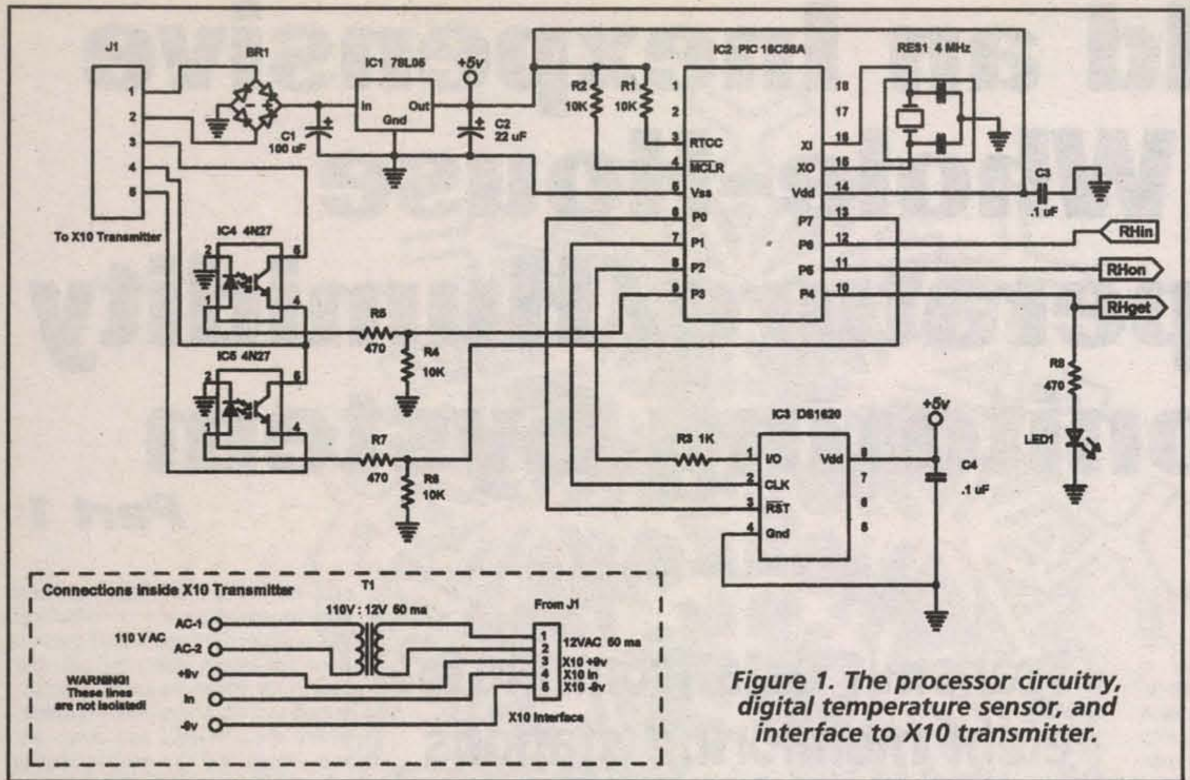


Figure 1. The processor circuitry, digital temperature sensor, and interface to X10 transmitter.

or humidity alone. The heat index accounts for the ability of moisture to evaporate (low humidity) or to not evaporate (high humidity). Table 1 shows the heat index for temperatures and humidities in 10°/% increments. Note the example above: 80° F, 90% RH feels like 88°, but 90° F, 90% RH feels like a whopping 122°!

Prolonged exposure and physical activity at a heat index of greater than 90 can cause heat exhaustion, while an index greater than 100 can lead to heat stroke. While the temperatures in our homes are not likely in this high a range, you can see from the chart that humidity does have an affect even at room temperatures, in the 60-90° F range. High humidities in the 80-90° F range make it feel five or more degrees warmer, while low humidities in the 60-70° F range make it feel five or more degrees cooler than a thermostat would say.

So why don't our thermostats measure heat index, rather than just temperature? One big reason is that monitoring and detecting water vapor is much more difficult than measuring other parameters, such as temperature, pressure, etc. Humidity sensors tend to have limited lifetimes, most are highly non-linear and highly temperature-dependent, and they typically have very high part-to-part tolerances, meaning they must be calibrated.

A typical calibration involves placing certain salt solutions in closed containers to give known humidity levels. This is not practical for most manufacturers, and probably nearly impossible for most home tinkerers.

being able to evaporate. If the humidity is very high, the moisture we secrete out of our sweat glands tends to remain on our skin. There is no significant gradient between the moisture on our moist skin to the moist atmosphere, so we experience no cooling effect.

On the other hand, when the humidity is very low, moisture on our skin evaporates very quickly into the relatively moisture-free atmosphere. When this evaporation takes place, a certain amount of heat is given up from our skin to the environment, and our skin feels cool. When our skin feels cool, we feel cool.

Air at any specific temperature can only hold a finite amount of water vapor. When the air is forced to hold as much moisture as possible, it is said to be saturated. At higher temperatures, the air can hold larger amounts of water vapor, in fact, much larger amounts – it is an exponential relationship. Relative Humidity is defined as the amount of water vapor that is currently present in the air, divided by the maximum that the air can hold at that same temperature. Therefore, there is a lot more moisture in the air at 90° F, 90% RH, than at 80° F, 90% RH.

It Ain't the Heat, It's the Humidity!

We can generate what is known as the heat index, using both temperature and humidity. The heat index is probably a better indicator of how we feel than either temperature

The NH-03 Humidity Sensor

The circuitry in this article is designed around a humidity sensor distributed by Figaro USA, Inc. The NH-03 sensor contains two relative humidity sensitive elements, made from a stable high polymer impregnated in porous ceramic. The sensor also contains two printed NTC thermistors on an alumina ceramic substrate.

The network of humidity and temperature sensors provide temperature compensation, as well as a linear output. The sensor is provided in a small (10 mm x 12 mm x 4 mm) plastic package with three leads, spaced 0.1 inch apart. Figaro states the overall long-term accuracy of the sensor to be ± 10% for 0-40° C (50-104° F) and 30-80% RH, but when used in the self-calibrating circuit (see below), deviations greater than about 3% RH haven't been detected.

Humidity measurement is complicated by the fact that any DC voltage applied to the sensor will degrade the humidity-sensitive elements. In a typical humidity measuring operation, an AC voltage of precisely 1 volt, 1 KHz is supplied across pins 1 and 3 of the sensor. The output is an AC voltage across pins 1 and 2. This AC output voltage is nearly a linear relationship with the % Relative Humidity.

Due to the sensor network, the output is basically independent of fluctuations in temperature and frequency. However, the output is very sensitive to the actual level of input AC voltage, as well as our ability to accurately measure small AC voltages.

A self-calibration technique is used to overcome the problems with the small AC voltages. Circuitry is provided to change the output AC voltage to a DC voltage and then translate the DC voltage to a pulse width. The PIC CPU chip is able to make precise timing measurements of the pulse width.

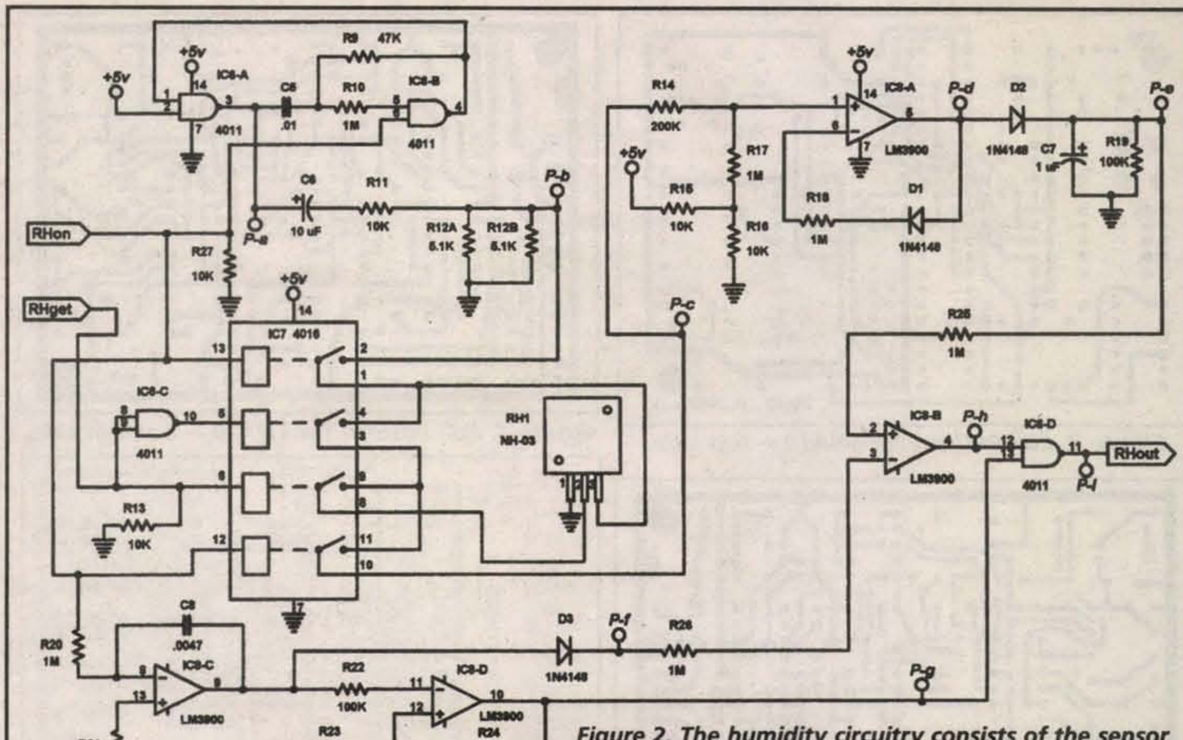


Figure 2. The humidity circuitry consists of the sensor and three ICs. It connects to the processor circuit via two inputs, one output, and voltage lines.

The measurement process is done twice; the first time measuring the results of the input voltage, the second time measuring the results of the output voltage. Both pulse widths are directly proportional to the corresponding AC voltages: the input AC voltage, a nominal one volt, and the output AC voltage which is a measure of the Relative Humidity and can vary anywhere between 0 volt to 1 volt. Dividing the pulse widths gives the same result as dividing the voltages. This software technique eliminates the need for calibration or for precise AC voltage generation and measurement equipment.

The DS1620 Temperature Sensor

If you read a lot of electronic and PIC literature and magazines, you've probably seen this temperature sensor made by Dallas Semiconductor described before. It is a truly digital chip; it measures the temperature by means of internal oscillators, and outputs data in digital format. It is accurate, stable, and is very easy to interface to a PIC chip. Since it requires no calibration, it is the perfect counterpart for the self-calibrating humidity circuit. Dallas claims the accuracy of the chip to be ±0.5° C (about 1.0° F).

The CPU

PIC microprocessor chips are turning up everywhere nowadays. They are becoming as common as 555 timer chips. The PIC16C58A from Microchip used in this THX10 circuit communicates with the humidity circuitry and with the temperature chip, and does some calculations to convert the data to °F and % RH. It then sends the data to an X10 transmitter as eight-bit binary sequences, and it communicates the findings on a single LED, used mainly for debugging.

Although any one of these tasks would not be a big problem, developing a circuit built up from discrete logic ICs to handle ALL these tasks would be impractical. The PIC chip does it all easily, and spends more than 90% of the time in a low power sleep mode.

The Processor Circuit, Temperature Sensor, and Interface

Refer to Figure 1 for details of the processor circuit. The circuit receives a 12-volt AC power input at pins 1 and 2 of J1. BR1 rectifies it, producing a DC voltage that is smoothed by C1, regulated by IC1, and filtered by C2, producing a 5-volt DC power supply. The total circuit draws at most 20 mA or so (most of the time much less), so the regulator runs cool. IC2 — the PIC CPU — receives the 5-volt supply with an additional capacitor, C3, to reduce high-frequency fluctuations.

RES1 connects to pins 15 and 16 of IC2 to provide a 4-MHz clock pulse. Unused pins 3 and 4 are pulled high by R1 and R2 to avoid

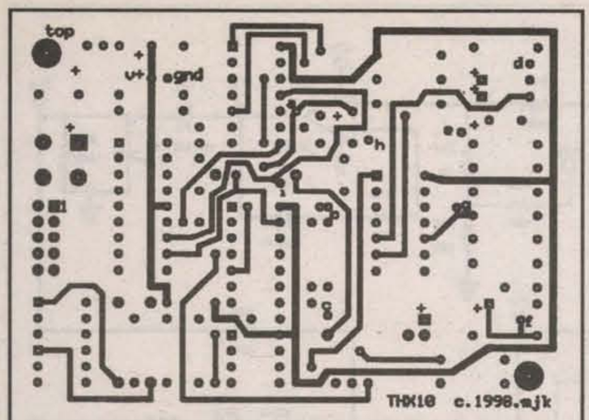


Figure 3. Foil Pattern for THX10 — top side.

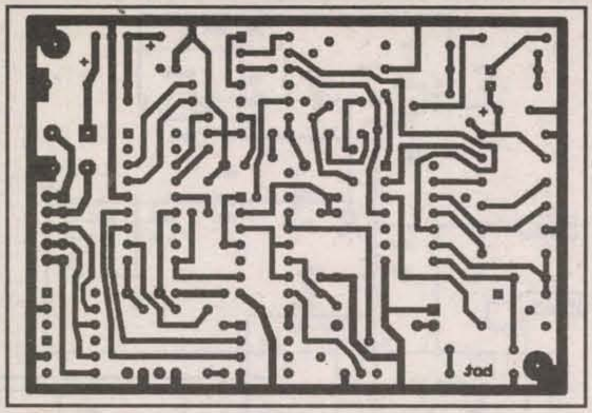


Figure 4. Foil Pattern for THX10 — bottom side.

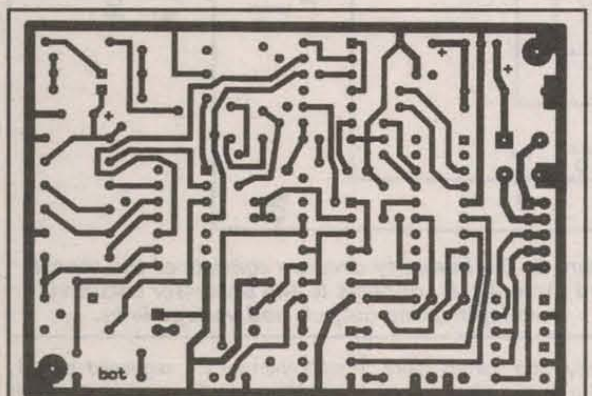


Figure 4a. Foil Pattern for THX10 — bottom side (inverted).

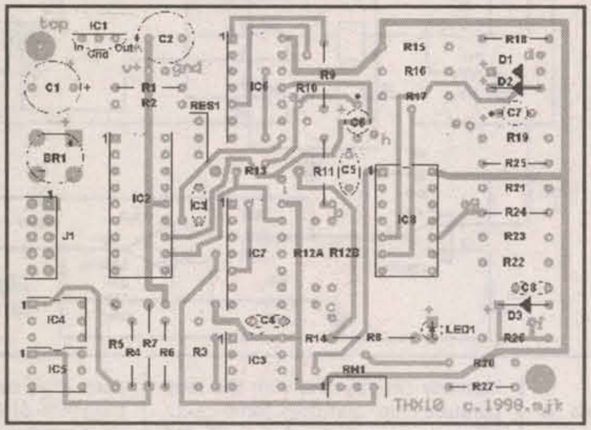


Figure 5. Parts placement for THX10 — top side of PC board.

spurious signals that could cause strange reactions. IC2, a programmed Microchip 16C58A PIC chip, uses the other lines to communicate with the temperature sensor, the humidity circuitry, and the X10 interface.

Pins 6, 7, and 8 are used to communicate to IC3, a Dallas DS1620 thermometer IC. This chip contains a built-in temperature sensor and digital circuitry that outputs the data in 0.5° C increments; this precision is approx. 1° F. Typical error for a normal environment (about 0 to 120° F) is well within the 1° F resolution.

C4 is an additional filter capacitor to reduce spurious high-frequency noise. Data is transmitted to/from input/output pin 1 of IC3, while pins 2 and 3 are inputs from IC2. More details on the DS1620 can be obtained from Dallas Semiconductor Corp.

Pins 10, 11, and 12 of IC2 are used to communicate to the humidity circuitry (more on this later). Pin 10 does double-duty by also driving LED1 through current limiting resistor R8. LED1 is used for monitoring and debugging, and as a human

```
' Program T_H_X10.BAS written in PBASIC for BASIC STAMP I
' For programmed PIC16C58A-04, email mkeryan@pobox.com
' Copyright 1998  Mike Keryan
' Interfaces:      input    Dallas DS1620 Digital Temperature IC
'                  input    Figaro NH-03 Humidity sensor and associated
'                           circuitry giving a variable width pulse
'                  output   single Led, used to display data
'                  output   two relays, one for on-bit, one for off-bit
'                           these control an X-10 control interface

'The system grabs either temperature (from a digital temperature IC)
'or humidity (from a linear humidity-dependent resistive sensor)
'alternately every 5 minutes. Each one is updated every 10 minutes.
'The display is a single Led which blinks the appropriate number
'of times to count out each digit of the temperature or humid. data.
'Captured data is output to the X-10 controller as a series of 8
'on or off bits. Temperature data is in deg. F., Humidity sent via
'X-10 is % relative humidity, with the last bit set (+128), so that
'receiving program monitoring X-10 line can tell which is which.

'————————input/output pins
SYMBOL RST = 0                    ' PIN0 is reset for DS1620
SYMBOL CLK = 1                    ' PIN1 is clock for DS1620
SYMBOL DQn = 2                    ' PIN2 is data i/o for DS1620
SYMBOL DQp = pin2                 ' PIN2 for inputting, outputting a bit
SYMBOL RelayOn = 3                ' PIN3 is relay output for on state
SYMBOL Led = 4                    ' PIN4 is output to Led
SYMBOL RHget = 4                  ' PIN4 also used to switch between:
'                                   0 = applied voltage measured
'                                   1 = response voltage measured
SYMBOL RHon = 5                   ' PIN5 high activates RH circuitry
SYMBOL RHin = 6                   ' PIN6 is input pulse for RH
SYMBOL RelayOff = 7               ' PIN7 is relay output for off state

'————————variable storage
SYMBOL DSout = W0       ' data to DS1620; W0 overlaps B0, B1,
SYMBOL DSin = W0        ' data from DS1620;          and BIT0-BIT7,
SYMBOL DSDat = W0       ' data in DS format;         and BIT8-BIT15
SYMBOL BitOut = BIT0    ' output data one bit at a time
SYMBOL BitIn = BIT8     ' input data one bit at a time
SYMBOL SignBit = BIT8   ' data is negative (deg C) when this bit is set

SYMBOL CountSec = B4    ' 8 bit counter for 2.3 second increments
SYMBOL WhichOne = B5    ' 1 = temperature, 0 = humidity
SYMBOL HumiData = B6    ' humidity, % RH
SYMBOL TempData = B6    ' temperature, deg F
SYMBOL LedData = B6     ' data to pulse out on LED
SYMBOL Unused = B7      '
SYMBOL DataOut = B8     ' data to send to relays
SYMBOL Pulses = B9      ' 8 bit register for counting pulses
SYMBOL I = B10          ' index for loop
SYMBOL J = B11          ' temporary variable
SYMBOL ABit = B11       ' bit sent to relays
SYMBOL V0 = W1          ' pulse width for applied voltage to hum. sensor
                        ' W1 overlaps B2 and B3
SYMBOL V1 = W6          ' pulse width for response voltage from hum. sensor
                        ' W6 overlaps B12, B13 which are used during
GOSUBS

'————————constants
SYMBOL WConfig = $0C   ' code to write to configuration register
SYMBOL CPU = %10       ' configuration bit for thermometer mode
SYMBOL OneShot = %01   ' configuration bit for one conversion only
SYMBOL StartC = $EE    ' code to start conversion
SYMBOL RTemp = $AA     ' code to read temperature out of DS1620

'————————initialize the DS1620 chip's EEPROM at power-up
        LOW RST                   ' deactivate DS1620
        HIGH CLK                  ' initially high per specs
        PAUSE 2000                ' let everything stabilize
        DSout = WConfig           ' write configuration
        GOSUB ShiftOut            ' to DS1620
        DSout = CPU + OneShot     ' thermometer in 1-shot mode
        GOSUB ShiftOut            ' to DS1620
        LOW RST                   ' deactivate DS1620
        Pulses = 3                ' send 3 long blinks
        GOSUB BlinkLed            '    to tell its on and working

'————————continually loop between here and end
Loop:
        WhichOne = WhichOne + 1 & 1      ' counts 1, 0, 1, 0, 1, ...
        IF WhichOne = 1 THEN Temper

'————————get humidity data when WhichOne = 0
Humid:
        HIGH RHon                 ' turn on humidity circuitry
        PAUSE 2000                ' wait till stable
        PULSIN RHin, 0, V0        ' get pulse width for V0 (applied)
        IF V0 < 10 THEN Humid     ' eliminate glitches
        HIGH RHget                ' switch from applied to response
        PAUSE 1000                ' wait till stable
        PULSIN RHin, 0, V1        ' get pulse width for V1 (response)
        LOW RHget                 ' shut down V1 output
        LOW RHon                  ' shut down humidity circuit
        HumiData = 140 * V1 / V0 + 61 / 2  ' % relative humidity
        DataOut = HumiData + 128              ' set high bit
        GOTO Relays
```

interface, but is not needed for operation otherwise.

Pins 9 and 13 are used as outputs to the X10 interface. A high (+5 volt) signal on pin 9 is used to send an 'on' signal to the X10 transmitter. A high signal on pin 13 sends an 'off' signal to the transmitter. The lines are kept low when not really sending signals by resistors R4 and R6. Resistors R5 and R7 limit the current to the light-emitting diodes in optoisolators IC4 and IC5. The outputs of these two ICs are NPN transistors that either conduct (send 'on' or 'off' signals to the X10 transmitter) when the LEDs are conducting, or are open circuits when no current passes through the diodes. The X10 interfacing is explained in more detail in the second part of this article.

The Humidity Circuit

Refer to Figure 2 to understand how the humidity circuit works. It is built around a relative humidity sensor, RH1, an NH-03 from Figaro USA, Inc. It contains two humidity-sensitive elements made from a stable high polymer impregnated in porous ceramic, and two printed NTC thermistors. The elements are manufactured so that when an AC voltage of about 1 volt AC/approximately 1000 Hz is applied to the input (across pins 1 and 3), an output AC voltage is presented (across pins 1 and 2) so that this output AC voltage is proportional to % relative humidity.

The linear, temperature-compensated output greatly reduces the problems that would be present for exponential-type outputs normally found with these types of sensors. However, there are two problems that present themselves: that of the AC input/output and the calibration of the AC signals.

AC voltage is required for input to the humidity sensor. Any DC applied to the sensor will cause permanent damage to the sensor element and render it useless. Therefore, a simple DC resistance circuit is out of the question. However, AC circuits are relatively difficult to regulate. A 10% deviation in the input signal would translate to an error of 10% or more. A self-calibration technique is used to get around these problems.

Two sections of a CMOS NAND gate (IC6-A and IC6-B) are used to create a 5-volt squarewave generator. Pin 6 is used to gate the oscillator; when it is high (+5 volt), the circuit oscillates, while when it is low (0 volt), there is no oscillation. This gate is controlled by the CPU pin 11 (signal labeled 'RHon.' The R9-C5 combination sets the rate of oscillation.

For the part values shown, it is approximately 1 KHz. Therefore, the output at pin 3 ('P-a' on Figure 2, pt 'a' on the PC board) is a 5-volt, 1-KHz gated squarewave. C6 is used to translate this from a [+5V to 0V] signal to a [+2.5V to -2.5V] (true AC) signal. It is reduced to a 1-volt signal [+0.5V to -0.5V] by the divider made up of resistors R11 and R12. This 1-V 1-KHz AC signal can then be applied to the humidity sensor.

IC7 (a CMOS quad bilateral switch) and gate IC6-C (used as an inverter) form a switch that isolates the humidity sensor when the circuit is not really measuring humidity. They also are used to switch either the input or the output to the measuring circuitry that follows it. When 'RHon' is high (+5V), the 1-V 1-KHz AC signal is applied to the input to the sensor, and an output is sent to

TABLE 1. HEAT INDEX TABLE

To use the table, find the temperature — in deg. F. — along the top, and the relative humidity — in % — along the left. The cell at the intersection of the two is the heat index. This is how hot the combination of temperature and humidity will actually feel.

Air Temperature, deg. F. / **Heat Index: Apparent Temperature**

Relative Humidity	70	75	80	85	90	95	100	105	110	115	120
0%	64	69	73	78	83	87	91	95	99	103	107
10%	65	70	75	80	85	90	95	100	105	111	116
20%	66	72	77	82	87	93	99	105	112	120	130
30%	67	73	78	84	90	96	104	113	123	135	148
40%	68	74	79	86	93	101	110	123	137	151	
50%	69	75	81	88	96	107	120	135	150		
60%	70	76	82	90	100	114	132	149			
70%	70	77	85	93	106	124	144				
80%	71	78	86	97	113	136	157				
90%	71	79	88	102	122	150	170				
100%	72	80	91	108	133	166					

```
'————get temperature data when WhichOne = 1
Temper:
        DSout = StartC              ' code to start a temp. conversion
        GOSUB ShiftOut              ' to DS1620
        LOW RST                     ' deactivate DS1620
        PAUSE 2000                  ' wait for conversion to end
                                    ' and additional second
        DSout = RTemp               ' code to get the temperature
        GOSUB ShiftOut              ' to DS1620

'————read data from DS1620 chip
        INPUT DQn                   ' make pin an input
        FOR I = 1 TO 9              ' for 9 bits
                DSin = DSin / 2     ' shift right 1 bit
                LOW CLK             ' falling clock triggers DS1620
                BitIn = DQp         ' get the data bit
                HIGH CLK            ' preset clock high
        NEXT I
        LOW RST                         ' deactivate DS1820

        IF SignBit = 0 THEN Skip        ' this means neg. deg. C
        DSDat = DSDat | $FE00           ' make 16-bit 2's compl.
Skip:
        TempData = DSDat * 9 + 325 / 10 ' convert to deg. F
        DataOut = TempData

'————send data to relays
Relays:
        FOR I = 1 TO 8                  ' for 8 bits
                ABit = DataOut & 1      ' lowest bit
                IF ABit = 1 THEN HiBit
LowBit:         HIGH RelayOff           ' pulse for off state relay
                GOTO RelayDelay
HiBit:
                HIGH RelayOn            ' pulse for on state relay
RelayDelay:
                PAUSE 500               ' 0.5 second on time
                LOW RelayOff            ' turn off
                LOW RelayOn             ' both relays
                PAUSE 1500              ' 1.5 second off time
                DataOut = DataOut / 2   ' shift to next bit
        NEXT I

'————display temperature by blinking led
Display:
        Pulses = LedData / 100      ' hundreds
        GOSUB BlinkLed              ' blink that many hundreds
        Pulses = Pulses * 100       ' either 0, 100, or 200
        J = LedData - Pulses        ' tens and units
        Pulses = J / 10             ' tens only
        GOSUB BlinkLed              ' blink that many tens
        Pulses = J // 10  ' units only
        GOSUB BlinkLed              ' blink that many ones

'————loop consumes 5 minutes, mostly in low-power mode
Loop5min:
        FOR CountSec = 1 TO 130         ' about 5 minutes per loop
                SLEEP 1                 ' low power for 2.3 seconds
        NEXT CountSec
        GOTO Loop                       ' redo everything
        END

'————send data to DS1620 chip
ShiftOut:
        HIGH RST                        ' activate DS1620
        OUTPUT DQn                      ' make pin an output
        FOR I = 1 TO 8                  ' for 8 bits
                LOW CLK                 ' preset clock low
                DQp = BitOut            ' data bit to DS1620
                HIGH CLK                ' rising clock triggers DS1620
                DSout = DSout / 2       ' shift right for next bit
        NEXT I
        RETURN

'————blink the led a certain number of times
BlinkLed:
        HIGH Led                        ' turn on Led
        PAUSE 10                        ' at least a short blink
        IF Pulses = 0 THEN DoneBlink    ' for zero count, skip loop
        FOR I = 1 to Pulses             ' do how many times
                HIGH Led                ' turn on Led
                PAUSE 500               ' wait 0.5 second
                LOW Led                 ' turn off Led
                PAUSE 500               ' wait 0.5 second
        NEXT I
DoneBlink:
        LOW Led                         ' turn off Led
        PAUSE 1000                      ' wait a second
        RETURN
```

PARTS LIST FOR HUMIDITY-TEMPERATURE TRANSMITTER

SEMICONDUCTORS
IC1 - 78L05 5-volt 100-mA voltage regulator integrated circuit, TO-92 package
IC2 - PIC16C58A-04, Microchip 8-bit RISC microcontroller integrated circuit programmed with THX10 program (see below)
IC3 - DS1620, Dallas digital thermometer integrated circuit, Jameco #114382
IC4, IC5 - 4N27 (NTE/ECG #3040) optoisolator: diode and NPN phototransistor integrated circuit, Jameco #144240 or Digi-Key #4N27QT-ND
IC6 - CD4011 quad 2-input NAND gate CMOS integrated circuit
IC7 - CD4016 quad bilateral switch CMOS integrated circuit
IC8 - LM3900N or CA3401N quad current-mirror op-amp integrated circuit
BR1 - W02G full wave bridge rectifier, 4 lead molded 200-PRV 1-Amp, Jameco #103018 or Digi-Key W02G-ND
D1, D2, D3 - 1N4148 or 1N914 silicon switching diode 75-PRV 10-mA
LED1 - Light emitting diode, red

RESISTORS
(All resistors are 1/4 watt, 5% units unless noted otherwise)
R1, R2, R4, R6, R11, R13, R15, R16, R27 - 10,000-ohm
R3 - 1000-ohm
R5, R7, R8 - 470-ohm
R9 - 47,000-ohm
R10, R17, R18, R20, R23, R25, R26 - 1.0-megohm
R12A, R12B - 5100-ohm (*see text*)
R14 - 200,000-ohm
R19, R22 - 100,000-ohm
R21 - 510,000-ohm
R24 - 120,000-ohm

CAPACITORS
C1 - 100-uF, 25-WVDC, electrolytic
C2 - 22-uF, 25-WVDC, electrolytic
C3, C4 - 0.1-uF, ceramic disk
C5 - 0.01-uF, 10% mylar
C6 - 10-uF, 25-WVDC, electrolytic
C7 - 1.0-uF, 25-WVDC, electrolytic
C8 - 0.0047-uF, 10% mylar

ADDITIONAL PARTS AND MATERIALS
J1 - 0.100" right angle male header 10 conductor (2X5), and matching IDC socket connector (such as Jameco S-10)
RES1 - 4-MHz ceramic resonator, Digi-Key PX400-ND or equivalent
RH1 - NH-03 temperature-compensated linearized-AC humidity sensor, available from Figaro USA, www.figarosensor.com (see below)
T1 - low profile transformer 115-V 60-Hz primary, 12-V @ 50-mA secondary, SPK0051200-10001 or equivalent, available from Advanced Components Industries, www.advancedcomponents.com (see below)
Mini-controller - X10 Powerhouse Transmitter MC460 (Tech America #980-0213, Home Automation Systems www.smarthome.com #4030), or Home Controls Inc. www.homecontrols.com #XT460X) or similar products by Stanley (Home Automation Systems #4031) or RadioShack #61-2677c (see text)
PC Interface - X10 Activehome CM11A (Home Automation Systems www.smarthome.com #1140), also available as part of X10 home automation kit at RadioShack stores, Home Controls Inc. www.homecontrols.com #XTCK11A, etc. (see text)

IC sockets, PC board (see below), suitable enclosure, wire, hardware, PC and software, etc.

Note: The following items are available from **M. Keryan, 207 Baucom Park Dr., Greer, SC 29650**: Preprogrammed IC2 and 3-1/2" diskette with X10 monitoring software, circuit board layout, etc., $15.00; Etched and drilled double-sided PC board, $20.00; RH1 humidity sensor, $14.00; T1 transformer $10.00. Quantity discounts of 20% for 3 or more of same items. Please include $5.00 shipping and handling per order ($10.00 for international orders), check or money order only in US funds. SC residents add 5% sales tax. Source code for PIC controller and for PC monitoring available.

Michael J. Keryan — 207 Baucom Park Drive — Greer, SC 29650
(864) 244-4175 — mkeryan@pobox.com

the rest of the circuit. However, signal 'RHget' (from the CPU pin 10) is used to create a SPDT switch so that the output via pin 10 of IC7 is either the input to the sensor (when 'RHget' is high, the AC signal is passed from pin 2 to pin 1 to pin 4 to pin 3 to pin 11 and then to pin 10) to measure the 'control' signal, or the output of the sensor (when 'RHget' is low, the AC signal is passed through pin 2 through the sensor from its pin 3 to pin 2, to IC7 pin 8 to pin 9 to pin 11 and then to pin 10) to measure the 'test' signal.

The result of all of the above: when 'RHon' is high and 'RHget' is low, the output 'P-c' is the control signal (the input to the sensor), which, at that point, is the 1-V AC signal attenuated slightly by passing through three sections of IC7. When 'RHon' is high and 'RHget' is also high, the output 'P-c' is the test signal (the output from the sensor), which is an AC signal, typically less than 1-V AC and directly proportional to % RH; this signal is also attenuated slightly by passing through three sections of IC7. The CPU then measures two signals: the control signal and the test signal.

Software inside the CPU's program divides the result from the test by the result from the control. This effectively cancels out any effects of voltage loss through IC7, deviations from 1 KHz, deviations from 1-VAC, deviations in the trianglewaves or amps (see below), etc. It completely eliminates the need for any calibration whatsoever.

The rest of the circuit is used to create a signal that the CPU can measure that is in some way directly proportional to the level of AC voltage at 'P-c.' In this case, it is a pulse width which the CPU measures. The signal at 'P-c' is an AC 1-KHz squarewave that varies from approx. 1-V (for 'control' or for 100% RH 'test') to nearly 0-V (for about 30% RH 'test'). The amplifier IC8-A and resistors R14, 15, 16, 17, and D1 rectify the AC signal and amplify it to more measurable levels. D2, C7, and R19 filter it so that the signal at 'P-e' is a DC signal that is approximately 2.5V maximum, about 0.5V minimum.

IC8-C and IC8-D and associated components (R20, 21, 22, 23, and 24, and C8) form a precision trianglewave generator, with a frequency of about 125 Hz. It also is gated (turned on) by a high level of 'RHon.' The output of the trianglewave is dropped a fraction of a volt through D3, so that the high tip of the triangle is at about 2.9V, while the low tip is about 0.4V, at 'P-f.' A squarewave at the same frequency of the triangle is output via pin 10 of IC8-D ('P-g'); the squarewave is high whenever the triangle is increasing (going from 0.4V to 2.9V), while it is low when the triangle is decreasing (going from 2.9V to 0.4V).

Another squarewave is created by IC8-B, used as a comparator. Here this squarewave at 'P-h' is high whenever the voltage of the trianglewave is less than the DC level at 'P-e.' The two squarewaves are gated by IC6-D NAND gate to form a pulse, that is at 0V only when the trianglewave is increasing and is at a lower voltage than the DC voltage at 'P-e.' The width of this negative pulse is therefore directly proportional to the DC voltage at 'P-e' and thus also proportional to the AC voltage at 'P-c.'

The humidity circuitry appears quite complex, as is its explanation. However, it uses three extremely inexpensive ICs and a handful of resistors, capacitors, and diodes. It is designed so that the results are virtually independent of any minor deviations in parts values, voltages, or frequencies. The results are almost totally defined by the precision and accuracy of the humidity sensor itself, and the cost of the circuitry of Figure 2 is also almost totally defined by the cost of the sensor.

Parts and Construction

Except for the oscillator of the PIC CPU, no very high frequencies are involved, and voltages and currents are low. Therefore, any type of circuit construction (breadboarding, wire wrapping, etc.) will work fine. However, to keep the circuit small and to avoid wiring errors, a printed circuit is recommended. Foil patterns for the top and bottom of a double-sided board are included if you are adept at etching your own boards. For the rest of you, PC boards can be purchased from the author (see the parts list).

A preprogrammed PIC CPU containing the THX10 program can be purchased, as well as the other hard-to-get parts (see the parts list). The humidity sensor is available from the author and through Figaro; there is no substitute for this item. Other transformers can be used to deliver 12 volts to the circuit, but the part shown in the parts list is ideal for making a compact system – it is only 0.6 inch tall, allowing a very thin case to be used. You should have no trouble finding any of the other parts; sources for some of them are shown in the parts list.

The op-amp (IC8) should not be substituted. It uses current-mirror techniques, so other types of op-amps will not work at all in the circuit. It is also about the least expensive op-amp you can find. For the resistors, you should stick to using 1/4 watt to ensure they will physically fit. The same goes for the capacitors; higher voltage caps will work fine, just make sure they will fit on the board. For J1, a 2x5 connector was used because a 10-pin female connector is easier to find than a five-pin connector. If you wish, use a five-pin connector installed in either of the rows on the PC board.

For R12, two 5100-ohm resistors are used in parallel to give a 2550-ohm equivalent. This is close enough to the desired 2500-ohm that would give an exact 1-volt p-p AC signal. If you can find one, use a single 2500-ohm 1% resistor installed in either the R12A or R12B position on the PC board. The only capacitors that are critical at all are C5 and C8. Make sure you use 10% mylar or better here to minimize timing drifts.

A red LED is specified in the parts list, but actually any color will do. You may want to splurge and get a high-brightness LED for about a dollar, instead of a standard brightness 20-cent LED. The brighter ones are easier to see from across the room.

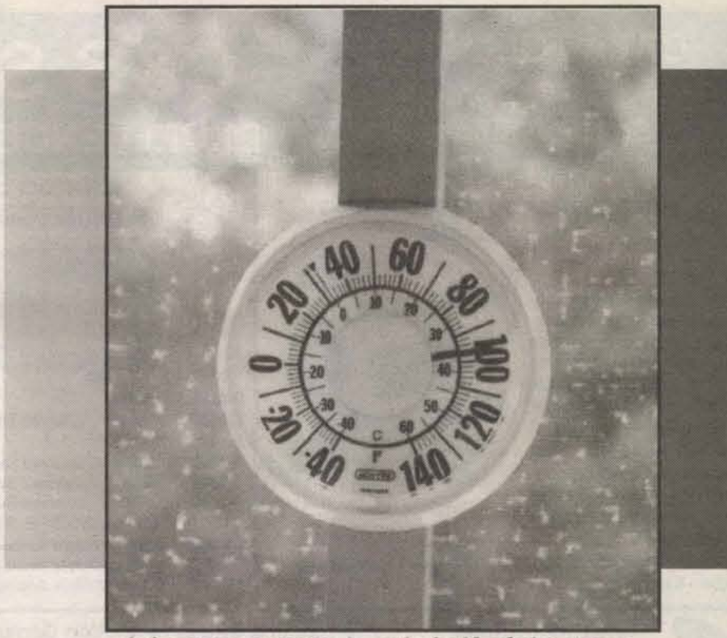
There are no jumpers to worry about. Use IC sockets for all the ICs except the regulator, IC1. When soldering in IC1, the LED, and the diodes, take care to not overheat the leads; you may want to use a hemostat-type heatsink clamped to the leads. If you build your system like the author, you will want to stand the LED off the PCB so that it will fit into a hole drilled in the top side of the case.

Using the placement diagram, solder in all the resistors and diodes (watch the diode orientation – the banded ends all point the same way, toward the left). Similarly, for the items that are partially round but have one flat side (IC1, BR1, LED1) – the flat ends all go toward the top of the board. RES1 can be oriented either way. RH1 must be oriented so that the front (the side with the two little 'M's) faces the closest edge of the PC board.

After all the parts are soldered in, inspect your work to make sure there are no solder bridges and that everything is clean and shiny (no cold solder joints). Then plug in all the ICs, making sure all pin 1s (the end with the dimple or notch) face towards the top of the board. Take the normal precautions to avoid static electricity discharges when handling the ICs.

Testing and Calibration

To test the board after construction, connect either a 12-volt (AC or DC) supply or a 9-volt battery to pins 1 and 2 of J1, with no connections to pins 3, 4, and 5 of J1. After a few seconds, you should see the LED blink three times. This indicates that the CPU and program inside it are working. After about 10 more seconds, you should see the LED blink out the temperature, in degrees F. After about five to six minutes, you'll see the LED come on for about two seconds, then after about 10 more seconds, it will blink out the humidity, in %. Try breathing directly on the humidity sensor just before it takes a reading, and notice the change in humidity.



The temperature is only half of the story.

You may be wondering how a single LED can be used to blink out this information to you in a meaningful way. It blinks in one-second intervals – 1/2 second on, 1/2 second off. One blink means 1, two blinks means 2, ... nine blinks means 9.

Between the hundreds and tens digits and between the tens and units digits, there is a longer gap, or pause. For a zero, there is a very short blink, one that is noticeably shorter than the others. For example consider a sequence like this: a very short blink – a pause – 7 blinks – a pause - 3 blinks; this is 0-7-3, or 73. The humidity is preceeded by about a two-second long blink to differentiate it from temperature.

What about calibration? There isn't any. The Dallas thermometer chip (IC3) is truly digital; it sends binary data to the CPU. The humidity circuit (see section: 'The Humidity Circuit') uses a self-calibration technique. Any inaccuracies that occur are due to either the sensors themselves, or are due to their placement and the possibility that they might not be ventilated adequately.

The only thing that remains to be tested is the interface to the X10 transmitter. We'll do that when we describe how to connect the sensor board to the transmitter.

For Next Time

This concludes Part 1 of this two-part article. To this point, we have constructed a PC board that contains sensors for temperature and humidity, and a PIC CPU that processes the data and sends the data to an interface. In its current state, it is a self-contained instrument that can communicate its findings via a LED.

Next time, we will explain how to interface this instrument to an inexpensive X10 mini-controller that transmits the data on our house power line. So, between now and then, build the sensor board and have fun watching the LED count. Later on, get the remaining parts: the mini-controller and the serial PC interface that will be used to receive the data on up to eight of the transmitters. Also make sure you have a free serial port on your PC. **NV**

Events CALENDAR

The Events Calendar is a free service for publicizing electronic events such as amateur radio hamfests, flea markets, etc. If your organization is sponsoring an event and would like a free listing, contact us at least 60 days in advance. Include your flyer, estimated attendance, name of the person to contact, and phone number.

Complimentary issues are available upon request for distribution to your attendees. A street address for UPS is required.

While we strive for accuracy in our calendar, we can not be responsible for errors or cancellations. The information contained in this column is for the use of the readers of *Nuts & Volts* and may not be republished in any form without the written permission of T & L Publications, Inc.

All listing information should be sent to:
Nuts & Volts Magazine
Events Calendar
430 Princeland Court
Corona, CA 91719
Phone 909-371-8497
Fax 909-371-3052
E-mail events@nutsvolts.com

FEBRUARY 1999

FEBRUARY 1

AZ - PHOENIX - Auction. St. Clement of Rome Catholic Church Social Hall, 15800 Del Webb Blvd. Talk-in: 147.30+ West Valley ARC, Ralph W0DNO, 602-582-8208.
E-Mail: w0dno@worldnet.att.net

FEBRUARY 6

AR - WEST MEMPHIS - Hamfest. Eugene Woods Civic Center, 212 W. Polk. 9am-4pm. VE Exams. Talk-in: 147.150+, 444.775+. Dixie AR Group, Kellye Farris KB5RCE, 870-732-8724.
E-Mail: kb5rce@media-two.com
E-Mail: dixiefest@media-two.com
Web: http://www.media-two.com/DARG

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

IA - MONTOUR - Hamfest. Jerry Morrison N0LEM, 515-484-6036. E-Mail: N0LEM@W0CXX-1.IA.USA.NA E-Mail: lmonster@pcpartner.net

KS - MOUND CITY - Hamfest. Mine Creek ARC, Bill VanKirk W0PT, 913-795-2080.
E-Mail: bvkirk@kanza.net

SC - NORTH CHARLESTON - Hamfest. Stall High School. 8:30am-4pm.VE Exams. Charleston ARS, Jenny Myers WA4NGV, 843-747-2324.
E-Mail: brycemyers@aol.com
E-Mail: wa4usn@amsat.org

FEBRUARY 6-7

FL - MIAMI - Tropical Hamboree. Fair Expo Center, S.W. 112th Ave. & Coral Way. VE Exams. Talk-in: 146.925, 146.76, 444.525. Dade Radio Club of Miami, Evelyn Gauzens. 305-642-4139, E-Mail: edg@elink.net. 305-226-5346, E-Mail: wd4sfg@bellsouth.net. Web: www.hamboree.org

FEBRUARY 7

OH - LORAIN - Hamfest. Northern Ohio ARS, Mike Willemin W8EU, 440-324-4574

PA - LATROBE - Hamfest. American Legion, 1811 Ligonier St. 8am-1pm. Talk-in: 145.150 (-600). Chestnut Ridge ARC, William Demosky K3AFS, 724-539-1552

FEBRUARY 12-13-14

FL - ORLANDO - Hamfest. Northern FL Section Conv., Tim Starr AE4NJ, 407-850-9258.
E-Mail: AE4NJ@aol.com
Web: http://www.oarc.org/hamcat.html

FEBRUARY 13

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

MA - MARLBOROUGH - Hamfest. Marlborough Middle School, Rt. 85. 10am-2pm. Algonquin ARC, Ann Weldon KA1PON, 508-481-4988

MI - NEGAUNEE - Swap & Shop. Township Hall. Talk-in: 147.27. Hiawatha ARA, Bob Serfas N8PKN, 906-226-9782. John Veight N8RSE, 906-228-9417

NY - WESTFIELD - Hamfest. Westfield Exempt Volunteer Fireman's Assn., 75 Bourne St. 8am-3pm. Talk-in: 145.350 (-). Chautauqua County RAs, Eric Kroon N2PCQ, 716-595-3220.
E-Mail: ekroon@netsync.net

PA - OBERLIN - Hamfest. Oberlin Fire Co., Fire Hall. VE Exams. Talk-in: 146.76. HRAC 717-939-4825. E-Mail: n3njb@juno.com

TX - CANYON - High Plains Hamfest. WTAMU Activities Center. Talk-in: 146.94- 88.5Hz, 444.200+ 88.5Hz, 145.35- 88.5Hz. ARES, POB 5378, Amarillo, TX 79117. E-Mail: wally@n4bz.org
Web: www.n4bz.org

FEBRUARY 14

CO - BRIGHTON - Hamfest. Aurora Repeater Assn., Wayne Heinen N0POH, 303-699-6335.
E-Mail: nrclog@aol.com

IL - ROCK ISLAND - Hamfest. QCCA Expo Center, 2621 4th Ave. Talk-in: W0BXR 146.28/.88 and 146.04/.64. Davenport ARC, Kent Williams K9UQI, 309-796-0718, 4-9pm only. E-Mail: k9uqi@arcsupport.com E-Mail: k9uqi@netexpress.net Web: http://www.arcsupport.com/drac

OH - MANSFIELD - Mid*Winter Hamfest & Computer Show. Richland County Fairgrounds. Talk-in: call W8WE on 146.34/94. InterCity ARC, Inc., Pat Ackerman N8YOB, 419-589-7133 after 2pm EST.

FEBRUARY 20

AR - RUSSELLVILLE - Hamfest. AR River Valley AR Foundation, Margaret Alexander KC5MCS, 501-968-7270. E-Mail: ealexand@cswnet.com

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

FL - BROOKSVILLE - Hamfest. Spring Hill VFW Post 10209, Spring Hill Dr. between US 41 & Mariner Blvd. Talk-in: 146.715. Hernando County ARA, Ralph Wilson AF4FC, 352-754-9653. Jim Angello KE4SZP, 352-688-5214.
E-Mail: jangello@fiber-net.com
Web: www.fiber-net.com/pub/hcara/index.htm

NY - HORSEHEADS - Hamfest. Elmira College Murray Athletic Center Domes, Rt. 14. 8am-3pm. VE Exams. Talk-in: 147.360+. ARAST, Gary Sekella N2OKU, 607-739-0134. E-Mail: arast@arast.org Web: http://www.arast.org

OR - RICKREALL - Hamfest. Polk County Fairgrounds, 520 S. Pacific Hwy. W. Talk-in: 146.86-. Salem Repeater Assn. and Oregon Coast Emergency Repeater, Evan Burroughs N7IFJ, 503-585-5924 before 8pm.
E-Mail: n7ifj@teleport.com
Web: http://sra.goldcom.com/sraflyer.htm

TX - SMITHVILLE - Hamfest. Bastrop County ARC, Lynn Fisk K5LYN, 512-360-4809. E-Mail: kc5kfv@onr.com Web: http://www.qsl.net/kb5yae

FEBRUARY 21

CANADA - BRITISH COLUMBIA - NEW WESTMINSTER - Hamfest. Burnaby ARC, Harry VE7HNC, 604-530-3962

MI - FARMINGTON HILLS - Swap 'n Shop. William M. Costick Activities Center, 28600 Eleven Mile Rd. 8am-3pm. Talk-in: 145.350-repeater and 146.52 simplex. Livonia ARCs, 734-261-5486. E-Mail: swap@larc.mi.org
Web: www.larc.mi.org

NC - ELKIN - Hamfest. Briarpatch & Foothills ARCs, Jimmy Holbrook KB4GKI, 336-957-3820. E-Mail: kb4gki@aol.com Web: http://members.aol.com/kb4ghi/kb4gki.html

NY - FREEPORT - Hamfest. Armory, 63 Babylon Tnpk. 8:30am-1pm. Talk-in: 146.850 (136.5 PL). LIMARC, 516-520-9311. E-Mail: hamfest@limarc.org Web: http://www.limarc.org

FEBRUARY 27

GA - DALTON - Hamfest. Dalton ARC, James Jordan K4FLG, 706-278-0630 evenings only

KY - CAVE CITY - Hamfest. Mammoth Cave ARC, 502-651-2363. E-Mail: lbrumett@glasgow-ky.com Web: http://www.scrtc.blue.net/mcarc

ND - BISMARCK/MANDAN - Hamfest. Central Dakota ARC, Dennis Murphy K0GRM, 701-258-6747. Web: http://www.qsl.net/cdarc

VT - MILTON - Hamfest and Convention. Milton High School, Rt. 7. 8am-3pm. Talk-in: 145.15-. RAs of Northern VT, Mitch Stern W1SJ, 802-879-6589. E-Mail: w1sj@vbimail.champlain.edu
Web: http://www.ranv.together.com

FEBRUARY 27-28

OH - CINCINNATI - Convention. Cincinnati Gardens, Exhibition Center. Great Lakes Div. Conv., William Tittle KA8LAY, 513-661-1861.
E-Mail: gldivconvention@juno.com

FEBRUARY 28

NY - CHEEKTOWAGA - Hamfest. Lancaster ARC, Luke Calianno N2GDU, 716-634-4667.
E-Mail: lcalianno@freewweb.com Web: http://hamgate1.sunyerie.edu/~larc/greaterbuffalowinterham

NY - MELVILLE - Hamfest. Radio Central ARC, JoAnn Colletti N2IME, 516-399-1877.
E-Mail: wo2n@li.net

OH - CIRCLEVILLE - Hamfest. Teays ARC, Roy Ulko KG8EK, 740-477-8310.
E-Mail: royulk@scioto.net

OH - CUYAHOGA FALLS - Hamfest. Emidio & Sons Party Center, 48 E. Bath Rd. 8am-2pm. Cuyahoga Falls ARC, Carl Hervol N8JLQ, 330-497-7047. E-Mail: carlh@pop.raex.com
Web: http://www.cfarc.org/hamfest.htm

PA - CASTLE SHANNON - Hamfest. VFD Memorial Hall, Library Rd. (Rt. 88). 8am-3pm. Talk-in: 146.955- N3RNX repeater. N3SH ARC, Steve Lane W3SRL, 412-341-1043,
E-Mail: slane@adelphia.net
Web: http://www.hky.com/~sanfordb/index.htm

VA - ANNANDALE - Hamfest. N. VA Community College, 8333 Little River Tpke. (Rt. 236). VE Exams. Talk-in: 146.91 (-) & 146.685 (-). Vienna Wireless Society, Mike Toia K3MT, 703-757-5021.
E-Mail: k3mt@erols.com
Web: http://www.erols.com/k3mt/vws

WV - FAYETTEVILLE - Hamfest. Plateau ARA, Juddie David Burgess KC8CON. E-Mail: kc8con@usa.net Web: http://www.geocities.com/Cape Canaveral/Launchpad/4842

COMPUTER SHOWS

AGI Shows, 317-299-8827.
E-Mail: info@agishows.com
http://www.agishows.com

Blue Star Productions
612-788-1901
http://www.supercomputersale.com

Computers And You, 734-283-1754.
www.a1-supercomputersales.com

Computer Central Shows
847-412-1900 & 1-888-296-6066.
E-Mail: compcent@megsinet.net
www.computercentralshows.com

Five Star Productions
810-890-0988 E-Mail: jeff@fivestar
www.fivestarshows.com

Georgia Mountain Productions
706-838-4827.
E-Mail: gamtnpro@blrg.tds.net
georgiamountain.com

Gibraltar Trade Center, Inc.
734-287-2000. Taylor, MI.
Gibraltar Trade Center, Inc.
810-465-6440. Mt. Clemens, MI.

MarketPro, Inc., 201-825-2229
http://www.marketpro.com

MarketPro, Inc., 301-984-0880.
E-Mail: md@marketpro.com
http://marketpro.com

Narisaam Computer Show
770-663-0983.
E-Mail: narisaam@aol.com
Web: http://www.shownsale.com

Northern Computer Shows
978-744-8440
E-Mail: inquiries@ncshows.com
Web: ncshows.com

Peter Trapp Computer Shows, 603-272-5008. Web: www.petertrapp.com

MARCH 1999

MARCH 5

MO - ST. LOUIS - Hamfest. Amateur Radio Auction, Bill Schmidt WA0JCO, 314-544-1515

MARCH 5-6

MS - PASCAGOULA - Hamfest. Jackson County Fairgrounds, Civic Center. Fri: 5pm-9pm, Sat: 8am-3pm. VE Exams. Talk-in: W5WA 145.110-. Jackson County ARC, Charles F. Kimmerly, 228-826-5811

MARCH 5-6-7

NE - NORFOLK - State Convention. Fred Wiebelhaus N0VLX, 402-379-1929.
E-Mail: dfwiebel@sufia.net Web: http://members.aol.com/davidn0xbn/evarc.html

MARCH 6

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

NJ - PARSIPPANY - Hamfest. PAL Building, Smith Field, Rt. 46 & Baldwin Rd. VE Exams. Splitrock ARA, Mark Turner KB2VKO, 973-347-3195 or 1-888-511-7272. E-Mail: mlturner@bellatlantic.net Web: http://ham.hsix.com/sara

TN - KNOXVILLE - Hamfest. Kerbela Temple, 315 Mimosa Ave. 8am-4pm. Talk-in: 144.83/145.43 or 146.52 simplex. Kerbela ARS, Paul Baird K3PB, 423-986-9562

MARCH 6-7

FL - NEW PORT RICHEY - Hamfest. Fred K. Marchman Technical Educational Center. Sat: 8am-5pm, Sun: 8am-3pm. Talk-in: 146.670 or 145.330. Gulf Coast ARC, Rick Brown KF4GXS, 813-842-2127. E-Mail: richar@gte.net

MARCH 7

FL - ZEPHYRHILLS - Hamfest. Zephyrhills ARC, Ernie Vanselow KD4VRV, 813-783-8389.
E-Mail: kd4vrv@gte.net

MA - WESTFIELD - Hamfest. Westfield South Middle School. MTARA, Jim Allen N1RUT, 413-568-1175 days, 413-536-5182 eves.
E-Mail: Jim.Allen@the-spa.com
Web: http://www.mtara.org

NY - LINDENHURST - Hamfest. Great South Bay ARC & Suffolk County RC, 516-422-9594.
E-Mail: ka2d@li.net Web: http://www.gsbarc.org

WI - WAUKESHA - Swapfest. Waukesha County Expo Center. 8am-2pm. VE Exams. Talk-in: 146.82 PL 127.3. SEWFARS, John Breecher N9NWN, 414-835-7035

MARCH 13

AZ - SCOTTSDALE - Hamfest. Scottsdale ARC, Roger Cahoon KB7ZWI, 602-948-3548

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

CA - LINDA - Hamfest. Yuba Sutter ARC, Clara KC6JPP, 530-742-2674. Ron W6KJ, 530-674-8533

FL - EAST ENGLEWOOD - Hamfest. Tringali Community Center, SR 776. Talk-in: 146.700. Englewood ARS, J.R. House K9HUY, 941-475-3005. George KA4JKY, 941-697-3445,
E-Mail: gshreve@ewol.com Web: http://www.flnet.com/~crosby/ears/index.html

FL - SEBRING - Hamfest. Highlands County ARC, Phyllis Dibble KD4CQG, 941-465-8176.
E-Mail: dibble@strato.net
Web: http://www.strato.net/~hamradio

KY - CAVE CITY - Hamfest. Mammoth Cave ARC, Larry Brumett KN4IV, 502-651-2363.
E-Mail: lbrumett@glasgow-ky.com
Web: http://www.scrtc.blue.net/mcarc

MO - KANSAS CITY - Hamfest. Ararat AR Shrine Club, Steve Dowdy WJ0I, 816-941-3392.
E-Mail: sdowdy@qni.com

Events CALENDAR

ND - WEST FARGO - Hamfest. Fairgrounds. 8am-3pm. VE Exams. Talk-in: 146.76-. Red River Radio Amateurs, Mark Kerkvliet KG0FR, 701-282-4716. E-Mail: mbkerk@worldnet.att.net Web: http://www.rrra.org

NJ - WEST ORANGE - Hamfest. High School, 600 Pleasant Valley Way. 8:30am-1pm. Talk-in: 146.415 +1.0 85.4T, 224.480 -1.6 no tone, 447.875 -5.0 156.7T, 146.520 simplex. IRAC, Jim Howe N2TDI, 973-402-6066. E-Mail: n2tdi@juno.com

WA - PUYALLUP - Hamfest. Mike & Key ARC, Michael Dinkelman N7WA, 253-631-3756 or 425-867-4797. E-Mail: mwdink@eskimo.com

MARCH 13-14

NC - CHARLOTTE - Hamfest & Computerfair. Charlotte Merchandise Mart, 2500 E. Independence Blvd. Mecklenburg ARS, Tim Slay WO4G, 704-382-3234 (W) or 704-948-6283 (H). E-Mail: wo4g@w4bfb.org Web: http://www.w4bfb.org/hamfest.html

LA - RAYNE - Hamfest. Acadiana ARA, Nolen Griffith K5ARH, 318-989-9039. E-Mail: k5dpg@aisp.net Web: http://www.acadian.net/w5ddl/

MARCH 14

IL - STERLING - Hamfest. High School Fieldhouse, 1608 4th Ave. Talk-in: 146.25/146.85 W9MEP. Sterling-Rock Falls ARS, Lloyd Sherman KB9APW, 815-336-2434. E-Mail: lsherman@essexl.com

IN - INDIANAPOLIS - Hamfest. State Fairgrounds. Morgan County Repeater Assn., Dennis Bauernfiend WB9ZNZ, 317-996-3782. E-Mail: dennis.bauernfiend@dfas.mil Web: http://www.eb1.com/mcra

OH - CONNEAUT - Hamfest. Human Resources Center, 327 Mill St. Conneaut ARC, Jack Marttila KA8TUU, 440-593-3353

MARCH 19-20

FL - FT. WALTON BEACH - Hamfest. Playground ARC, Clyde Gowdy KE4FLC, 850-244-0624. E-Mail: parcfest@aol.com

ME - LEWISTON - ME State Convention. Androscoggin ARC, Ivan Lazure N1OXA, 207-784-0350. E-Mail: ilazure@gwi.net

OK - TULSA - OK State Convention. Maxwell Conv. Center, 700 S. Houston Ave. Talk-in: 145.11 & 443.85. Green Country Hamfest Assn., Merlin Griffin WB5OSM, 918-622-2277. E-Mail: info@GreenCountryHamfest.org Web: http://www.GreenCountryHamfest.org

MARCH 20

AR - JONESBORO - Hamfest. Jonesboro ARC, Mike Conley KC5ISI, 870-931-9957. Evelyn Castleberry N5DSY, 870-932-1660. E-Mail: jsnodgra@insolwwb.net

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

FL - STUART - Hamfest. Martin County ARA, David Millard KE4AMW, 561-288-7100

MI - MARSHALL - Hamfest. Southern Michigan ARS & Marshall HS Photo Electronics Club, Wes Chaney N8BDM, 616-979-3433. E-Mail: n8bdm@voyager.net

MARCH 20-21

TX - MIDLAND - Hamfest. Midland ARC, Beverly Harwood KC5BNT, 915-686-1841. E-Mail: shamrock@apex2000.net Web: http://www.lxnet/edge/midswap.htm

MARCH 21

CT - SOUTHINGTON - Hamfest. Southington ARA, Chet Bacon KA1ILH, 860-628-9346. E-Mail: hcbacon@connix.com Web: http://www.connix.com/~hcbacon/sara.html

NC - KINSTON - Down East Hamfest. Lenoir County Fairgrounds, Hwy. 11 S. 8am-3pm. Doug Burt W4OFO, 252-524-5724

NJ - TRENTON - Hamfest. Tall Cedars of Lebanon picnic grove, Sawmill Rd. Talk-in: 146.67-. Delaware Valley Radio Assn., Darryl Foyuth N2JVP, 609-882-2240 E-Mail: n2jvp@amsat.org Web: www.slac.com/w2zq

OH - MAUMEE - Hamfest. Lucas County Recreation Center, 2901 Key St. 8am-2pm. Talk-in: 147.27+ or 442.85+. Toledo Mobile Radio Assn., Paul Hanslik N8XDB, 419-243-3836. Web: http://www.tmrahamradio.org

WV - CHARLESTON - Hamfest. Charleston Area Hamfest & Computer Show, Jimmie Hewlett WD8MKS, 304-768-1143

MARCH 27

CT - POMFRET - Hamfest. Eastern CT ARA, Paul Rollinson KB1CNW, 860-928-2456. E-Mail: paulrollinson@worldnet.att.net

CT - WATERFORD - Auction. Waterford Senior Center, Rt. 85. Talk-in: 146.730-. RAS of Norwich, Tony Griggs AA1JN, 860-859-0162. Mark Venable N1RSK, 860-572-9380, E-Mail: mvenable@99main.com Web: www.ims.uconn.edu/~rason

IN - MICHIGAN CITY - Hamfest. High School, 8466 W. Pahs Rd. 8am-1pm. Michigan City ARC, Inc., Ron Stahoviak N9TPC, 219-325-9089

NY - NEWARK - Hamfest. Drumlins ARC, E-Mail: n2mkt0@aol.com

TX - WEATHERFORD - Hamfest. ARC of Parker County, Elizabeth Hunkele N5ONE, 817-594-1700. E-Mail: eliz@mesh.net

MARCH 27-28

MD - TIMONIUM - Maryland State Convention. Sharon Dobson N3QQC, 410-HAM-FEST (Box 3772), 1-800-HAM-FEST (Box 3772). E-Mail: n3qqc@amsat.org Web: http://www.gbhc.org

MARCH 28

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

FL - LEESBURG - Hamfest. Lake ARA, Paul Branch K3NON, 352-343-8729. John Wentz W8HFK, E-Mail: w8hfk@aol.com

NH - HENNIKER - Hamfest. Contoocook Valley RC, Jock Irvine N1JI, 603-428-3476 ext. 256

OH - MADISON - Hamfest. Lake County ARA, Roxanne, 440-256-0320

APRIL 1999

APRIL 2-3

OK - MOORELAND - Hamfest. Tri-State AR Group, Duane Henderson KC5NID, 580-994-2223. E-Mail: kc5nid@pldi.net

APRIL 3

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

APRIL 9-10

GA - ATLANTA - Southeastern VHF Conference. Southeastern VHF Society, Dick Hanson K5AND, 770-844-7002. E-Mail: k5and@prestique.net Web: http://www.svhfs.org.svhfs

APRIL 9-10-11

CA - FRESNO - Int'l DX Convention. Gordon Girton W6NW. E-Mail: gordon@svpal.org

Continued on page 59

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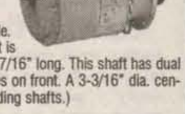

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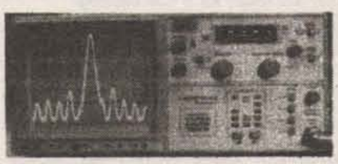

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NEW! CABLE converter electronic service equipment and supplies for most cable converter boxes. Highest service, lowest prices. Call Ken Erny Electronics. 24 hr. order and information hot line 516-389-3536.

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125 CHANNEL Digital Pro converter with audio & video $82 each. Panasonic TZ-PC175DG2-7 converter with volume control $135 each. The best converters you can buy! Please call 1-888-561-4796.

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FREE CABLE DESCRAMBLER PLANS! For details write: Sierra Publishing, 909 E. Yorba Linda Blvd., Suite H-181, Dept. NVL, Placentia, CA 92870.

AS-IS converters Oak Sigma, $20; Zenith, $7; genuine unmodified DPV5, $10. Call John 419-243-7856.

THE BEST is back to stay. Master code recovery. 16c5x, 16c62x, PALS, GALS, other microcontrollers, etc. Check out our web page at www.acdinc.com for details or call 703-764-5361 or write Advanced Circuit Designs, Inc., 5765-F Burke Centre Parkway, Suite 317, Burke, VA 22015.

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RAINBOW KITS

NEW

FAN CONTROLLER

Use this kit to control cooling fans, or any device that is temperature activated. Output is 100mA. For a 3 Amp application use the Relay kit RP-1 or the new Micro-controlled Relay PRC-1 kit. Temperature probe included. Operating voltage: 7.5 to 18v DC
Size:1.5" x 1.2
(Temperature Range 32° - 200° F)
FC-1 KIT **$14.95**

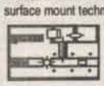
FLASHING SAFETY LIGHT

- Push ON / Push OFF switch.
- Flashes 3 weeks on 2 AAA batteries.
- Great for kids, bike riders and joggers.
- Keep in car for emergencies.
- Tough ABS case with belt clip
- Size: 1 3/8" x 2 1/4" x 1 1/8"

BFL-3 BUILT **$6.95** 2 for **$9.95**

WIDE BAND PRE-AMP

Uses PCB and surface mount technology for better performance.



Use this for scanners, HT's, Frequency counters, Satellite Receivers. It amplifies low-level (weak) signals. If the signal is extremely low, two amplifiers can be used in a series.

- 1MHz to 2.5 GHz 2.8dB NF
- 1dB compression=OdBm
- Gain: 1MHz- 20dB to 2.5GHz-6dB
- Power requirement: 12v @ 6Ma

WBA-6 KIT **$19.95**

KEY CHAIN LASER PEN

Comes with 4 extra heads
• Smiley face • I Love You • Hearts • Skull
(all different) 2 1/2" Long 4mm/650 nm
LP-4 BUILT **$12.95**

TV NOTCH FILTERS
FOR CHANNELS 2 thru 22 ONLY

Our TV filters eliminate unwanted TV channels or interference that alters both sound and video with a BEEP BEEP BEEP. Works on cable channels (2 thru 22) only.

NOTE: All TV Filter Kits are sold for educational purposes only. You must obtain permission from your local cable company before using these filters on your cable system.

DF-222 KIT $14.95

FM STEREO TRANSMITTER

Have your own FM radio station. Any stereo signal you plug into the FMST-100 transmitter kit will be transmitted to any FM radio tuneable from 76 to 108MHz FM. Plug in your CD player, tape deck and have a wireless link to any FM radio, within 200 ft. Listen to your CD while mowing the lawn. Transmit from your car to your camper, or through an auditorium. Transmit music on one channel sing on the other. Compatible with any audio system. Clarity is excellent, aprox. 40dB stereo separation. Length of antenna determines distance of transmission. Comes complete with left & right input level control as well as a crystal for left & right stereo separation. ANTENNA NOT INCLUDED 9v Battery operation.

FMST-100 SIZE: 1.5" x 1.6" KIT **$29.95**
Cabinet SIZE: 1.5" x 2.5" x 3" **$8.95**

RAINBOW MINI-LIGHT Super Bright Flashlight

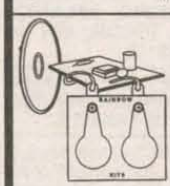
- LED's don't burn out!
- Battery lasts for years!
- If you have your keys, you'll have a flashlight.
- Replaceable battery!
- Better buy 2, your wife is going to take yours!

Lights up a complete bedroom at night

Red	MLR	$9.95 each
Yellow	MLY	
Blue	MLB	$12.95 each
White	MLW	
Infrared	MLI	

SHOWN ACTUAL SIZE

LIE DETECTOR



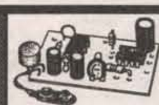
This kit can be great fun at parties. When you lie, generally your hands will sweat and the more you sweat the louder the tone. This kit allows you to measure these changes, only a slight amount of change will cause the tone to increase in frequency. Power requirement 6 to 12v DC. SIZE: .8" x 1.2"
LD-1 KIT **$9.95**

BUSY PHONE LIGHT

Add this little kit to any or all of your telephones. When one phone is used a red LED will light on the other extension. This lets everyone know when your computer modem is in use. Power requirement 9v DC. SIZE: 1.1" x .6"
TEL-LITE KIT **$9.95**

This Manual contains schematics, parts lists & P.C. board layouts for many of the Rainbow Kits. Use your own parts to construct our kits.
KIT BOOK $14.95

SUPER SNOOPER BIG EAR



Listen through walls, hear conversations across the room. Add a parabolic reflector and hear blocks away. The BIG EAR can be hidden about anywhere. Makes an ultra sensitive intercom. Can be used as a 1.5W AMP. We supply a mini-electret mike in the kit. Power requirement 6 to12v DC. SIZE:1.75" x 1"
AA-1 BUILT $29.95 KIT **$10.95**

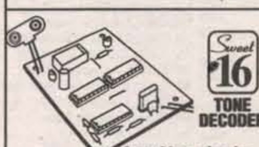
STROBE LIGHT

Do you need an attention getter, warning light, or flashing light for model airplanes? Then this kit is for you. Use it as an emergency light for your auto, radio tower, even use it on your bicycle. Has a variable flash rate. Power requirement 6 or 12v DC. Size 3.5" x 1.9"
ST-1 KIT **$11.95**

AUDIO PREAMP
Boost your microphones output up to line level!

Plug your mic into our AP-1 and drive your amp. to full capacity. Connect an AP-1 to a pair of amplified speakers, plug your mic in and you have an instant PA system. Requires 6 to 12v DC Size: 1.75" X 1"
AP-1 KIT **$9.95**

TONE DECODER



Sweet 16 tone decoder operates great over phone lines, radios or scanners.

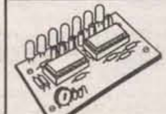
- 16 TTL Level Outputs
- DTMF Decoder Decodes 16 different touch tones using the phone, radios, or scanners.
- One relay & driver circuit on board.
- 9v battery powered. Size: 2 3/4" x 2 1/8"

TT-16 KIT **$34.95**

WIRELESS FM MICROPHONE

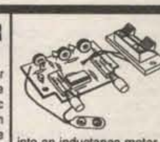
Small but mighty this little jewel will out perform most units many times its price. It really stomps out a signal. The WM-2 kit is a buffered wireless mike that operates from 80MHz to 120MHz FM, the frequency of any broadcast FM radio. Includes a mini-electret mike. 6 to 12v DC. SIZE:1.25" x 1"
WM-2 KIT **$14.95**

DC VOLTAGE MONITOR



If battery status is important, you need this kit. This kit uses 7 LEDs to monitor 12v DC in 1v, 1/2v, or 1/4v steps. Monitor 8v or 5v in 1/4v steps. Great for boats, motor homes, model planes or race car ni-cads. All parts and instructions are included. SIZE: 1.3" x 2.7". *If you want to switch more power see our Triac (TP-1).*
VM-1 KIT **$7.95**
For 110 AC VM110 KIT **$10.95**

INDUCTANCE METER

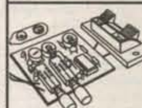


This is the kit everyone has been asking for. Turn your digital volt ohm meter into an inductance meter. It will read inductors 3uH to 7MH. Power requirement 9v DC.
SIZE: 1.75" x 2.5"
IA-1 KIT **$14.95**
IA-1CABINET **$8.95**

DIGITAL THERMOMETER

The DT-3 kit will turn your digital volt ohm meter into an accurate digital thermometer with .1 degree resolution. Measure temperatures from -40° to 250F° The remote sensor is .25" sq. and can be mounted many feet from the meter. Power requirement 9V DC
SIZE: 2" x 1.35"
DT-3 KIT **$8.95**

CAPACITANCE METER



This kit will turn your digital volt meter into a capacitance meter. Turn that junk box of unmarked capacitors into a fortune of usable parts. Measure capacitors from <2.2pF to 2.2uF. Power requirement 9v DC. SIZE: 1.80" x 2"
CA-1 KIT **$12.95**

VOICE ACTIVATED SWITCH

This VOX circuit can be used to operate a tape recorder, ham radio, CB radio, or turn on an alarm. The VOX-1 kit has 100MA of output that operates a relay, light, motor, ? What could you do with a sound activated switch? Power requirement 7.5 TO 18v DC. SIZE: 1.5" x 1.3"
If you want to switch more power see our Triac (TP-1) or Relay (RP-1)Power kit.
VOX-1 KIT **$6.95**

PHONE RECORDING SWITCH

This phone line powered switch is small enough to be installed anywhere. Every time the phone is picked up the recorder will record both sides of the conversation automatically. Use it in your office to record all phone calls so you don't loose important information. SIZE:1" x .6"
If you want to switch more power see our Triac (TP-1) or Relay (RP-1)Power kit.
TEL-SW1 KIT **$12.95**

WATER ALARM

Don't ever get stuck with a flooded basement or over fill your water bucket. When the liquid level reaches the sensor it automatically turns the pump on or off. The Water Alarm supplies you with 100 mA of output that activates a relay (that you supply). This relay can turn on a sump pump, or in applications where you are filling a area with liquid it turns off the pump. Sensor included. Size 1.4" x 2"
WA-2 KIT **17.95**

Please add sufficient postage First lb $5.50 Canada $7.50 Additional LB. Add $1.00 US FUNDS ONLY We will accept telephone orders for Visa or Mastercard
8E

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Alltech Type 32, Precision Attenuator, 0-100dB	$300
Argosystems AS210, Frequency Calibration System	$2,000
Bird 4381, RF Power Analyst, Opt. 832	$200
Boonton 102B, Signal Generator, .45-520MHz	$500
Boonton 518-A4, Q Standard	$100
Boonton 82AD, Modulation Meter	$650
Boonton 92BD, Digital RF Millivolt Meter	$250
Boonton 4200/4E, Power Meter, 18GHz	$600
Boonton 4200/4G, Power Meter Sensor, .01-26.5GHz	$200
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HP 3325A/01/02, Function Gen. Opt. 01/02	$1,500
HP 33322H, Programmable Attenuator, DC-18GHz	$250
HP 3400A, RMS Voltmeter, 10Hz-10MHz	$200
HP 3455A, Digital Multimeter	$300
HP 3456A, Digital Voltmeter, 6.5 Digits	$600
HP 3468A, Multimeter, 5.5 Digits	$400
HP 4140B, Picoammeter, DC Source	$2,000
HP 4274A, Multi-frequency LCR Meter, Opt. 001,002, HPIB	$3,000
HP 436A/022, Power Meter, HPIB	$1,000
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HP 5182A, Waveform Recorder, Generator	$500
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HP 86260A, RF Plug-In, 12.4-18GHz	$400
HP 86290A, RF Plug-In, 2-18GHz	$1,200
HP 86290B, RF Plug-In, 2-18GHz	$1,400
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Texscan SSG2000, Freq. Syn., 100KHz-2GHz, AM, FM	$1,800
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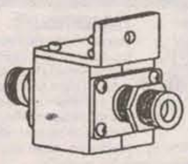

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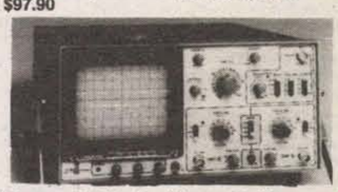

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HP 600 Series, Officejet 500, 570, 600	7	14	**4.71**	**3.21**	32.95	44.95
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Canon BJ-10, 200, 210, 240, 250 Apple SWriter 1200, 1500	14	20	**2.15**	**2.00**	29.95	39.95
Canon BJC-4000 Series, C2500, C3000, C3500, C5000 Apple StyleWriter 2400, 2500	60	60	**0.50**	**0.67**	29.95	39.95
Canon BJC-600, 610, 620 Apple SWriter Pro	20	13	**1.50**	**3.07**	29.95	39.95
Epson Stylus Color, Color Pro, Pro XL	12	12	**2.50**	**3.33**	29.95	39.95
Epson Stylus Color II, IIs	15	15	**2.00**	**2.66**	29.95	39.95
Epson Stylus Color 500, 200	20	17	**1.50**	**2.35**	29.95	39.95
Epson Stylus Color 400, 600, 800, 850, Photo	20	17	**1.50**	**2.65**	29.95	44.95
Lexmark JP 1000, 1020, 1100, ExecJet II, IIc, Medley 4C	10	17	**3.00**	**2.35**	29.95	39.95
Lexmark JetPrinter 5700, 5000, 7000, 7200	10	17	**4.00**	**2.35**	39.95	39.95
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Apple StyleWriter 2400, 2500	$5.50	$12.95
Canon BJC-600, 610, 620 Apple StyleWriter Pro	$4.95 (9cc)	$4.95 @ (9cc)
Hi-Capacity Canon BJC-600, 610, 620	**$5.95 (15cc)**	**$5.95 @ (12cc)**
Canon BJC-70, BJC-80	$9.95 (3-pak)	$14.95 (3-pak)
Epson Stylus Color, Color Pro, Pro XL	$12.00	$19.00
Epson Stylus Color II, IIs	$14.00	$19.00
Epson Stylus Color 500, 200	$14.00	$19.00
Epson Stylus Color 400, 600, 800, 850,1520, Photo	**$14.00**	**$19.00**

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Events CALENDAR

Continued from page 42

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Web: http://www.amateur-radio.org/ncdxc.org

APRIL 10

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

MN - ROCHESTER - Hamfest. Rochester ARC, John Scott N0HZN, 507-285-6522.
E-Mail: n0hzn@aol.com
Web: http://members.aol.com/rarchams/

NC - MORGANTON - Hamfest & Computer Fair. Burke County Fairgrounds, Hwy. 181N (Exit 100 Eastbound, Exit 105 Westbound I-40). 8am-5pm. Talk-in: 147.15 (K4VLY repeater). Catawba Valley, Tom Tayler, 704-433-6205.
E-Mail: kc4qpr@vistatech.net

WA - SPOKANE - Hamfest. Lilac City ARC, Warren Kelsey KJ7BB, 509-534-8443

APRIL 11

NC - RALEIGH - RARSFest. State Fairgrounds, Jim Graham Bldg. 8am-4pm. Raleigh ARS, Wilbur Goss WD4RDT, 919-266-9883. E-Mail: k4hf@juno.com

WI - MADISON - Hamfest. Madison Area Repeater Assn., Paul Toussaint N9VWH, 608-245-8890. E-Mail: n9vwh@hotmail.com

APRIL 17

AL - ALBERTVILLE - Hamfest. Marshall County ARC, Buddy Smith KC4URL, 256-593-2516.
E-Mail: kc4url@airnet.net

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

ID - IDAHO FALLS - Hamfest. Eastern Idaho UHF Society, Jay Greenburg WA4VRV, 208-524-1388. E-Mail: wa4vrv@srv.net
Web: http://www.srv.net/~wa4vrv/hamfest.htm

KY - MURRAY - Hamfest. Murray State University ARC, Pat Compton KF4FMZ, 502-762-6433.
E-Mail: patrick.compton@murraystate.edu Web: http://mursuky.edu/clubs/msuarc/hamfest.htm

MN - BLAINE - Hamfest. Robbinsdale ARC, Jerry Dorf N0FWG, or Harriet Johanson 612-537-1722.
E-Mail: jerryd@skypoint.com

MO - JOPLIN - Hamfest. Joplin ARC, Ray Brown KB0STN, 417-781-4967. E-Mail: raybrown@ipa.net
Web: http://www.joplin-arc.org

OK - LAWTON - Hamfest. Lawton Ft. Sill ARC, Bob Morford KA5YED, 580-355-6120 or 580-353-8074

APRIL 18

CT - HARTFORD - 1999 Trinity College Fire-Fighting Home Robot Contest. Trinity College campus. Jake Mendelssohn, 190 Mohegan Dr., West Hartford, CT 06117.
E-Mail: JMENDEL141@AOL.COM
Web: http://www.trincoll.edu/~robot

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

PA - MONROEVILLE - Hamfest. Two Rivers ARC, Michael Kowalcheck, Jr. KV3L, 412-751-9657

APRIL 23-24

AR - LITTLE ROCK - Hamfest. Jim Blackmon K5VZ, 870-246-7833 H, 870-246-6734 W.
E-Mail: lrhamfest@usa.net
Web: http://www.aristotle.net/~ares/hamfest/

APRIL 24

AR - BENTONVILLE - Hamfest. Benton County Radio Operators, Betty Weiberg N0XWQ, 417-435-2332

IA - DES MOINES - Hamfest. Des Moines RAA, Duane Bower WB0UCY, 515-287-6542

NJ - HARMONY - Hamfest. Warren County Farmers Fairgrounds, Rt. 519 N. 8am-2pm. VE Exams. Talk-in: 147.375+ 146.730-. Cherryville RA II, Inc., Randy Vance N2MQZ, 908-788-4080 or 908-454-4370. E-Mail: n2mqz@aol.com
Web: mailto://w2cra@qsl.net

NM - ALBUQUERQUE - Hamfest. Albuquerque ARC & AR Caravan Club, Chuck Opdyke KC5GA, 505-858-0306. E-Mail: n5oqj@worldnet.att.net

VA - CHESAPEAKE - Hamfest. Chesapeake AR Service, Jim Cannon KF4RQQ, 757-382-0193.
Web: http://www.qsl.net/cars

WA - VANCOUVER - Hamfest. Clark County ARC, Luther Brisky KC7KVL, 360-896-8909 or 360-254-5082. E-Mail: lwayne@e-z.net
Web: http://www.w7aia.org

APRIL 25

FL - GAINESVILLE - Hamfest. Gainesville ARS, H. Walter Johnston W4TKE. E-Mail: w4tke@juno.com E-Mail: w4tke@gator.net

IL - ARTHUR - Hamfest. Moultrie ARK, Ralph Zancha WC9V, 217-873-5287 or 217-543-2178.
E-Mail: rzancha@one-eleven.net Web: http://home.stlnet.com/~jhudsonl/hamfest.html

IL - GALVA - Hamfest. Bill Anderson WB9TEW, 309-932-3023. E-Mail: bill@inw.net

OH - ATHENS - Hamfest. Athens County ARA, Drew McDaniel W8MHV, 740-592-2106.

E-Mail: dmcdaniell@ohiou.edu

MAY 1999

MAY 1

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

TN - NASHVILLE - Hamfest. Nashville ARC, Bob Malone WB5ZDS, 615-865-6225

WI - CEDARBURG - Hamfest. Ozaukee RC, Joe Holly AA9HR, 414-377-2137

MAY 1-2

NJ - EDISON - Trenton Computer Festival. NJ Convention Center, Raritan Center. Sat: 9am-5pm, Sun: 9am-4pm. KGP Productions, Inc., Marin Light, 1-800-631-0062. E-Mail: kgp@mail.com Web: www.tcf-nj.org

TX - ABILENE - West Texas Section Convention, Peggy Richard KA4UPA, 915-672-8889. E-Mail: jimr@swconnect.net

MAY 2

MD - HAGERSTOWN - Hamfest. Community College, Athletic and Recreation Bldg. 8am-3pm. Talk-in: 147.090+. The Antietam Radio Assn., Tina Jones KB8ZQM, 304-728-7769. E-Mail: kb8zqm@intrepid.net Web: http://www.erols.com/rjlong61/ara

NY - YONKERS - Flea Market. Lincoln High School, Kneeland Ave. 9am-3pm. VE Exams. Talk-in: 440.425 PL 156.7, 223.760 PL 67.0, 146.910, 443.350 PL 156.7. Metro 70cm Network, Otto Supliski WB2SLQ, 914-969-1053

WV - RIPLEY - Hamfest. Jackson County ARC, Gary Casto AG8RY, 304-372-2849

MAY 8

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

TX - CHICOTA - Hamfest. Red River Valley ARC & ARES of Lamar County, Kevin "Mort" Winslow N3YNL, 214-894-3088. E-Mail: 4n3ynl@unicomp.net

MAY 14-15-16

OH - DAYTON - Hamfest. Dayton ARA, Dick Miller N8CBU, 937-427-3109. E-Mail: chair@hamvention.org Web: http://www.hamvention.org

MAY 15

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

GA - STATESBORO - Hamfest. Statesboro ARS, Martin Holzman WB4MOG. E-Mail: mart@bulloch.com

MAY 16

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

MAY 22-23

WA - YAKIMA - WA State Convention. Yakima ARC, C. Jo Whitney KA7LJQ, 509-965-3379. E-Mail: kb7hdx@televar.com Web: http://eagle.ykm.com/~w7aq/hamfest.html

MAY 29

CANADA - MANITOBA - WINNIPEG - Hamfest. Winnipeg ARC, Ed Henderson VE4YU, 204-694-0667. E-Mail: edve4yu@pangea.ca

NY - PLATTSBURGH - Hamfest. Champlain Valley ARC, Bernhard Jakobetz KC2ALG, 518-643-9657

MAY 30

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

JUNE 1999

JUNE 5

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

JUNE 5-6

OR - SEASIDE - SEAPAC Ham Convention. Seaside Convention Center. VE Exams. Randy Stimson KZ7T, 503-297-1175. E-Mail: rastimson@att.net

JUNE 12

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

JUNE 19

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

JUNE 20

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

JULY 1999

JULY 3

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

JULY 10

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

NY - BATAVIA - Hamfest. Genesee fairgrounds. 6am-3pm. Talk-in: W2RCX 147.285+. "Gram," Harold Hay, 716-343-2844. E-Mail: Wa2abq@aol.com

JULY 17

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

JULY 18

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

JULY 25

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

AUGUST 1999

AUGUST 7

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

AUGUST 14

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

Events CALENDAR

AUGUST 15

KY - LEXINGTON - Hamfest. National Guard Armory. 8am-4pm. VE Exams. Talk-in: 146.760-. John Barnes KS4GL, 606-253-1178. E-Mail: KS4GL@juno.com

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

AUGUST 21

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

SEPTEMBER 1999

SEPTEMBER 4

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

SEPTEMBER 11

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

SEPTEMBER 18

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

SEPTEMBER 19

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

SEPTEMBER 26

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

NY - YONKERS - Flea Market. Lincoln High School, Kneeland Ave. 9am-3pm. VE Exams. Talk-in: 440.425 PL 156.7, 223.760 PL 67.0, 146.910, 443.350 PL 156.7. Metro 70cm Network, Otto Supliski WB2SLQ, 914-969-1053

OCTOBER 1999

OCTOBER 2

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

OCTOBER 9

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

OCTOBER 16

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

OCTOBER 17

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

NOVEMBER 1999

NOVEMBER 6

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

NOVEMBER 13

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

NOVEMBER 20

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

NOVEMBER 28

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

DECEMBER 1999

DECEMBER 4

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

DECEMBER 11

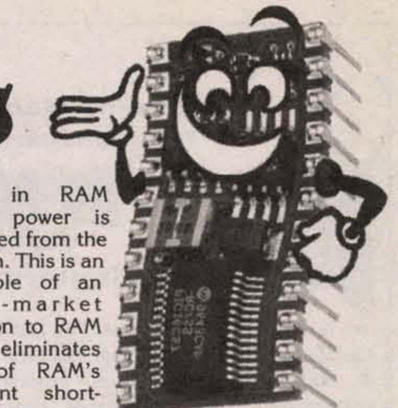
CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves

DECEMBER 18

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

STAMP APPLICATIONS

by Lon Glazner



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

Storing Data With The RAMPack B

Overview

A problem commonly faced by Stamp users is how to store data that can sometimes come in overwhelming quantities. We're not talking just a few bytes here and a few bytes there. We're talking about a few hundred bytes — or more — that need to be stored for later use. If you ever wanted to store a text file, and parse the data out to some serial device, or have a string of serial data stored automatically for you, then the RAMPack B may fit the bill.

More importantly, we'll be using this month's RAMPack B (RPB) overview as a stepping stone. Next month, we'll use the serial data storage capacity of the RPB to store graphic bit-map (*.BMP) data files. These files will be downloaded directly from your PC into the RPB. Next month's article will also use the Scott Edwards Electronics, Inc., G12032 Mini Serial Liquid Crystal Display (G12032 LCD). With the RPB and the G12032 LCD, developing graphic displays becomes a relatively simple task. Some limited animation with the graphic display is also possible using these two devices in tandem.

In this article, we will start off covering some of the basic functions of the RPB, briefly discuss data conversion, and finish up with how to use the First-In-First-Out(FIFO) buffer mode to store serial data automatically. But first, an overview of electronic memory "types."

Data Memory Discussion

There are quite a few ways to store data in today's electronic devices. There are typically four areas of concern that need to be addressed when selecting a memory device. These areas are speed, volatility of memory, input/output (I/O) pins required to access the memory, and how often the memory can be written to.

For example, with serial EEPROM (Electrically Erasable PROM), such as Microchip's 24LCxx series, you gain the dual benefits of a low pin count to access the memory and non-volatile memory (stored data is retained after power is removed). With EEPROM, you can usually access memory with two or three I/O pins depending on the type of memory you use. Parallax provides application notes for interfacing a BASIC Stamp to EEPROM. In fact, the BASIC Stamp has EEPROM on board that can be accessed through the PBASIC READ and WRITE commands. EEPROM is usually an excellent vehicle for the storage of data in electronic designs. It is low-cost, easy-to-use, and has memory that is retained even after power is lost.

There are only three downsides to EEPROM. First, EEPROM is usually only guaranteed for one million erase/write cycles. This may seem like a lot, but if you were to update a memory location every three seconds, the EEPROM could fail after only 35 days of use. Secondly, interfacing to EEPROM is not always the easiest thing for beginners to accomplish. Finally, compared to other memory types, access time for EEPROM is considered slow. For the experienced Stamp user, the second shortcoming is of little consequence, and the third isn't entirely relevant because of the operating speed of BASIC Stamps.

SRAM (Static RAM), on the other hand, has no limitation on how many read/write cycles it can be used for, but requires a large number of I/O pins to address memory locations. In fact, with no additional logic buffers, more than 22 I/O pins could be required. The additional problem of volatile memory (data is lost when power is removed) usually precludes SRAM from being an attractive memory storage device for Stamp-based designs. SRAM, and RAM in general, has one additional advantage of fast access time that makes it attractive to designers using much faster processors than the BASIC Stamp.

There are additional types of RAM including Dallas Semiconductor NVRAM (non-volatile RAM). NVRAM provides a back-up lithium power source to retain data in RAM when power is removed from the system. This is an example of an after-market addition to RAM that eliminates one of RAM's inherent shortcomings.

The RPB is another such attempt to delete the shortcomings of RAM-based memory. The RPB is kind of like "smart RAM." With the RPB, access to SRAM can be accomplished with a single I/O pin. The communication format used by the RPB is the very common 8N1(eight data bits, no parity, one stop bit) serial communication.

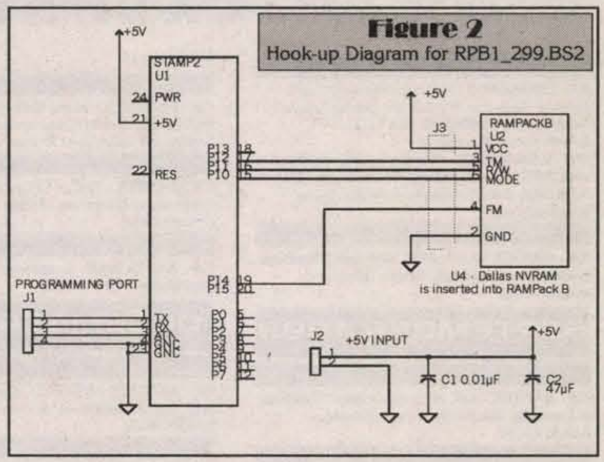


Figure 2
Hook-up Diagram for RPB1_299.BS2

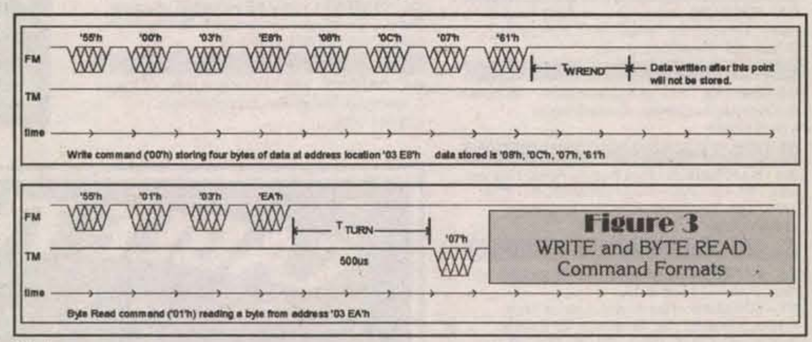


Figure 3
WRITE and BYTE READ Command Formats

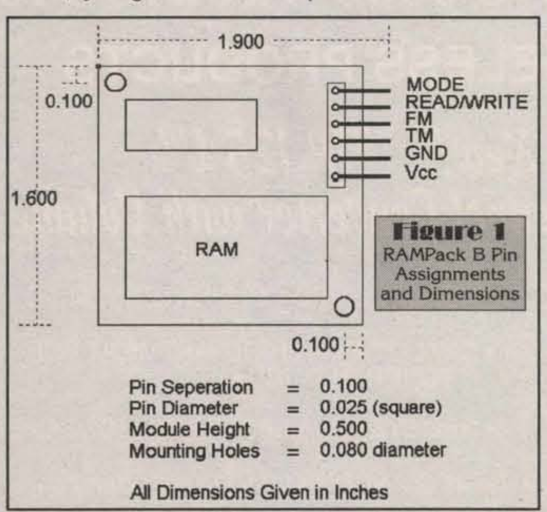


Figure 1
RAMPack B Pin Assignments and Dimensions

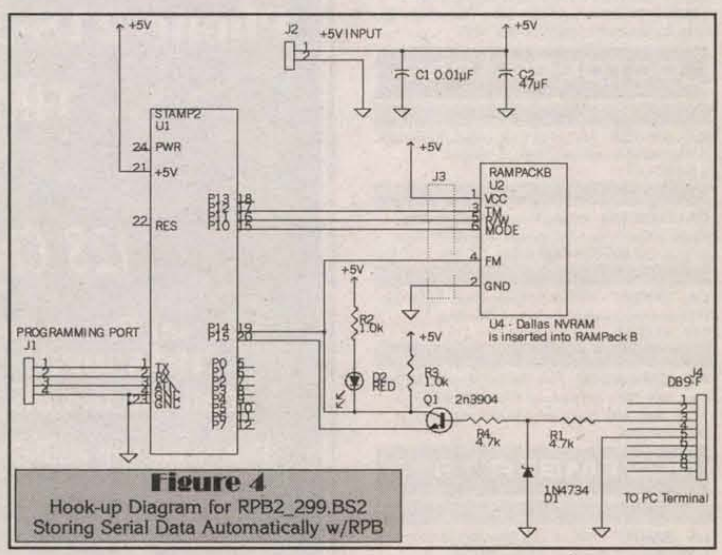


Figure 4
Hook-up Diagram for RPB2_299.BS2
Storing Serial Data Automatically w/RPB

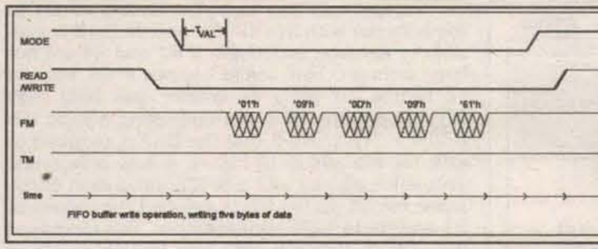


Figure 5 RAMPack B FIFO Write Operation

This is the same format as is used in many devices such as serial printers, PCs, GPS receivers, and the BASIC Stamp. In the RPB, SRAM comes socketed in the module. This SRAM can be removed and replaced with NVRAM. The RPB normally comes with 8Kx8 byte SRAM. 8Kx8 byte SRAM has room to store 8,192 bytes of data. The user can replace the 8Kx8 byte SRAM with 32Kx8 byte SRAM and extend the storage capability of the RPB to 32,768 bytes of data.

I used a Dallas Semiconductor DS1230Y-150 32Kx8 byte NVRAM in the RPB used in this design. I tend to keep one of these lying around for test purposes. There is no reason that the 8Kx8 byte SRAM that the RPB is sold with can't be used for any of the functions described in this article.

Using the RAMPack B WRITE and BYTE_READ Commands

To start with, we'll be taking a look at just the WRITE and BYTE READ commands of the RPB. All commands sent to the RPB must be prefaced with a $55, or '55'hex. This is a binary '01010101', and is used by the RPB to calculate the baud rate that the Master unit is using to send data. In this design, the Master unit is a BASIC Stamp 2. For more information on the RPB data formats, I would recommend downloading the latest data sheet from "www.solutions-cubed.com."

Code Listing 1 — RPB1_299.BS2 — shows one example of writing and reading data from the RPB using just the WRITE and BYTE READ commands. The WRITE command discussed here should not be confused with the PBASIC WRITE command, which accesses EEPROM on-board the BASIC Stamp. All Solutions Cubed Mini-Mods — of which the RPB is one — can communicate using the PBASIC SEROUT and SERIN commands.

In RPB1_299.BS2, part of the ASCII character set is written to the RPB with the WRITE command. These ASCII values are then read back to the BASIC Stamp 2 (BS2) using the BYTE READ command. Figure 2 can be used as a hook-up, or wiring diagram, if you want to try this yourself. This connection scheme uses two I/O pins to communicate with the RPB. You could connect the TM and FM pin of the RPB together and run this program using one I/O pin on the BS2. Multiple baud rates are used in this code example to display how the communication baud rate to and from the RPB can be changed on the fly.

The RPB WRITE command follows a simple format. Figure 3 displays the serial format in hexadecimal values. The decimal equivalents work for these values as well. The data string for a WRITE command always starts with the sync byte ('55'hex), then the command byte ('00'hex), followed by the high address byte, and low address byte, for the address location that the WRITE is to begin at. For example, to start writing data at address location 1000 ('03E8'hex), you would send '03'hex as the high address byte, and 'E8'hex as the low address byte. After this data is received by the RPB, it will store any subsequent bytes of data sequentially

SOURCES

For more information on the BASIC Stamp, contact:

Parallax, Inc.
3805 Atherton Road, #102
Rocklin, CA 95765
phone **(916) 624-8333**
http://www.parallaxinc.com

Scott Edwards Electronics, Inc.
2700 E. Fry Blvd. Suite A4
Sierra Vista, AZ 85635
phone **520-459-4802**
fax **520-459-0623**
www.seetron.com info@seetron.com

Solutions Cubed
Lon Glazner
3029 Esplanade Suite F
Chico, CA 95973
E-Mail: **lon@solutions-cubed.com**
Phone: **530-891-8045**
Fax: **530-891-1643**

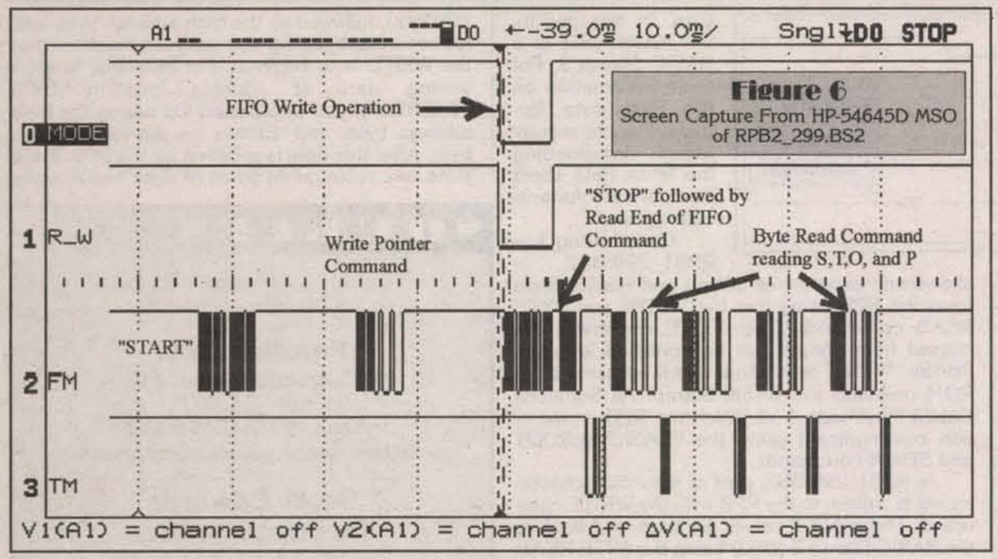


Figure 6
Screen Capture From HP-54645D MSO of RPB2_299.BS2

in RAM. The RPB will exit the WRITE subroutine if there is no data received after a period of time. The time it takes for this to occur is based on the baud rate that data is being received at. For 9600 baud, the time the FM line must remain high for a WRITE to end is roughly 2ms.

For the BYTE READ command, the RPB expects the sync byte ('55'hex), then the command byte ('01'hex), and finally the high and low address bytes for the memory location that you would like to read. The RPB will send the data byte requested on the TM line in 500us. Figure 3 displays this function with data displayed in hexadecimal format.

Storing Serial Data Automatically With The RAMPack B

While the RPB WRITE and BYTE READ commands are useful, they don't solve a very common problem Stamp users run into. It's difficult to store large amounts of serial data for later use by the Stamp. Using the circuit in Figure 4 and the RPB's FIFO mode, you can easily interface to the RPB to store serial data from a PC terminal program.

Some explanation of the circuit in Figure 4 is required. The transistor Q1 — along with D1, R1, and R4 — acts to invert and limit data signals from the PC serial port to the BS2 and RPB. This could be considered a "poor-man's" RS-232 converter. Data received at the RPB's FM pin from the PC will be at roughly TTL levels. R2 and D2 just provide a visual indication when data is being transmitted. The red LED, D2, will flash when data is present at the FM pin.

One of the trickier aspects to using the RPB FIFO mode in this configuration lies in the need to send commands to the RPB. Because the Master unit (BS2) has to share the FM pin with the serial data source (PC in this case), the BS2 must have the ability to seize the serial data line. This is accomplished by connecting the P15 (FMEN in code) of the BS2 to the emitter of Q1. If P15 (FMEN) of the BS2 is an output high (5VDC), then Q1 is effectively removed from the circuit. In this configuration, P14 (FMBS2) can be used to send commands to the RPB.

Current can flow from the emitter of Q1 to the collector with this kind of switch. So it is possible to damage an I/O pin if R1 and R4 are not large enough. This would happen if Q1 were to be turned on while its emitter was held high (5VDC) and the BS2 was outputting a logic low (0VDC). The current that the BS2 is required to sink for the circuit in Figure 4 was only 6mA. This value agreed with a SPICE simulation of the same circuit. In the lab, I reduced the values of R1 and R4 to 1.0K ohm resistors. This increased the current that the BS2 had to sink to about 30mA. If you use this circuit, I would recommend sticking with the values in Figure 4. You should also write your code to minimize the possibility of the BS2 writing to the RPB while your serial data source is sending data.

It is also necessary to give the serial data source (PC) access to the RPB. When the BS2 outputs a logic low (0VDC) at P15 (FMEN), it provides a ground path for the emitter of Q1. This effectively places Q1 in the circuit. When P15 (FMEN) is low, then P14 (FMBS2) should be configured as an input pin. P11 (R_W) and P10 (MODE) are also used to place the RPB in FIFO mode. In this application, the FIFO write operation is used to automatically store data sequentially in RAM with the RPB. Figure 5 shows the proper pin configurations for the RPB MODE and READ/WRITE pins for a FIFO write operation. Tval is the time from executing a FIFO write operation until serial data will be accepted. The maximum time to expect here is 20us.

Code Listing 2 — RPB2_299.BS2 — stores data from a text terminal into the RAM residing on the RAMPack B. This routine waits for the ASCII characters "START" to be received by the BS2 before executing a FIFO write operation. Any text typed into the data terminal after the "START" characters are received will be stored sequentially in RAM. When the ASCII characters "STOP" are received, the BS2 will read the data stored in the RPB and display it via the Debug command. The RPB baud rate is set to 9600 baud just after the "START" is received. Up to 8,192 characters could be stored in RAM using this routine and the SRAM that an RPB is sold with.

I should note a sticky point in this design. The "START" that is received by the BS2 is also

Code Listing 2. RPB2_299.BS2 Storing Serial Data Automatically with the RPB

```
'RPB2_299.BS2 - Storing Serial Data Automatically with the RPB: This program waits for the characters
'"START" to be received. Once received the RPB has its internal baud rate reset to 9600 by the WRITE
'POINTER command. This command also has the effect of pointing any subsequent FIFO write operations
'to address location '0000'hex. Data is then loaded into the RPB while it is in FIFO write mode until the
'BS2 receives the characters "STOP". The READ END OF FIFO command is used to find the last address
'pointed to by the FIFO write operation. This value is always the same as the number of bytes stored during
'the FIFO write operation. The last byte of data written during a FIFO write operation will be at one less
'than the value returned by the READ END OF FIFO command.
'
'*****************************************************************
'Program Variables
'
Address         VAR     Word                'Stores address in RAM to write or read from
Addr_lo         VAR     Address.lowbyte     'Address is broken into bytes for sending to the RPB
Addr_hi         VAR     Address.highbyte    'Address is broken into bytes for sending to the RPB
DataByte    VAR     Byte                    'Used to hold data to be sent or received
End_Addr    VAR     Word                    'Stores Read End of FIFO pointer
End_Addr_loVAR      End_Addr.lowbyte        'Pointer broken into bytes for receiving from the RPB
End_Addr_hiVAR      End_Addr.highbyte       'Pointer broken into bytes for receiving from the RPB
'*****************************************************************
'Pin Assignments
'
FMEN            CON     15                  'Enables/disables data from serial data source
FMBS2           CON     14                  'From Master pin: sends data/commands to the RPB
TMBS2           CON     12                  'To Master pin: receives data from the RPB
R_W             CON     11                  'Read/Write pin: selects type of FIFO operation
MODE            CON     10                  'Mode pin: enables/disables FIFO mode
'*****************************************************************
'Communication Constants
'
Sync            CON     $55                 'Sync byte
B_Read          CON     $01                 'Byte Read command
W_Pointer   CON     $05                     'Write Pointer command
EOF_PointerCON      $07                     'Read End of FIFO command
Baud            CON     84                  '9600 baud
'*****************************************************************
'Initialization of registers
Initialize:
        High    FMEN                        'Disable data from serial data source
        High    MODE                        'Disable FIFO mode
        High    R_W                         'Default to FIFO read
        Pause   500                         'Allow RPB time to power up
        debug   CR,CR,"Initialized",CR
'*****************************************************************
MainProgram:
'Wait for "START" from serial data source, display message when received
'
        Low     FMEN                        'Enable data from serial data source
        Serin   FMBS2,Baud,[wait("START")]
        debug   "START Received",CR
        High    FMEN                        'Disable data from serial data source
'
'At this point the RPB has reset itself due to the "START" data and has returned to a default baud rate of
'2400. The Write Pointer command is used to reset the address that the FIFO write operation will start at,
'and reset the RPB baud rate to 9600 for further data.
        Address = 0                         'Pointer will be reset to '0000'hex
        Serout  FMBS2,Baud,[Sync,W_Pointer,Addr_hi,Addr_lo]
        Input   FMBS2                       'Make FMBS2 an input pin
        debug   "Resetting FIFO Pointer",CR
        debug   "Entering FIFO Buffer Mode",CR
        Pause   100
'
'Enable FIFO write operation and wait for "STOP" to be received
        Low     FMEN                        'Enable data from serial source
        Low     R_W                         'Select FIFO write
        Low     MODE                        'Enable FIFO buffer
        Serin   FMBS2,Baud,[wait("STOP")]
        High    MODE                        'Disable FIFO buffer after "STOP"
        High    R_W                         'Default to FIFO read
        High    FMEN                        'Disable data from serial source
        Debug   "STOP received",CR,CR
'
'The Read End of FIFO command is used to determine how many bytes of data were stored during the
'FIFO write operation. This value is used to set up a For...Next loop to read back all of the data and
'display it using the Debug command.
        Serout  FMBS2,Baud,[Sync,EOF_Pointer]
        Serin   TMBS2,Baud,[End_Addr_hi,End_Addr_lo]
        Debug   "Number of bytes in message = ",Dec End_Addr,CR
        Debug   "Data received after START is...",CR
        For     Address = 0 to End_Addr-1   'Read data from '0000'hex to (End_Addr - 1)
                Serout  FMBS2,Baud,[Sync,B_Read,Addr_hi,Addr_lo]
                Serin   TMBS2,Baud,[DataByte]
                Debug   DataByte            'Display data read
        Next
        Goto    Initialize                  'Start over
        END:
```

received by the RPB on its FM pin. Since these characters do not meet the typical command structure that the RPB expects (sync byte, then command byte, etc.), the RPB will execute a system reset. This reset returns the RPB to a default condition which has the baud rate set to 2400. Sending any valid command from the BS2 to the RPB at 9600 baud prior to executing a FIFO write operation resets the internal baud rate of the RPB to 9600 baud.

In RPB2_299.BS2, this is done by resetting the RPB's internal address pointer with the WRITE POINTER command ('05'hex). This command resets the internal address pointer to '0000'hex, as well as setting the RPB baud rate to 9600.

The hassle of dealing with the effects that the "START" characters have on the RPB can be easily removed. The BS2 could simply execute a FIFO write operation, and then wait for the "STOP" characters. In this manner, all received data would be loaded into the RPB. Since this design interfaces to a human typist, through the PC, adding additional Debug routines and commands can be accommodated. The Debug commands used in this routine might cause unnecessary delays and can be removed in designs where timing is critical.

In instances where data is received as one long string — such as from GPS receivers — it is best to execute a FIFO write operation immediately and wait until a particular end-of-string message is received. In this design, the "STOP" constitutes the end-of-string message.

Figure 6 displays a screen capture from an HP-54645D MSO (Mixed Signal Oscilloscope). This image is of a slightly-modified version of RPB2_299.BS2. From it, you can see how the data flows from the serial data source to the RPB, and then from the RPB to the BS2. I should note that my serial data source was a PC utilizing a common terminal program found on most IBM-style computers available today. The communication parameters that I used were 8N1 serial data, 9600 baud, no-handshaking, and local-echo "on."

In Closing

Most of the difficulty in interfacing the RAMPack B's FIFO mode to the BS2 concern the pin sharing requirements for TM and FM pins. These difficulties can usually be overcome with a minimum of additional electronic parts. Often times, the BASIC Stamp is expected to operate as kind of a "traffic director" for serial data. In these instances, the RAMPack B can be effectively used to buffer serial data.

Next month, we'll take a look at pin sharing with the TM pin, as well as the FM pin. Sharing both pins allows the BASIC Stamp and RPB to act as traffic director and data buffer in a myriad of configurations. One such configuration will be covered in the March installment. Next month, we'll trap serial data from a PC, and then send the data to the Scott Edwards Electronics G12032 LCD. The same circuitry we used in Figure 4 will be added to, to accommodate the sharing of the TM pin, and to convert from non-inverted serial data to inverted serial data. The end result will be a device that records bit-maps from your PC and can then display these bit-maps to a graphic LCD. **NV**

Lon Glazner is a partner and engineer at Solutions Cubed. Solutions Cubed is an innovative group of design engineers who specialize in embedded control design. They also produce a line of BASIC Stamp compatible products called Miniature Engineering Modules.

Code Listing 1. RPB1_299.BS2 ASCII Loop Program

```
'RPB1_299.BS2 - ASCII Loop Program: this Basic Stamp2 program writes part of the ASCII character set
'to the RAMPack B at 4800 baud. It then reads the data back in reverse order at 2400 baud. This data is
'displayed using the Debug command. Finally, the data is read back at 9600 baud in the order in which it
'was stored, this data is also displayed via the Debug command.
'
'''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''
'Program Variables
'
Address     VAR    Word                'Stores address in RAM to write or read from
Addr_lo     VAR    Address.lowbyte     'Address is broken into bytes for sending to the RPB
Addr_hi     VAR    Address.highbyte    'Address is broken into bytes for sending to the RPB
Baud        VAR    Word                'A word variable is used to store the data rate
DataByte    VAR    Byte                'Used to hold data to be sent or received
A           VAR    Byte                'For...Next variable
'''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''
'Program Constants
'
FMBS2       CON    14                  'From Master pin: sends data/commands to the RPB
TMBS2       CON    12                  'To Master pin: receives data from the RPB
B_Write     CON    $00                 'Write command for the RPB
B_Read      CON    $01                 'Byte read command for the RPB
'''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''
'Initialization of registers
            Pause       100            'Allow some time for RPB to power up
            Address =   0              'Default address is 0
            DataByte = 33              'Start data at ASCII "!"
'''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''
MainProgram:
'Write data to RPB at 4800 baud
'
            Baud    = 188                                          'Write data at 4800 baud
            For     A = 1 to 58                                    'Send ASCII "!" through "Z"
                    Serout  FMBS2,Baud,[$55,B_Write,Addr_hi,Addr_lo,DataByte]
                    Pause   20                                     'Allow time for WRITE to end
                    DataByte = DataByte +1                         'Point to next ASCII character
                    Address = Address +1                           'Point to next address
            Next
'
'Read data from RPB at 2400 baud, reads data in reverse order of how data was written to RAM
            Baud    = 396                                          'Read data at 2400 baud
            For     A = 1 to 58
                    Address = Address - 1                          'Read starting at last byte written
                    Serout  FMBS2,Baud,[$55,B_Read,Addr_hi,Addr_lo]
                    Serin   TMBS2,Baud,[DataByte]
                    Debug   DataByte, " "                          'Display byte received
            Next
'
'Read data from RPB at 9600 baud, reads data in the same order as data was written to RAM
            Baud    = 84                                'Read data at 9600 baud
            Debug   CR,CR                               'Place a blank line between data sets
            For     A = 1 to 58
                    Serout  FMBS2,Baud,[$55, B_Read,Addr_hi,Addr_lo]
                    Serin   TMBS2,Baud,[DataByte]
                    Debug   DataByte, " "               'Display byte received
                    Address = Address + 1               'Read data start at first byte written
            Next
            END:                                        'End of program
```

AMATEUR ROBOTICS NOTEBOOK

by Robert Nansel

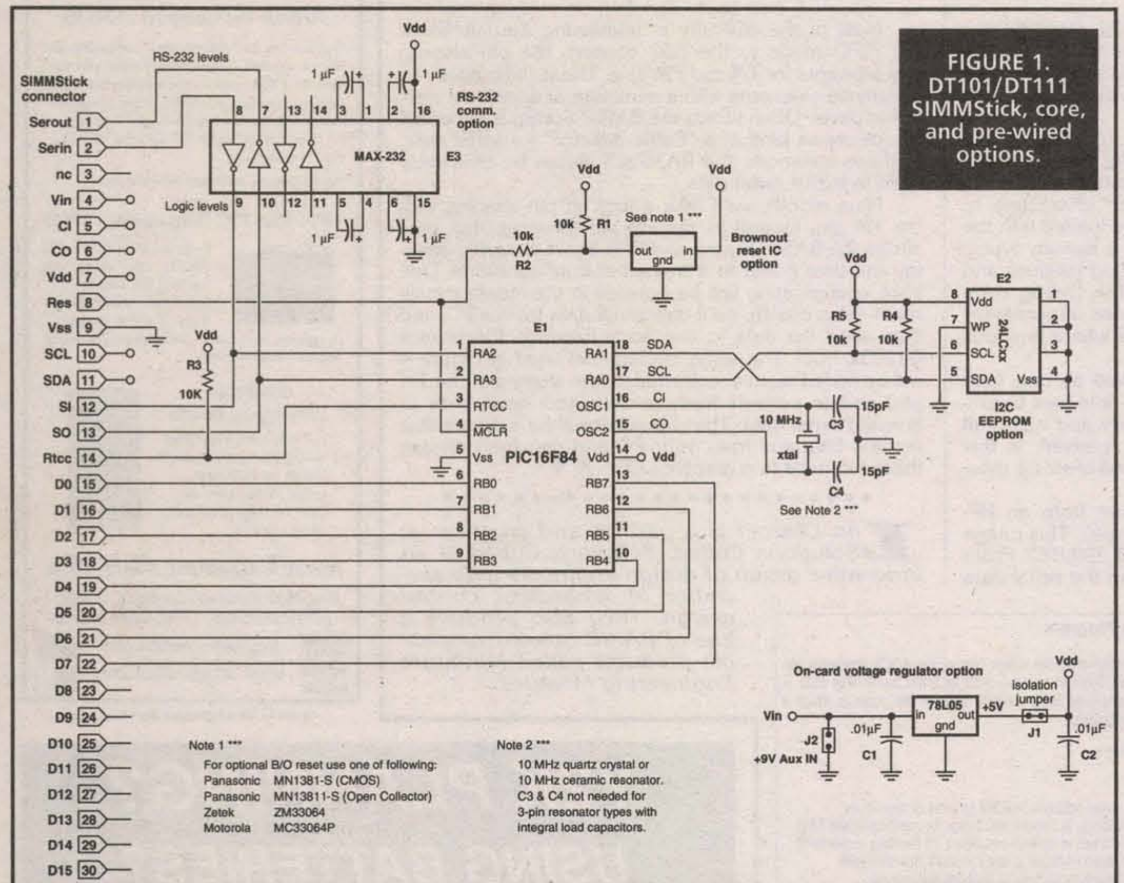


FIGURE 1. DT101/DT111 SIMMStick, core, and pre-wired options.

This month, I'm going to start a project a bit different from past Breadbot projects. Over the last seven columns, I've shown three different versions of Breadbot: The first used a Parallax BASIC Stamp 1 (the BS1-IC Breadbot was covered in this column in the June and July '98 issues of *Nuts & Volts*); the second used a BASIC Stamp 2 (the BS2-IC Breadbot was covered in the September '98 column); and the third used a homebrew BS2-IC clone based on the PIC002 SIMMStick PCB (the BS2 SIMMStick project was covered in the October '98 column, and SIMMSticks were covered in the August '98 issue). The common thread for these projects, of course, is that they are all programmed with some variant of PBASIC or another.

The BS-2 SIMMStick project was the most complicated of the three projects in terms of the wiring, soldering, and debugging involved, but with a little VROC methodology, it wasn't difficult to get the thing to work.

If you will recall, VROC stands for Voltage + Reset + Oscillator + Communications — the essentials of getting any embedded microcontroller system to work. I stated then that when all four of these elements are working properly — assuming the software is already debugged — then the embedded microcontroller system will work. Debugged software is always the big "if," but using known-good firmware in the form of a pre-programmed BS2 PIC chip ensured no trouble from that front.

Over the Falls

In this project, however, I won't be starting with the known-good firmware of PBASIC, so beyond getting the VROC details nailed down, there's the issue of bringing up an embedded system with untested software. When you have to debug hardware and software at the same time, the potential complexity isn't doubled, it's squared; software bugs can masquerade as hardware bugs and vice versa, and if you venture out in these waters unprepared, you have paddled out into a swift stream indeed. That thunder you hear up ahead is white water, and you find yourself going over the falls with PIC assembly language as the barrel.

To make the plunge survivable — and even enjoyable — we need to start with the simplest hardware and software combination possible, the bare minimum needed to tell that both hardware and software are functioning as designed.

With PCs, the usual first program you write is the good old "Hello World" program which prints (big surprise) "Hello, World!" to an appropriate text display such as an LCD screen or a laser printer. Breadbot doesn't have any text device to print to — not yet, anyway — so we'll need some other output device. Among embedded control programmers, the output device of choice for the microcontroller equivalent of "Hello World" is the LED. If you can get a microcontroller to blink an LED on demand, you'll survive going over the falls.

It may sound trivial, merely blinking an LED, but the first time you program any new microcontroller — especially one in a homebrew system — you'll discover how incredibly difficult it can be to get all the I/O, status, and configuration registers properly programmed just to make that LED blink. In effect, you are using the microcontroller as a tool to help build and debug itself. And a blinking LED gives you one very important thing: success. If you can make that LED blink, it means you've got the hardware working — half the battle.

The Hardware

The hardware, in this case, is a PIC16F84 built on a DonTronics DT101 or DT111 PCB (Figure 1). I'm not going to present the detailed assembly instructions for the DT101 as I did for the PIC002 I used in the BS2 SIMMStick project. The DonTronics board has a clear component placement silkscreen (unlike the PIC002), and you can ftp summary instructions for building the DonTronics DT101 from Wirz Electronics at dtp://wirz.com/3rdParty/DT101/dt101.pdf.

For your initial tests, you will need nine components, those marked by asterisks in the parts list.

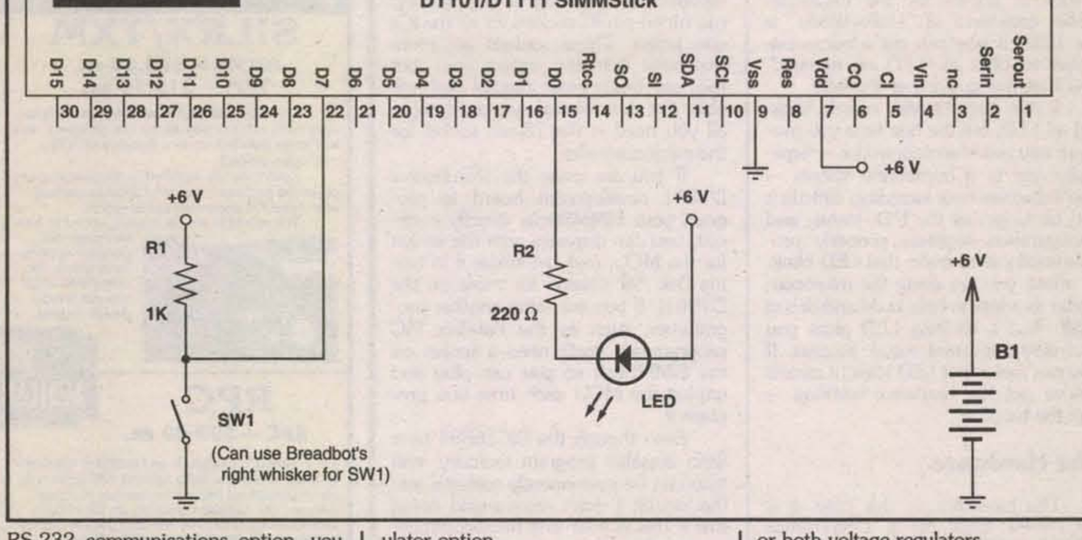
First solder in J8, the 30-pin right angle header connector. In addition — although they aren't required — I do recommend soldering in high-quality, machined-pin IC sockets for all the ICs you install. These sockets are more expensive than the regular ones, but they are much more rugged and reliable. For the minimal system, though, all you need is the 18-pin socket for the microcontroller.

If you are using the DonTronics DT001 development board to program your SIMMSticks directly in-circuit, you can dispense with the socket for the MCU, and just solder it in (see my Dec '98 column for more on the DT001). If you are using another programmer, such as the Parallax PIC programmer, you'll need a socket on the SIMMStick so you can plug and unplug the MCU each time you program it.

Even though the PIC16F84 uses flash erasable program memory, and thus can be permanently soldered into the circuit, I don't recommend doing this if this is your first microcontroller project. Few things are more frustrating than frying a brand new MCU, but having to then unsolder and replace it before work can continue — and possibly damage the PCB in the process — is one of them.

After you've familiarized yourself with the characteristics of PICs and SIMMSticks, then it might be a good idea to solder the MCU to the board. It will be a more reliable connection when subjected to the vibration of a moving robot, and it will also be cheaper. If you choose to install the

FIGURE 2. SIMMStick test circuit.



RS-232 communications option, you should at least use a socket for the MAX-232 because it's pretty easy to accidentally zap it when you're working out serial cable problems.

Power Supply

You can power this circuit either directly at Vdd (pin 7 of the SS-Bus) from Breadbot's six-volt battery pack, or at Vin (pin 4 of the SS-Bus) from a nine-volt battery. For the latter, you'll need to install the on-card voltage regulator option.

To install this option, you'll need C1, C2, J1, and VR1. The +5V regulator VR1 isn't labeled on the DT101 silkscreen (not enough room), but it goes between C7 and J1 with the flat of the TO-92 package facing J1. If you are installing this option, after you solder in VR1, I recommend that you cut the trace on the solder side of the board that shorts the pads of J1 together, solder in the J1 header, and place a shorting jumper between its pins.

The reason for this is that the DT001 programmer automatically switches SS-Bus pin 7 between its own +5V Vdd and +13V Vpp supplies during programming, so if you have VR1 installed on the DT101, its output must be temporarily isolated from the programmer during programming. Otherwise, VR1's +5V will fight against Vpp's +13V, and the result may be curls of blue smoke from one or both voltage regulators.

At the very least, the programmer won't be able to burn the program into the PIC. A sign that the SIMMStick's Vdd supply isn't isolated from the DT001 programmer's Vdd is that the DT001's Vdd indicator LED will be lit when you plug the SIMMStick in the programming slot and switch the Run/Load switch to the "Load" position; when you switch to "Run," the Vdd LED will go out. I'll talk more about using the DT001 later.

If you are using a separate PIC chip programmer, then install the J1 isolation jumper option if you want, though it's only really necessary in this case if it's possible you will ever apply voltages to both Vin (SS-Bus pin 4) and Vdd (SS-Bus pin 7) simultaneously. As with the BASIC Stamps, use one or the other, but not both.

Next, solder in C1 and C2. With the SIMMStick oriented component side up and the SS-Bus connector fac-

```
title "test1 - Poll a Bit"
;
;  Constantly polls input bit for switch closure, indicates result with LED
;

        LIST P=16F84, F=INHX8M, R=DEC
        errorlevel 0,-305
        INCLUDE "\pic\mpasm\P16F84.inc"

; Registers

 __CONFIG _CP_OFF & _WDT_OFF & _HS_OSC & _PWRTE_ON

        PAGE

        org 0

        bsf     STATUS, RP0
        bcf     TRISB & 0x07F, 0; Set RB0 to Output
        bcf     STATUS, RP0
wait_ON
        btfsc   PORTB,7                 ;
        goto wait_ON                    ; Wait for switch press

        bcf     PORTB,0                 ; Turn LED ON

wait_OFF
        btfss   PORTB,7                 ;
        goto wait_OFF                   ; Wait for switch release

        bsf     PORTB,0                 ; Turn LED OFF

        goto wait_ON

end
```

Continued on page 82

Questions & Answers

TECH FORUM

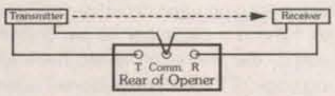
This is a READER TO READER Column. All questions AND answers will be provided by *Nuts & Volts readers* and are intended to promote the exchange of ideas and provide assistance for solving problems of a technical nature. All questions submitted are subject to editing and will be published on a space 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 would like to hook-up a circuit that is similar to the beam-braking safety part of my garage door opener. It is a Chamberlain unit.

I want to use this system in conjunction with a burgler alarm system. There is no schematic with the opener. Refer to the following schematic for wiring information.



Can someone supply a simple circuit that I can try? What kind of sender unit and optical detector is required?

2991 **Roger W. Hamel**
Cedarville, MI

In most projects that use crystals, they never specify series or parallel. What is the difference between series and parallel crystals? Are they interchangeable?

For example, a 20 pF capacitance of the parallel crystal, is this internal or external and is this a set value or minimum or maximum?

The capacitance in most projects vary from 10 to 30 pF, is this for series or parallel and how do you calculate the value?

2992 **Marvin Saj**
Ontario, Canada

Is there a simple circuit modification to add to a triac light control to provide "soft-on" function to increase bulb life? Is it known what the bulb makers believe is possible here? I wonder if the relatively new axial disposed filaments are more prone to failure from mechanical shock?

2993 **John Connell**
San Francisco, CA

Are ZN416 (preferred) or ZN414 available somewhere? These are simple AM radio receiver ICs. I would like to purchase some, but haven't been able to locate any of either type.

2994 **David Rowe**
Sacramento, CA

I would like to have the pinout for an Analog Device AD2038 temperature meter. It was described in the 1987 short-form selection guide.

Through experimentation, I have resolved many of the interconnect requirements, but not all. A pinout would be helpful.

2995 **Kenneth Keck**
via Internet

I am looking for a circuit that I can use to calculate the time between two vehicles in motion.

Vehicle 1 will have the circuit installed, and needs to calculate how far behind (in seconds) vehicle 2 is following.

2996 **Mike Ciotti**
via Internet

I have a gasoline 120V AC 8KW generator that I use at job sites. The thing just rip-roars whether I have a power tool plugged into it or not.

Can anyone direct me to a circuit that can do load sensing to see if a load is on-line, which would then run a servo motor, or solenoid to open the throttle on the engine, and when the load is removed to idle it back down?

It does have a 12V battery to provide sensing voltage.

2997 **John Jones II**
via Internet

Is there an antenna for shortwave radio? Where can I find it or them?

2998 **Nelson Ortega**
Tampa, FL

I have a project underway that uses two separate inexpensive Elenco sine/squarewave generators.

On these, the frequency output is controlled by a simple potentiometer. I need to be able to control these pots using a computer/Visual Basic 6. Does anyone know how I can accomplish this? I wish to use a mouse, where pressing the left mouse button assumes control of generator 1, allowing mouse movement to control frequency. Pressing the right button would adjust generator 2.

Also, once frequency 1 is set, I would like things set up so that pressing the right button would start up the second generator at the same frequency as generator 1. I am sure all this could be done in software, perhaps directly controlling a Sound Blaster card, but currently I am trying to control those pots via RS-232.

2999 **Tom Moore**
via Internet

I am looking for a circuit that will interface with the data port of a number of automobile on-board computers.

My immediate need is for a 96 Jeep Cherokee. Once I get to talk to the computer, I would need to figure out what I'm seeing. Possibly using a BASIC Stamp and or a laptop to help decode the information?

Trying to troubleshoot a newer vehicle now is much harder than it was back before the days of the on-board computers.

29910 **Joe Reed**
Charlotte, NC

I am looking for a device that would protect equipment from voltage sags during brownouts and from power going on and off quickly as often happens during blackouts.

This device would pass power from the AC mains to the load device(s) as long as the AC supply remains inside an acceptable range of voltages (from 100 to 130 VAC). But, if voltages drops (or goes too high), then it disconnects the devices from the mains (both sides, hot and neutral) and keeps them disconnected until the voltages on the mains have returned to normal values and have stayed there continuously for at least 100 seconds.

The device must be able to support inductive and non-inductive loads of up to 15 amps. The device could be completely prepared for consumers (like a power strip is) or could be a component that requires the addition of power plugs and sockets.

29911 **Nelson Bolyard**
via Internet

I have a DBS receiver that is capable of controlling a VCR via an IR emitter.

Due to my shelf arrangement and room conditions, the DBS receiver does not reliably control the VCR.

I would like to build a simple 'repeater' circuit in which an IR sensor placed in front of the emitter of the DBS receiver would transmit, via a short cable, to an IR emitter placed in front of the VCRs IR receiver.

I am sure there are some inexpensive IR modules available from distributors that might do the job easily, but I am not very familiar with them.

29912 **Lee Roth**
Columbus, OH

I am looking for a device for a telephone line that has the Caller Line ID (CLID) feature.

One side of this device would hook to the telco line, the other side

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.
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- 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.

ANSWER TO #1996 - JAN. 1999

What you are describing is a frequency detector. It should be fairly simple to construct using a couple of LM567 tone decoders.

Referring to Figure A, U4 is set up to detect an input frequency of 60 Hz and with a little logic, turn on D2. When the input frequency is less than 60 Hz, D1 is on and D2 is off. When the input frequency is greater than 60 Hz, U5 turns on D3 and disables operation of D1 and D2 through the nand gates U2A and U2C.

To set up U4, monitor the center frequency of the decoder on pin 6 with a scope or frequency counter and adjust R4 for an output of 60 Hz. Likewise, to set up U5, monitor the center frequency of the decoder on pin 6, adjust R6 for an output of 62 Hz. See Figure A for circuit details.

Kevin Goodwin
Oceanside, CA

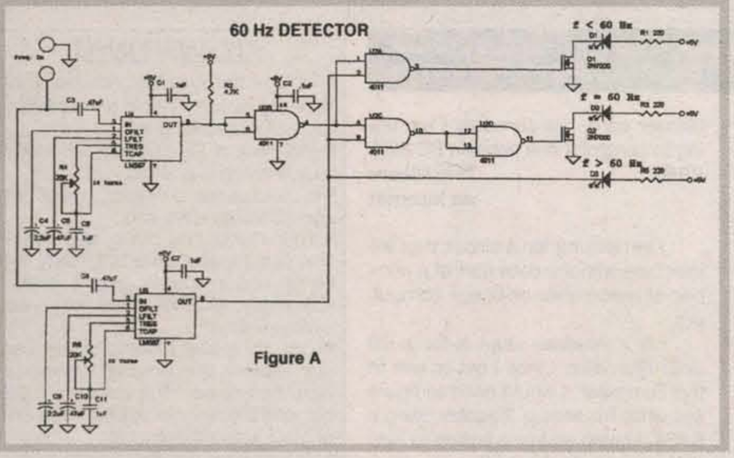


Figure A

would be connected to the phone(s).

The device would prevent the phones from ringing unless and until CLID information containing a number was supplied by the telco. The device would not ring the phone for incoming calls that have no CLID information, nor for calls whose CLID info indicates P (private) or O (Out of area), or any other non-numeric info for the phone number.

The phones that connect to this device must still be able to get dial tone and/or answer calls merely by lifting the receiver, and the telco line features that require flashing the hook (e.g., call waiting, three-way calling) must continue to work with those phones.

29913 **Nelson Bolyard**
via Internet

ANSWERS

ANSWERS TO #19917 - JAN. 1999

You can solve this problem by getting a device known as the "ymouse" manufactured by **P. I. Engineering**, 2296 Williamston Rd., Williamston, MI at **1-800-628-3185** or **517-655-5523**.

This adapter will handle either two mice or one mouse and a touchpad device, or one mouse and a trackball, and connects to the computer's serial DB9 port.

They also manufacture adapters for PS2, keyboards, and laptops.

The website can be found at http://www.ymouse.com

Arthur Hazboun
Harbor City, CA

ANSWERS TO #19917 - JAN. 1999

You may want to consider purchasing a Y-splitter which would allow two pointing devices to be used simultaneously by your PC.

A mail order business called **Cyberguys** sells these Y-splitters for both serial and PS/2 pointing devices. They are advertised to work with standard mice, trackballs, and other pointing devices such as touchpads. The catalog number is 104-0520, and they are priced at $45.95 each. Check them out on the web at **www.cybererguys.com** or by voice at **1-800-892-1010**.

John McMichael
Laramie, WY

ANSWER TO #1998 - JAN. 1999

It sounds to me like a case of AGC overload with resultant cross-channel modulation. That's a fancy way of saying those two channels are way too strong for your TV set, and your high-gain antenna is not helping one bit.

If the antenna has a pre-amplifier in it, that will just make things worse.

Here's a simple test: instead of your big antenna, connect a halo loop or maybe just a couple of paper clips to the antenna terminals of your TV set. The picture may look weaker, but the bars should go away.

Once you have determined that too much signal level is the problem, then you can address how to reduce the signal on those two channels while still receiving other stations in the area.

Tuning stubs used as notch filters would be one approach. Turning off the pre-amplifier (if there is one) might do the trick, or pointing the antenna in some other direction, such as 90 or 180 degrees off-course.

Harry Boling
Garland, TX

ANSWERS TO #1999 - JAN. 1999

You want a set of cascaded timers. This should be easy using 555 ICs. Connect pin 2 (trigger, active low) on each timer via resistor to +V and a capacitor to pin 3 (output) on the preceding timer. The trailing edge of the output pulse will spike the trigger low starting the next timer.

To start the timers properly, you should probably set up a momentary switch to all the resets (pin 4, active low), and a momentary switch to pin 2 of the start timer.

Peter Hanely
via Internet

ANSWERS TO #1999 - JAN. 1999

CEBEK recently released a three- timer circuit designed to simulate the operation of a traffic light. Time settings are adjustable from 4 to 50 seconds for the "Red" and "Green" outputs. The "Yellow" output is automatically set to 1/4 of the time setting.

This circuit operates at 12V DC and can switch up to 2A. This will easily control relays to operate the light at 120 VAC.

Best of all, the price of this board level unit is under $20.00 available from **MCM Electronics, 1-800-543-4330**. Order number is 28-6215.

Alex McIlwain
Lakeland, FL

ANSWERS TO #1999 - JAN. 1999

Rather than using discrete components to generate timing signals for the traffic light, have you considered using a PIC microcontroller from Microchip Electronics?

A PIC 12C508, for example, has six I/O pins and sells for under $2.00 in single quantities. It also has its own clock which runs at 4 MHz and should be accurate enough for your application.

If you don't mind setting the delay values in software, you should literally need no external components to get the timing signals, since three of the six I/O pins could be pro-

ANSWERS TO #19915 - JAN. 19915

You can make a dual channel oscilloscope act like a Huntron Tracker (characteristic curve tracer) by using an external sinewave generator and a resistor. The signal generator (or scope) must have a floating common.

Channel-A of the scope measures the voltage across the component under test, Channel-B measures the current.

Set the scope time scale to X vs. Y (or A vs. B). Apply a 5Vpk (10Vpp) 1KHz sinewave to the component under test in series with a 1,000 ohm resistor. Connect the scope's CHA-COM and CHB-COM to the junction of the component under test and the resistor.

Connect CH-A to the junction of the signal generator output and the component under test, connect CH-B to the junction of the signal generator and the resistor.

Be aware that some tiny diodes have very low Imax. The above circuit will put up to 5mA though your component. Lower the signal voltage or increase the resistance appropriately.

Use a relay or toggle switch to place other components into this circuit automatically for comparison of "good" vs "bad" components.

Anthony Tekatch
Ontario, Canada

ANSWERS TO #19915 - JAN. 1999

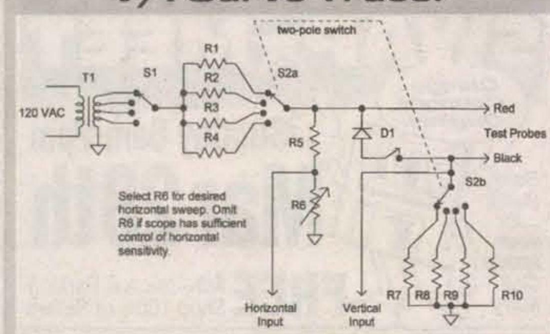
We have a .pdf file on our web site that shows a curve tracer that may be added to most oscilloscopes like the one requested by the reader, Joe Farley. **http://www.wenzel.com/pdffiles/curve.pdf** (A copy is reprinted here, to the right.)

The simple version may be all that you need, but the multi-voltage design has enough voltage and power to look at the behavior of power devices and enough sensitivity to non-destructively characterize delicate components. Just make sure the switch settings are right.

I also like the built-in diode for single-polarity testing when high-reverse voltage can cause damage.

Charles Wenzel
Austin, TX

V/I Curve Tracer



The V/I Curve Tracer is an indispensable tool for troubleshooting circuits and testing components. The circuit traces the current versus voltage curve for the component under test on an ordinary oscilloscope. The peak-to-peak test voltage is adjusted by selecting different taps on a power transformer and the test current is limited by a selected series resistor. The voltage and current ranges are not critical and a single voltage version built with no switches will prove quite useful. The "deluxe" version shown in the schematic provides four test voltages with current ranges from a few hundred microamps to a few hundred milliamps. An optional diode is included in the output to limit the voltage swing to a single polarity to prevent reverse breakdown when checking delicate devices.

T1: Unless you plan to test high-power devices, T1 may be a small power transformer with a few different secondary voltages. The prototype depicted in the schematic has four secondary taps but a center-tapped 24VAC transformer will give two useful test voltages of about 17 and 33 volts peak. Avoid voltages much above 24VAC to reduce risk of shock.

S1: A single-pole switch with enough positions to accommodate the desired number of test voltages.

S2: A two-pole switch with enough positions to accommodate the desired number of test current ranges. Note that the switch selects resistor pairs: R1 & R7, R2 & R8, R3 & R9, R4 & R10.

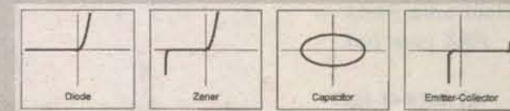
R1 - R4: These resistors limit the test current. R1 could be a 100 ohm, 10 watt resistor for a high power range capable of testing incandescent lamps (and quickly zapping semiconductors!). R1 works with the current sensing resistor R7. The current sensing resistors should be about 1000 times smaller than the series resistors so R7 should be 0.1 ohms if R1 is 100 ohms. The power dissipated in the current sensing resistors will be small so any style may be used.

Try R2 = 1000 ohms, R3 = 10,000, and R4 = 100,000 ohms.

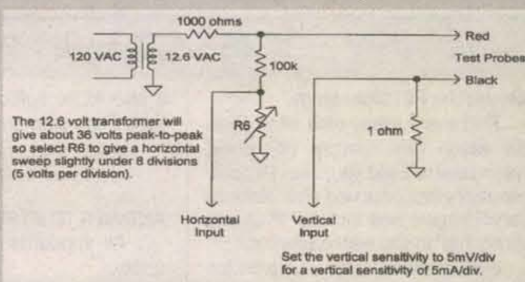
Following the 1/1000 guideline gives R8 = 1 ohm, R9 = 10 ohms, R10 = 100 ohms. Note that these current sense values give four ranges from 100mA to 100uA with about 10 mV per vertical division for the oscilloscope. If the oscilloscope does not have a vertical sensitivity of 10 mV per division, the current sense resistors (R7 - R10) may be increased.

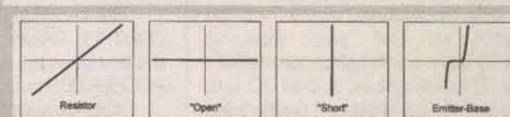
D1: A silicon diode capable of handling the highest test current and voltage. A 1N4002 should work well for most applications. When the diode is in the circuit, it will limit the negative swing to under -1 volt.

Here is a simple version with a single voltage range of about 18 volts peak and a current limit of about 18



milliamps peak. The transformer is an ordinary "filament" transformer or similar with a single secondary. This one-range tracer is quite useful for quick checking of zeners, transistor junctions, LEDs, and most other semiconductors.





grammed to provide the timing signals for the lights.

If you are new to programming PICs, check out the Microchip web site at www.microchip.com and invest some time in learning. If you do a lot of work with electronic circuit design, the time you are able to save on projects like this should more than make up for the time you invest in

TECH FORUM

learning the PIC technology.

There are many web sites available which give sample PIC code, explain how to build your own PIC programmer, etc. Just use your favorite search engine and include "PIC" and "Microchip" in the search terms.

If you want to simply buy a device for this application, check out the "Lights to Go" web site at http://www.trafficlights.com/e5ad.htm. This describes a $44.00 unit they sell for controlling a traffic light. It should be sufficient to control the light if you plan on using it indoors.

Mark Winters
Orem, UT

ANSWER TO #1993 - JAN. 1999

All modems should have that ability.

Go to START — SETTINGS — CONTROL PANEL — MODEM. When the box pops up, choose the DIALING PROPERTIES button.

Approximately 2/3 down the newly displayed window is a check box for "Call Waiting" make sure it is not checked. If it is not, go to START — PROGRAMS — ACCESSORIES — DIAL-UP NETWORKING. Highlight the "Entry Name" or "Connection Name" you connect to.

Now choose FILE — PROPERTIES.

In the windows that pops up, verify that the "Telephone Number" box does not have a *70 (or whatever your phone company uses to disable call waiting) in the box, if it does, delete ONLY the *70 click ok and close the other windows. That should fix your problem.

If this does not fix it, you should check that you do not have your calls automatically forwarded when the number is busy.

Gregg Berkholtz
Portland, OR

ANSWER TO #1992 - JAN. 1999

You are probably suffering from two separate problems, but both of them are related to the current the motors draw.

First, your power supply probably cannot provide enough current when the motors are first turned on. Although the motors may say they are 5 amperes, the current the motors draw when they are first turned on could be much higher. If it is high enough, then the supply voltage may dip low enough that the microcontroller gets upset. The motor supplies and the logic supplies should be separate, you don't want the dip on the motor supply to affect the microcontroller.

If you must use one supply, then connect the motor to the supply directly, but use a series diode to connect the positive supply to the microcontroller. If the motor supply dips, then the diode will reverse bias and prevent the motor from pulling down the microcontroller supply.

The microcontroller power supply (not the motor) should have some large capacitors so it can coast through the dip in the motor supply. Use a scope to look at the power supply.

Second, you probably have a wicked ground loop. You must arrange your ground wires so none of the motor current flows through any of the microcontroller ground connections. The microcontroller ground connections include the grounds used for the power devices that turn the motors on and off.

You may need transformer or optoelectronic coupling. The generalized notion is called single point grounding.

Here's what happens: Say the motor current does flow through the microcontroller ground. Say the resistance of the ground connection is 0.1 ohms. If the motor startup current is 20 amperes, then the voltage drop across the ground connection is 2 volts — more than enough to change a logic state from false to true.

You may also want to add some capacitors, diodes, and resistors across the motor, but these components are usually added to reduce the stress on the power switching components or to reduce RFI.

Gerald Roylance
Mountain View, CA

ANSWER TO #1991 - JAN. 1999

There are several PLL ICs that can be used for a 100-1000 MHz synthesizer.

Motorola's MC145200 will work to 2 GHz. National has an LMX2315, and Harris has an HFA3524. Even better for this application would be a fractional-N chipset, but I don't have any data handy. All these chips are programmed serially, so the interface to a computer is simple.

Unfortunately, the problem in building such a synthesizer is not the IC, but the oscillator. It is tough to build an oscillator that covers one octave, but you want to cover about 3.5 octaves.

The simplest way around the oscillator range problem is a heterodyne design. Use a VCO that covers 5.1 to 6.0 GHz, mix it with a 5.0 GHz local oscillator, and use the 0.1-1.0 GHz result as the synthesizer output. The frequencies are a little scary, and the performance won't be great.

An alternative is to build a 250-500 MHz VCO to cover the middle octave. Other octaves are derived from this signal. Switch in a doubler if you need the top octave, or use one or two dividers to get the lower octaves. You will need six or seven half-octave filters to clean up the output signal.

There are a lot of switches, so we are not talking about something simple. The performance should be better than the heterodyne design.

Building a one-octave VCO is difficult, and building a good one is an art. The good ones are bandswitched and vary the oscillator bias conditions in different bands. They also use pre-tuning and compensate for changes in PLL loop gain.

For low-noise oscillators, the VCO tuning sensitivity is often less than 500 KHz/volt and the VCO will have 32 tuning bands.

Good (but expensive) texts are: Manassewitsch, *Frequency Synthesizers: Theory and Design*, and Rohde, *Microwave and Wireless Synthesizers*.

Gerald Roylance
Mountain View, CA

ANSWER TO #129818 - DEC. 1998

I recall that one of the hobby electronics magazines did a construction project a while back on building a GPIB interface, perhaps *Electronics Now*, or *Popular Electronics*.

However, Computerboards, Inc. in Massachusetts sells a GPIB interface for $249.00 new. Their phone number is 508-946-5100.

You can probably get the spec for the GPIB interface from the National Instruments or Hewlett-Packard web site.

Joe Heck
Wrentham, MA

ANSWER TO #129817 - DEC. 1998

It is very simple to construct a linear, 10X amplifier, for this application. It is also very inexpensive (total cost is about 45¢).

Build the non-inverting amplifier exactly as drawn in the book, *The Art of Electronics*, by P. Horowitz and W. Hill.

For instance, one could use a LM 358 op-amp, a 1 Kohm resistor, a 3.3 Kohm resistor, a 5.6 Kohm resistor, and a 7-32 volts DC power supply (or just an ordinary 9-volt battery).

1. Connect the positive terminal of the power supply to pin #8 of the LM 358.

2. Connect the negative terminal of the power supply to pin #4 of the LM 358.

3. Connect the end of the 5.6 Kohm resistor to pin #1.

4. Connect one end of the 3.3 Kohm resistor to the free end of the 5.6 Kohm resistor. (5.6K + 3.3K = 9K. This is R2 on the drawing.)

5. Connect one end of the 1 Kohm resistor to the free end of the 3.3 Kohm resistor. (This is R1 on the drawing.)

6. Connect the free end of the 1 Kohm resistor to the negative terminal of the power supply.

7. Connect the junction of the 3.3 Kohm and the 1 Kohm resistor (that made in step #5) to pin #2 of the LM 358.

8. Be sure to connect the negative terminal of the power supply to the ground of the sensor (s).

Continued on page 81

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ADVERTISER'S INDEX

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

MAGNIFIERS 1X to 1000X

by John C. Little

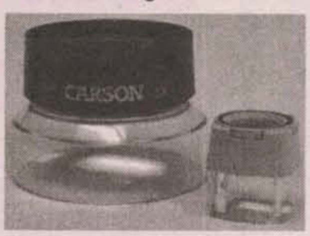
Magnifiers come in many sizes, shapes, and prices. To put a numerical value on the property we call magnification, you need to go back to 1800's England when they defined the near point. The near point is the closest distance from the eyes most adults can comfortably focus and is defined as 10 inches (250mm).

This is the basis for determining the property we call magnification of near subjects. If you look at one line 10mm long from 10 inches, and it covers a particular angle, and compare it to another line 5mm long with a magnifier, and it covers the same angle, you have a 2X magnifier.

Under the same viewing conditions, a 0.1mm line covering the same angle would mean you are using a 100X magnifier. Not all manufacturers use this definition of magnification and use the term *power* instead. Power is not that rigorously defined and often refers to the increase in area. In this case, the magnification factor is the square root of the power. A 9X power lens would have a magnification factor of about 3X.

When you focus your eyes from infinity to 10 inches, it's similar to introducing a four diopter lens into the view. My old eyes don't come close to the 10-inch focus of the average adult, so I have

Figure 1



a different size image on the retina. Individual differences and preferences support the thousands of different magnifiers in the marketplace.

Simple Lens Magnifiers

Simple lens magnifiers use one lens group between the eye and the subject under observation. These simple magnifiers may be a single lens, several lenses cemented together and, in rare cases, air-spaced lenses. They may yield magnifications from a little over 1X to over 300X. In the current commercial market, you can find magnifiers that provide slightly over 1X to about 25X. Higher magnifications are now provided by the more easily used compound magnifiers.

Compound magnifiers differ from the simple magnifiers in that they use a second set of lenses to magnify the image of the primary group. Representatives of compound magnifiers are microscopes, binoculars, and telescopes. There are image magnifiers that use infrared, ultraviolet, X-ray, and electrons, but we will only cover the visible frequencies.

A popular form of simple magnifiers in Figure 1 is an oversized 5X and a focusing 8X model. When you look through these magnifiers, you will find that for practical purposes, the visual linear magnification is about half the stated value. If you put the magnifier on a piece of quadrille paper, you can easily see the degree of magnification. You can increase the magnification by lifting it from the surface of the subject and increasing the distance to your eye, however, a little bit goes a long way as the image is quickly distorted beyond use. The ones shown cost about $5.00 to $10.00.

Some magnifiers include a measuring reticle (a glass scale) at the focal plane for accurate measurements of length, angle, or thread pitch. More highly corrected optics can increase the price up to $250.00 for special applications such as photo retouching. Most of the simple magnifiers on the market today use clear bodies so you can view either opaque or transparent subjects.

Another simple magnifier is the eyeloupe shown with a spring retainer in Figure 2. It is difficult to find eyeloupes with a spring retainer now, but plain loupes from 2X to 5X are available at less than $10.00.

Bi-ocular Magnifiers

Your local drugstore carries a very economical bi-ocular magnifier called reading glasses. The strongest sold is usually 3.25 diopter that give a little less than a 2X stereo view and are priced at $8.00 to $15.00. (The diopter is one meter divided by the focal length of the lens.) The "half glasses" allow quick orientation of your subject by looking over the top. Some people may be uncomfortable trying to converge the sight lines and maintain a stereo view so close to the face.

A solution is the head-mounted magnifiers, some with flip-up lenses that are available in 2X to 8X. These are designed with wedge shaped lenses to ease the strain of the converging sight lines. They are priced in the $20.00 to $50.00 range.

Shown in the background of Figure 2 is an inexpensive compound microscope that is found in magnifications from 20X to 100X. The higher mag-

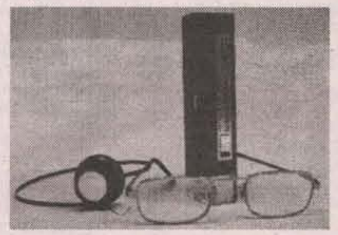


Figure 2

nifications do not seem to have a consistent, good image quality so they should be carefully examined before purchasing. This type of microscope usually includes a "flashlight" to illuminate an opaque subject. They are particularly useful in the field for simple tasks. They are priced from $5.00 to $20.00. Some models can be focused below the plane of the foot. With these, you can examine a few of the problems on PC boards.

Compound Magnifiers

When you look into a compound microscope, you see the image at the end of a dark tube. How far away the image appears is determined by the eyepiece. How much of the subject you can see is determined, in part, by the focal length of the objective and the diameter of the field stop in the eyepiece. The field stop is a disk located at a focal plane within the eyepiece. It gives a sharply-defined limit to the image and also limits the image projected up the tube to the optically-corrected area.

As the focal length of the objective gets smaller, you get higher magnification and a smaller field of view. The common plan achromats (color-corrected objectives), when used with 10XWF eyepieces, have these approximate field diameters: 40X 4.5mm, 100X 1.75mm, 400X 0.45mm, 1000X 0.18mm. When you look at a printed circuit board and need a larger field of view or a greater depth of field, you must increase the focal length of the objective(s). Changing from a 10X eyepiece to a 5X will only make the image look farther away while the area covered by the image stays about the same.

The approximate magnification of the compound microscope is determined by multiplying the magnification factor marked on the objective by the factor on the eyepiece. This is only an approximate value due to manufacturing variations and the settings of the eyepiece diopter adjustment. For accurate measurements, you will need the optics calibrated using a stage micrometer and a reference reticle mounted in the eyepiece.

Stereo Microscopes

Stereo microscopes are two compound microscopes mounted so that the sight lines converge at about a seven-degree angle. A typical fixed magnification stereo microscope is illustrated in Figure 3. This arrangement provides an apparent depth perception similar to that of the near point. These microscopes are designed primarily for those applications where there is a need to manipulate the subject. Image erecting prisms or mirrors are introduced into the optical train without which a direct stereo image could not be obtained.

Applications for stereo microscopes include: electronic surface mount placement and attachment, repair of fine mechanisms, quality control, and a long list of other applications. A single magnification model will cost from $125.00 to over $300.00. Two or more fixed magnifications will cost $250.00 to $1,000.00. Remember that at magnifications above 10X, hand/eye coordination and tremor will bring more frustration than satisfaction for many placement tasks. It is the same problem you would have controlling handheld binoculars.

Locating solder faults and other QC work is more easily done at higher magnifications. Most of the current manufacturers provide good optics except for some of those sold in toy and hobby stores. The primary difference among different models and manufacturers is the quality of the illumination system and the quality of the mechanical work. The graph (Figure 4) illustrates the diameter of the field of view with different values of magnification. It should only be used as a rough guide because of the variations from manufacturer to manufacturer. You would not be able to see a whole 16-pin DIP or the top of a TO-8 can at 30X.

Figure 3

In my experience, perhaps one-half to one percent of users have difficulty attaining or maintaining a fused stereo image from a stereo microscope. This is usually an example of the strong habit of combining the eyes focus and the convergence of the sight line. This is a learned response and can be overcome with practice. It often helps to focus the instrument on a subject, lift your head, and focus on a distant object, close your eyes, and place your head over the eyepieces and opening the eyes. The stereo view pops into view in most cases. Those who need to wear corrective glasses for astigmatism should look for designs providing high eyepoint eyepieces. The near or farsighted can usually use a microscope without glasses.

Zoom Stereo Microscopes

Stereo zoom microscopes are the industry standard for electronic assembly. As assembly people become more experienced, they like to work at increasing magnifications and the zoom optics provide a continuously variable magnification and depth of field. Most current stereo zooms provide visual magnification from 7X to at least 30X. With auxiliary lenses and eyepieces, the range can be expanded from 3.5X to over 200X. The cost of new instruments run from $650.00 to over $4,000.00.

Stereo zoom heads (pods) are sold installed in many designs of stands (Figure 5) and lighting systems, as well as a trinocular photo tube design for camera or video use. If your PC boards are less than 7.5 inches in the narrow dimension, then nearly all stand designs will allow you to work on the whole board. Larger dimensional subjects may require boom stands or other solutions.

Other Compound Microscopes

The average student and research grade compound microscope (under $2,000.00) has a maximum visual resolution of about 900X when using air to glass or oil immersion objectives in visible light. This is a result of the physical limitation of the phenomenon of diffraction. For the technologist, the real question is not the degree of magnification but how much information is retained in the image. With a microscope set at 1000X visual magnification, you can take a photograph and print the image on a billboard at say 10,000X. There would not be any more information than at 900X, in fact there would be a lot less. Magnification alone will rarely be the main factor in microscopy.

Figure 5

There are no universal compound microscopes (those useful for every type of subject), although some in the $50,000.00 range may come close. The purchaser must decide what information they are seeking, what lighting is needed, and the effort and type of sample preparation they are willing to perform to acquire a useful image.

There are hundreds of useful books on microscopes and dozens of excellent ones to help in the selection of the proper microscope for your application. You should be aware, however, that the selection of a specific microscope brand is like selecting a brand of automobile. If you ask an experienced professional for a recommendation, most will quote the brand they are using although the basic microscope has changed little in the last 75 years. All well-designed microscopes should last a lifetime with a reasonable amount of care while a good warranty will cover that rare one that slips through the quality control checks.

One, Two, or Three Eyes?

You would think that a binocular microscope would be inherently better than a monocular model; they certainly cost more. For short term use, it is hard to say. You need to balance the image degradation of at least four air to glass surfaces in a binocular head against the discomfort of using a single eye. If you do not plan intense viewing sessions lasting longer than an hour at a time, a monocular model should work very well.

Do you need a third eye (a trinocular head)? It is difficult but not impossible to obtain excellent photomicrographs or videomicrographs with binocular heads. Because of the angle of the eyetube, it is difficult but you can configure a copy stand for photography. You need to figure about $200.00 more for a trinocular head over the binocular. A good copy stand will cost a little less. Some trinocular heads blank out the two viewing eyepieces when in the photo mode while others allow a small portion of the light to be projected to the eyes to track moving subjects.

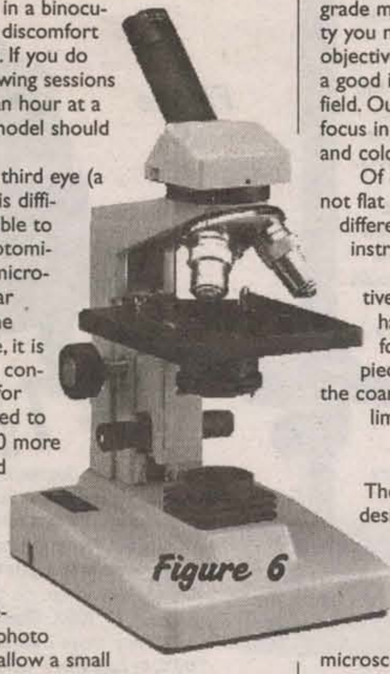


Figure 6

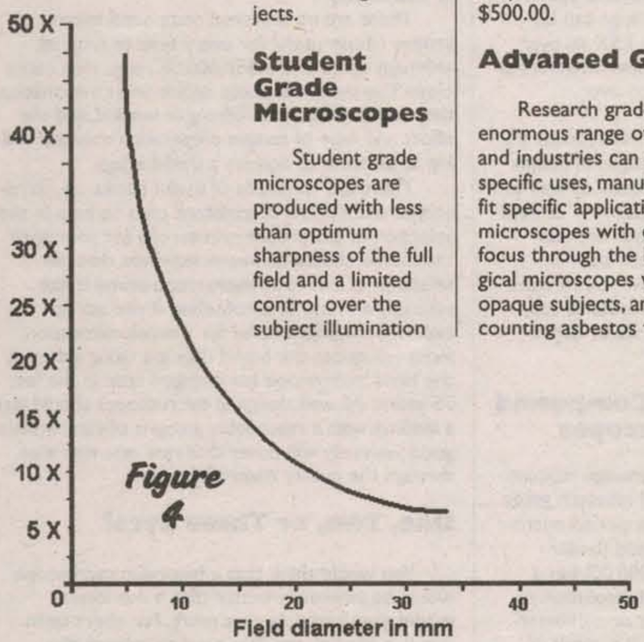


Figure 4

Student Grade Microscopes

Student grade microscopes are produced with less than optimum sharpness of the full field and a limited control over the subject illumination compared to a research model. However, student grade microscopes may provide all the image quality you need for non-critical use. The achromatic objectives used in this class of instrument provide a good image in the central 60% of the image field. Outside that area the image is not in focus in the same plane as the central area and color fringes increase.

Of course, if your subject is not flat it may not make much difference. Most of these instruments come with 4X, 10X, and 40X objectives. They may or may not have both coarse and fine focus control. With 10X eyepieces and 40X objectives (400X), the coarse focus mechanism has reached its limit so adding a 100X objective to the instrument is not very practical.

These instruments are designed with only transparent subjects in mind, however, in a pinch, you can view an opaque subject up to about 100X with a strong sidelight. Shown in Figure 6 is one of the few student microscopes designed to be upgraded. Student grade microscopes cost from about $125.00 to $500.00.

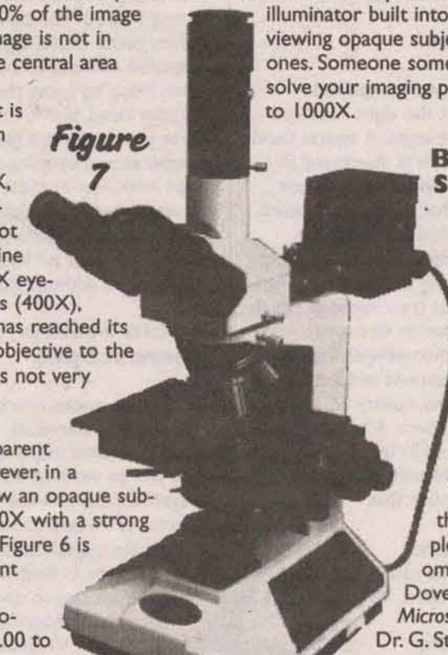


Figure 7

Advanced Grade Microscopes

Research grade microscopes are available in an enormous range of designs. Because laboratories and industries can afford instruments designed for specific uses, manufacturers modify their designs to fit specific applications. There are tissue culture microscopes with extended clearance objectives to focus through the bottom of a petri dish, metallurgical microscopes with reflective illumination for opaque subjects, and polarizing microscopes for counting asbestos fibers. The list goes on and on.

Wherever and from whoever you decide to purchase an advanced microscope, make sure they know your imaging problem and will help you solve it.

The cost of a quality full-sized biological microscope is about $700.00. Such an instrument would have 4X, 10X, 40XSL, and 100XSL oil objectives, a binocular head with 10XWF eyepieces, a mechanical stage, an Abbe' condenser, and a variable intensity light source. In Figure 7, is an unusual current product in that it has a vertical illuminator built into the trinocular head for viewing opaque subjects as well as transparent ones. Someone somewhere has a magnifier to solve your imaging problem in the range of 1X to 1000X.

Books and Other Sources

To decide the specifications for your new microscope purchase the book *Exploring with the Microscope* by W. Nachtigall/Sterling Publishing Co., ISBN #0-8069-0867-x; a winner at $14.95. This book has over 100 color micrographs.

To familiarize you with the nomenclature and simple sample preparation, I recommend you invest in a Dover book titled *The Microscope and How to Use It* by Dr. G. Stehli, ISBN #0-486-22575-5; economically priced at $4.95 (1996).

One of my favorites is the 1958 book *Practical Use of the Microscope* by G.H. Needham. The current price is $99.00. This book has just been reprinted and is available through McCrone Accessories at www.mccrone.com.

The Microscope Society of America has a website (www.msamicroscopy.com) with information on local microscope chapters, and an extensive bibliography is also available.

Get on the web and search with the words "light microscopy;" it will be a long list. **NV**

I can be reached at jlittle@netwizard.net for comments or brickbats. You can also write me at:

Seabird Technical
3580 Haven Avenue
Redwood City, CA 94063-4603

www.seabirdt.com

Don Lancaster's

RESOURCE BIN

number eighty five

Another look at some favorite websites.

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.

Be certain to frequently check out my new *Guru's Lair* web site you'll find at (where else?) *www.tinaja.com.* This is the place you'll go for instant tech answers. Among the many files in our library, you will find complete reprint sets for all of the *Resource Bin* and other columns. Plus a brand new Research InfoPack Service.

You will get the best results if you have both *Netscape Communicator* and *AcrobatReader 3.0* installed.

Where to go for what?

Quite a bit has happened since we last surveyed great places to visit on the web. So I thought it was way past time for an update. Needless to say, the web is where *everything* technical or electronic now seems to be coming down. You simply cannot afford to miss out. You can easily sample the web at your local school or library if you are not yet online.

We saw how to get yourself on the web in RESBN78.PDF. And secrets of web-based research in RESBN71.PDF.

You'll need a newer computer that supports *Netscape* or another modern browser. Perhaps a Pentium running Windows 98. Or a *Linux* box. While you can use Web TV (I feel this is an outright joke) or any national service such as AOL, I strongly believe a local ISP or *Internet Service Provider* is often your best way to go. Typical charges are around $19.00 per month or less. This usually includes a CD-ROM or similar startup software.

You can pick up that latest *Netscape Browser* free at *www.netscape.com.* One useful local ISP is *www.zekes.com.*

Tip: Do look into the new wireless services being offered by a few ISPs. These can end up 400K fast, leave you connected all the time, and tie up no phone lines or have any telco or cable fees. But the transceivers are costly and you'll need line-of-sight.

If you are brand new to the web, you go to a site by booting Netscape and then entering a url address into the *Location* box.

NEXT MONTH:
Don explores the denizens in the pseudoscience morass.

When you find sites you like, you save them by clicking on the *Bookmark* button. Much more on web use, from bare startups to fancy advanced home page design are at *www.tinaja.com /weblib01.html.*

You will find untold zillions of web sites active today. How do you locate the better ones? My choices here are simply based on the sites that I use most often. Instant "hot buttons" for linking most of these are now found at *www.tinaja.com.* Here are several of my current favorites ...

www.questlink.com

This is *the* place to go for electronic data sheets and all application notes. They are industry wide, and represent pretty near anybody and everybody. They also let you instant order small quantities of many harder-to-get ICs and semiconductors.

As with my own site and just about any other source of decent tech info on the web, you will need an *Acrobat Reader* to let you view their ap notes and data sheets. You get this free from *www.adobe.com.* For Acrobat utterly and totally blows HTML away on all counts. More info about this superb PostScript extension can be found at *www.tinaja.com/acrob01.html* and at my *www.tinaja.com/post01 .html.*

Additional electrical engineering links and link farms can be found at *www.tinaja.com /eewb01.html.* Since the link farms do such an incredibly good job here, I personally provide ee links only to the farms and the actual sites I have a repeating need for.

www.hotbot.com

This one is my favorite web search engine. You'll go here to find what is where on the web. Just type in some keywords, and dozens to hundreds of results get listed. Put the keywords in quotes when searching for a name or other exact match. You can also make use of their "links to this url" search as a great ego trip to find out just who is linking your own site.

There are hundreds of other search engines. The *www.altavista.digital.com* is quite popular, although I use it only for emergency backup. There's also an "inference engine" that trys to gather together larger concepts for you up at *www.infind.com.* When this works, it performs very well. When it misses, it does so badly. An example of a *meta* search engine master site which links hundreds of others is *www.kresch.com.* They also offer all sorts of webmaster tools, free search engine submissions, and bunches more.

Books

My very favorite online bookstore is *www.lindsaybks.com.* Who specialize in republishing the "lost technology" titles on everything from old machine shop practice to his early radio books. The quickest way to reach them is to click through on one of their banners found on my website. More info on banners at *www.tinaja.com/advt01.html.*

That 800-pound gorilla, of course, is *Amazon Books.* Who have now become *the* place to go to get *any* book on *any* topic. Reach them by way of *www.tina ja.com/amlink01.html.* I have also placed a few carefully selected book recommendations on dozens of topics here.

By the way, your use of this exact *www.tinaja.com/amlink01 .html* link to Amazon supports both your *Resource Bin* and the *Ask the Guru* web pages at zero additional cost to you.

Oxbridge Media Finder

The fastest, cheapest, and the most convenient way to get up to speed on most any technical topic is by use of those industry insider trade journals. Find these at *www.mediafinder.com.*

Online and E-Mail publisher linkings often do get provided in their listings. But sadly, Oxbridge does not give you complete snail-mail addresses as a free service. Instead, you may have to use the backwards phone finders found at *in-123.infospace.com* or at *www.anywho.com* to pin these down.

Additional phone number sources and other useful web utilities appear at *www.tinaja.com .webwb01.html.*

RESOURCE BIN

SOME RECOMMENDED WEBSITES

www.adobe.com	Acrobat readers and PGML info	www6.MapsOnUs.com	Maps and trip planning
www.tinaja.com/acrob01.html	Acrobat independent support	www.kresch.com	Meta search engine site
www.terraserver.microsoft.com	Aerial & satellite photos	www.drms.com	Military surplus electronics
www.anywho.com	Alternate backwards phone list	us.imdb.com	Movie reviews
www.icmaster.com	Alternate chip info source	www.tinaja.com/dntkwb01.html	Non-technical site favorites
www.drebes.com	Alternate people finder	www.ebay.com	Online real time auctions
www.bigfoot.com	Alternate people finder	www.tinaja.com/patnt01.html	Patent and patenting alternative
www.infospace.com	Alternate people finder	www.whowhere.com	People finder ·
www.altavista.digital.com	Alternate search engine	www2.shef.ac.uk/~chem/web-elements	Periodical table of chem elements
www.tinaja.com/amlink01.html	Amazon book access	www.tinaja.com/post01.html	PostScript independent support
ln-123.infospace.com	Backwards phone directory	www.ups.com	Real time package tracking
www.tinaja.com/advt01.html	Banner advertising secrets	www.tinaja.com.webwb01.html	Resource links for the web
www.tinaja.com/beewb01.html	Bee's favorite links	www.hotbot.com	Search engine site
www.netscape.com	Best Internet browser	www.lindsaybks.com	Source for "new-old" books
www.classifieds2000.com	Buy or sell a car	www.zekes.com	Southeastern Arizona ISP
www.tinaja.com/consul01.html	Consultant's network	wwwdaztcn.wr.usgs.gov	Stream gauge realtime info
www.craftsfaironline.com	Crafts links	www.etrade.com	Stock buy/sell/trade
www.unitedmedia.com/comics/dilbert	Dilbert	quote.yahoo.com	Stock quotes
www.tinaja.com	Eclectic computer & electronic info	www.tinaja.com/barg01.html	Surplus test equipment
www.questlink.com	Electronic data sheets & ap notes	www.tinaja.com/dtekwb01.html	Technical web site favorites
www.tinaja.com/eewb01.html	Electronic engineering sites	www.thomasregister.com	Thomas registry of manufacturers
www.mohotta.com	Essential hacker nutrients	www.bsinet.com/map1	Topographic map CD ROM's
www.healthy.net	Free Medline access	www.horizons.com/suremaps	Topographic maps online
www.weavespindye.org	Handweaving links	www.mediafinder.com	Trade journal directory
www.infind.com	Inference search engine	www.internic.net/cgi-bin/whois	Url finder
www.tinaja.com/info01.html	Infopack research service	www.usps.com	US Post Office
www.internic.net	Internet url registration	www.virtualflorist.com	Virtual flowers
datamation.com/Plugin/jobs/jobs.html	Job links	www.ghgcorp.com/stilgar/shuttlelinks	Weaving links
www.monster.com	Job opportunities	www.tinaja.com/weblib01.html	Webmastering secrets
www.kbb.com	Kelly Blue Book car values	www.usps.gov/ncsc	Zip code directory

www.drms.com

This is your main site to go to for military surplus sales. As we've seen, there's all sorts of incredible surplus bargains these days. It is now super easy to bid on the web and pay by VISA. We saw lots of details on the access secrets a few months back in RESBN81 .PDF and RESBN82.PDF.

Examples of the gettable goodies are at *www.tinaja.com /barg01.html.*

For convenience, I've split this site access up into these four hot buttons at *www.tinaja.com* ...

DRMS1 — *DOD stuff for sale*
DRMS2 — *Preliminary results*
DRMS3 — *Final sales results*
DRMS4 — *Master search engine*

What I'll personally do is grab the info off the web. Then I print it and stash it in a time ordered box. First the descriptions, then their offerings, and finally a search on items of any special interest. The latter to find their condition and acquisition cost. I will also try to actually inspect their lots when and where feasible. Or have them inspected for me. I'll then worry about and revise the bids for a week before submitting them.

The general object of the game is to buy for a penny on the dollar, sell for a dime, and then try to make a nine percent profit. But lately, I have been bidding far lower. When you win too often, you're paying way too much.

The feds are experimenting with private surplus sales. An outfit called *Levy-Latham* is now handling some of the federal surplus auction offerings.

Be sure to check out their website at *www.levylatham.com.*

Maps and Aerial Photos

I have long been a topo map freak. Besides having handled my share of underground cave mapping. There's a wide variety of map-related websites that are good and getting better.

Start off with *www6 .MapsOnUs.com.* These folks sell "roadmap" style maps and trip planning routes. I've found them to be exceptionally useful.

I recently got off on the wrong 4WD track near the Galiuro Wilderness. I was utterly amazed to find this trail online, and was quickly able to "fly" on over to the Powers Hill trail I was really looking for. On the other hand, *Maps On Us* seems to refuse to let you go over Mule Creek pass or through the "tunnel" in Lordsburg.

A useful second alternate here is *MapQuest* at *www.mapquest.com.* Who I have found almost as good.

The actual USGS topo maps are still at their "stumbling first steps" stage. Although I'd expect a superb quality free site shortly. That seamlessly lets you print and map to high res.

Meanwhile, there is a new USGS map site up as *Map One* and found at *www.horizons.com /suremaps.* This one seems more interested in selling stuff than presenting it online. They seem to have missed the essential fact that web success depends on giving a lot away to sell a little.

Somewhat poorly scanned versions of the USGS maps themselves (sadly with those infuriating borders intact) are sold by *www.bsinet.com/map1* and a few others. Prices are around $16.00 for 64 quads and a viewer.

Yet another "almost but not quite there" is the outrageously fascinating *Terra Server* image base that's up at *www.terraserv er.microsoft.com.* This one offers free "flyby" topographic and satellite maps. Down to one meter per pixel resolution, even. There are over four terabytes of data here!

But even with the latest additions, the coverage remains limited. It does take a lot of practice to interpret aerial photos. Especially if they are in black and white and lack a stereo viewing. Things sure get confusingly fuzzy and blobby at maximum resolution. But I would expect hires stereo color maps online within a year or two at most.

Runway maps and other pilot info for airports is at *www.airnav.com.*

These are especially handy if a pilot is going to visit you. But they seem to have left Thatcher International off their list. Probably because there's a few old refrigerators and other minor debris where the runway used to be.

Finally, I have found the USGS real time stream gauge site to be quite interesting. White water folks consider this data essential, while I've found it handy to spot out which remote 4WD crossings are and are not passible. It is also fun watching floods move down through the Gila Valley.

Try out *wwwdaztcn.wr.usgs .gov* or some similar page for your state. Be sure to check these out.

Patents

Patents tend to be highly overrated. Since not one patent in two hundred ever shows a net positive cash flow, a patent repository is mostly of, for, and by losers. Studying patents can (and almost always does) end up as a mind-rotting waste of time.

Nonetheless, there is an intriguing site up at *patent.wom plex.ibm.com.* This one has summaries and full images of most patents back to 1971, along with collections of other IP info.

More on the perils and pitfalls on patents and patenting are found at my *www.tinaja.com /patnt01.html.* Along with my tested and proven real-world alternatives.

Bee's Favorites

Bee is an unindicted *Guru's Lair* co-conspiractor. Her tastes in web sites are wildly different from mine. At any rate, here are some of the sites that Bee uses the most ...

For investments, stock quotes from *quote.yahoo.com* and the actual trades at *www.etrade.com.* This one does take a membership and investment. For free medline access, *www.healthy.net.*

For movies, *us.imdb.com.*

For timely customer package real time tracking, *www.ups.com.*

For postal rates *www.usps.com.* Or their zip code directory over at *www.usps.gov /ncsc.*

Plus, of course, Dilbert who is over at *www.unitedmedia.com /comics/dilbert.* Virtual flowers at *www.virtualflorist.com.* And don't forget the essential hacker nutrients at *www.mohotta.com.*

Bee is also very much into string bending, so two sites of major interest are a weaving guild at *www.weavespindye.org* plus the weaving links at *www.ghg-corp.com/stilgar/shuttlelinks.* Additional craft links of all flavors are found at *www.craftsfairon-line.com.*

There is also the new *www.ebay.com* auction site. But this one can end up a giant time and dollar sink.

Lots of additional annotated links (similar and otherwise) can be found at *www.tinaja.com /beewb01.html.*

Plus a Few More of Mine ...

Such as that periodical table of the elements chem info you should find at *www2.shef.ac.uk /~chem/web-elements.* Or the extensive job opportunities at *www.datamation.com/PlugIn/jobs/j obs.html* or at *www.monster.com.* Or blue book car values at *www.kbb.com.* Or car sales at *www.classifieds2000.com.*

Or the good old Thomas Registry at *www.thomasregister .com.* That web url registration site up at *www.internic.net*. Or their *Whois* site finder service up at *www.internic.net/cgi-bin/whois*. Or the people finders at *www.whowhere.com*. At *www .drebes.com*. At *www.bigfoot.com*. Or at *www.infospace.com*.

More of my favorites are found at *www.tinaja.com/dtekwb01.html* or at my *www.tinaja .com/dntkwb01.html*.

For More Info

Annotated links to many hundreds of other useful web sites are found on various pages of my *www.tinaja.com*. I also have a service where I can do fee-based research for you. Web centered or otherwise. Many times I can find better and more useful answers a lot quicker than you might by yourself. See *www.tinaja.com /info01.html*.

We also have a unique consultant's network of individuals which I can personally recommend for just about any technically related task. You will find their links and capabilities up at *www.tinaja.com/consul01.html*.

There's also my US no-fee helpline service as noted below.

This Month's Contest

As our contest for this month, just tell me about your favorite web site and why you like it.

There'll be a dozen or more of my new *Incredible Secret Money Machine III* books going to the better entries. Plus an all expense paid *tinaja quest* for two (FOB Thatcher, AZ) going to the very best of all.

Send your written and snail-mailed entries on this contest directly to me here at *Synergetics*.

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**. 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**.*

TECH FORUM

CONTINUED FROM PAGE 73

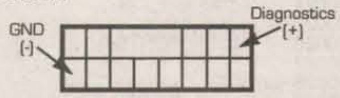
Now, when you connect your sensor's signal to pin #3 of the LM 358, a signal 10X as large will appear at pin #1.

Thomas Ng
San Jose, CA

ANSWER TO #129816 - DEC. 1998

You can use an analog voltmeter to retrieve the trouble codes from the on-board computer. The diagnostic connector and voltmeter hook-up varies with the model and year.

On the Galant, Starion, Van, Montero V6 (1987 and 1988) and all models 1989 and on, the diagnostic connector is in or under the glove compartment. To retrieve trouble codes, connect the meter as shown.



On 1983 to 1986 models, the diagnostic connector is located under the battery tray or the right side firewall near the computer.

On the Mirage Turbo (1987/1988), connect the meter to a good ground and the single connector on the firewall near the set timing connector.

Turn the ignition on and watch the voltmeter, count the number of sweeps. The meter will sweep every 2 seconds in a 10 second period. The codes can be determined as follows:

00000 = 0
10000 = 1
01000 = 2
11000 = 3 etc.

This is based on the binary numbering system.

You should consider buying a scanner instead of trying to build one. The two companies most likely to have a scanner to fit your needs are: **OTC Tools**, 655 Eisenhower Dr., Owatonna, MN 55060. Or **Snap On Tools, Inc.**, Kenosha, WI 53141-1410, Phone number is **414-656-5200**.

Dennis Gifford
Henagar, AL

ANSWER TO #129810 - DEC. 1998

The FUJITSU M2312K disk drive is (according to the FUJITSU CE manual) an 84MB SMD disk drive. Transfer rate is 1.229 MB/sec. It requires +5, +24, and -12 volts.

Digital Equipment Corp., Prime Computer, Data General, and many other manufacturers used them either as OEM drives, or third-party companies made controllers to use them with the previous computer manufacturers.

I have two of them hooked to a DEC 11/73 computer, and they make quite a bit of noise and heat.

Joe Heck
Wrentham, MA

Continued from page 68

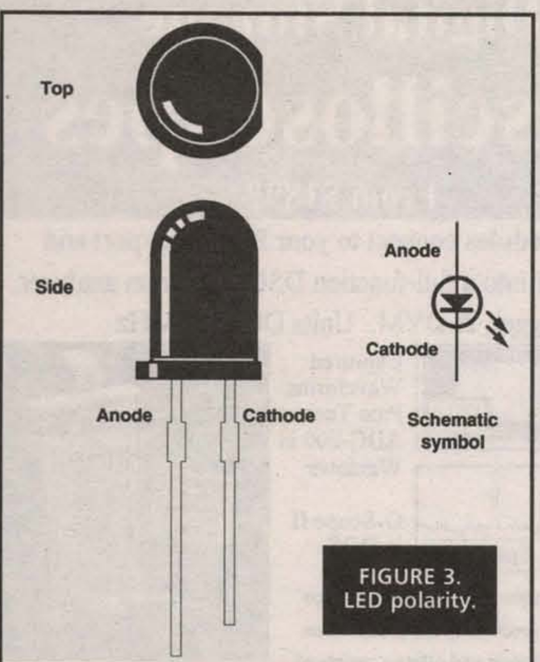


FIGURE 3. LED polarity.

```
LOC  OBJECT CODE   LINE SOURCE TEXT
     VALUE

                   00001 title "test1 - Poll a Bit"
                   00002 ;
                   00003 ;  Constantly polls input bit for switch closure, indicates result with LED
                   00004 ;
                   00005
                   00006         LIST P=16F84, F=INHX8M, R=DEC
                   00007         errorlevel 0,-305
                   00008         INCLUDE "\pic\mpasm\P16F84.inc"
                   00001         LIST
                   00002 ; P16F84.INC Standard Header File, Version 2.00 Microchip Technology, Inc.
                   00136         LIST
                   00009
                   00010 ;  Configuration Registers
                   00011
2007 3FF2          00012 __CONFIG _CP_OFF & _WDT_OFF & _HS_OSC & _PWRTE_ON
                   00013
                   00014
                   00015
0000               00016         org 0
                   00017
0000 1683          00018         bsf     STATUS, RP0
0001 1006          00019         bcf     TRISB & 0x07F, 0            ; Set RB0 to Output
0002 1283          00020         bcf     STATUS, RP0
                   00021
0003               00022 wait_ON                                     ;
0003 1B86          00023         btfsc   PORTB,7                     ; Wait for switch press
0004 2803          00024         goto wait_ON
                   00025
0005 1006          00026         bcf     PORTB,0                     ; Turn LED ON
                   00027
0006               00028 wait_OFF                                    ;
0006 1F86          00029         btfss   PORTB,7
0007 2806          00030         goto wait_OFF                       ; Wait for switch release
                   00031
0008 1406          00032         bsf     PORTB,0                     ; Turn LED OFF
                   00033
0009 2803          00034         goto wait_ON
                   00035
                   00036   end
```

ing you so the SIMMStick's notch is to the lower left, C1 goes in the upper left corner of the board just above C5; C2 goes to the right of J1.

When you've completed the power supply section of the DT101, apply 9V to SS-Bus pin 4 and ground to pin 9. First, test the voltage at the output of the voltage regulator, then at pin 14 of E1, and finally at pin 7 of the SS-Bus; you should read a nice, clean +5V at all three points.

If any of these tests fail, go back and check your solder joints and check continuity of the board against the schematic. In particular, make sure you have continuity between E1 pin 5 and SS-Bus pin 9 (the ground connections) and then between E1 pin 14 and Vdd (the +5V supply). Verify power and ground connections for all the options you install. A good way to do this is to use a highlighter and a photocopy of the schematic; highlight each connection as you probe them out on the board until you either find a problem or you run out of circuit board traces.

Reset Circuitry

The minimum reset circuitry consists of two 10K ohm resistors R1 and R2; in the absence of other reset circuitry, they function as a 20K pull up on the MCLR\ or Res, SS-Bus pin 8. In addition to these two resistors, you can install a reset IC. Note 1 in Figure 1 gives a list of optional brownout voltage detector reset ICs that will work for this board. While strictly not required — my DT101 worked fine without one — I find these reset chips to be quite valuable in that they increase reliability and predictability of the reset action, and I plan to install them in all future boards.

When a reset chip is installed, R2 serves to limit current at the OUT pin of the reset IC, especially for CMOS versions with an active pull up, such as the Panasonic MN1381-S; for open collector versions, R1 functions as the pull up resistor.

While you are soldering in the above reset pull up and current limiting resistors, you might as well solder in R3, too. It pulls the MCU's RTCC input high so the pin doesn't float, leading to possible spurious counts at the RTCC input.

To test these components, measure the resistance between SS-Bus pins 7 and 8 (between Vdd and Res) without power applied to the board; it should read about 20K ohms. If you have installed one of the brownout reset ICs, measure the voltage at SS-Bus pin 8 while gradually increasing a variable DC input at SS-Bus pin 4 (Vin) from 0V to 9V. The Res line should stay low until Vin reaches somewhere above 4.5V, at which point it will jump up to about the same level as Vdd. If you temporarily tie the Res line low, pin 4 of E1 should also drop low, regardless of the voltage at Vin.

Oscillator Section

The oscillator section is just two 15pF capacitors, C4 and C5, and a 10-MHz crystal. If you choose to use a three-lead ceramic resonator with built-in load capacitors, you don't need C4 and C5. In any case, make sure that the load caps (built-in or external) are between 15pF and 33pF to ensure reliable oscillator start-up.

Finish up the SIMMStick hardware by plugging in a programmed PIC16F84, and you're all set.

What? You don't have a pre-programmed F84? Check out the December '98 "Amateur Robotics Notebook" for PIC programmer resources. As I said then, I use two different parallel port programmers — the DonTronics DT001 and the Parallax PIC16Cxx-PGM; I use these with Igor, the 386 DOS machine I keep chained up in my basement.

The DT001 can be configured to program individual chips, to program SIMMStick boards in-circuit, or to function as a SIMMStick motherboard, with lots of expansion connectors and an RS-232 communications port. It comes as a bare PC board directly from DonTronics in Australia or from any of the numerous SIMMStick distributors worldwide. It costs about $75.00 US to build if you install all the many options DonTronics has provided.

The Parallax PIC16Cxx-PGM costs a bit more than the DT001, but it comes already built and can handle a wider range of PIC chips, including the older 12-bit core family, which uses a different programming method than Microchip's newer PICs. It's available in a "Hobbyist Pack" for $109.00 US from Digi-Key.

If you use the Parallax programmer, you'll be using Parallax's own programming software, which is well described in the manual that you can download from their website. If you've never built a microcontroller system before, you may want to go this route just so you have one less piece of hardware to debug.

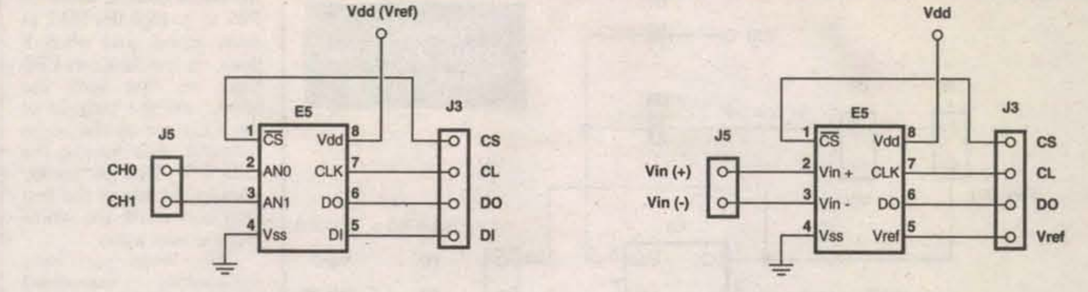
To use the DT001 as a programmer, you will need to download an appropriate version of Nigel Goodwin's PIC84PGM software. You can find all his versions for DOS and Windows at: http://www.lpilsley.demon.co.uk/programs.htm. You can also find the software at DonTronics at http://www.dontronics.com/download.html. The latest version of the DOS software is at http://www.dontronics.com/zip/picprog2.zip.

The DOS screen capture shows the various menu options for the PIC84PGM software. Use "M" to toggle between the PIC16C84 and the PIC16F84 (you want the latter), "H" to load your hex file, and "P" to program the chip. Easy. Unless your parallel port doesn't want to talk with PIC84PGM.

This happened to me. For some reason, Igor's parallel printer port wasn't recognized by PIC84PGM. Installing a cheap $13.00 parallel port card in Igor solved the problem. Be sure to read all of Goodwin's documentation, too, because he has a couple command line switches that invoke debugging modes of PIC84PGM to help troubleshoot parallel port problems. "/D" turns on a debugging mode that shows program initialization details, in particular the PICPROG.CFG setting. Another handy debugging mode is the "/T" test mode option which helps sort out problems with the connection between the parallel port and the programmer.

Igor, Bring in the Hex!

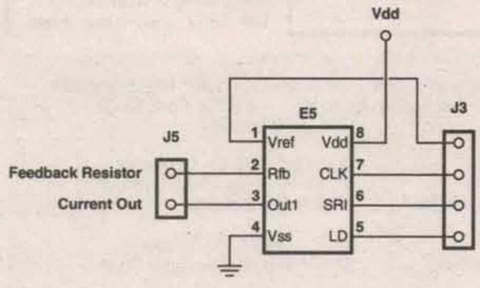
None of the above will do you any good if you don't have a .HEX or .OBJ file to load into the program buffer. TEST1.ASM is a simple test program to exercise the DT101 hardware, and TEST1.LST shows this same file after it's been assembled by MPASM. I've been using both the Parallax assembler and Microchip's MPASM for my PIC development work, but here I'll just talk about MPASM.



a: Serial A/D converter, dual channel option

b: Serial A/D converter, differential input option

FIGURE 4.
DT101 ADC & DAC options.



c: Serial D/A converter option

Serial ADC chips:

National	ADC0832	8-bit, 2-channel
National	ADC0831	8-bit, 1-channel, differential input
Linear Tech	LTC1298	12-bit, 2-channel
Linear Tech	LTC1292	12-bit, 1-channel, differential input
Linear Tech	LTC1297	12-bit, 1-channel, diff. input, w. low power auto-shutdown

Serial DAC chips:

Linear Tech	LTC8043	12-bit, multiplying current output DAC
Linear Tech	LTC1595	16-bit, multiplying current output DAC

MPASM is available for free download from the Microchip website ("asm22000.zip" is the file you want). It comes with all the INCLUDE files for every PIC Microchip makes; this means you don't have to retype all of the register names and equates; for working with the PIC16F84 chip, you just include the P16F84.inc file in your source file (see line 8 of TEST1.LST).

While you're visiting the Microchip site, you might also want to download MPSIM, a software PIC simulator. This program has a horrible user interface (more about that next time), but it is free and it runs under DOS so computers like my Igor can handle it. For those of you running Windows (the majority, I suppose), you might want to try MPLAB, instead. It does everything that MPASM and MPSIM do (and quite a lot more), it's also free, and the MPLAB simulator interface is far superior to MPSIM. The point is, you need to get yourself set up with one or another of these packages.

This is Only a Test ...

The simplest blinky light program uses great gobs of time delay loops to make the LED change state slow enough that the human eye can perceive the blink. Another, only slightly more complicated system, is a program that causes the LED to turn on and off in response to an external input, say, a switch. The software is actually simpler to write for this one, and the extra hardware is just a switch and a pull up resistor, so that's what I've used (Figure 2). The code for this is easy (see TEST1.ASM).

If you've never worked with assembly language before, TEST1.ASM may seem quite daunting. It's really quite simple, though. I'll use the TEST1.LST file to show, line-by-line, what's going on.

Lines 1 through 5 are just title and comments, all of which the assembler ignores when producing code; they're just there to help you, the programmer, keep track of what you're doing. Line 6 tells the assembler that we want to use the PIC16F84 chip, that we want the output file (the ".HEX" file) to be in the form of an eight-bit Intel Hex format (nevermind, trust me), and that we want to use decimal numbers as the default. Line 7 sets up which types of error messages will be displayed during assembly. Line 8, as I said above, includes the standard equates and goofy register names that Microchip

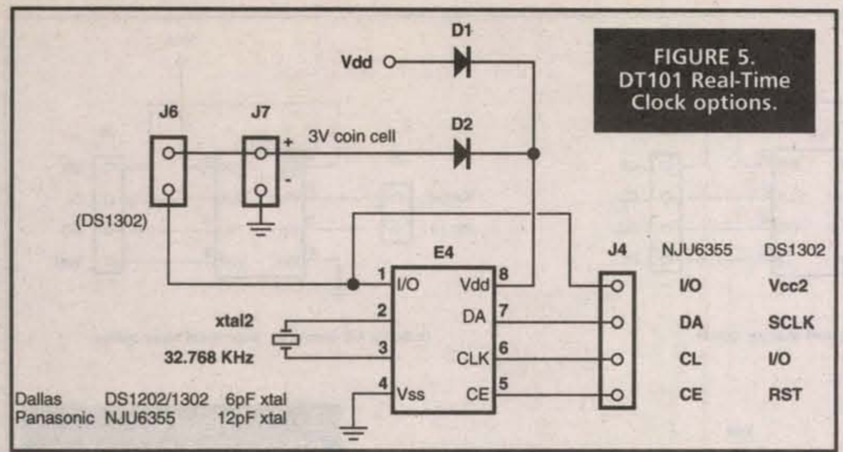


FIGURE 5. DT101 Real-Time Clock options.

uses for PICs.

Skipping down, line 12 sets up the configuration bits for the F84; in this case, the F84 is being configured with the CP Code Protect for code protection OFF, the WDTE watchdog timer disabled, the HS oscillator option set up for a high speed crystal or resonator, and the PWRTE power-up timer enabled (to make sure power to the chip is stable before the PIC starts execution).

Line 16 sets the start of the program at address location zero. Line 18 switches to RAM Bank1 to access the TRISB register, line 19 clears bit0 of TRISB to set up Port B bit0 as an output, and line 20 switches the RAM bank back to Bank0. Now the preliminaries are over, and the main program begins.

```
PIC84PGM Programmer    Version 2.01a   Copyright (C) 1997 Nigel Goodwin.
  WDT: No   PUT: Yes    CP: No    Osc type: HS     Printer Port: $378
    Prog Data Loaded:                        Hex Data Loaded:

H : Load HEX file from disk.                 O : Load OBJ file from disk.
P : Program target 16x8x.                    V : Verify programmed 16x8x
R : Read program & data from 16x8x.          S : Display Buffers.

Alt-W : Toggle WDT Fuse.                     Alt-P : Toggle PUT Fuse.
Alt-C : Toggle Code Protection Fuse.         Alt-O : Toggle Osc Type Fuse.

W : Write Program in buffer as HEX file.
D : Disassemble program in buffer.           M : Micro Type - 16F84

C : Clear Buffer.                            T : Card Type  - SINGLE

A : About PIC84PGM Programmer

E : Erase Target 16x8x.                      Q : Quit programmer.
```

The Big Moment

Lines 22 through 24 constitute a simple two-instruction loop that waits for the switch SW1 to be pressed (see Figure 2). In line 23, "btfsc PORTB,7" does a bit test on Port B, bit 7 (PB7), and it executes the next instruction only if PB7 is set high; that is, it skips the next instruction only if PB7 is clear. As long as the SW1 remains open, PB7 will be pulled high through R1, the goto instruction will not be skipped, and the wait for SW1 to be pressed will continue.

When SW1 is finally pressed, PB7 drops low and the "btfsc PORTB,7" instruction skips over the "goto wait_ON" instruction. What happens next is that "bcf PORTB,0" is executed, which clears Port B, bit 0 (PB0).

Recall from lines 18 through 20 that PB0 was set up as an output; when PB0 is cleared, that puts a voltage near ground on the cathode side of the LED, with 6V already present on the anode. This allows current to flow through the LED, thus lighting it up.

The code contained in lines 28 through 32 does just the opposite of the above code; it waits for PB7 to go high (for SW1 to open again), and when it does, on line 32 it sets PB0 high, so that both the anode and the cathode of the LED are at the same potential, thus turning the LED OFF. Line 34 merely goes to the top of the first loop and starts the whole process over again.

So, when you have successfully assembled TEST1.ASM, burned it into the PIC, and wired the DT101 up in the test circuit as shown in Figure 2, if everything is working right, the LED will shine when you close SW1 and go dark when you open SW1.

It's a pretty round-about way to light up an LED, I know, but it will give you a definite go/no-go assessment of your SIMMStick, and once you have confidence that the DT101 is working (VROC, remember?), then you can dive into more interesting software. But that will have to wait until next time.

DT101 Options

I've not even scratched the surface of the DT101, of course. You can install a MAX-232 for serial communications with your PC or other SIMMSticks, you can add on a I2C serial EEPROM for expanded data storage (Figure 1), and you can even add an ADC or a DAC (Figure 4) for analog I/O capabilities, and a real-time clock and calendar (Figure 5) so your robot will know what time it is and (maybe) what all the fuss is about Y2K. Feel free to experiment with any or all of these but, for the next few installments, I'll be concentrating on what you can do with the core circuit to make some really cool robots.

GrowBot?

Speaking of cool robots, I'd hoped to give a hands-on review of Parallax's new Growbot kit this month, but I haven't been able to get ahold of one yet. The basic configuration of GrowBot will be familiar to anyone who has followed the Breadbot series (i.e., bow-tie bumper up front, same wheel size, two servo motor drive, four AA-cell holder slung underneath, with a BS2-IC for the brain), but it's a slick, expandable design that uses a printed circuit board for the body of the robot instead of a solderless breadboard. Also, they've considerably simplified the caster arrangement, using what appears to be a plastic ball to act as a rollerskid (rolls forward or backward, skids sideways).

They've also got a serial programming port and a couple expansion ports for "AppModules" which stack on headers in the middle of the robot. One AppModule is apparently a solderless breadboard, another is a board suitable for wirewrap or point-to-point breadboarding. The Parallax website also has hints of AppModules such as "ISD Mobile Recording Studio," "LED Display Terminal," and "Infrared Proximity Sensor." I can't wait to get my hands on some of these. As soon as I do, I'll let you know all about them. I'm not sure what the price will be by the time you read this, but it should be $150.00 to $180.00 US range.

Winding Down

I still haven't got the Breadbot wheel encoders working yet. I've been promising them for months now, I know. Let me just say I haven't forgotten; accurate wheel encoders are essential for my future plans with Breadbot.

Finally, I've been doing some more inspirational reading from the Lindsay Publications catalog. This month's book of the month is actually seven books, namely the seven-volume *Build Your Own Metal Working Shop from Scrap* series by Dave Gingery. If you haven't heard of these books, then you really should take a look.

As always, if you have suggestions for improving Breadbot, if you've built a Breadbot, or if you have questions or comments about amateur robotics topics, you can reach me at:

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

In Volume 1, you build his Charcoal Foundry with which you learn to make aluminum castings in green sand molds. Volume 2 — The Metal Lathe — details how you use those aluminum castings from the foundry to build a precision bench-top metal-cutting lathe with a 7" swing and 12" between centers. You then use the lathe and the foundry to build practically everything else required for a fully-equipped machine shop, including The Metal Shaper in Volume 3; The Drill Press in Volume 4; the Milling Machine in Volume 5; and Dividing Head & Deluxe Accessories in Volume 6. Volume 7 — Sheet Metal Brake — doesn't require the lathe or other tools of the earlier volumes, though it does require some welding and simple drilling.

Can you build a whole metal-working shop from scrap? Well, Dave Gingery has done it, and so have quite a few others. The only precision tool Dave used for building his first lathe was a blade-type feeler gauge, yet that same lathe holds to within 0.001" taper an eight-inch piece of stock, pretty impressive for a $50.00 home-made lathe!

Many others have built Gingery machines, too, just by following his directions. I know, I've talked with some of them. Gingery isn't a professional machinist or a foundryman, and you don't need to be either to use his books to build your own machine shop. Gingery's a dedicated amateur who likes to build precision machines, be they lathes or steam engines, and I think robot builders can get a lot of insight from his books. The whole seven-volume set costs about $60.00, but none of the individual books cost more than $10.00 US, so you can check them out one at a time, if you want. By all means, though, at least get "The Charcoal Foundry," because that is the foundation from which the rest of the series builds.

That's it. Next month, I'll continue with the DT101 brain transplant, with a few surprises thrown in. **NV**

Item	Description	Vender	P/N
C1,C2	0.01µF 50WV, 5%, polyester	Digi-Key	P4582-ND
C4*,C5*	15 pF 5% monolith ceramic cap	"	P4839-ND
C5,C6,C7,C8	1µF, 16V tantalum	"	P2105-ND
D1,D2	Schottky diodes (see Figure 5)	"	11DQ03-ND
E1*	10 MHz PIC16F84 MCU	"	PIC16F84-10/P-ND
E2	24LCXX I2C EEPROM		
E3	RS-232 level converter	"	MAX232CPE-ND
E4	Real-Time Clock option (see Figure 5)		
E5	ADC/DAC option (see Figure 4)		
J1,J2, J5-J7	2-pin single row straight pin header	"	929647-02-36-ND
J3,J4	4-pin single row straight pin header	"	
	J1-J7 above are cut from 36-pin pin header		
J8*	30-pin single row, RA pin header	"	S1111-30-ND
R1*,R2*,R3*,R4,R5	10K ohm	"	10KQBK-ND
RVD	Reset Voltage Detector, 4.5V, CMOS	"	MN1381-S-ND
PCB*	DT101 or DT111 SIMMStick	Wirz Elex	DT101 or DT111
VR1	+5V positive regulator, 100 mA, TO-92	Digi-Key	NJM78L05A-ND
XTAL1*	10 MHz crystal, HC49/US case	"	X422-ND
XTAL2	32.768 KHz (see Figure 5)		
Misc:			
	8-pin DIP IC sockets	Digi-Key	ED3308-ND
	16-pin " " "	"	ED3316-ND
	18-pin " " "	"	ED3318-ND
	Shorting jumper (to isolate +5V from Vdd	"	SPC02SYAN

* Required components; see text & figures.

RESOURCES MENTIONED IN THIS ARTICLE:

Dallas Semiconductor
4401 South Beltwood Parkway
Dallas, TX 75244-3292
Tel: 1-972-371-4448
Fax: 1-972-371-3715
www.dalsemi.com
(Serial RTCs, temp. sensors, batt. monitors)

DonTronics
P.O. Box 595
Tullamarine 3043
Australia
Tel: 613+9338-6286
Fax: 613+9338-2935
dontronics.com
(SIMMStick PC boards, development systems, & software)

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Fax: 1-815-935-5477
www.lindsaybks.com
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Milpitas, CA 95035-7417
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www.linear-tech.com
(Serial A/D & D/A convertors)

Microchip Technology, Inc.
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Fax: 1-602-899-9210
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National Semiconductor Corp.
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Santa Clara, CA 95052-8090
Tel: 1-800-272-9959
TWX: 1-910-339-9240
www.national.com
(Serial A/D & D/A converters)

Parallax, Inc.
3805 Atherton Road, Ste. #102
Rocklin, CA 95765
Tel: 1-800-512-1024, 1-916-624-8333
www.parallaxinc.com
(PIC16Cxx-PGM programmer, SX-Key debugger/programmer, BASIC Stamps)

Wirz Electronics SIMMSticks
P.O. Box 457
Littleton, MA 01460-0457
Tel: 1-888-289-9479
Fax: 1-978-448-0196
www.wirz.com
(SIMMSticks, SLI serial LCD interface, kits)

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Tucson 85713

The Electronic Thrift Store
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El Mirage 85375

Tower Records
3 E. 9th St.
Tempe 85281

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Tullamarine 3043
www.dontronics.com

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Cucamonga 91730

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Santa Ana 92705

All Electronics
905 S. Vermont Ave.
Los Angeles 90006

14928 Oxnard St.
Van Nuys 91411

Allen's To Go
13461 Hwy. 88
Lockeford 95237

Alltronics
2300-D Zanker Rd.
San Jose 95131

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234-1/2 N. Brand Blvd.
Glendale 91203

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Los Angeles 90046

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Westminster 92683

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7207 Arlington Ave. Ste. G
Riverside 92503

Op Amp Technical Books
1033 N. Sycamore Ave.
Los Angeles 90038

Panorama Electronics
8737 Van Nuys Blvd.
Panorama City 91402

Sandy's Electronics Supply, Inc.
20655 Soledad Cyn. Rd. #15
Santa Clarita 91351

Sav-On Electronics
13225 Harbor Blvd.
Garden Grove 92643

SIERRA MADRE NEWSSTAND
55 N. Baldwin Ave.
Sierra Madre 91024

The Red Barn
Hwy. 299
Bieber 96009

Tower Books
211 Main St.
Chico 95928

7840 Macy Plaza Dr.
Citrus Heights 95610

1280 E. Willow Pass Rd.
Concord 94520

630 San Antonio Rd.
Mountain View 94040

1600 Broadway
Sacramento 95818

5950 Florin Rd.
Sacramento 95823

2538 Watt Ave.
Sacramento 95812

2727 El Camino Real
San Mateo 94403

Tower Magazines/News
885 Riverside Pkwy.
West Sacramento 95605

Tower Records/Video
220 N. Beach Blvd.
Anaheim 92801

2520 Durant
Berkeley 94704

212 F St.
Davis 95616

5703 Christie Ave.
Emeryville 94608

2052 Redwood Hwy.
Greenbrae 94904

6310 E. Pacific Coast Hwy.
Long Beach 90803

2280 Market St.
San Francisco 94114

3205 20th Ave.
San Francisco 94132

2525 Jones St.
San Francisco 94133

871 Blossom Hill Rd.
San Jose 95123

1205 W. Covina Pkwy.
West Covina 91790

Video Electronics
3829 University Ave.
San Diego 92105

CANADA

Com-West Radio Systems Ltd.
48 E. 69th Ave.
Vancouver, BC V5X 4K6

Muir Communications Ltd.
3214 Douglas St.
Victoria, BC V8Z 3K6

COLORADO

TH Electronics
216 Commerce Dr., Unit 2
Ft. Collins 80524

Tower Records/Video
2500 E. 1st Ave.
Denver 80206

Western Test Systems
530 Compton #C
Broomfield 80020

CONNECTICUT

Archway News
64 Bank St.
New Milford 06776

Electronic Service Products
437 Washington Ave.
North Haven 06473

DELAWARE

Newark Newsstand
70 E. Main St.
Newark 19711

DISTRICT OF COLUMBIA

Tower Records
2000 Pennsylvania Ave.
Washington 20006

FLORIDA

Alfa Electronic Supply
1502 S. St. Rd. #7
Hollywood 33023

Al's News
8219 S.W. 124th St.
Miami 33156

Bob's News & Books
1515 S. Andrew Ave.
Fort Lauderdale 33316

Clarks Out of Town News
303 S. Andrews Ave.
Fort Lauderdale 33301

Mike's Electronic Distributing Co.
1001 N.W. 52nd St.
Fort Lauderdale 33309

Skycraft Parts & Surplus, Inc.
2245 W. Fairbanks
Winter Park 32789

Sunny's At Sunset, Inc.
8260 Sunset Strip
Sunrise 33322

GEORGIA

Tower Records
3400 Around Lenox Dr.
Atlanta 30326

HAWAII

SolarWorks!
525 Lotus Blossom Ln.
Ocean View 96737

Tower Records
4211 Waialae Ave.
Honolulu 96816

611 Keeaumoku
Honolulu 96814

IDAHO

The Current Source
5159 Glenwood
Boise 83714

ILLINOIS

City Newsstand
4018 N. Cicero
Chicago 60641

Tower Records/Video/Books
383 W. Army Trail Rd.
Bloomingdale 60108

2301 N. Clark St. #200
Chicago 60614

1209 E. Golf Rd.
Schaumburg 60173

INDIANA

Harbourtown Sales
108 Park 32 W. Dr.
Noblesville 46060

KANSAS

Hollywood At Home
9063 Metcalf Ave.
Overland Park 66212

Lloyd's Radio & Electronic, Inc.
220 W. Harry St.
Wichita 67213

LOUISIANA

Lakeside News
3323 Severn Ave.
Metairie 70002

MARYLAND

Silicon Valley Electronics
2014-A Industrial Dr.
Annapolis 21401

Tower Records/Video
2566 Solomons Island Rd.
Annapolis 21401

1601 Rockville Pike #210
Rockville 20852

MASSACHUSETTS

Full Spectrum Communications
244 Essex St.
Salem 01970

Newsbreak, Inc.
579 G.A.R. Hwy. Rt. 6
Swansea 02777

Tower Records #172
360 Newbury St.
Boston 02115

MICHIGAN

Little Professors Book Center
22174 Michigan Ave.
Dearborn 48124

MW Electronics
229 E. Michigan Ave.
Paw Paw 49079

Purchase Radio Supply, Inc.
327 E. Hoover Ave.
Ann Arbor 48104

Tower Records
1214 S. University Ave.
Ann Arbor 48104

MINNESOTA

Radio City, Inc.
2633 County Road 1
Mounds View 55112

MISSOURI

Accurate Instruments
11201 E. 24 Hwy.
Independence 64054

Electronics Exchange
8644 St. Charles Rock Rd.
St. Louis 63114

NEVADA

Amateur Electronic Supply
1072 N. Rancho Dr.
Las Vegas 89106

Less Buster's Electronics
2930 N. Las Vegas Blvd.
VSTG-22
North Las Vegas 89030

Radio World
1656 Nevada Hwy.
Boulder City 89005

Tower Records/Video
4580 W. Sahara Ave.
Las Vegas 89102

6450 S. Virginia
Reno 89511

NEW JERSEY

Sys-Com
707 22nd St.
Union City 07087

JR Tech Systems
1309 Hwy. 71
Belmar 07719

NEW MEXICO

Newsland Bookstore
2112 Central S.E.
Albuquerque 87106

NEW YORK

All Phase Video Security, Inc.
70 Cain Dr.
Brentwood 11717

Goldcrest Electronics
480 St. Paul St.
Rochester 14605

Ham Central
3 Neptune Rd.
Poughkeepsie 12601

Hirsch Sales Corporation
219 California Dr.
Williamsville 14221

Tower Records/Video
105 Old Country Rd.
Carle Place 11514

350-370 Route 110
Huntington 11746

1961 Broadway
New York 10023

383 Lafayette St.
New York 10003

OHIO

Compustuff
241 Great Oaks Trl.
Wadsworth 44281

Digital One
7603 Mentor Ave.
Mentor 44060

Footsteps
4925 Jackman Rd. Store #58
Toledo 43613

Hosfelt Electronics, Inc.
2700 Sunset Blvd.
Steubenville 43952

Keyways, Inc.
204 S. 3rd St.
Miamisburg 45342

Leo's Book Shop
330 N. Superior St.
Toledo 43604

Powermaxx, Inc.
1587 U.S. Route 68 N.
Xenia 45385

OKLAHOMA

Steve's Books & Magazines
2612 S. Harvard
Tulsa 74114

OREGON

News & Smokes
2295 W. Main St.
Medford 97501

News & Smokes #8
259-C Barnett Rd.
Medford 97501

Norvac Electronics
7940 S.W. Nimbus Ave. Bldg. 8
Beaverton 97005

960 Conger
Eugene 97402

1545 N. Commercial N.E.
Salem 97303

Powell's Technical Bookstore
33 N.W. Park
Portland 97209

Taylor News & Books
133 W. Main, Ste. 102
Oklahoma City 73102

Tower Books
1307 N.E. 102nd Ave.
Portland 97220

PENNSYLVANIA

Bedford St. News
308 Bedford St.
Johnstown 15901

Genes Books, Inc.
King of Prussia Plaza
King of Prussia 19406

Lehman Scientific
2997-F Cape Horn Rd.
Red Lion 17356

Montco Electronics & Computers
2555 Industry Ln. Ste. D
Norristown 19403

Surplus Al
RR 1 Box 337
Hunlock Creek 18621

Tower Books
425 South St.
Philadelphia 19147

Tower Records
340 W. Dekalb Pike
King of Prussia 19406

SOUTH CAROLINA

555 Electronics
5646 Farrow Rd.
Columbia 29203

TENNESSEE

Tower Books
204 W. End Ave.
Nashville 37203

TEXAS

BDL News, Inc.
809 Pierce
Houston 77002

Electronic Parts Outlet
3753-B Fondren Rd.
Houston 77063

Mouser Electronics
958 N. Main St.
Mansfield 76063

Tanner Electronics
1301 W. Beltline #105
Carrollton 75006

Tower Records
2403 Guadalupe
Austin 78705

VIRGINIA

Satellite Headquarters
7920 Timberlake Rd.
Lynchburg 24502

Tower Records/Video/Books
4110 W. Ox Rd. #12124
Fairfax 22033

1601 Willow Lawn Dr.
Richmond 23230

8389 E. Leesburg Pike
Vienna 22182

WASHINGTON

A-B-C Communications, Inc.
17541 15th Ave. N.E.
Seattle 98155

Bohica Concepts
214 2nd St.
Morton 98356

Cody Books Ltd.
1125 Fir Ave.
Blaine 98230

Service Request
3304 W. Rowan Ave.
Spokane 99205

Supertronix
18650 68th Ave. S.
Kent 98032

Tower Books
10635 N.E. 8th St.
Bellevue 98004

20 Mercer St.
Seattle 98109

WISCONSIN

Amateur Electronic Supply, Inc.
5710 W. Good Hope Rd.
Milwaukee 53223

Greenfield News & Hobby
6815 W. Layton Ave.
Greenfield 53220

Cudahy News & Hobby Ctr.
4758 Packard Ave.
Cudahy 53110

Doing Electronic Calculations With ELCAD

by Fred Blechman

ELCAD (Electronic Computer-Aided Design) is a simple, $14.95 software program for the IBM PC with Windows 3.1 or 95. It allows you to do some fairly complex electronic calculations easily and quickly, and print out the results.

There are a number of ways that electronic circuits come into being. Some hobbyists and professionals have the "knack" and the experience to put together solid-state circuits with the proper transistors and integrated circuits, using the correct resistance, capacitance, and inductance values, with little apparent effort.

Some build a circuit using the "cut and try" approach, eventually getting to the proper component values.

Others follow schematics already designed to do the job, commonly created by designers using data sheets and books full of electronic formulae.

With the advent of the computer, circuit design has become more available to hobbyists and experimenters using some sophisticated software, most costing hundreds of dollars.

But what if you just need to do some occasional circuit design that doesn't justify the cost and time to learn to use the expensive all-encompassing circuit design programs? Enter ELCAD.

For only $14.95, ELCAD allows you to quickly and easily do many commonly-used electronic calculations. Probably the best way to illustrate this is to describe how the program operates and the kind of calculations it performs. You can then decide for yourself how it might be helpful in your situation.

FEATURES

ELCAD does 23 different types of calculations, as well as presenting the resistor color code in a graphical manner. The calculations include: Ohm's Law for DC and AC circuits; parallel resistors; RC time constants; power supply ripple filter capacitance; single-layer coil windings; transformer windings; 555 astable and monostable circuits; unijunction oscillator and timer circuits; programmable unijunction transistor oscillator; heatsink calculations for size, wattage, and temperature; transistor common-emitter, common-collector, and common-base designs.

In all cases, context-sensitive HELP files are available for every screen, and the entire HELP file can be printed out. Navigation between screens is effortless.

Each calculation screen shows a schematic, and the appropriate boxes to enter data. The results are shown, and can be printed out for future reference.

To give you an idea of how the program works, we'll briefly cruise through many of the functions.

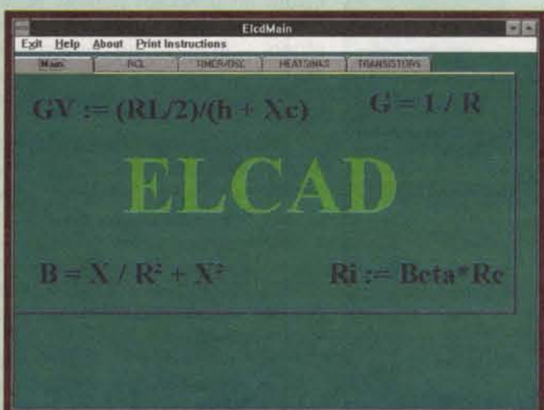

Figure 1. ELCAD Main Menu offers four category "tabs" for calculations.

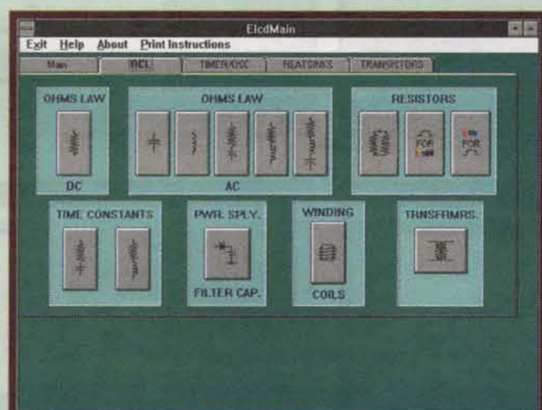

Figure 2. RCL screen offers seven types of calculations.

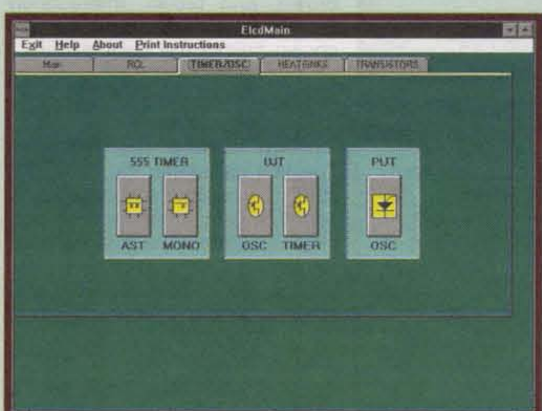

Figure 3. TIMER/OSC screen offers three types of calculations.

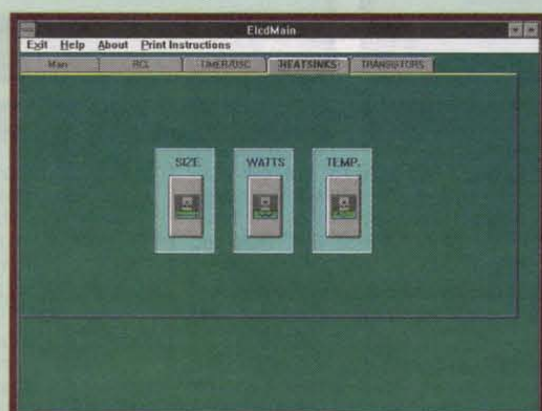

Figure 4. HEATSINKS screen offers three types of calculations.

MAIN MENU (Figure 1)

No formal installation is required. Just run ELCAD.EXE from the supplied 3.5-inch diskette while in Windows, and the Main Menu screen pops up.

The menu bar at the top of the screen lets you "Exit," or get "Help" about this screen, or get details "About" ELCAD, or "Print Instructions" (the entire Help file). ALT-H or F1 on any screen will also call up context-sensitive help.

Using the mouse is the easiest way to maneuver through this program. All mouse clicks are with the left mouse button.

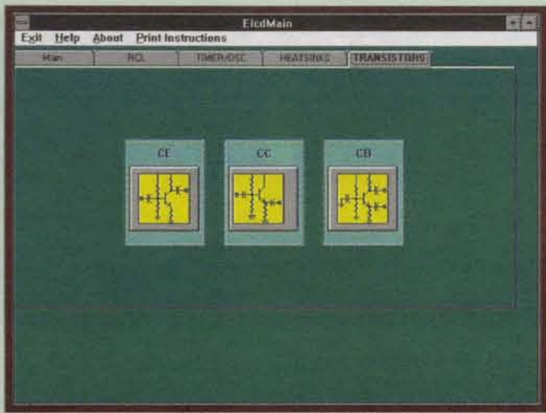

Figure 5. TRANSISTORS screen offers three types of calculations.

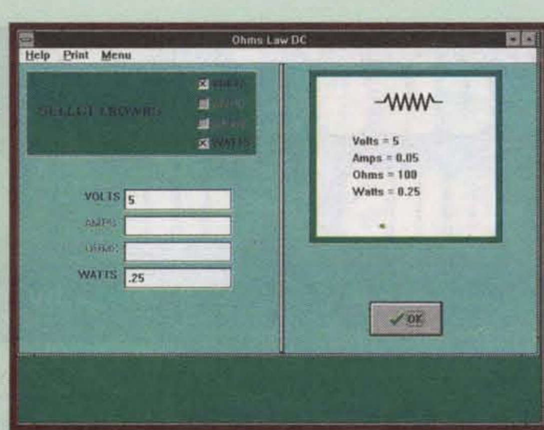

Figure 6. Ohm's Law DC Calculation.

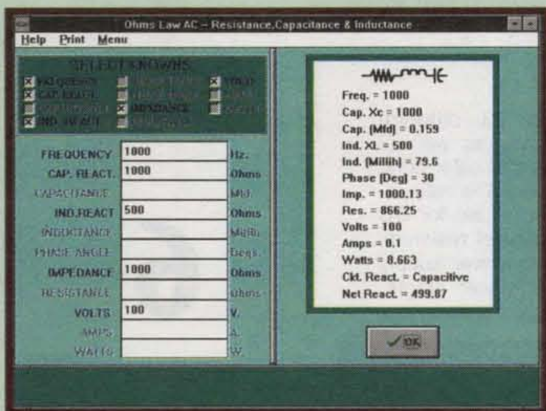

Figure 7. Ohm's Law AC Calculations.

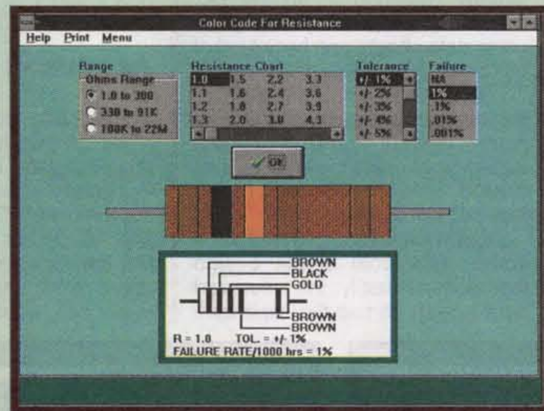

Figure 8. Resistance Color Code.

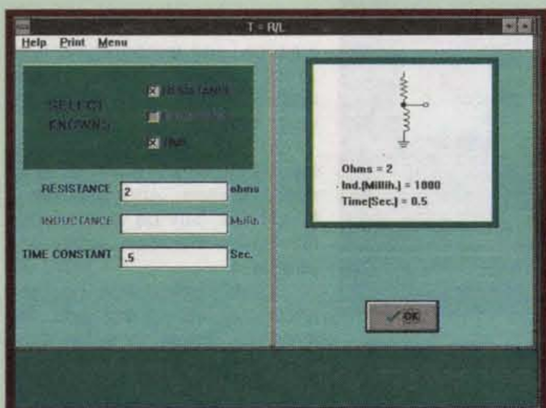

Figure 9. Time Constant Calculation.

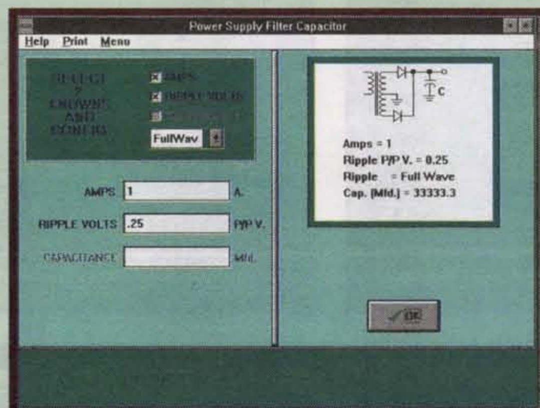

Figure 10. Filter Capacitor Calculation.

Five categories are shown as tabs near the top of the screen. Using the mouse or arrow keys, you select the category you wish to access. Figures 2, 3, 4, and 5 show each of the category screens.

RCL CALCULATIONS

Ohm's Law for DC Circuits

Figure 6 shows typically how most of the ELCAD screens work. You select those items for which you have data, and the rest are calculated. The results are then displayed and can be printed out.

On this screen VOLTS, AMPS, OHMS, and WATTS are the variables. You simply check the boxes for the items for which you have data. When check box titles go gray, there are enough selections to compute for the grayed items.

For example, suppose you need a resistor to dissipate .25 watts at 5 volts. Put a check in the box by VOLTS and WATTS. The AMPS and OHMS check boxes become gray. The VOLTS and WATTS titles become black, ready for you to enter 5 and .25, respectively.

You use the tab or mouse to select the edit box, and enter the data. When you click on the OK button, or press Enter, the Amps and Ohms calculations are displayed in the white box to the right. To print out the results, just click on PRINT. To return to the main menu, click on MENU.

Ohm's Law for AC Circuits

Five screens allow you to calculate: capacitive reactance; inductive reactance; resistor and capacitor in series; resistor and inductor in series; or resistor, inductor, and capacitor in series. The latter screen is shown in Figure 7.

As you can see, there are 11 different data entry boxes available here, but you only need to use some. When you "Select Knowns" by checking boxes at the top left of the screen, the values that can be calculated turn gray.

For example, suppose you want to know what size capacitor and inductor to use at 1000 Hz to get a capacitive reactance of 1000 ohms and an inductive reactance of 500 ohms, and what size resistor is needed to get an impedance of 1000 ohms and what wattage resistor is needed at 100 volts. This is not a simple calculation, since there are so many variables. But it's easy in ELCAD.

You select the knowns: FREQUENCY, CAP.REACT, IND.REACT, IMPEDANCE, and VOLTS, and enter the data in those boxes. Click on "OK" and answers are instantly displayed in the white box to the upper right. The watts shown are for the resistor. Simple!

Resistors

Three screens are available for resistors. The first is for up to six resistors in parallel. The calculation for two is easy, but much more involved for six! The real "plus" here is that you can also calculate an unknown parallel resistance — together with up to five others — to make the combination equal to a desired value. This is real handy when trying to trim a circuit.

The other two screens in this section show resistor codes; one "decodes" known resistor color bands, the other shows the bands to look for when seeking a particular value of resistor. These screens go beyond just the three normal bands, and include tolerance and failure rate band colors.

Figure 8 shows the determination of color codes for a desired resistor value. In this case, 1 ohm with a 1% tolerance and 1% failure rate indicated the bands would be (left to right) brown, black, gold, brown, and brown. Interestingly enough, the actual colors are shown (within the color accuracy of your monitor settings).

Time Constants

Two screens are available. The first calculates the time constant for a resistor and capacitor in series, a fairly common (and simple) calculation. The time constant value is the time it takes for the capacitance to be charged to 63% of its full potential charge level.

The other screen allows the calculation of the time constant for a resistor and inductor in series, much less common. Here the time constant value is the time it takes for the induced current to reach 63% of its full value.

For the example shown in Figure 9, we entered a resistance of 2 ohms and a time constant of .5 seconds to determine that the inductor would need to be 1000 millihenries. Of course, either of the three variables can be calculated from any two specified values.

Power Supply Filter Capacitor

On this single screen, you can determine the proper size filter capacitor for a desired ripple voltage with either a full-wave or half-wave power supply operating at a designated current. Or, knowing the capacitance used, you can calculate the ripple at a particular current.

As shown in Figure 10, you select two knowns and either full-wave or half-wave. We wanted to know the size filter capacitor to use to have .25 ripple volts with a full-wave supply delivering 1 ampere. We would need a hefty 33,333 microfarad capacitor!

Air Core Coil Inductance

The inductance of a single-layer air-core coil depends on its length, radius, and turns per inch. The wire size determines the turns per inch if close wound. With this screen, as shown in Figure 11, you can either find the total number of turns or the inductance by entering the proper values. Notice that a WIRE GAUGE window pull-down allows you to select wire gauge, and shows turns per inch (TPI) for the selected gauge.

This is no trivial calculation. We wanted to calculate what it would take to make a 10 microhenry air core coil using 8-gauge wire wound on 1-inch radius for a length of .5 inches. The result shows this would take 11.8 turns of wire. Alternately, we could have calculated the inductance using the radius, length, and number of turns.

Transformers

Figure 12 shows the transformer calculations, where you select the data you have, and the program calculates the result. For example, say you have a common collector transistor audio output stage that gives you a 10-volt RMS output. You want to deliver a 0.5 watts of power to an 8-ohm speaker.

To deliver 0.5 watts to an 8-ohm speaker, you would need 2 volts RMS. (This is based on volts = square-root of the product of the watts and resistance. In this case, voltage is the square root of .5 watts times 8 ohms, or the square root of 4, which equals 2. Oddly, this calculation is NOT done by the program!)

Checking PRI.VOLTS, SEC.VOLTS, and SEC.IMPED, and entering 10, 2, and 8, respectively, in those boxes yields a result of 200 ohms for the primary impedance needed.

TIMER/OSCILLATORS

555 Timer

Two different configurations of 555 timers are shown, astable (runs by itself — an oscillator) and monostable (stays in one condition until triggered, then resets when it times out).

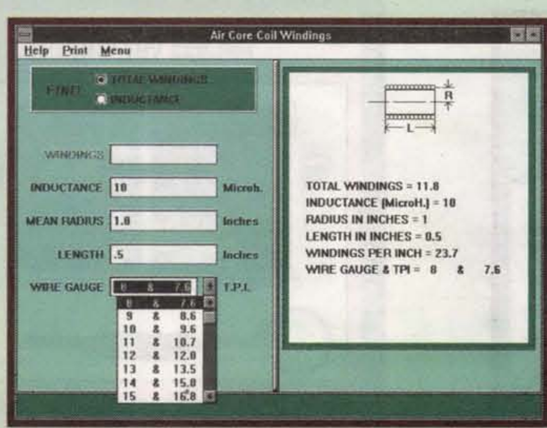

Figure 11. Air Core Coil Calculation.

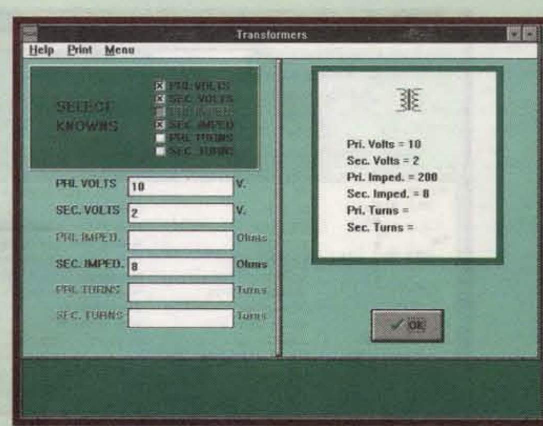

Figure 12 . Transformer Calculation.

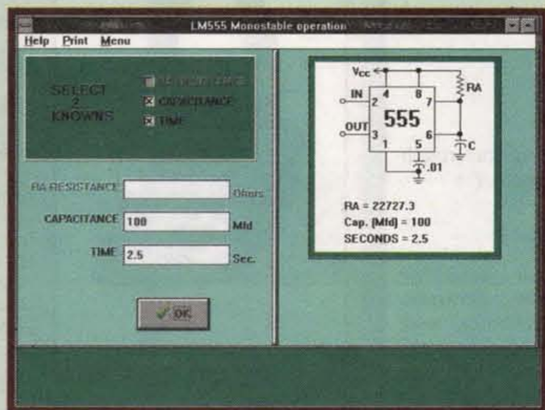

Figure 13. Monostable 555 Calculation.

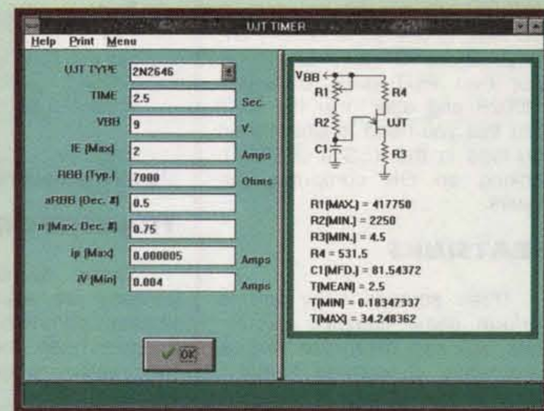

Figure 14. UJT Timer Calculation.

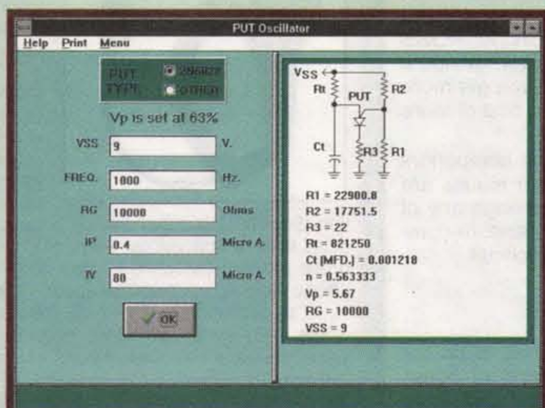

Figure 15. PUT Oscillator Calculation.

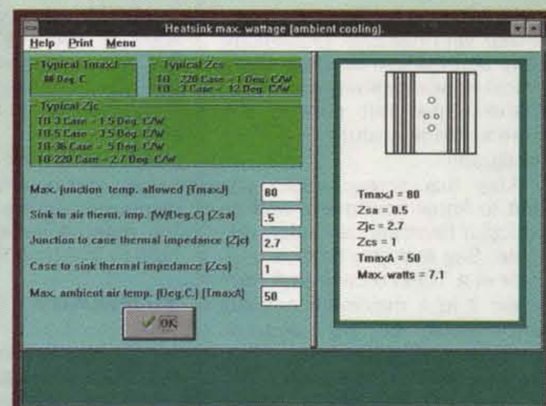

Figure 16. Heatsink Wattage Calculation.

Figure 13 shows the monostable 555 screen. You select two knowns in the selection box and then enter the data in the edit boxes that are selected. Click on "OK" to display the results. Here it can be seen that a 100 microfarad capacitance with a required time out of 2.5 seconds would require a resistor value of 22,727.3 ohms.

Note that this is calculated based on the presumed value of the typical electrolytic capacitor, which in actuality is highly variable from the marked value. In this case, it would make sense to use a 50K potentiometer in place of the resistor to set the time. The calculated value merely gives you an idea of the resistance needed.

Unijunction Transistor (UJT)

Two Unijunction Transistor screens are provided. One is an oscillator circuit, the other a timer. The timer circuit is shown in Figure 14.

The 2N2646 is shown as the default UJT type, but a pull-down allows you to select from nine others, and enters the appropriate values for that UJT in the fill-in boxes.

If you want to use a UJT other than that shown, either select "NOT LISTED" and fill in your own UJT data, or select one that has data close to what you need and alter only the UJT data that you need to alter.

Fill in the TIME and VBB that you want, click on OK, and the circuit component values are calculated and displayed.

Programmable Unijunction Transistor (PUT) Oscillator

Figure 15 shows the PUT

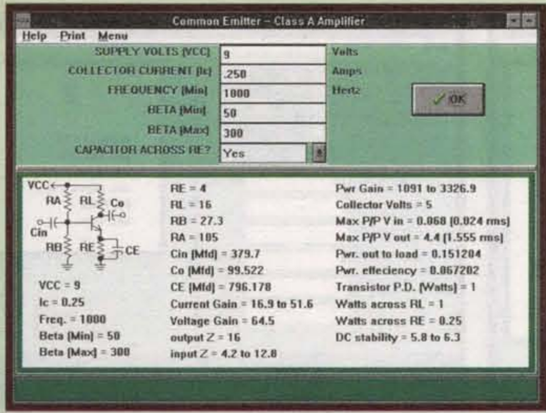

Figure 17. Common Emitter Calculation.

Oscillator screen. Only one PUT, a 2N6068, has pre-entered data. If you want to use some other PUT, either select "OTHER" and fill in your own PUT data, or select 2N6028 and alter only the PUT data that you need to alter. When you type in the VSS and FREQ, clicking on OK computes the results.

HEATSINKS

Three screens allow you to perform some complex calculations. You can determine various parameters concerning heatsink size, heatsink wattage, or heatsink temperature.

Figure 16 shows the screen for calculations involving the maximum wattage for an ambient-cooled heatsink. For those not familiar with heatsink technology, many strange symbols are used. Typical values for some are shown at the upper left part of the screen. Temperatures are in Centigrade.

Use this screen when you want to know how many watts a particular heatsink can safely dissipate. Say that you have a transistor in a TO-220 case and want to use it in a maximum ambient temperature of 50 degrees Centigrade. You intend to use a heatsink that its source catalog has rated with a sink to air thermal impedance of .5 watts per degree Centigrade.

Using the information in the upper boxes, you would enter in the following data:

TmaxJ = 80
Zsa = .5
Zjc = 2.7
Zcs = 1
TmaxA = 50

Click on OK and the result shows maximum watts = 7.1

TRANSISTORS

Three transistor amplifier screens are available: common emitter, common collector, and common base. The common emitter amplifier screen is shown in Figure 17.

The SUPPLY VOLTS must be greater than 1 volt. After entering in the COLLECTOR CURRENT, the minimum FREQUENCY, and the BETA range, you select if you want a CAPACITOR ACROSS RE, the emitter resistor, or not. If you use a capacitor, you get more stage gain, but at the cost of more distortion.

Click OK and the component values and parameter results are displayed. You can change any of the entered values and re-compute to fine-tune the circuit.

SUMMARY

While not intended to do the hundreds (thousands?) of possible types of electronic calculations, ELCAD very easily and elegantly performs the common calculations described. As a hobbyist or experimenter, you may find it handy. **NV**

Source

By the time you read this, ELCAD's author, programmer Brian Ellis (bellis@aol.com) intends to add even more calculations. The program, supplied on a 3.5-inch 1.44MB diskette for the IBM PC using Windows 3.1 or 95 (not available for the Macintosh), can be ordered for $10.00 postpaid USA from:

F.N.C. Corp.
350 Adam Dr.
South Elgin, IL 60177
(847) 695-1210

MFJ-922 VHF/UHF DUAL BAND ANTENNA TUNER

This compact dual band VHF/UHF antenna tuner from MFJ Enterprises, has a single meter that reads SWR and power. No adjustment is needed.

It covers VHF from 136 to 175 MHz, and UHF from 420 to 460 MHz. You can read power up to 150 watts in two ranges: 60 watts or 160 watts.

The MFJ-922 works for HTs, mobile rigs, or amplifiers up to 150 watts. It has a compact size – 4x2x1-1/4 inches – so it will fit in a shirt pocket. Cost is $79.95.

COMMUNICATION HEADPHONES

MFJ's new communication headphones work well for amateur radio and shortwave radio listening in all modes – SSB, FM, AM, data, and CW. Each earphone has individual volume/bass controls.

A 40 mm driver unit reproduces enhanced communication sound, and there is near zero loss on signal transmission from the gold-plated plug and cord. The lightweight earphones (eight ounces) come with nine feet of cord.

The MFJ-392 handles 450 mW and has a frequency response of 100-24,000 Hz. Impedance is 16 ohms at 1 KHz; sensitivity is 102 dB/mW. It works in mono or stereo mode and includes a free 1/4-inch phono adapter. Price is $19.95.

VOX SPEAKER/MICROPHONE

MFJ-298I features an electronic adjustable VOX control and is handy for use with any kind of handheld VHF, commercial, amateur, or marine radio. It also works for mobile hams and emergency operators on-the-go who need total hands-free operation.

In the VOX position, you just talk and the MFJ-298I automatically keys your HT. A "TRANSMIT" red LED lights up while your VOX is enabled.

This VOX mic picks up your voice, not background sound. Two condenser microphones are installed for feedback prevention. Sensitivity is adjustable by rotating the trimmer switch which accommodates loud or soft voices. With MFJ's VOX speaker/microphone in the appropriate position (attached to your front pocket or lapel), the sensitive microphone picks up your normal speaking voice.

This mic works well for emergency operators such as fire, police, EMT, and active ham radio operators because it runs off of two "AA" batteries. Transmission is voice-activated in the "on" position. In the "off" position, you can use the MFJ VOX mic as a regular speaker/microphone. Transmission is activated only by pushing the PTT switch. The durable, hard plastic speaker mic fits in the palm of your hand.

A free external earphone is included. The earphone can be connected to the earphone jack for total hands-free operation, or for monitoring the frequency.

The VOX speaker/microphone is compatible with most Icom, Yaesu, Standard, RadioShack, Alinco, and ADI handheld transceivers with two prong plug-ins.

Price is $39.95. For further specifications and other details on this or any of the other MFJ products listed here, contact:

MFJ ENTERPRISES, INC.
P.O. BOX 494, DEPT. NV
MISSISSIPPI STATE, MS 39762
601-323-5869 FAX: 601-323-6551

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430 Princeland Court, Corona, CA 91719
or E-Mail to newproducts@nutsvolts.com

New Product News

BASICBOX

Advanced Graphic Systems announces the release of their newest product – a single board computer – the BasicBox.

The BasicBox is an all-inclusive system that comes with everything needed to get up and running in a short amount of time. Within minutes, the system is fully assembled, cabled into the PC, and powered on providing fully functional computing around its 8052 microprocessor with built-in BASIC-52 interpreter.

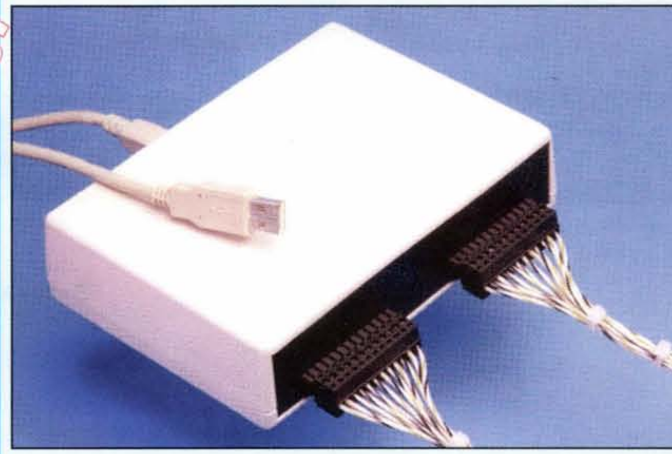
The computer, whose concept was adopted from Jan Axelsons' *Microcontroller Idea Book*, was designed with education in mind, but built to meet the demands of real-world control applications.

The BasicBox comes with an industrial-quality single board computer, an experimenter's board which allows testing and debugging of Basic programs, power supply, all neccessary cables, Jan Axelsons' *Microcontroller Idea Book*, communications software, and lots of programming examples.

It retails currently for $249.00 in single quantities.

For more information, contact:

ADVANCED GRAPHIC SYSTEMS
4055 GRASS VALLEY HWY., #103
DEPT. NV
AUBURN, CA 95602
530-887-1619 FAX: 530-887-0107
WEB: http://www.ags-gv.com



JSB-210 USB RELAY MODULE

J-Works, Inc. has begun shipping the Model JSB-210 USB Relay Module.

The Model JSB-210 has 8 or 16 "form C" relays and plugs 'n plays into the standard USB (Universal Serial Bus). The user controls the relays from any programming language that supports USB communications.

Plug-in style terminal block connectors allow quick hook-up to three contacts per relay. Each relay contact is rated at 1 amp @ 30VDC, and 0.5 amp @ 120VAC.

The module replaces internal PC-based plug-in cards in various test, control, and measurement applications. The single unit price for the Model JSB-210 is $170.00 to $205.00.

For more information, contact:

J-WORKS, INC.
12328 GLADSTONE AVE., UNIT 4
DEPT. NV
SYLMAR, CA 91342
818-361-0787 FAX: 818-270-2413
E-MAIL: admin@j-works.com
WEB: http://www.j-works.com

E-Mail your New Products to: newproducts@nutsvolts.com

DIGITAL MULTIMETERS/CURRENT CLAMPS

Jensen Tools introduces a full line of high-quality digital multimeters and current clamps. From the full-featured JTM-105 – a true RMS meter – to the JTM-63 – a low-cost, pocket-sized meter – the line provides a good value, costing less than comparable meters.

The entire line has been engineered to exacting tolerance and is manufactured using components of the highest quality, allowing Jensen Tools to offer a three-year "no hassle" warranty.

Jensen Tools can also ship the meters within 24 hours with a certificate of calibration for a small fee.

For more details, contact:

JENSEN TOOLS, INC.
7815 S. 46TH ST., DEPT. NV
PHOENIX, AZ 85044-5399
602-968-6241 FAX: 602-438-1690
WEB: http://www.jensentools.com

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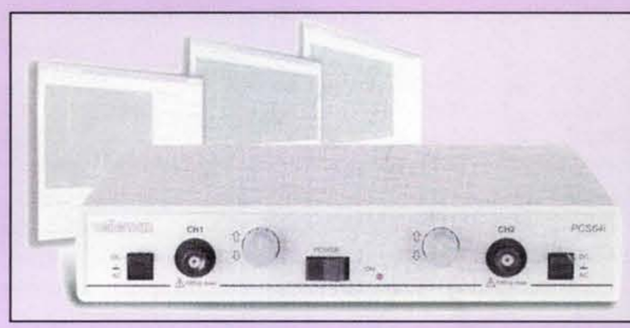

Velleman, Inc., announces the PSC64I PC Digital Storage Oscilloscope for use with an IBM-compatible PC. The PCS64I is geared towards both hobbyists and professionals.

It is a factory assembled and tested unit featuring two separate channels and a maximum sample rate of 64MHz. All standard scope functions are available, including features only found on digital equipment.

Apart from Y-position and input coupling, all settings are software-controlled.

The supplied WinDSO software (Windows™ 3.11/95/98) includes oscilloscope, spectrum analyzer, and recorder modules. A DOS oscilloscope module is also provided.

Some features included are:

Oscilloscope – Timebase 0.1µs to 100ms/div sensitivity; 10mV to 5V/div selectable trigger source, edge and level with pre-triggering; on-screen markers; true RMS readout; and X/Y mode.

Spectrum analyzer – Frequency range 0 to 16 MHz; linear or logarithmic readout; zoom function; and on-screen markers.

Recorder – Timebase 20ms to 2000s/div; automatic storage (up to one year); on-screen markers; and zoom function.

WinDSO allows saving of the sampled data as a graphic or ASCII format.

The oscilloscope is FCC-approved, fully optically isolated from the PC, and is equipped with a charging circuit for an optional battery pack.

For more information, contact:

VELLEMAN, INC.
7415 WHITEHALL ST., STE. 119, DEPT. NV
FORT WORTH, TX 76118
817-284-7785 FAX: 817-284-7712
E-MAIL: velleman@earthlink.net
WEB: www.velleman.be

VECTRONICS NEW KIT LINE

Vectronics announces the arrival of the highest quality in electronic hobby kits.

Over 30 different kits are included in VECTRONICS new kit line, which provide a professional product at a hobby price. From short-wave converters to aircraft receivers, and ham radio kits to an old fashioned crystal radio kit.

The kits are created by engineers who are hobbyists-at-heart. Each kit features a professional quality epoxy glass PC board with solder mask and screen printed components legend, and the highest quality components.

Our kits also feature an extensive "owner's manual," which has been written specifically for each kit. This detailed, yet still easy-to-follow manual features illustrations, specific instructions, and even a schematic diagram. Not only are step-by-step instructions and helpful tips provided, our comprehensive manual also guides you into the next step – the fun of using your equipment!

For more information, contact:

VECTRONICS
1007 HWY. 25 S., DEPT. NV
STARKVILLE, MS 39759
601-323-5800 FAX: 601-323-6551
WEB: http://www.vectronics.com

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