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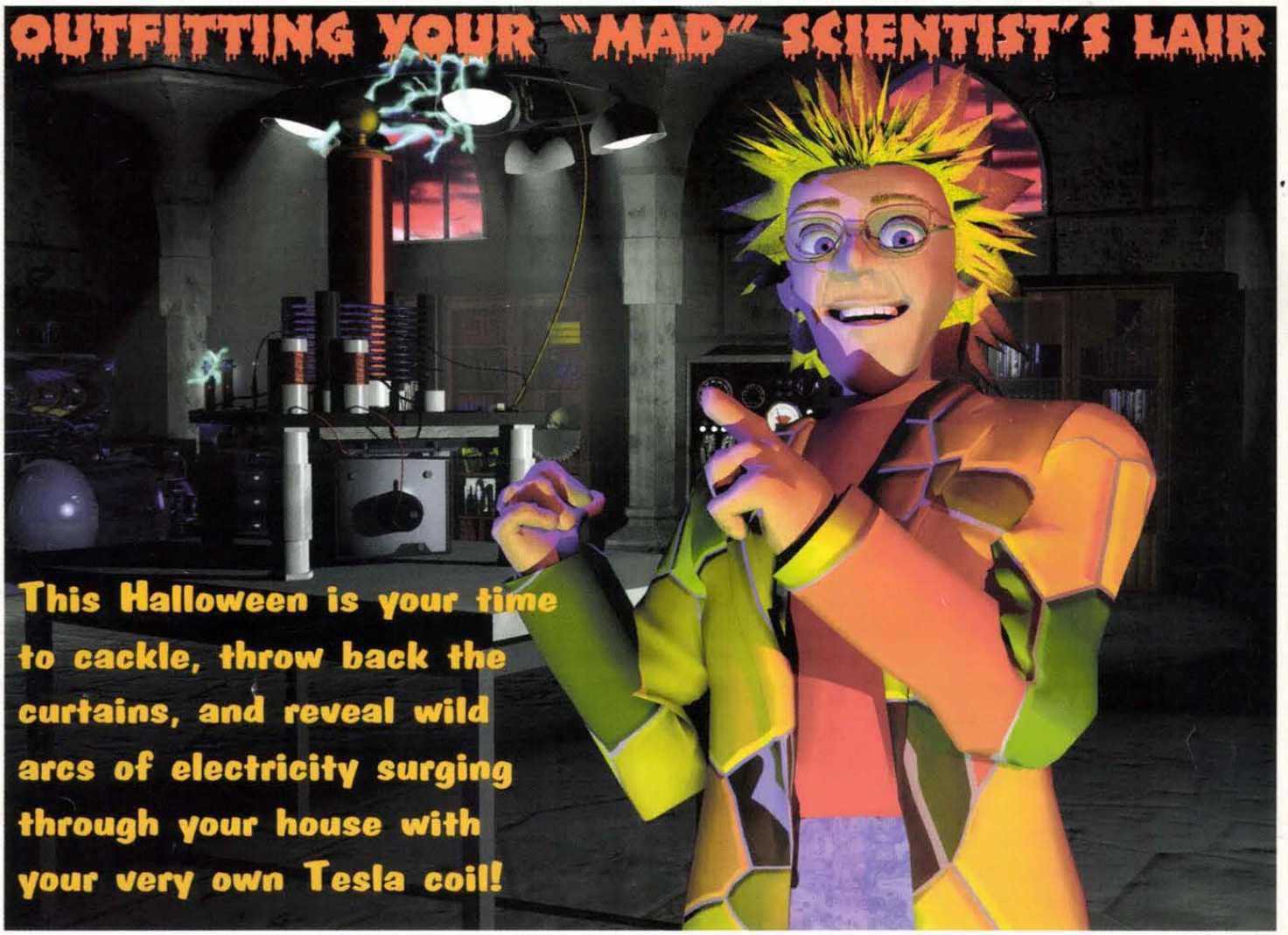
September 1999 Vol. 20 No. 9

OUTFITTING YOUR "MAD" SCIENTIST'S LAIR



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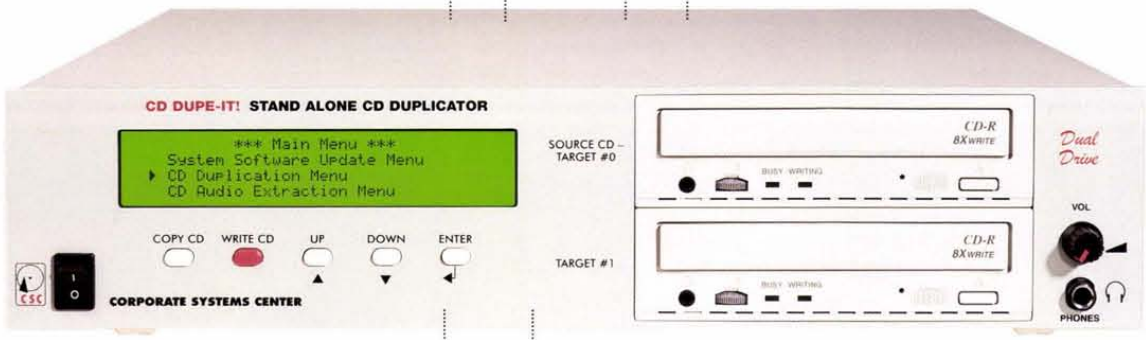

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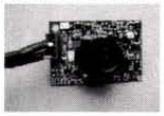

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- All we have is cameras with stand, and SCSI-II interface
- The camera is on a weighted stand that extends from 13" tall to over 20" tall, and has a electret microphone
- Color camera is digital output, but some delicate SMT surgery will provide NTSC signals (not for amateurs!)
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About the Cover

The lab on the cover is a 3D re-creation of the labs and sets used in the original 1931 version of *Frankenstein* with Boris Karloff and Lon Chaney. Of course, there are a few modern features added to this lab, and a couple hidden surprises. (Can you find the photo of the artist and the author of the Tesla coil article?) The Tesla coil seen is an exact replica of the one designed and built by Walt Noon. Matthew Roddy is a video producer and 3D artist in Southern California. For the cover, he used Imagine for Windows 2.0 (by Impulse/www.coolfun.com) and Corel Photo 8 (www.corel.com).

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by David Williams

ION PROPULSION IS A REALITY!

On October 24, 1998, NASA launched the spacecraft Deep Space 1 with a remarkable new ion drive. The Deep Space 1 mission was the first launch of NASA's New Millenium program. This is the first time that ion propulsion has been used as the primary means of propelling a spacecraft.

In a spacecraft, ion propulsion has advantages over conventional chemical propulsion systems. It can operate on a small amount of fuel for extended periods of time.

The limitations of ion propulsion are that it produces very low thrust and uses a lot of electricity. The engine on Deep Space 1 consumes 2,500 watts of electrical power at full throttle, but only exerts 1/50th of a pound of thrust. However, given extremely long periods of time, an ion thruster can allow a spacecraft to achieve theoretical velocities over 60,000 miles per hour.

Since NASA's ion engine works in the vacuum of space, it uses xenon gas as a fuel. Solar panels on the spacecraft generate the electricity needed to ionize the gas and to charge a grid in the engine's chamber to a 1,200 volt potential. The charged grid exerts a strong electrostatic pull on the xenon ions. The electrostatic force is powerful enough to cause the xenon ions to reach an exhaust velocity over 30 kilometers per second.

BUILD YOUR OWN ION PROPULSION MOTOR

Now you can build your own ion propulsion motor that works on the same basic principles as NASA's Deep Space 1 craft. This project uses a high-voltage potential that generates four streams of "ion wind." The ion streams exert enough force to spin a rotor at a remarkable speed. This high-tech device makes a great science project or an interesting desktop toy. The ion motor also generates negative ions, which can reduce pollen and pollution in the air to produce a healthier environment.

The ion motor in this project doesn't need exotic gases for fuel, because it ionizes regular air. Figure 1 is a block diagram that demonstrates the motor's principles.

A wall transformer provides nine volts DC to a step-up voltage converter. The DC-to-DC converter boosts the nine volts to a negative potential of over 10KV. The output current of the converter is limited to a safe level of less than 0.5 milliamps. The high-voltage is connected to a metal pivot pin and a PC board rotor is balanced on the point of the pin. The rotor has four ion discharge points made from four bent pieces of solid wire.

During operation, the four wire tips on the rotor get charged to 10,000 volts and the strong negative potential affects the surrounding air. Any air molecules that come near the wire tips become negatively charged "ions."

Since opposite charges attract and similar charges repel each other, the negative air molecules are repelled from the negative wire tips. As the air moves quickly away, it creates an "ion wind." It also generates a reactive force on the wire tips that causes the rotor to spin on the pivot pin.

The neutral side of the DC-to-DC converter is connected to an aluminum plate on the bottom of the ion motor's enclosure. This metal plate is at a higher voltage potential than the negatively charged air ions. Therefore, it attracts some of the ions and gives the rotor additional speed.

CONSTRUCTION

All the parts for the ion motor are shown in the Parts List. The rotor is made from a small printed circuit board. The foil layout for the PC board is shown in Figure 2.

Begin by inserting one of the pin sockets in the center of the PC board rotor as shown in Figure 3. Solder the socket in place and then insert and solder the four jumper wires on the rotor. Trim any excess wire from the bottom side of the rotor, and then bend the four wire tips as shown in Figure 4.

Next, take the wall transformer and cut off any connector from the end of the wires. Then separate the two wires for a distance of 1 inch and strip back about 1/2 inch of the insulation from each wire. Identify the positive (+) wire and twist it together with the red wire on the high voltage power supply. Use a plastic wire nut to hold the two wires together. Take the nega-

tive (or ground) wire from the transformer and twist it together with the black wire on the high voltage power supply. Solder the two wires to the metal ring lug as shown in Figure 5.

Place the high voltage power supply on the aluminum base plate and attach it to the plate with a #4-40 screw and hex nut. Make sure to place the ring lug under the nut as shown.

Now insert the remaining pin socket in the plastic case. Turn the case over and solder the high voltage output wire to the pin socket as shown in

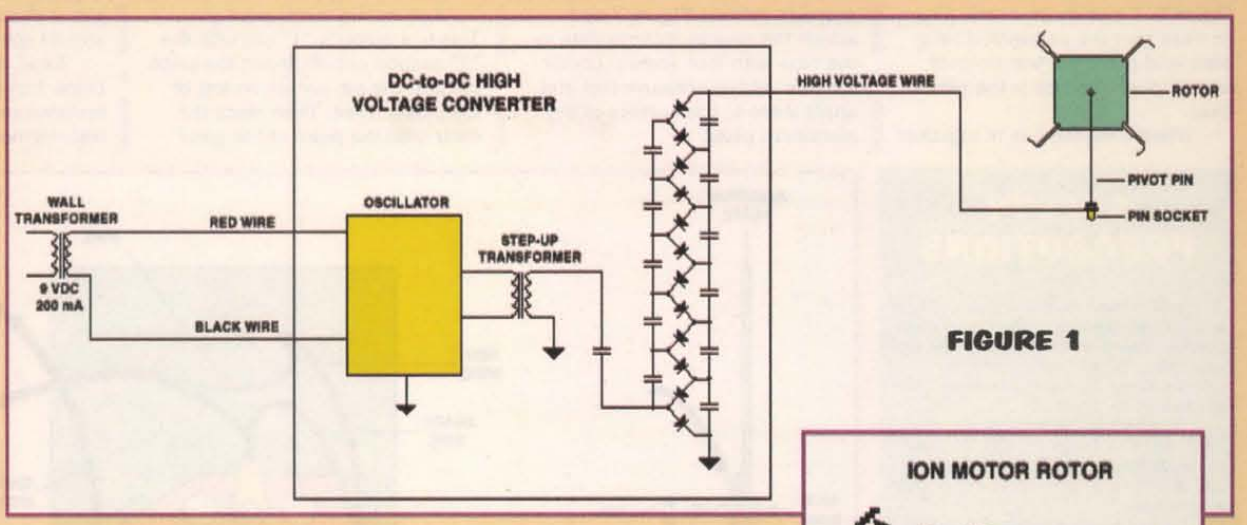


FIGURE 1

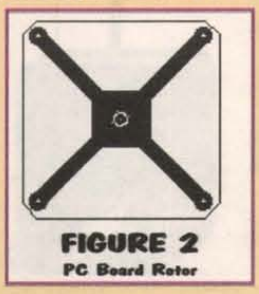


FIGURE 2
PC Board Rotor

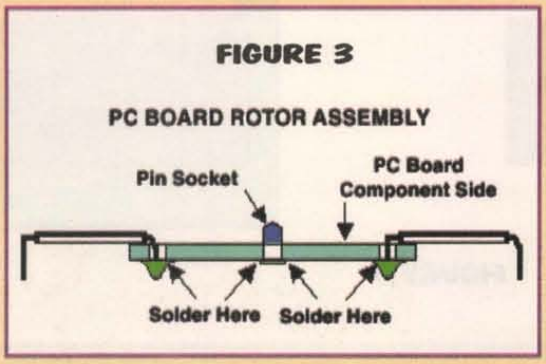


FIGURE 3

FIGURE 4

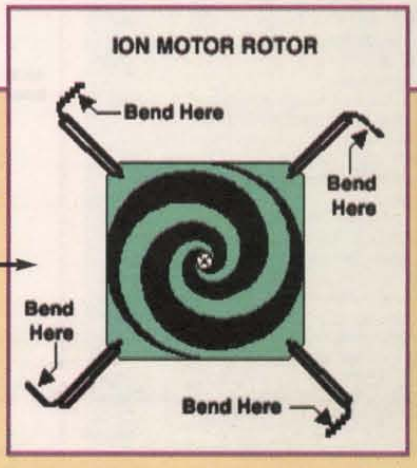


Figure 6. Carefully place the plastic case over the assembled baseplate and guide the transformer wire through the slot in the plastic case.

When everything is fit together properly, refer to Figure 7 and attach the aluminum baseplate to the case with four screws. Locate the four rubber adhesive feet and apply them to the corners of the aluminum plate.

Locate the metal pivot pin. This is a quilter's "T" pin with the "T" section cut off. Insert the pivot pin into the pin socket on top of the plastic case. Then place the rotor onto the point of the pivot pin. It should be balanced and should spin freely.

Read the safety precautions below before you plug in the wall transformer. As soon as the wall transformer is plugged into a wall

SAFETY PRECAUTIONS

This project contains high-voltages and a sharp pivot pin. The current has been limited to a safe level, but the unit can deliver small "static electricity" shocks. Keep the Ion Motor away from children at all times.

Never leave the point of the pivot pin exposed. Always remove the pivot pin from the pin socket whenever the unit is not in use or whenever the rotor is removed.

Do not touch any metal surfaces on the ion motor while power is on. The Ion Motor can generate "static electricity" sparks, so do not operate the unit near combustible materials or gases.

Do not run the Ion Motor near electronic equipment including computers. The Ion Motor can cause an electrical charge build-up inside nearby equipment that could damage electronic circuits. Do not use any electronic equipment to make measurements on the Ion Motor.

Never use the Ion Motor to charge a capacitor or Leyden jar. Fatal voltage and current levels can result.

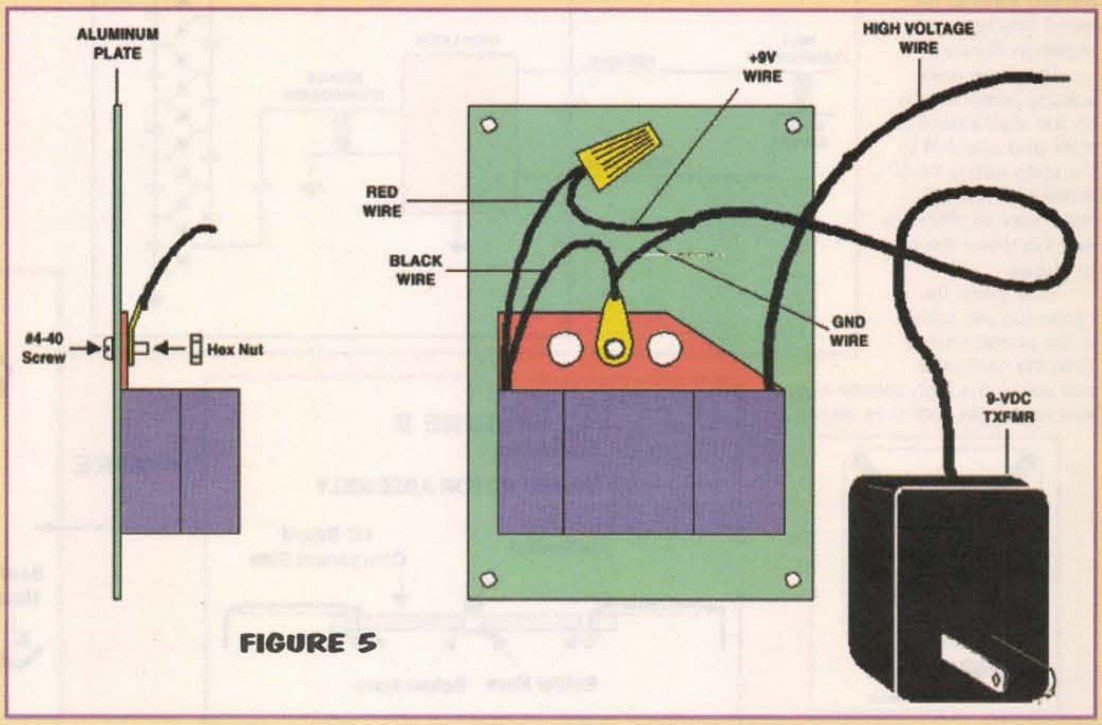
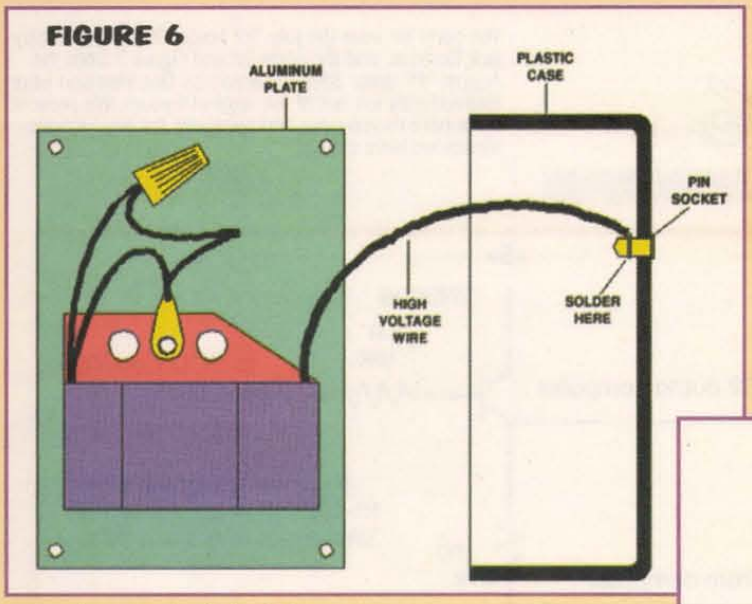
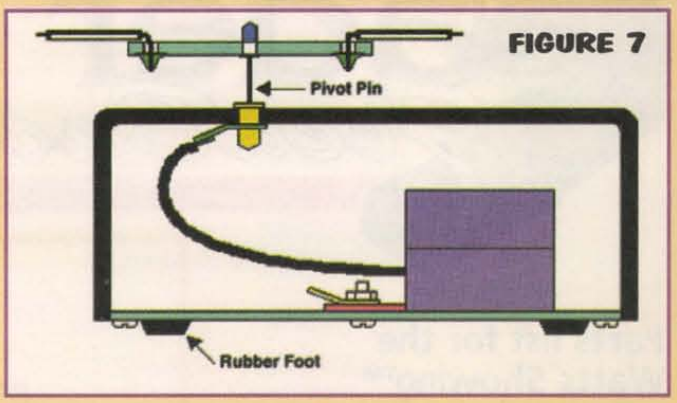


FIGURE 5





outlet, the rotor should begin to turn and then gradually pick-up speed.

You can leave the Ion Motor running continuously, and it will add negative ions to the room. There have been many studies of the effect of negative ions on people. The results indicate several positive effects including: mood enhancement, reduced airborne contaminates, and improved physical performance. The FDA limits health claims on negative ion generators, but you can experiment and determine the benefits for yourself.

ADDITIONAL EXPERIMENTS

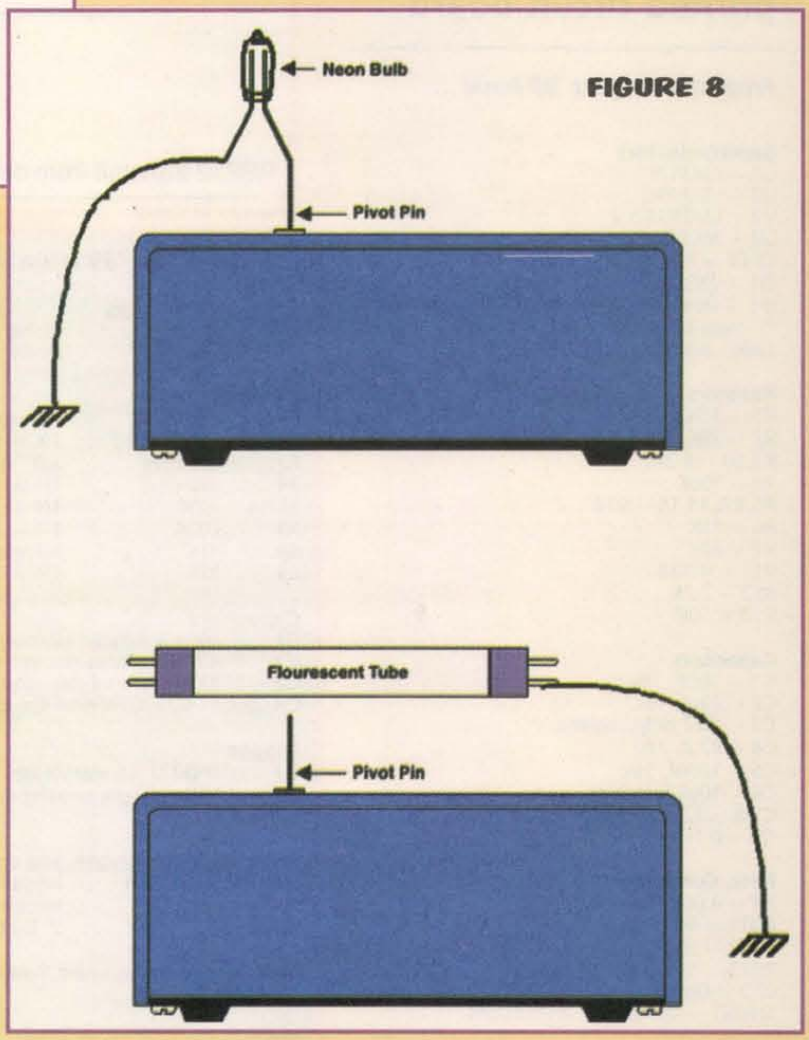
It was mentioned earlier that the aluminum plate on the bottom of the enclosure attracts the ions and increases the speed of the rotor.

You can investigate this phenomenon further by getting another metal panel and connecting a wire from it to the aluminum plate on the bottom of the ion motor. Place the new movable metal panel near the rotor and watch the rotor speed increase. Be careful to not get the metal so close to the rotor that sparks occur.

How does this work? Well, the attractive force between two different voltage potentials varies inversely as the square of the distance between them. This means the forces are much stronger as the surfaces get closer together. In fact, that is why you get a spark if the plate is too close to the rotor. With 10KV and a small gap, the attraction is so incredibly strong that the air ionizes to a plasma and the voltage jumps across the plasma in the gap.

Refer to Figure 8 for other ways the unit can be used for high voltage experiments. A neon bulb will glow when one leg is grounded and the other leg is brought near the pivot pin. A flourescent bulb will generate an even more interesting glow in a similar configuration. In both cases, you are seeing the ionization of the gases in the tubes.

Note that using neon or flourescent bulbs for high voltage experiments may leave the bulbs unusable. NV



PARTS LIST FOR THE ION MOTOR

TXFMR ..... Nine-volt DC, 200mA Wall Transformer.
PS ..... 10KV DC Step-up Power Supply.
ENCL ..... Phenolic Plastic Enclosure.
PCB ..... PC Board for Rotor (ION0399).
JP1-4 ..... Solid Wire Jumpers (four each).
SOK1-2 ..... Metal Pin Sockets (two each).
PIVOTPIN ..... Quilter's "T" Pin used as Rotor Pivot.
BASEPANEL ..... Aluminum Panel Enclosure Bottom.
FEET ..... Adhesive Rubber Feet (four each).

MISC. PARTS
- #4 Screws (5 each) - #4 Nut - Wire Nut - Metal Solder Tab

The following items are available from:
LNS Technologies, P.O. Box 67243, Scotts Valley, CA 95067;
Phone: 831-768-9155; www.techkits.com
ION MOTOR-KIT: Complete kit of parts for the Ion Motor including printed circuit board rotor, drilled plastic case, high-voltage power supply, transformer, and all other components listed above $29.00.
Please add $5.00 shipping/handling. California residents add 8% sales tax. MC/VISA orders accepted. No COD orders.

reader FeedBack

Ooops!!

The parts list from the July '99 *Voice Changer* article by Jack Dennon, and the parts list and Figure 7 from the August '99 *Watts Showing* article by Dan Harrison were inadvertently left out of the original layouts. We present them here to you now, and apologize for any inconvenience we have caused.

Parts list for the Watts Showing™ printed circuit board

From the August '99 issue ...

Semiconductors
U1 – LM317L
U2 – LM393N
U3 – LM2931-5.0
U4 – MC68HC705P6 *
OPT1 – PS2501 (PANASONIC)
Q1 – 2N3906
D1 – 1N4148
* - must be programmed with dwm.s19 code - available from web site

Resistors
R1 – 3.9K
R2 – 39K
R3,10 – 8.2M
R4 – 100K
R5,8,9,14,15 – 91K
R6 – 15K
R7 – 30K
R11 – 470Ω
R12 – 2.2K
R13 – 10K

Capacitors
C1 – 10UF, 16v
C2 – 22uf, 16v
C3 – .022 polyproplene
C4 – 22uf, 16v
C5 – 100uf, 16v
C6 – 10uf Tantalum
C7,8 – 22pf ceramic
C9 – 0.1uf

Misc. Components
X1 – 4.00MHz crystal
POT1 – 500ohm
POT2 – 500k ohm
POT3 – 10k ohm
LCD – Optrex
SHUNT – see text for instructions

Other Parts
16ga, three-wire extension cord
Enclosure
Strain reliefs (2)
6-9vdc wall transformer
SPST power switch
Wire nut for 16ga wire

Kit of all PCB mounted parts, PCB, LCD, and enclosure with LCD cut-out is available from **Harrison R&D** for $79.00 + $5.00 S&H. Does not include extension cord or wall transformer. PC board and programmed U4 is available for $25.00 plus $3.50 S&H. Phone 281-485-7107 or write to 9802 Sagequeen Dr., Houston,TX 77089.

www.ghg.net/dharrison

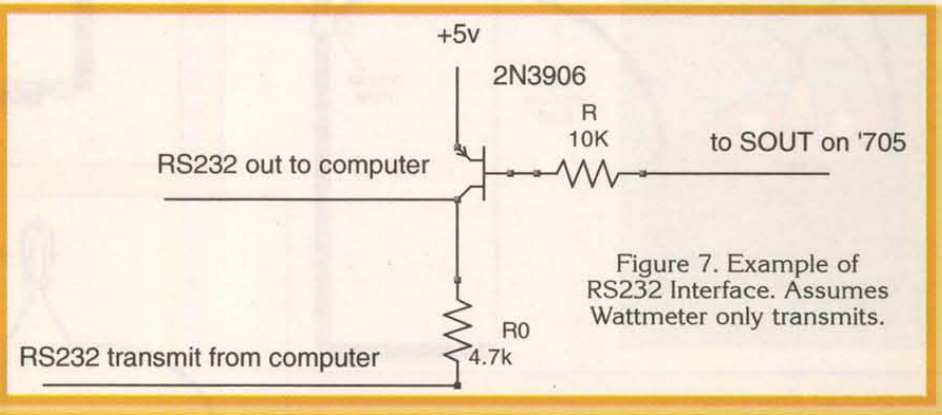


Figure 7. Example of RS232 Interface. Assumes Wattmeter only transmits.

Parts List

From the July '99 issue ...

Integrated Circuits

U1	HT8950A	Holtek voice modulator	Digi-Key HT-8950A-ND
U2	LM386	Audio power amp	Digi-Key LM386N-1-ND

Resistors

R1,R10	1K	1/4 watt resistor	Mouser 29SJ250-1K
R2	330 ohm	1/4 watt resistor	29SJ250-330
R3	500 ohm	3/8" sq. trimpot	569-72P-500
R4	470 ohm	1/4 watt resistor	29SJ250-470
R5,R6	4.7K	1/4 watt resistors	29SJ250-4.7K
R7	100K	1/4 watt resistor	29SJ250-100K
R8	47K	1/4 watt resistor	29SJ250-47K
R9	33K	1/4 watt resistor	29SJ250-39K

Capacitors

C1	100 microFarad electrolytic	Mouser 140-XRL25V100
C2	4.7 microFarad electrolytic	140-XRL25V4.7
C3	22 microFarad electrolytic	140-XRL25V22
C4,C5,C6	0.1 microFarad film cap	Digi-Key P4525-ND

Diodes

D1	1N5227 3.6 volt Zener	Mouser 583-1N5227B
D2	LED red light emitting diode	604-L53HD

Switches, microphone, and speaker

Sw1, Sw2, Sw3, Sw4	keypad switches	Mouser 101-0461
MIC	electret microphone	Digi-Key P9970-ND
SPKR	2" 8-ohm speaker	Jameco 135589

Misc: Printed circuit board, 9-volt battery clip, power switch, hookup wire, solder, suitable enclosure.

Kit
A kit consisting of the printed circuit board and board-mounted components is available for $9.95 plus $3.00 for shipping and handling, from:

MicroMethods
P.O. Box 909, Warrenton, OR 97146.
(503) 861-1765 voice/fax.

We can accept check, money-order, Visa, or Mastercard. No CODs. Charge card orders do have to be submitted via fax; signature is required.

Add $5.00 for shipping outside the U.S. The kit is easy to build but unless you have some experience assembling circuit boards you may want someone else do the assembly as we cannot accept returns once you start soldering. The etched and drilled printed circuit board is available for $6.50 postpaid to U.S. addresses.

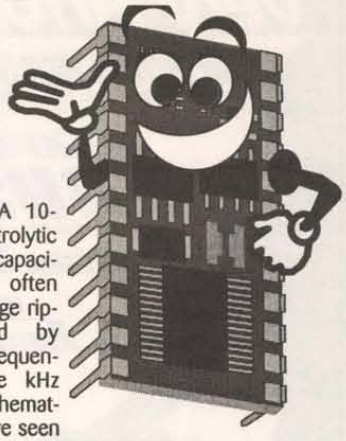
The HT8950A is available from:
Digi-Key - (800) 344-4539; (218) 681-3380 fax
http://www.digikey.com
Digi-Key part number: HT-8950A-ND Voice modulator IC 16-Dip $3.14 @ 1 ea., but of course they do have a minimum order.

The other parts are available from either Mouser or Jameco:
Mouser Electronics - (800) 346-6873
Jameco Electronics - (800) 831-4242

Reader Feedback is continued on page 68

STAMP APPLICATIONS

by Lon Glazner



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

Protecting Your Stamp From The Cold, Cruel World

I've spent the last few months working on a design that is going to be located in a very inhospitable environment. I've had to deal with widely varying temperatures, a noisy power bus, high current loads, and a slew of other factors which don't look upon electronics in a friendly manner.

Overview

All of this work started me thinking about some of the things that I take for granted. There are a few tried and true circuits that I regularly use for protecting my microcontroller designs. I thought it might be nice to cover a few of these concepts, as well as some techniques for powering your BASIC Stamp designs. These are circuits and/or techniques that have helped me to ensure successful electronic designs. I'm no analog guru – nor do I pretend to be one – but the concepts that I'm laying out here can help you to avoid many of the pitfalls that the real-world often presents.

It is also helpful to keep in mind that no matter how well thought out your PBASIC program is, a noise spike can still scramble the brains of your BASIC Stamp. This can lead to unpredictable behavior, or a complete system failure of your BASIC Stamp design.

De-coupling Capacitors

It is good practice to isolate your local circuit (which can be an IC or group of ICs) from your supply impedance. This is termed "de-coupling," and is routinely accomplished with capacitors.

Each IC in your circuit could benefit from de-coupling capacitors, but it is essential to use de-coupling capacitors on any high-speed logic chips that you may be using (the BASIC Stamp). The fast rising and falling edges of your logic level signals as they switch states require additional current pulses from your power supply. Small ceramic capacitors can supply these currents, when kept in close proximity to your ICs. Placing the de-coupling capacitor within a half inch of your IC will typically do the trick. In most cases, the actual value of the de-coupling capacitor can vary. A good rule of thumb is to use a value between 0.1uF and 0.01uF.

For circuits that are driving large loads, it may be necessary to use low frequency de-coupling capacitors. A 10-47 uF electrolytic or tantalum capacitor can often reduce voltage ripple caused by switching frequencies in the kHz range. All schematics that I have seen of the various BASIC Stamps have shown a 22uF capacitor on the output of the on-board linear regulator, so some protection of this type may already be in place.

I have found that placing a 0.022uF de-coupling capacitor as close to each IC as possible reduces noise on the power bus significantly. I also ensure that at least one 22uF capacitor is included in each design, and that a few 2.2uF ceramic capacitors are located next to any IC that may be driving additional circuitry.

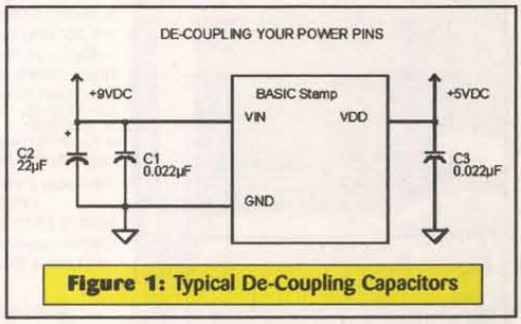


Figure 1: Typical De-Coupling Capacitors

I think the best philosophy regarding de-coupling capacitors is that they are cheap, so use them with great vigor, and sprinkle them throughout your design.

Power Supplies

Electronics these days tend to end up in just about any place you can imagine. Cheap power supplies, car batteries, or noise caused by switching inductive loads (like turning on motors or lamps) can create enormous problems for logic level parts such as the BASIC Stamp.

Filtering your incoming power supply can be done several ways. A resistor in series with the Stamp VIN pin, as well as a low-frequency de-coupling capacitor, can act as a low-pass filter which will smooth out noise spikes. Pre-regulating your supply, such as with a zener diode, can help reduce the damaging characteristics of an inductive spike on your input voltage.

The zener diode will act as a "rough" regulator acting to keep the voltage on your VIN pin at the zener's rated voltage. The zener can clamp positive going voltage spikes, and reduce the effects of negative going voltage spikes. Figure 2 shows an input clamping circuit that can be used to protect your BASIC Stamp. Figure 3 is a simulation of the zener clamping circuit and how it handles both

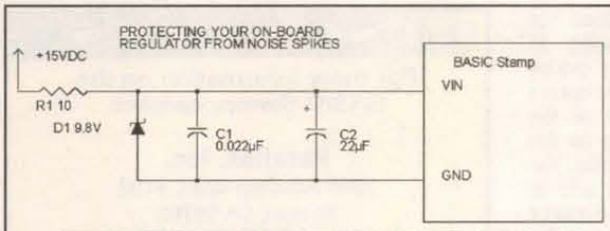


Figure 2: Zener Clamp on Your Power Input Supply

positive and negative voltage spikes of 9us duration.

Power dissipation in your clamping circuit can be a problem if you select a zener diode that is rated at a voltage below your input voltage (as I did in my simulation). Your series resistor is then dissipating power based on the difference between your input voltage and the voltage that your zener diode is regulating at.

What usually works best is to select a low value series resistance (or none if your circuit is drawing a significant amount of current) and a zener diode whose voltage rating is slightly higher than the power supply you are using. For instance, if you were powering the BASIC Stamp with a 12VDC supply, you might select a 10-ohm series resistor, and a 13V zener diode. The goal here is to protect the BASIC Stamp from voltage spikes that might damage its on-board regulator.

Power dissipation can often be a problem with the BASIC Stamp on-board linear regulator. The power dissipated by a linear regulator can be characterized by (Vin-Vout)*Isupply. The higher the input voltage, the less current required to overheat a linear regulator. With a 30VDC input voltage, a five-volt regulator will have to dissipate one watt of power, as heat, when supplying just 40mA. Placing another, higher value linear regulator between the input voltage and the Stamp's VIN pin can allow both regulators to share the power dissipation requirements.

As your input voltage gets higher, this becomes more difficult since many linear regulators are rated for 30-35VDC maximum input voltage. A transistor and zener diode pre-regulator can sometimes allow you to get the job done. Many transistors can handle large voltage drops from their collector to emitter (denoted in the data sheet as Vce), but heatsinking will still be required, and may be extensive. Figure 4 shows an example of a zener diode-NPN voltage regulator.

Protecting Your Input Pins

The BASIC Stamp is based on a Microchip PIC microcontroller. These microcontrollers have internal protective diodes that shunt signals higher than about 5.6V to the +5VDC bus, and signals lower than -0.6V to the ground bus. There can be some interesting unintended consequences regarding these protective diodes.

One of the more interesting is that the BASIC Stamp can be powered off of one of its I/O pins. For example, if the BASIC Stamp was not powered, but a +5.7VDC signal was present on one of its I/O pins, the protective diode would be forward biased (turned on), and about 5VDC would then be present at the Stamp's +5VDC bus, and could power the BASIC Stamp.

Furthermore, positive voltage spikes present on your I/O pins can be translated directly to your BASIC Stamp +5VDC output (or negative going spikes to your ground bus). This can create problems which are hard to diagnose. Imagine turning on a relay with your BASIC Stamp, and watching your temperature sensor go up in smoke. There is no apparent connection between the two devices, yet they are only separated by diodes internal to the microcontroller which the BASIC Stamp is based on.

Protecting your input pins can be done in a manner similar to the zener diode clamp used on the power supply. Yet, in this case, the series resistor can be much larger and can be a more active instrument in attenuating voltage spikes. The input impedance for a BASIC Stamp pin set as an input is about 1 megohms (very rough estimate). The input impedance can be estimated from the leakage current that is typical of an input pin (about 1uA maximum).

Any series resistors should be selected so as not to form a voltage divider with the input impedance of a BASIC Stamp pin configured as an input. This is especially important if your input signals are already attenuated by external devices such as op-amps which do not have rail-to-rail outputs (like the LM741).

A series resistor of about 1k ohms, in conjunction with a zener diode rated for 5.1-5.6V, and a capacitor can effectively protect input pins from voltage spikes, and reduce noise that might affect your BASIC Stamp's program flow. The series resistor forms a low-pass filter with the capacitor in this circuit. If you are measuring pulses or frequencies with a particular Stamp pin, be sure to select component values so that your signals are not attenuated out of existence by the protective circuit. You can calculate the frequency threshold of a low-pass filter with the equation ...

$$f = 1/(6.28*R*C)$$

When measuring short pulses, keep in mind that the rise time of your pulse will be limited by the low-pass RC filter described above. The time it takes for a signal to rise from 10% of its maximum voltage to 90% of its maximum voltage through an RC filter can be approximated by 2.2*R*C. This is also considered the rise-time of the signal in question. For the circuit in Figure 5, this rise-time is roughly 48us. This is the time it takes for a five-volt pulse to rise from 0.5V (10% of 5V) to 4.5V (90% of 5V).

This means that if you are intent on measuring short pulses, you should consider the effects of filtering on the BASIC Stamp's ability to make the measurement in question. Figure 6 provides a graphical representation of the

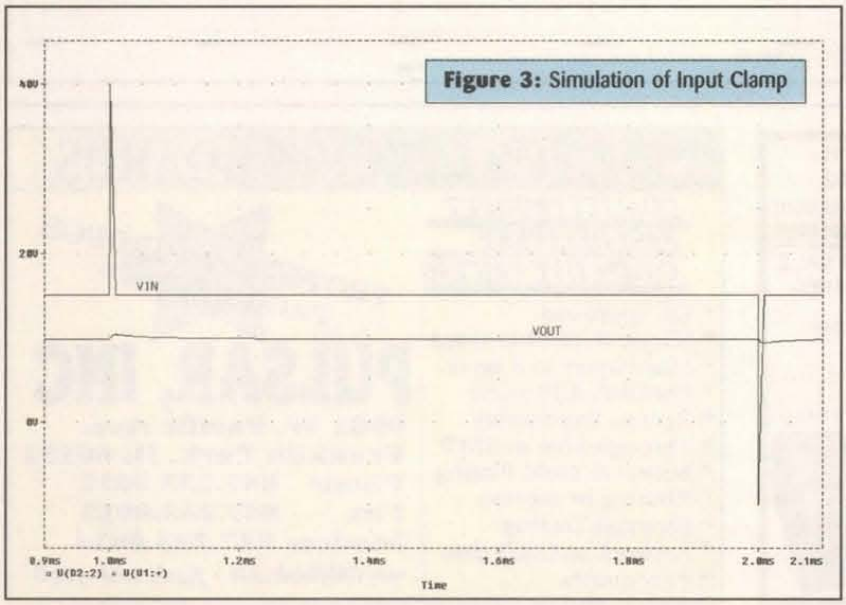


Figure 3: Simulation of Input Clamp

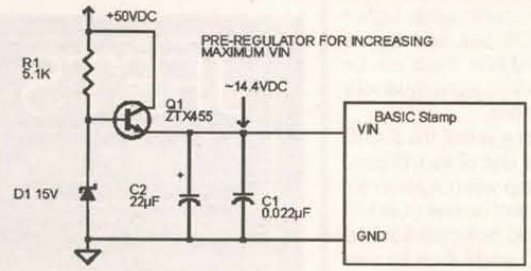


Figure 4: Rough Zener-NPN Pre-Regulator

rise time for the filter circuit in Figure 5.

Figure 7 shows the input signal versus the signal as seen by the BASIC Stamp after the signal passes through the protective circuitry in Figure 5. The incoming signal has a 50kHz 0.5V peak-to-peak noise signal, a logic level pulse, and a 1us glitch. As you can see, the protective circuit filters out most of the noise and prevents the glitch from reaching the BASIC Stamp. The glitch is too short and, due to the rise time of the RC filter, it never reaches a logic high level which could be measured by the BASIC Stamp.

One killer of electronic components is electrostatic discharge (ESD). If you don't believe me, try walking across your carpet with just socks on – be sure to shuffle your feet – and then touch your finger to your favorite BASIC Stamp project. Of course, if you do this, you'll be shelling out some bucks for a new BASIC Stamp, and probably a handful of other replacement components. On second thought, just take my word for it.

But you can see from being shocked by your friends, neighbors, and loved ones that we humans have quite a capacity (or is it potential?) for carrying potential (or is it capacity?). Anyway, we can all carry a healthy enough charge to zap a BASIC Stamp into next week. This can be particularly common in designs with keypads.

Figure 8 shows a commonly used method of protecting I/O pins on microcontrollers from ESD when interfacing to switches or buttons. The pull-up resistor (82k ohm) is required to ensure that pressing the switch does not short your power supply to ground. The switching diodes allow transient voltages to open a path to either ground or the +5VDC bus, depending on the polarity of the voltage spike. The 1k ohm series resistor acts to limit the current during transient voltage spikes and protects the diodes which limit the voltage on the microcontroller input pins.

The diodes which are internal to the Stamp I/O pins (that I had mentioned earlier in the article) can be used in place of the external switching diodes, but should probably not be considered as robust a form of protection.

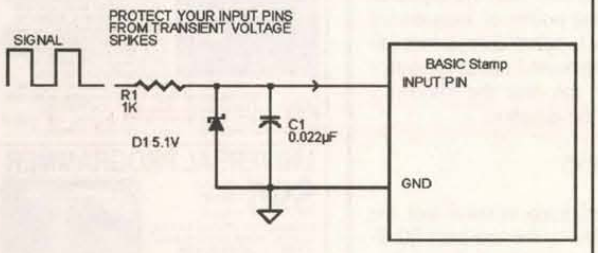


Figure 5: Protective Circuit for Input Pins

Conclusion

I think two general rules apply to protecting your BASIC Stamp designs:

Rule 1: If any connection interfaces to the outside world, PROTECT IT.

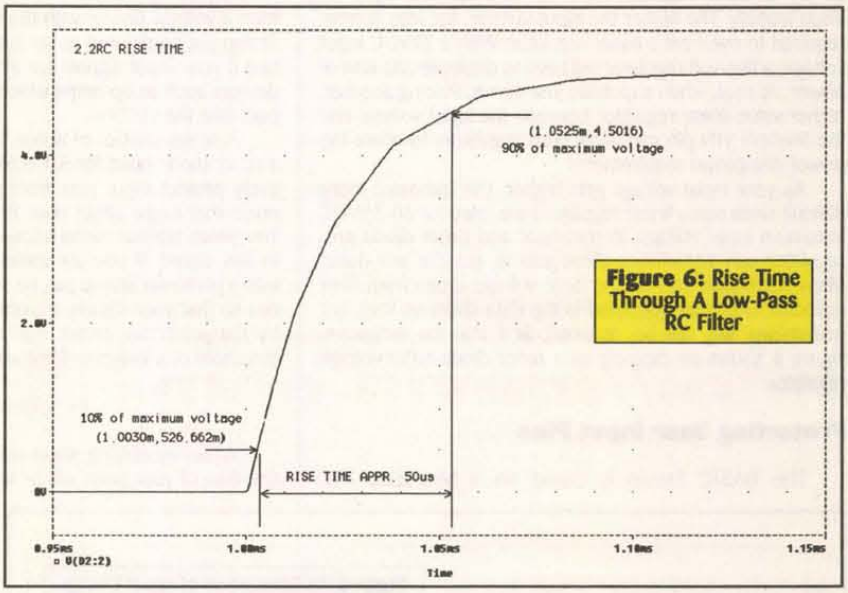


Figure 6: Rise Time Through A Low-Pass RC Filter

RESOURCES

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.
1939 S. Frontage Rd. Ste. F
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**
www.solutions-cubed.com
Phone: **530-891-8045**
Fax: **530-891-1643**

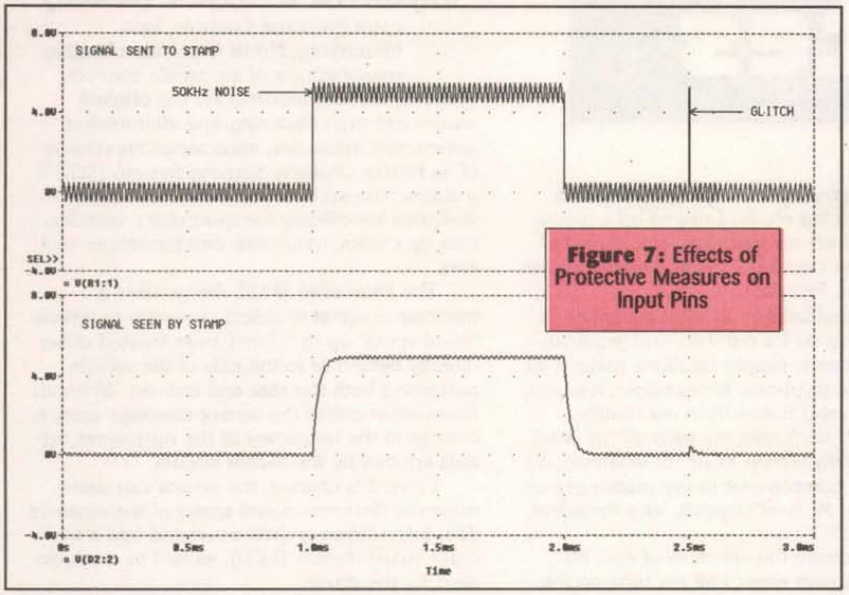


Figure 7: Effects of Protective Measures on Input Pins

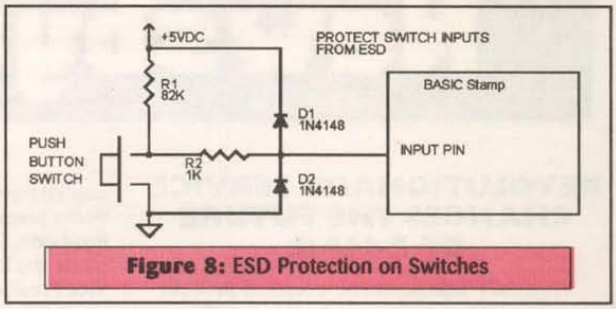


Figure 8: ESD Protection on Switches

Rule 2: If you can think of something bad that somebody could do to your design, assume it WILL HAPPEN.

When you are planning a BASIC Stamp design, always take time to look at where each connection is going. And try to figure out what odd things may happen to it. If you have a keypad or LCD display, can somebody spill liquid on it? If you have a relay that you are controlling, what happens if it can't close or open? If you are using switching transistors, can they overheat? If a part blows up, will it blow up open or shorted?

Spending ample time figuring out both how to protect your electronics, as well as what to protect them from, can be surprisingly beneficial. There are certainly cases where protection is not much of a concern. Most chip-to-chip connections are short and don't require much in the way of filtering or protective circuitry.

There are also situations that cry out for protective measures. For example, you may have a small robot using an IR detector for wall sensing. It's a good idea to mount IR detectors of this nature at a point where they are unobstructed by objects on the robot itself. This may be at a distance from your BASIC Stamp. Any wires or ribbon cables connecting these two devices will act as antennae and can conduct noise generated by your motors, battery chargers, or any other "noise generators." These kinds of connections are good candidates for protective circuitry.

After a while, protecting your circuits becomes second nature, and you start making trade-offs such as cost versus the level of protection you may receive from a specific circuit addition. I always try to add all of the protective circuitry that I can think of and, after the design is up and running, I whittle away the things that may be overkill.

In the end, good engineering is about one-third experience, one-third forethought, and one-third time in (or sometimes out) of lab testing. I think there is another ± one-third or so wrapped up in test equipment, time of day, amount of beer you had the night before, and a few other important factors. Of course, the most indisputable measure of good engineering is design survivability. So protect your Stamps, and give them good safe homes! **NV**

Newsbytes

REVOLUTIONARY SERVICE CHANGES THE FUTURE OF E-MAIL

ACT TeleSolutions, a leading provider of live operator messaging solutions, will revolutionize person-to-person mobile communications today with **ibyphone**, an exciting, innovative E-Mail service. This is the first initiative in the company's plans to make all that is available on the internet accessible via telephone, paving the way for the future of the wireless world.

Pioneered by XACT, ibyphone is the first subscription-based E-Mail service that enables its customers to send E-Mail from any telephone, at any time, via live operator. Unlike other companies' attempts to fill the mobile E-Mail void with technology-driven solutions, ibyphone offers a simple, personalized, device-free alternative. "ibyphone is the customer-driven evolution of mobile communications for the E-Mail generation," says Dan Joseph, co-founder and CEO. "It enables users to bridge the gap between themselves and technology, through human interaction. Technology alone is an inadequate answer to problems inherent in mobile messaging. And who wants to have to drag around bulky machinery just to stay in the loop? The real answer is simplicity, customizability, and flexibility. Busy people seek solutions that give them — not the technology — control over their communications. ibyphone offers that solution and that control in an affordable package. The response from our test subscribers has been phenomenal."

Using ibyphone is easy. Subscribers just call a toll-free number from any telephone, and dictate their message to a highly skilled Telephone Service Representative, who can send it instantaneously to any number of individuals or groups. It's that simple. ibyphone optimizes and personalizes the user's experience. Subscribers identify themselves with a PIN number, and are greeted by name. Service Representatives access the subscriber's online address book for rapid addressing to groups or individuals, and can add new addresses upon request. Representatives are trained to take messages quickly and accurately, and can read back and edit each message to ensure content quality. The ibyphone system was developed to mirror all E-Mail capabilities, enabling a host of service options and features. Subscribers register online at www.ibyphone.com, where they can customize delivery, signoff and confirmation options, build an address book for mobile access, and select a usage plan. Activation is immediate.

XACT's test market shows that professionals who rely on both mobile telephony and E-Mail could identify numerous situations in which ibyphone has met their needs in a way nothing else could. Such "ibyphone moments" speak for themselves. For instance:

* "I was running late, and needed to reach my team with an update and game plan before getting on a long flight. I realized there was no way I'd have time to boot up my laptop and find a place to log on. So I zipped off a group ibyphone, (which my team had already acted on by the time I landed.)" Scott Mataya, Senior Vice President, Petopia.

* "I'm a real believer in what advances in technology can do for our lives and productivity. But sometimes, simple solutions make a lot of sense. Take ibyphone, for example. It's great to be able to send E-Mail from my mobile phone, when I can't take my eyes off the road, or don't have my laptop along, or whatever. It's a very useful complement to my mobile phone and laptop." – Michael Doppelt, Vice President, Bear Stearns.

* "I coordinate the activities of over 80 people, and spend about half my time on the road. I like ibyphone because it allows me to set up groups for the teams I need to manage. I often want to communicate the same thing to 10 or more people. Before, I would have had to make a half dozen calls to do this, and still I couldn't be sure everyone got the message. Now I can take care of things with one phone call! – Dan Feldstein, President, Shopper's Advantage.

* "I started using ibyphone to E-Mail in a pinch. Then it occurred to me that I could use it in the car to actually accomplish something useful during my commute. That means less time I have to spend on E-Mail in the office or when I get home. Plus, getting CC'd means I don't forget to follow-up. ibyphone is a great tool." Mitch Smith, President and CEO, On the Go Hosiery.

"ibyphone adds control, convenience and power to the way people interact with one another," says Dave Guttman, co-founder and President of ibyphone and XACT TeleSolutions. "It allows customers to take advantage of a direct phone-to-E-Mail solution without a costly investment in high-tech devices that will be obsolete in a matter of months. With over 38 million professionals already carrying cell phones, and over 40 million professionals sending an average of 30 E-Mails a day, ibyphone meets a critical and unmet need. Communication via E-Mail whenever and from wherever one chooses."

Beyond its advantages as a completely mobile solution, ibyphone is affordable and accessible. XACT invites interested parties to try ibyphone free for a month. Thereafter, subscribers can select a usage plan from a range of packages designed to meet the requirements of target customer groups, such as "The Entrepreneur" or "The Road Warrior." Packages start at as little as $9.95 per month.

From unrivaled simplicity, accuracy, and flexibility to complete control and mobility, the first generation of ibyphone is undoubtedly a missing link in mobile telecommunications. True pioneers in the person-to-person communication industry, the ibyphone team has created the first complete and custom-designed solution to sending E-Mail.

http://www.ibyphone.com · 212-813-1700

ROSTRA OBSTACLE SENSING SYSTEM (ROSS)

Rostra Precision Controls, Inc., Laurinburg, North Carolina, a leading manufacturer of electronic controls, systems, and components for the original equipment manufacturing and after-market automotive industries, announced the release of its Rostra Obstacle Sensing System (ROSS), a state-of-the-art obstacle detection system designed specifically for sport utility vehicles, pick-up trucks, mini-vans, and passenger vehicles.

The innovative ROSS design uses a microwave signal to detect obstacles in vehicle "blind spots" up to 12 feet away located either directly behind or to the side of the vehicle, protecting both the rear and corners. When an obstruction enters the sensor coverage area, a change in the frequency of the microwave signals emitted by the sensor occurs.

From this change, the sensor can determine the distance to and speed of the obstacle. This information is then converted into a tri-color visual display (LED), as well as an audio alert for the driver.

The ROSS technology is a major improvement over existing obstacle detection systems, because the sensor can be mounted out of view behind the vehicle bumper. Also, unlike obstruction detection systems currently on the market, the ROSS is not affected by adverse weather conditions such as snow, fog, hard rain, sleet, darkness, extreme heat, or bright sunlight, any of which can prevent obstacles from being detected in time to prevent an accident.

"The ROSS is an economical way to greatly reduce and/or eliminate the risks and repair expenses associated with the low speed obstacle collisions that frequently occur while driving in reverse gear," says Raymond Ford, President, Rostra Precision Controls.

According to a recent Allstate Insurance Company survey, 27% of all automobile accidents occur while driving in reverse gear. These types of mishaps are surprisingly costly to repair. A 1999 study conducted on six different sport utility vehicles by the Insurance Institute for Highway Safety revealed that typical repair bills for low-speed (five miles per hour), reverse gear collisions between the vehicles and stationary objects can range from $3,000.00 to $6,000.00.

The suggested retail price for the ROSS is less than $300.00 installed, which includes a three-year, 36,000-mile warranty.

Easily mounted on both newer and older vehicle models, the ROSS comes with a universal installation kit and can be installed in less than 30 minutes without drilling holes in the vehicle, unlike other obstacle sensors. Rostra Precision Controls plans to make the ROSS available through automotive retail outlets by early September 1999.

Rostra Precision Controls is an ISO 9001 and QS 9000 certified manufacturer of automotive products and is the single largest supplier of cruise controls and transmission modulators and solenoids to the automotive aftermarket industry in the U.S.

Rostra Precision Controls specializes in the areas of vehicle speed control systems, transmission components, and vehicle comfort seating systems such as seat heaters, lumbar supports, and the industry-leading technology of the 'Active Seat'. Rostra Precision Controls employs 185 individuals at its headquarters in

Continued on page 86

WORLDS SMALLEST *** 100mW *** VIDEO TRANSMITTER, ON SALE

Incredibly only 0.98" x 0.8" x 0.037" in size. Transmits crystal controlled hi-res. images with 100mW output! The transmitter you've been waiting for. **Shown actual size.** Smaller than the 9V battery which powers it. Draws only 35mA! Factory tuned. Receive on cable channel 59. Will work with color or B&W cameras. UHF Bow tie antenna with balun and 3' F cable for TV included. Perfect with our GM1000A. Both will fit in a cig. pack with battery!

SEPTEMBER SPECIAL TVX-100.$159. with GM1000A CAM....$209.

ULTRA PRECISE, KENSINGTON LABS, XY STAGE.

Model 8500-6X, 6"X6" of high performance travel. One of the best linear stages available. Highly repeatable, ultra-precise. Precision ground surfaces result in unmatched laboratory-grade performance. Linear glass scale, internally attached to the table, eliminates all drivetrain errors not measurable when an encoder is attached to the motor. System provides up to 0.025µm res. over 100 mm. Built from stress relieved 7075 aluminum. Crossed-roller bearings for excellent stiffness, load capacity and lifetime. Combined with a very low friction preloaded leadscrew and DC servo motor drive provides 20,000 hour MTBF. 100 mm/sec maximum speed and >50kg load capacity. Size: 15"L x 9"W x 2.75"H Regular price > $4Kea. X&Y stage with motors. USED, Very good condition. **SEPTEMBER SPECIAL, 8500-6, XY STAGE.....$1295**

IR SOURCE with 1,000,000CP ! Hand held, long range illuminator. One of the most powerful available. Quartz halogen spotlight combined with the best military, glass IR filter. Because it's solid glass & not laminated plastic it can take the heat. Includes a coiled cord,std. cig. lighter plug. Operates from 12VDC. **SEPTEMBER SPECIAL, IR-SPOT $99**

ARGON LASER POWER SUPPLY. INDUSTRY STANDARD, AMERICAN LASER 60X

We were fortunate to obtain these unused and factory refurbished ALC 60X power supplies. Always in demand but hard to find. They can power most Argon heads up to 12AMPS. We have no manuals at press time. If you have a 60X series head or similar this is the unit for you. 110VAC power. Rugged anodized aluminum, housing with internal fan. Size: 8"x8"x11"L, 22 lbs. Don't miss out. Very Ltd. Qty.

ALC60X...$299ea. or 2 for $549

NEW! 0.008lux, COLOR NIGHT VISION CAMERA! UNBELIEVABLE LOW LIGHT PERFORMANCE. Our GMV-2K, DOES it in COLOR TOO!

For covert, military and scientific applications that must be color, this is it. Performance is enhanced through low speed electronic shuttering and digital frame memory. With an auto iris lens, 24 hour monitoring is possible. Auto sensitivity mode starts as it becomes dark. Eight Gain/Shutter modes are user selectable. Normal, X4, X8, X16, X24, X32, X64, X128. These provide frame rates of 60, 15, 8, 4, 3, 2, 1, and 0.5 frames per second. Auto/Manual white balance. Aluminum housing with dual 1/4x20 mounts. Specs: 1/3" CCD, with 291K pixels, 320 Lines, <1 Lux std. mode sens., 12VDC @200mA, Std. video out on BNC. Size: 54mmx50mmx94mm long. With pwr. adapter. All functions can be externally controlled via an 8 pin mini DIN. Uses std. c-mount lens not included.

Special Item, GMV2K.....$589ea.
4mm, f1.4 A/I lens with custom cable.....$119ea.

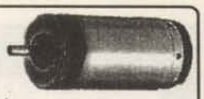
SEPTEMBER SPECIAL, PRICE BUSTER DEAL ..... NEW, SHARP, YH-7B50, COLOR, CCD CAMERA.

Now available for a fraction of its' original price. Great looking styling. Camera has a very stable, manually adjustable pan and tilit base. Base is removable for tripod mounting via standard 1/4-20 mount on bottom. Front panel LED power indicator. Excellent video performance packaged in a sturdy 2.7"W x 1.4"H x 5.8"L, 11 oz. package. Simply connect camera to any "Video Input." RCA cable supplied. Camera has 5.6mm lens with fixed focus from 18" to infnity. No adjustment required! Power is 6VDC from power adapter also included. 1/3" CCD, 300Lines resolution 25% better than standard VHS! Auto white balance. Perfect fro any general purpose video application. Brand new, in original sealed boxes.

Don't miss out on this super special deal.

YH-7B50 COLOR CAMERA...$59ea. Super deal 2 for $99

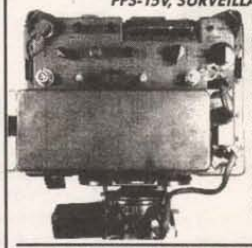
MINIATURE and, PRECISE, PORTESCAP, SWISS, GEARMOTOR.



State of the art "ironless" type, mini motor type M11-210-54-0 with approx: 40:1 gearbox. Size: 16mm d. x 43mm L Operating parameters: @6VDC input, 8mA, 141RPM No Load, @ 12VDC input, 12mA 290RPM No Load

PORTESCAP, TYPE B: $15ea. 2 for $27, Special....10 for $125

PORTABLE, PERIMETER PROTECTION PPS-15V, SURVEILLANCE RADAR SYSTEM!



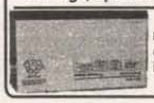
Up to 3000 Meter range. Provides audible indication of objects w/alarm. Control panel with LED display of battery, signal strength, range and azimuth. Can be operated remotely via supplied cable and detachable control panel. 12VDC or 28VDC powered. Includes heavy duty, military, aluminum transit case, headphones, battery and tripod. Only 14 lbs. Latest flat antenna design. Motorized sweep.

SEPTEMBER SPECIAL.....$1295

ALL TYPES of COVERT CAMERAS, all available with audio,

Specification for all models include: 1/3" CCD, 410 Lines Res., 0.3 Lux sensitivity, Power from 9 to 12VDC @100mA, 90° FOV lens except dome and PIR which are 80° , All focus from 2 ft. to infinity. Standard NTSC video out. SENSITIVE to IR. note: Smoke & Motion detectors not functional, Clock & Exit operate normally. Dome is 3.5"H x 5.5"Diam. Don't see what you want? We can put a camera in anything you desire.

Smoke Det., Motion Det., Clock or Dome Camera, Special...$79ea.
Exit Sign, Special.....$99ea. Please add $10 for audio. (any model)



6V@12AH SEALED, RECHARGEABLE, BATTERY

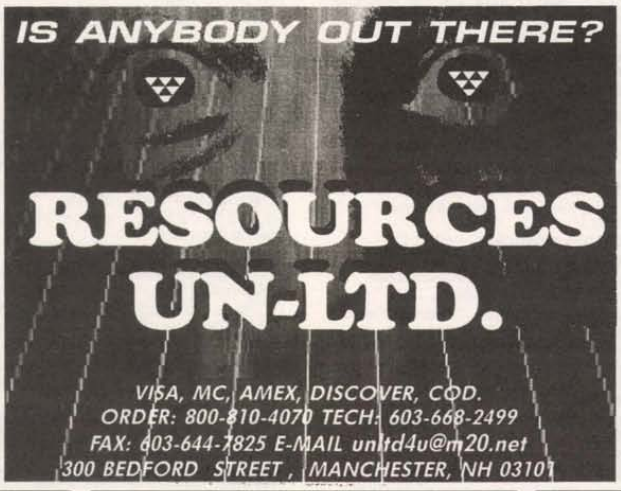
New Panasonic, LCR6V12Pt. Tough to get at a discount. Very compact. Two top mounted 1/4" faston connectors. Perfect for high drain projects. Size: 5.9"L x 3.7"H x 1.9"D

2 for $20, 10 for $89

NEWPORT TRANSLATION STAGES. also a few other goodies too!

MODEL:	DESCRIPTION:	EACH
270	LAB JACK	$249
RSA-2T	360 deg. Rotary Stage with Clear Aperture.	$129
625A-4	Laser Holder	$149
481A	Rotary Stage	$189
M36	Translation Stage	$249
460A-XY	X-Y Translation Stage	$189
M37	3 Axis Trans. Stage	$289
415	Vertical Trans. Stage	$129
M360-90	Mnting. Plate 90deg.	$29
M436	Translation Stage	$199
M150	Magnetic Mtg. Base	$129
420	Linear Trans. Stage	$119
HP10703A	INTERFEROMETER	$129
HP10702A	INTERFEROMETER	$129
HP10780A	RECEIVER	$199
RUCKER & KOLLS 222	X-Y-Z MICRO POSIT.	$ 50

10V @ 2.5 AH SEALED, LEAD ACID, PACK Each pack consists of five, 2 Volt cells. Each cell the size of a 'D' battery. Arrainged as 1X5 cells. Enclosed in an ABS outer shell. (removed for photo) Perfect for high drain applications. Make custom packs of any rating. Size: 7.5"L x 2.8"H x 1.5"D **5-five packs for $20, 30 for $99**

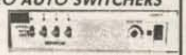


MOTORIZED 10X ZOOM, SURVEILLANCE LENS

New, 11mm to 110mm, f1.8, C-Mount, Fujinon, industrial quality optics paired with precision drive enable smoooth remote operation of FOCUS, ZOOM and IRIS. Unit is open frame, black anodized alum. structure supports the sophisticated drive. Two models: Mod Z5 std, or Mod Z10 has HP optical encoders for position feedback (128ppr) on zoom & focus Edmunds sells the lens w/o drive for $869ea. Motorized unit sells for >$2000. Very limited quantity.

Model Z5.....$349ea. Model Z10.....$399ea.
New ZOOM LENS CONTROLLER.....$169ea.

NEW! 4 or 8 CHANNEL, VIDEO AUTO SWITCHERS



Model GM34 or GM38. Connect to any four standard video signals and they will be sequentially output to the dual rear panel BNC outputs. Front panel user adjustable, variable dwell 1 to 15 sec per channel. Auto or manual switching with channel bypass. Compact only 8.6"W x 3.7" D x 1.75" H, ac powered. Video loop through.

GM-34.....$79, GM-38.....$99

WEATHER RESISTANT Camera Enclosure,

Solid, extruded aircraft aluminum. Glass window. Strain reliefs for cables. Size: 3.5"w x 3.7"h x14"L,

Special.$59ea. w/110V heater..$69ea.
Heavy Duty Alum. Adj. Mount....$29ea.

NEW GM182, 580 LINE, CCD CAMERA,

1/3" CCD, 580 Lines Res., 0.1 Lux sens., AGC, Auto Shutter. Pwr. 12VDC @120mA, 3.6mm, 71° FOV, Real glass lens. Focus from 10mm to infinity. Standard NTSC video out. 1/2 once! SENSITIVE to IR. Size: 1.7"sq. x 1"d. with 6" leads. Superior quality for demanding applications. **GM182, with AC power adapter.**

SEPTEMBER SPECIAL.....$169ea.

MICRO CAMERA, with MIRROR IMAGE

Perfect for "rear view." 1/3" CCD, with 266K Pixels. 410 Lines Res., 0.3 Lux sens. AGC and Auto/Man Shutter. Low Power 12VDC @100mA 3.6mm, 92° FOV, focus from 10mm to infinity. A real glass lens! WHY BUY DISCONTINUED OR SURPLUS? New first quality Standard NTSC video out. 1/2 once! IR SENSITIVE!

GM251, with AC power adapter.....$69ea.

ULTRA MINI and WEATHERPROOF, "LIPSTICK" CAM

Sleek black anodized, alum. housing, O-Ring sealed & RAINPROOF. Adj. tilting mount. 1/3" CCD, 380 Lines, 0.3 Lux, AGC, Auto Shutter. 9-12VDC @100mA, 4mm, f1.8, 78° FOV real glass lens, NTSC video. <1ounce! IR SENSITIVE. 23mmdX50mm, 36" cable with BNC video & DC barrel jack.

PINHOLE Model. So tiny you can install it directly into a door. Only a 0.9" diameter hole! Specs as above. 90° FOV Pinhole lens. 1/2 once! Size only 23mm d.x35mm long. Think of the places you could put this little jewel.

GM-200K-STD....$99 OR GM-200K-PH lens....$99

NOW YOU CAN SEE WHAT THE "FISHES ARE DOIN' (down 60 ft.) UNDERWATER B&W CAMERA with INTERNAL, INFRA-RED ILLUMINATOR!

Sleek black anodized, BRASS, housing. O-Ring sealed & WATERPROOF. Adjustabe mount incl. Specs: 1/3" CCD, 400 Lines res., 0.05 Lux sensitivity, AGC, Auto Shutter. 12VDC @225mA, 4mm, 78° FOV lens, A real glass lens. NTSC video out. Superior construction. SENSITIVE to IR. Ultra small Size only: 1.25"diam. X 2" long. With 60 ft. cable. Great for general outdoor use also. **GM-300KIR.....$199**

DAYLIGHT/LOW LIGHT MINI CAM & A/I LENS, For dawn 'till dusk

applications. Rugged alum. housing, dual mtg. sockets. 1/3" CCD, 420 lines res., 0.1 Lux sens., AGC, 12VDC @120mA. Take full advantage of camera sensitivity with super, 4mm, f1.4, 78° FOV Auto Iris lens included. BNC video out. 50mm sq. X 65mmL. Power adapter included. **GM-510A/I...$199 or 2/$369**

SUPER, MINI C-MOUNT CAMERAS, Super sensitive, GM410 or the general purpose GM412,

The GM-412 specs: B&W, size 1.5"sq. X 2.4"L, 250,000 Pixels, **380** Lines Resolution, Sensitivity **0.3** Lux, The GM410 specs: size only 1.5" SQ. x 1.6"L, >270,000 Pixels, **410** Lines Res., Sens. **0.05 LUX.**, Both cameras are 1/3" CCD with AGC & Electronic shutter. 12V @110mA power. NTSC out. IR SENSITIVE, BNC video out, Both use std. DC pwr. jack. Aluminum housings with dual threaded top and bottom mounting. True performance not hype! These cameras will outperform ***ANY*** camera in this magazine. Multi-lens options are available to exploit their superior performance.GM412 shown bottom. GM410 shown top.

GM412, less lens..$119,
GM410, less lens..$169

low cost MICRO CAMERA, w/audio 1/3"

CCD, 410 Lines Res., 0.3 Lux sens., AGC, Auto Shutter. Pwr. from 9 to 12VDC @100mA, 250k PIXELS, Std. model, 4mm, 78° FOV lens, Pinhole, 90° FOV. A real glass lens. Both focus from 10mm to infinity. Std. NTSC video out. 1/2 ounce! SENSITIVE to IR. Size Std: 1.25"sq. x 1"d. PH is 0.6"d, 1.6M long wiring harness with connectors included. **WARNING:** Don't confuse these models with LOW RESOLUTION, HIGH LUX C-MOS CAMERAS.

GM-1000A-STD.....$59 GM-1000A-STD/Aud.....$64
GM-1000A-PH.....$59 GM-1000A-PH/Aud.....$64
GM-1000A-CMNT..$59 GM-1000A-CMNT/Aud.$64

Micro Lenses for GM1000 series

2.5mm, 150°.....$22	8.0mm, f2.0.....$22
4.3mm, 78° f1.8.....$22	12.0mm, f2.0.....$22
6.0mm, f2.0.....$22	5mm, 70°PH.....$22

C-MOUNT LENSES

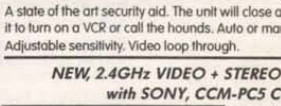
LOW LIGHT	STANDARD
16mm, f1.6, 15° FOV $39	4mm, 80° FOV $24
8mm, f1.3, 40° FOV $49	8mm, 40° FOV $24
4mm, f1.4, 78° FOV $49	12mm, 28° FOV $24

MOTORIZED ZOOM LENS SPECIAL 6X magnification, 12X on a 1/3" camera! Auto iris too!

New, fabulous hi-res. optics with std. C-Mount. Superior Fujinon and Vicon lenses. Normally cost from $600 to $1500. There is no substitute for a good lens! All drive motors will operate from 6-12VDC. Auto iris has a built in amp which works with any cameras video output for control.

Type B-6, 12.5 to 75mm, 6X, f1.2 ..... $179 or 2 for $349
ZOOM LENS CONTROLLER, NEW $169

Brand New, Video Motion Sensor. Model VM10. Attach to any standard video signal and you've got an electronic "watchman" diligently watching the entire scene. Or any adjustable sized area within the scene. Such as a doorway or even a drawer or cabinet.



A state of the art security aid. The unit will close a contact when it senses a change. Use it to turn on a VCR or call the hounds. Auto or manual reset. Compact, ac powered. Adjustable sensitivity. Video loop through. **NEW, VM10.....$189ea.**

NEW, 2.4GHz VIDEO + STEREO AUDIO TRANSMITTER with SONY, CCM-PC5 COLOR CAMERA.

Originally sold for $500! Now available for a fraction of that price. Great looking styling. Camera has a very stable, adjustable tiliting base, front panel LED pwr. indicator and sensitive built in electret mic, providing excellent audio and video performance from one compact package. Simply connect camera to the completely self contained 2.4GHz transmitter. All cables supplied. You can transmit up to 700 feet clear line of sight! Companion matching receiver works with any TV or VCR. Internal patch antennas. Camera has adjustable focus 6mm lens. (1" to infinity, macro capable) Auto power off when the privacy shutter is closed. Power is 7-13VDC. (all pwr. adapters and cables included) 1/3" CCD, 330Lines res. 35% better than standard VHS! Can als be used to transmit VCR oputput to another TV fo remote viewing.

SPECIAL, 2.4GHz SONY-ASTROVIEW....$189ea. or 2 for $339
addtl. 2.4GHz TRANSMITTER/RCVR. less Camera...$129ea.

Events

SEPTEMBER 1999

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

SEPTEMBER 4

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

CANADA - ONTARIO - CARP - Hamfest. Ottawa ARC, Jim Cummings VE3XJ, 613-446-1225. E-Mail: fleamarket@oarc.net Web: http://oarc.net/fleamarket

NM - ALAMOGORDO - Hamfest. Otero County Fairgrounds, US 54 & Fairgrounds Rd. VEC testing. Alamogordo ARC, Larry Moore WA5UNO, 505-437-0145

PA - UNIONTOWN - Hamfest. Uniontown ARC, Carl Chuprinko WA3HQK, 304-594-3779

SEPTEMBER 4-5

NC - SHELBY - Hamfest. Shelby ARC. John Ledford N4GOQ, 704-482-4507. E-Mail: n4goq@shelby.net Web: http://www.shelby.net/n4fan

SEPTEMBER 10-11

AR - MENA - Hamfest. Queen Wilhelmina Hamfest Assn., Charlotte Lee KC5DOR, E-Mail: blee@ipa.net. Ray Lively W5DLC, 903-764-5599, E-Mail: raysoft@intrastar.net Web: http://qwha.intrastar.net

SEPTEMBER 11

AR - MOUNTAIN HOME - Hamfest. Twin Lakes ARC, Miles Waldron N5QMI, 870-492-4466. E-Mail: mpwaldron@centuryinter.net

AZ - KINGMAN - Hamfest. Hualapai ARC, Ron Miller KK6BM, 520-757-3770. E-Mail: rmiller@kingman.com Web: http://www.qsl.net/harc-az

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

DE - DOVER - Hamfest. Kent County ARC, Larry Roll K3LT, 302-678-4841. E-Mail: yodoc@aol.com or k3lt@magpage.com

IN - SPENCER - Hamfest. Owen County ARA, Kathryn Smith K9INU, 812-829-2140

ME - WINDSOR - Hamfest. Fairgrounds. AARA, Frank N1ITR, 207-623-9217

MN - RUSH CITY - Hamfest. East Central MN ARC, Larry Jilek KA0MEN, 320-358-4205

MO - COLUMBIA - Hamfest. Good Time Country, 5551 S. Hwy. 63. 8am-2pm. VE Exams. Central Missouri Radio Assn., Nathan Odle KB0NNV, 573-474-9247. E-Mail: nathano@odle-associates.com Web: http://www.qsl.net/~cmra

NY - BALLSTON SPA - Hamfest. County Fairgrounds. 7am-3pm. VEC Exams. Talk-in: WA2UMX 146.40/147.00 & 147.84/147.24. Saratoga County RACES Assn., Darlene Lake N2XQG, 518-587-2385 E-Mail: lake@capital.net

PA - ERIE - Hamfest. Franklin Twp. Firehall. VE Exams, 9am, Franklin Center Methodist Church, Rt. 98. Talk-in: 146.01/61. Radio Assn. of Erie, Dr. Tom McClain N3HPR, 814-833-1640. E-Mail: TEM@ERIE.NET Web: http://www.erie.net/~n3ntj/hamfest.htm

WA - PUYALLUP - Tacoma Electronics Fleamarket. (Pierce County Fairgrounds), Frontier Park, 21718 Meridian Ave. E. 9am-3pm. Talk-in: 147.38+ PL 103.5, simplex 146.58. RCT, Roger 253-475-4293. E-Mail: rtwig@worldnet.att.net Web: www.mashell.com/~roblee/rct.htm

SEPTEMBER 11-12

FL - MELBOURNE - Hamfest. Auditorium. Platinum Coast ARC, Tim Madden KI4TG, 407-724-9339. E-Mail: ki4tg@msn.com

KY - LOUISVILLE - ARRL KY State Convention. Bullit County Fairgrounds, I-65 (South 25 min.). Greater Louisville Hamfest Assn., Herbert Rowe W4WQD, 812-282-7007 or 812-948-0037 (commercial), 502-935-7197 or 606-284-9090 (FleaMkt/TailGate) E-Mail: wd4ixl@juno.com Web: http://www.thepoint.net/~glha/

SEPTEMBER 12

DE - FELTON - Hamfest. Kent County ARC, Larry Roll K3LT, 302-678-4841. E-Mail: W3HZW@hotmail.com

IL - JOLIET - Hamfest. Bolingbrook ARS, Marti Barton KA9ZJJ, 815-436-0559. E-Mail: mkbarton@flash.net

MA - SOUTH DARTMOUTH - Hamfest. At club. SE MA ARA, Bill K1IBR, 508-996-2969

OH - FINDLAY - Hamfest. Hancock County Fairgrounds. Talk-in: 147.15+, 444.15. Findlay RC, Bill Kelsey N8ET, 419-423-4604. E-Mail: kanga@bright.net Web: http://www.bright.net/~kanga/w8ft/

PA - BUTLER - Hamfest. Butler County ARA, Gerald Wetzel W3DMB, 724-282-6777. E-Mail: w3dmb@aol.com Web: http://www.nauticom.net/www/cliff/hamfest.html

SEPTEMBER 17

NJ - PISCATAWAY - Ham & Electronics Auction. North Stelton Firehouse, Haines Ave. E of Stelton Rd. 6pm. Piscataway ARC, Marty 732-396-1836 (before 9pm)

SEPTEMBER 17-18

FL - LAKE CITY - Hamfest. American Legion Hall, 4306 S. Hwy. 41. Fri: 4-9pm, Sat: 8am-5pm. Columbia ARS, Colin Boutwell WA5RKR, 904-755-7969 or 1-800-752-7969, E-Mail: wa5rkr@isgroup.net. Joe Aymond WD4EOJ, 904-935-2405 after 5pm, E-Mail: wd4eoj@isgroup.net

SEPTEMBER 18

AR - LITTLE ROCK - Hamfest. CAREN, Scott Derden K5SCD, 501-834-1881 E-Mail: sderden@flash.net Web: http://carenclub.webjump.com

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

IL - ROLLING MEADOWS - W9DXCC Convention. Northern Illinois DX Assn., Bill Smith W9VA, 847-945-1564 E-Mail: w9va@aol.com Web: http://www.qth.com/w9dxcc

KY - CAVE CITY - Hamfest. Convention Center. VE Exams. The Southern KY DX Assn., Larry Brumett KN4IV, 502-651-2363. E-Mail: lbrumett@glasgow-ky.com Web: http://www.geocities.com/CapitolHill/5421

MA - MARSHFIELD - Hamfest. Fairgrounds, Rt. 3A. Genesis ARS, Lou N1WNT, 781-837-6651. E-Mail: n1wnt@mediaone.net Web: http://home.ici.net/~marsfair/marsfair.html

ME - LINCOLN - Hamfest. Burr School. VE testing. Bagley ARC, Sylvia N1JNR, 207-732-5185.

MI - GRAND RAPIDS - Hamfest. Grand Rapids ARA, Ed Novakowski N8UXN, 616-458-9029. E-Mail: barbv@voyager.net Web: http://www.w8dc.org

MI - MT. CLEMENS - Hamfest. L'Anse Creuse ARC, John Slobodnik N8NXW, 810-791-4484 or 810-757-8192 Ext. 151, E-Mail: irish12@juno.com Betty McGinn N8SIH, 810-791-4484, E-Mail: boops@juno.com Web: http://www.flash.net/~lcarc/

NY - HAMBURG - Western NY ARRL Section Convention. Harold Smith K2HC, 716-424-7184 E-Mail: info@buffalohamfest.org Web: http://www.buffalohamfest.org

NY - MARGARETVILLE - Hamfest. Margaretville ARC, Harold Murken NQ2Y, 914-586-3893. E-Mail: bourke@catskill.net

PA - SCHNECKSVILLE - Hamfest. Fire Dept. on PA Rt. 309. Talk-in: 146.70 (PL 151.4)/R, 444.90 (PL 151.4)/R. DLARC, William Goodman K3ANS, 610-258-5063. E-Mail: aa3ix@arrl.net Web: http://www.kutztown.edu/faculty/chuk/dlarc/

RI - FORESTDALE - Flea Market and Auction. VFW, Rt. 146. Rhode Island Amateur FM Repeater Service, Rick Fairweather K1KYI, 401-725-7507. E-Mail: k1kyi@juno.com

TX - WEBSTER - Hamfest. Clear Lake ARC, Bob Biekert KA5GLX, 281-488-2913 E-Mail: ka5glx@clarc.org Web: http://www.clarc.org

SEPTEMBER 18-19

IL - PEORIA - Hamfest. Peoria Area ARC, Jim Williams N9HHU, 309-692-3378. Fax: 309-698-8643. E-Mail: jimeoc@worldnet.att.net or jimn9hhu@juno.com Web: http://www.w9uvi.org

TX - EL PASO - International Hamfiesta. Craig Lyles KC7UXM, 915-821-7501

VA - VIRGINIA BEACH - Hamfest and VA State ARRL Convention. Pavilion. Sat: 9am-5pm, Sun: 9am-4pm. Talk-in: 146.970. Manny Steiner K4DOR, 757-HAM-FEST. E-Mail: HAMFEST@EXIS.NET or Lewis B. Steingold W4BLO, 757-486-3800 Web: WWW.VAHAMFEST.COM

SEPTEMBER 19

CT - NEWTOWN - Hamfest. Edmond Town Hall, Rt. 6. 9am-2pm. Talk-in: 146.67. Candlewood ARA, Jeff Cantor WB3DLG, 203-798-6860. E-Mail: wb3dlg@earthlink.net Web: http://www.danbury.lib.ct.us/org/cara/

MA - CAMBRIDGE - Flea at MIT. Albany and Main Sts. 9am-2pm. Talk-in: 146.52 & 449.725/444.725 W1XM/R PL 114.8 (2A). Nick Altenbernd KA1MQX, 617-253-3776 (9-5). Web: http://web.mit.edu/w1mx/www/swapfest.html

MI - ADRIAN - Hamfest. Lenawee County Fairgrounds. VE Exams. Adrian ARC, Brian Sarkisian KG8CO, 517-265-1537. E-Mail: kg8co@lni.net Web: http://www.lni.net/~w8tqe

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

NY - BETHPAGE - Long Island Hamfair. Briarcliffe College, 1055 Stewart Ave. 8:30am-1pm. VE Exams. Talk-in: W2VL 146.85 repeater (136.5PL). Long Island Mobile ARC, Rich N2WJL, 516-520-9311. E-Mail: hamfest@limarc.org Web: http://www.limarc.org

OH - CINCINNATI - Hamfest. Kolping Center. 8am-4pm. Greater Cincinnati ARA, Jim Weaver K8JE, 513-825-2868. E-Mail: JimWeaver@aol.com Tom Denham K8VOE, 513-779-3951. E-Mail: tdenham@eos.net

PA - YORK - Hamfest. York County Area Vocational Technical School, Queen St. (Exit 6E off I-83). 8am-3pm. York Hamfest, 717-764-8193 (ph/fax). E-Mail: W3SST@juno.com Web: http://www.yorkhamfest.org

SEPTEMBER 24-25

MI - FLINT - State Convention. University of MI-Flint Riverfront Campus. Tuscola County ARA & Bay Area ARA, Val Rose N8EXV, 810-607-7732. E-Mail: n8exv@yahoo.com

SEPTEMBER 25

AL - MOBILE - Hamfest. Mobile ARC, Tommy Thompson KC4OLV, 334-653-9239 or 334-431-2019. E-Mail: kc4olv@zebra.net Web: http://www.angelfire.com/al/marc3/

FL - DAYTONA BEACH - Hamfest. Embry Riddle Aeronautical University Campus, Clyde Morris Blvd. 9am-5pm. ARRL Exams. Talk-in: 147.150 +600. DBARA, E-Mail: munseyj@mindspring.com Web: http://www.america.com/~dbara/ or http://www.db.erau.edu/campus/student/club/erara

NJ - MT. HOLLY - Hamfest. Mt. Holly Armory, Rt. 38. 7am-2pm. South Jersey Radio Assn. Joseph Cramer N2XYZ, 609-268-2135. E-Mail: n2xyz@sjra.org Web: http://www.sjra.org

NY - HORSEHEADS - Hamfest. Chemung County Fairgrounds. 6am-3pm. FCC Exams. Talk-in: 147.96/36, 444.20. ARAST, Dave Lewis, 607-589-7495. E-Mail: info@arast.org hamfest@arast.org or winterfest@arast.org

WA - WALLA WALLA - Hamfest. Walla Walla Valley ARC, Jack Babbitt, Sr. WA5ZAY, 509-525-7003. E-Mail: wa5zay@valint.net

SEPTEMBER 25-26

AK - ANCHORAGE - State Convention. Anchorage ARC, Rick Marvin KL7YF, 907-277-6741. E-Mail: rlment@alaska.net

IL - GRAYSLAKE - Radio Expo '99. Lake County Fairgrounds, Rts. 45 & 120. Sat: 8am-4pm, Sun: 8am-3pm. VEC Testing. Talk-in: 146.16/76 MHz (107.2 Hz PL). Chicago FM Club, Mike Brost WA9FTS, 708-457-0966 (Voice Mail/Fax). Web: http://www.chicagofmclub.org

NH - LANCASTER - Hamfest. Lancaster Fairgrounds, Rt. 3 North. 9am. VE Exams. Talk-in: 145.430 & 145.150 & 147.315. Moose Swappers, Russ Boyce N1YZE, 603-922-5514. E-Mail: cusvt@together.net

SEPTEMBER 26

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

CO - LONGMONT - Hamfest. Boulder ARC, Randy Cassingham K0RCC, 303-664-5366.

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
810-379-3333. 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.

KGP Productions
1-800-631-0062, 732-297-2526.
E-Mail: kgp@mail.com

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

Events CALENDAR

E-Mail: arcie@thisistrue.com
Web: http://www.thisistrue.com/barc.html
FL - NEW PORT RICHEY - Hamfest. Recreational Center. 9am-3:30pm. Talk-in: 145.35 & 147.15. SARC, Mike Whitmore WB8ONY, 727-934-0228
MA - FRAMINGHAM - Hamfest. High School. FARA, Bev N1LOO, 508-626-2012
MD - BOWIE - FARFEST '99. Prince George's Stadium, Rt. 301, 1/4 mi S of Rt. 50. 6am (tailgate). VE Exams. Talk-in: 147.075 & 146.52. Foundation for Amateur Radio, Al Brown KZ3AB, 301-490-3188, Mary Morris N4TCI, 703-971-3905. E-Mail: Al Brown@ix.netcom.com
E-Mail: amateur radio@hotmail.com
Web: http://www.amateurradio-far.org
NC - BUTNER - Hamfest. Falls Lake ARC, Wiley Ayscue N4NCK, E-Mail: n4nck@bellsouth.net http://www.angelfire.com/nc/n4nck/flarc.html
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
OH - BEREA - Hamfest. Cuyahoga County Fairgrounds. 8am-2pm. VE Exams. Talk-in: 146.73- PL110.9. Hamfest Assn. of Cleveland, Ron Nichols N8LZA, 1-800-CLE-FEST or 216-999-7388. E-Mail: info@hac.org
Web: http://www.hac.org

OCTOBER 1999

OCTOBER 1

WI - RACINE - Auction. Racine Megacycle Club, Dennis Doonan W9DAD, 414-552-6RMC.
E-Mail: w9dad@arrl.net
Web: http://www2.wi.net/~hamradio/auction.html

OCTOBER 1-2

AR - SPRINGDALE - Hamfest. Northwest AR ARC, Clarence Morrow KC5UEW, 501-631-9231

OCTOBER 1-2-3

CA - LONG BEACH - ARRL Southwestern Division Convention. Nate Brightman K6OSC, 562-427-5123.

OCTOBER 2

AK - FAIRBANKS - Hamfest. Arctic ARC, Fred Brown KL7CUS, 907-452-3452. E-Mail: fbrown@mosquitonet.com. Jim Movius KL7EGO, 907-452-6347. E-Mail: ajmovius@gci.net
Web: http://www.aarc.uaf.edu
CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
FL - MAITLAND - Hamfest. Bahia Shrine AR Unit, Cecil Morehouse K4KEN, 407-281-9169
MO - WARRENSBURG - Hamfest. Warrensburg Area ARC, Keith Haye WE0G, 816-697-3426. E-Mail: we0g@microlink.net
NJ - LEONARDO - Hamfest '99. Croydon Hall, Leonardville Rd. east of Hosford Ave. 8am. VE Exams. Talk-in: 145.485 (-). Middletown Township OEM & Garden State ARA, Mario Sellitti N2PVP, 732-787-7184. E-Mail: gsara@monmouth.com
Web: http://www.monmouth.com/~gsara
NY - SYRACUSE - Hamfest. Pompey Hills Fire Dept., off Rt. 20. 8am-2pm. Talk-in: 147.90/30. RAGS, Vivian Douglas WA2PUU, 315-469-0590. E-Mail: ragsonline@hotmail.com
Web: www.pagesz.net/~rags
PA - LEWISBURG - Computer, Amateur Radio & Electronics Show & Flea Market. Silver Moon Antique & Flea Market Show Area. Rt. 15, 2.3 mi N of Rt. 45. 9am-4pm. Talk-in: 147.270 Repeater & 146.52 simplex. Susquehanna Valley ARC, George Machesic 570-286-2086. E-Mail: gpmac@netscape.net, Dave Welker k3si@hotmail.com Web: http://loveland.dynip.com/svarc
SC - ROCK HILL - Hamfest. York County ARS, Haney Howell K2XN, 803-323-4534.
Web: http://www.ycars.org
TX - BELTON - Hamfest. Bell County Expo Center. Temple ARC, Mike LeFan WA5EQQ, 254-773-3590. E-Mail: hamexpo@tarc.org
Web: www.tarc.org

OCTOBER 3

IA - WEST LIBERTY - Hamfest. Iowa City & Muscatine ARCs, Bruce Dagel WB0GAG, E-Mail: wb0gag@excite.com Web: http://www.netins.net/showcase/mrc/pictures/hamfl.jp
NY - QUEENS - Hamfest. Hall of Science parking lot, Flushing Meadow Park Corona, 47-01 111th St. 9am-3pm. Talk-in: 444.200 repeat, PL 136.5, 146.52 simplex. Hall of Science ARC, Stephen Greenbaum WB2KDG, 718-898-5599.
E-Mail: WB2KDG@Bigfoot.com
PA - WRIGHTSTOWN - Hamfest. Middletown Grange Fairgrounds, Penns Park Rd. Talk-in: 146.52 simplex. Mt. Airy VHF RC, Mark Schreiner NK8Q, 610-847-2285, E-Mail: nk8q@amsat.org. Bob Minch N3XEM, 215-822-0779,
E-Mail: raminch@bellatlantic.net
Web: http://www.ij.net/packrats/l

OCTOBER 8-9

FL - STARKE - Hamfest. Bradford County Fairgrounds, US 301 N. Fri: 2pm-8pm, Sat: 8am-4pm. Talk-in: 145.150-. Bradford Area ARC, Walt Terrell 904-755-4964 or Tony Spatafore 904-964-9328. E-Mail: wb2fgl@techcomm.net
Web: www.angelfire.com/fl/arcba/index.html
NH - ROCHESTER - Hamfest. Fairgrounds. Hoss Traders, Joe Demaso K1RQG, 207-469-3492.
E-Mail: k1rqg@aol.com
Web: http://www.qsl.net/k1rqg/

OCTOBER 8-9-10

CA - BAKERSFIELD - Hamfest. Bakersfield ARA, Robert Gerner Jr. KB6JFL, 661-588-7065.
E-Mail: w6bar@hotmail.com Web: http://members.tripod.com/~w6bar/bara.html

OCTOBER 8-9-10-11

CA - SAN DIEGO - 17th Space Symposium & AMSAT-NA Meeting. Duane Naugle KO6BT, 619-273-4088. E-Mail: ko6bt@amsat.org
Web: http://www.amsat.org

OCTOBER 9

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves
GA - AUGUSTA - Hamfest. ARC of Augusta, Terry Brown KE4MHN, 706-796-1128. E-Mail: cookie4u@cheerful.com Henry Arostegui KN4AV, 706-793-1625, E-Mail: kn4av@bellsouth.net Web: http://www.gabn.net/kd4ahqweather/arca.html
WA - BREMERTON - Hamfest. President's Hall, Kitsap County Fairgrounds. License Exams 10am. Talk-in: WW7RA repeater 146.620-, tone 103.5, simplex 146.520. North Kitsap ARC, Marcie Stilwell, 360-697-2797. E-Mail: nkarc@yahoo.com
Web: http://www.silverlink.net/nkarc

OCTOBER 9-10

FL - TAMPA - Hamfest. 4050 Dana Shore Dr. Sat & Sun 9am-3pm. Egypt Temple ARA, George Dixon 813-933-4350; Len Smith 813-684-4408; Larry Padgett 813-948-6500, E-Mail: kf4iti@ij.net
TN - MEMPHIS - Memfest '99.

OCTOBER 10

CT - WALLINGFORD - Connecticut State ARRL Convention. Mountainside Special Event Facility, High Hill Rd. 9am-3pm. Nutmeg CT Conv.

Events CALENDAR

Nutmeg Hamfest Alliance, Gordon Barker K1BIY, 860-342-3258 E-Mail: k1biy@juno.com. E-Mail: nutmeghamfest@qsl.net Web: http://www.qsl.net/nutmeghamfest

MD - WEST FRIENDSHIP - CARA Hamfest. Howard County Fairgrounds, S of I-70, E of Rt. 32. 8am-3:30pm. VE Exams. Talk-in: 147.135 (-) repeater, 146.52 simplex. CARA, 410-796-2587. Web: http://www.ocbs-nt-server.umaryland.edu/cara/hamfest.htm

MI - MASON - Hamfest. Ingham County Fairgrounds. 8am-2pm. Talk-in: 145.390-. Central MI ARC & Lansing Civil Defense Repeater Assn., Don Tillitson WB8NUS, 517-321-2004. Web: http://www.qsl.net/cmarc/hamfair-html

NC - MAYSVILLE - Hamfest. Jo Ann Taylor WD4JYR, 252-393-2120

OH - LIMA - Hamfest. Northwest OH ARC, Greg Schwark N8WBD, 419-647-6321. E-Mail: gas1950@aol.com

OCTOBER 15-16

MS - BILOXI - Hamfest. MS Coast ARA, Wayne Miller KB5AAU, 228-539-9929. E-Mail: kb5aau@worldnet.att.net Web: http://www.ametro.net/mcara

OCTOBER 15-17

CA - CONCORD - Pacific Div. Convention. Mt. Diablo ARC, Dick Brown KT6X, 925-676-9048. E-Mail: paccon99@pacbell.net

OCTOBER 16

AZ - TUCSON - Hamfest. OPRC/ARCA, Glenn Henderson WA7OBG, 520-749-5478. E-Mail: linus@primenet.com

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

IL - GODFREY - Hamfest. Community College, River Bend Arena. VE testing. Talk-in: 145.230, 442.225. Lewis & Clark RC, Harold Elmore N9HE, 618-466-1909. E-Mail: n9whh@ezl.com Web: http://www.ezl.com/~lmiller/lcrc.html

MT - BOZEMAN - Hamfest. Gallatin Ham Radio Club, Laura Marino Lubner KJ7UN, 406-586-6659. E-Mail: ghrc@bigfoot.com Web: http://ghrc.webjump.com

TN - GRAY - Hamfest. Appalachian Fairgrounds, off I-181. Kingsport, Bristol, and Johnson City Radio Clubs, POB 3682 CRS, Johnson City, TN 37602

TX - DENTON - Hamfest. Denton County ARA, Don Mathis KB5YAM, 972-292-1203. E-Mail: dmathis@lsic.net. Web: http://lsic.net/dhf

OCTOBER 16-17

FL - PALM BEACH GARDENS - Hamfest. AMARA Shrine Temple, 3650 RCA Blvd. Sat: 9am-4pm, Sun: 9am-2pm. Talk-in: 147.165/147.765. Palm Beach Repeater Assn., Ken Summerell KD4CTG, 561-640-9447. E-Mail: sum@flinet.com

OCTOBER 17

MA - CAMBRIDGE - Flea at MIT. Albany and Main Sts. 9am-2pm. Talk-in: 146.52 & 449.725/444.725 W1XM/R PL 114.8 (2A). Nick Altenbernd KA1MQX, 617-253-3776 (9-5). Web: http://web.mit.edu/w1mx/www/swapfest.html

MI - KALAMAZOO - Hamfest. County Fairgrounds. Talk-in: 147.040 K8KZO. Kalamazoo ARC & SW MI AR Team, Charles Burgstahler KA8BLO, E-Mail: ka8blo@net-link.net Web: http://www.qsl.net/ka8blo/hamfest.html

OH - ASHLAND - Hamfest. County Fairgrounds, Claremont Ave. 8am-2pm. Talk-in: 147.105+, 71.9PL. Ashland Area ARC, David Fike N8UCA, 419-289-1082, daytime. Mike Stroub KC8LCH, 419-945-2777, nighttime. E-Mail: aaarc@hotmail.com

PA - SELLERSVILLE - Hamfest. NEW Sellersville Fire House, Main St. Bethlehem Pike. 7am-1pm. VE Exams. Talk-in: 145.31 (144.71 input) W3AI repeater. R. F. Hill ARC, Linda Erdman KA3TJZ, 215-679-5764. Web: http://www.rfhill.ampr.org

WA - CHEHALIS - Hamfest. The Southwest Washington Fairgrounds. Talk-in: 147.06+ 110.9 pl, simplex 146.46. Chehalis Valley ARS, Jim Kruger KK7AB, 360-748-1930; KK7AB@ARRL.net or Bill Harwell KC7QHJ, 360-748-8086. E-Mail: bharwell@localaccess.com Web: http://www2.localaccess.com/teaser/cvars/

OCTOBER 23

LA - LAKE CHARLES - Hamfest. Southwest LA ARC, Dick Rogers WB5TUG, 318-474-7947. E-Mail: hotred@linknet.net

NH - NASHUA - Hamfest. Res Ctr Church, Antique RC, 617-923-2665

OK - ALTUS - Hamfest. Altus Area ARA, Mike Schenkel W5VXU, 580-846-5578. E-Mail: w5vxu@juno.com

OR - RICKREALL - Swap-Toberfest. Polk County Fairgrounds. 9am-3:30pm. Talk-in: 146.86-. Mid-Valley ARES, Bob Boswell, W7LOU 503-623-2513, E-Mail: w7lou@goldcom.com Web: http://www.teleport.com/~n7ifj/swaptobe.htm

TN - CHATTANOOGA - Hamfest. C. Jordan in E. Ridge. Chattanooga ARC, David Hoffman KE4FGW, 423-877-7398. E-Mail: w4am@qsl.net Web: http://www.qsl.net/w4am

OCTOBER 24

IN - LEBANON - Hamfest. Boone County Fairgrounds. 8am-1pm. VE testing. Boone & Clinton County ARC, Sara Lecklitner KB9OEZ, 765-482-9152

MD - WESTMINSTER - Mason-Dixon Computer & Hamfest. Carroll County Ag Center. 8am. VE Exams. Talk-in: 145.410 CCARC Repeater. Carroll County ARC, Wayne Wilson N3UN, 410-795-2556 (ph/fax). E-Mail: k3pzn@qis.net. Web: http://www.qis-net/~k3pzn

MI - WARREN - Hamfest. Utica Shelby Emergency Comm. Assn. Debbi Cokewell KB8YYB, 810-263-0227. E-Mail: cuer@juno.com Web: http://www.useca.org

NY - LINDENHURST - Hamfest. Great South Bay ARC, Tom Carrubba KA2D, 516-422-9594. E-Mail: info@gsbarc.org Web: http://www.gsbarc.org

PA - GREENSBURG - Hamfest. 8am-2pm. Talk-in: 147.180+. Foothills ARC, Jim Yex WB3CQA, 724-864-6228. E-Mail: jpyex@sgi.net Web: http://www.geocities.com/Heartland/Acres/7896/

OCTOBER 29-30

FL - JACKSONVILLE - Greater Jacksonville Amateur Radio & Computer Show. Morocco Shrine Auditorium, 3800 South St., Johns Bluff Rd. Fri: 1-8pm, Sat: 9am-5pm. VE Exams. Greater Jacksonville Hamfest, Woody Parker KF4GSK, 904-743-3121. E-Mail: sbarber@mediaone.net. Web: http://www.ccse.net/~lrich/hamfest98.htm

OK - KINGSTON - Hamfest. Texoma Hamarama, Herb Sleeper WB5PHM, 940-855-5820. E-Mail: retmarine@cst.net Web: http://www.qsl.net/kc5sig/hamarama

OCTOBER 30

MN - ST. PAUL - Hamfest. The New RiverCentre. 8am-4pm. VE Exams. Twin City FM Club, Dale Reak KB0VCV, 612-687-9535. Web: http://www.hamfestmn.org

OCTOBER 31

IA - DES MOINES - Hamfest. Tikva Tracer ARC, Randall Lees N0LMS, 515-279-4241. E-Mail: hamfestiowa@juno.com Web: http://www.bestofiowa.com/hamfestiowa/

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DEALER DIRECTORY

The dealers listed below carry the latest issue of Nuts & Volts, for your convenience.

ALABAMA

Little Professor Book Center
2717 S. 18th St.
Birmingham 35209

RT Systems

Amateur Radio Supply
8207 Stephanie Dr.
Huntsville 35802

ARIZONA

Batteries Plus #330
3014 N. Dobson
Chandler 85224

Batteries Plus #334
1155 S. Power Rd. #108
Mesa 85206

Batteries Plus #331
2404 E. Bell Rd.
Phoenix 85032

Batteries Plus #332
3415 W. Glendale Ave. Ste. 4
Phoenix 85051

Batteries Plus #333
1829 E. Southern Ave.
Tempe 85282

Elliott Electronic Supply
1251 S. Tyndall Ave.
Tucson 85713

Power Quality, Inc.
642 E. 39th Pl. Ste. 5
Yuma 85365

Tower Records
3 E. 9th St.
Tempe 85281

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P.O. Box 595
29 Ellesmere Cres.
Tullamarine 3043
www.dontronics.com

CALIFORNIA

Abletronics
9155 Archibald Ave. Unit E
Cucamonga 91730

Advanced Computer Products, Inc.
1310 "B" E. Edinger Ave.
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

Centerfold International
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Los Angeles 90046

Del Amo Books & News
3758 Sepulveda Blvd.
Torrance 90505

Electro Mavin
2985 E. Harcourt St.
Rancho Dominguez 90221

Ford Electronics
8431 Commonwealth Ave.
Buena Park 90621

Harding Way News
113 W. Harding Way
Stockton 95204

Harold's Newsstand
524 Geary St.
San Francisco 94102

Hi-Fi Doctor
1814 E. Ball Rd.
Anaheim 92805

HSC Electronic Supply
4837 Amber Ln.
Sacramento 95841

3500 Ryder St.
Santa Clara 95051

5681 Redwood Dr.
Rohnert Park 94928

Hyatt Electronic Surplus
371 N. Johnson Ave.
El Cajon 92020

JK Electronics
6395 Westminster Ave.
Westminster 92683

Laurel Park News
4346 Laurel Canyon Blvd.
Studio City 91604

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7207 Arlington Ave. Ste. G
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Los Angeles 90038

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8761 Van Nuys Blvd.
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Sandy's Electronics Supply, Inc.
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Santa Clarita 91351

Sav-On Electronics
13225 Harbor Blvd.
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Sierra Madre Newsstand
55 N. Baldwin Ave.
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The Red Barn
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Emeryville 94608

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2280 Market St.
San Francisco 94114

3205 20th Ave.
San Francisco 94132

2525 Jones St.
San Francisco 94133

871 Blossom Hill Rd.
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Video Electronics
3829 University Ave.
San Diego 92105

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Vancouver, BC V5X 3E3

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Denver 80206

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Purchase Radio Supply, Inc.
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Ann Arbor 48104

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Las Vegas 89106

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VSTG-22
North Las Vegas 89030

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Boulder City 89005

Tower Records/Video
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Las Vegas 89102

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Brentwood 11717

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Poughkeepsie 12601

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Carle Place 11514

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New York 10023

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Mentor 44060

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Toledo 43613

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Tulsa 74114

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Oklahoma City 73102

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Medford 97501

News & Smokes #8
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Medford 97501

Norvac Electronics
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Beaverton 97005

960 Conger
Eugene 97402

1545 N. Commercial N.E.
Salem 97303

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Portland 97209

Tower Books
1307 N.E. 102nd Ave.
Portland 97220

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308 Bedford St.
Johnstown 15901

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King of Prussia Plaza
King of Prussia 19406

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Red Lion 17356

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Philadelphia 19147

Tower Records
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King of Prussia 19406

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Nashville 37203

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BDL News, Inc.
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Electronic Parts Outlet
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Houston 77063

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Carrollton 75006

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Austin 78705

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Richmond 23220

Tower Records/Video/Books
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Richmond 23230

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A-B-C Communications, Inc.
17541 15th Ave. N.E.
Seattle 98155

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214 2nd St.
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3304 W. Rowan Ave.
Spokane 99205

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10635 N.E. 8th St.
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Seattle 98109

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Milwaukee 53223

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99K002 $49.00

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98Z011 3 for $10.00

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.002uF 36kV high current pulse capacitor. It has 3/8" x 2" flat strap leads. 2 3/4" W x 1 3/4" L x 8/10" T.

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RC3120B - 3.25"H x 16.75"W x 9.5"D $46.00

RC3120C - 3.25"H x 16.75"W x 13"D $53.00

RC3120D - 5"H x 16.75"W x 13"D $58.00

RC3120E - 5"H x 16.75"W x 16.75"D $63.00

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NEC AMPLIFIED SPEAKERS

Use to amplify output of tape or portable radio, or as multimedia speakers. Excellent sound quality for their size. Approx. 30 watts, line out for recording, and earphone jacks. Simple schematics to build your own power supply included. ±15VDC @ 1A. Approximate size: 11"H x 5"W x 5"D.

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Pair of amplified NEC speakers, factory power supply, and cables.

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ROTARY COAXIAL CABLE STRIPPER

For RG-58, RG-59, RG-62 type cables.

97Z025 $9.95 each

L297 BIPOLAR DRIVER CONTROLLER

Controller chip for bipolar stepper motors. These are solder pulls with trimmed leads. They have tested good.

99S002 $3.95 each

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Drives a bipolar stepper motor. They are solder pulls with trimmed leads. These ICs have tested good.

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Comes wth a 25MHz 486-SX CPU. Board supports SX25, SX33, DX25, DX33, DX40, DX50, DX2-50, DX2-66, DX2-80. All info silkscreened on board. Seven ISA slots and 2 VESA local buss extensions. Used, tested good. While supplies last...

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PELTIER JUNCTION

1-3/16" sq. x 1/16" copper plate soldered to opposite side of module that is soldered to 2" x 3" x 1/2" heatsink.

Nominal Voltage: 12V @ 0.72A. Use to cool Pentium CPUs or devise your own applications. Units may be paralleled for increased capacity. Voltage is reversible and this device can be used to either heat or cool.

98U001 $19.95 each

24V DIAPHRAGM AIR PUMP

24VDC @ 400mA (max.), Free air 0.3 CFM. Max. pressure approx. 11 lbs. Max. vacuum approx. 20"Hg. Dimensions 4"W x 4½"L x 3½"L.

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LIQUID CRYSTAL SHUTTER/VARIABLE DENSITY FILTER

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

92L012 Only $9.95 each

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T 1 3/4 package, waterclear, 8000mcd.

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14-DAY PROGRAMMABLE TIMER

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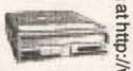

REMOVABLE HARD DRIVE

Syquest SO555 44MB removable SCSI cartridge hard drive. (Removed during upgrade)

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Stand for pencil type irons. All metal construction. It is easy to assemble.

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ALPHA SOLDER

1lb spool of .036 diameter, 60/40 rosin core solder.

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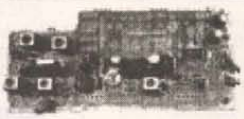

6 METER FSK RECEIVER

Crystal controlled on 50.675 receive frequency. Superhet with 10.7MHz IF. Three ICs and one transistor. Not a kit! New, with schematics and spec sheet for major components.

92A067 $9.95 each

BOOM MIKE

Electret condenser type. This versatile microphone may be wired for handy-talkie, sound card, telephone, base station, aircraft radio, CB radio, motorcycle intercom, etc. An earphone or miniature speaker may be installed in either or both muffs. The microphone unit can be easily removed and installed on another headset or helmet.

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"Semiuniversal" RCA 39-BUTTON REMOTE CONTROL

"Semi-universal" unit works on several products and brands. Just press desired function button and enter the 3-digit code provided. Requires four AAA batteries (not included). Unused.

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A random selection of wall power supplies with assorted voltages and current ratings.

94E004 10 for $14.95

2 CHANNEL UHF SWITCH KIT

Uses two button keyring UHF transmitter to toggle two relays on/off on a receiver PCB up to 40 meters away. 300MHz to 375MHz transmission frequency set by trimcap.

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STEPPER MOTOR

400 step/rev. (0.9°/step). NEMA 17 size, 2.5 cm deep, ball bearing, 5mm dia. shaft front and rear. Front shaft has a sleeve pinned to it to make it 7mm dia. by 1.5cm long. Bipolar 70 Ohm coils. Menebea (Japan) P/N 16PY-Q203-01.

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BIPOLAR STEPPER MOTOR DRIVER IC

600mA output current capability per channel. 1.2A peak output current (non-repetitive) per channel. Enable facility. Temperature protection. Logical "0" input voltage up to 1.5V (high noise immunity). Internal clamp diodes. With documentation.

L293D $3.00 each

by Richard Panosh

Put the Operation back in Op-Amps

Almost every project today uses an op-amp to amplify analog signals.

The reasons are multiple, as they can perform as gain blocks, they are economical, they have a small package outline, and provide excellent performance. Some manufacturers even supply the op-amp with internal resistors to establish the fixed gains without the external components and lost real-estate.

Today, most op-amps are also frequency compensated to provide stable unity gain and even drive capacitive loads without going into oscillation.

The term op-amp, however, refers to ***Operational*** amplifiers that were originally designed to perform mathematical operations in analog computers. They can do more then just amplify.

Op-amp circuits routinely employ negative feedback to achieve their performance, and positive feedback is avoided unless one wants to build an oscillator. Generally, the difference between negative feedback and positive feedback is understood as the difference between stability and instability.

There is, however, a large range within these limits. In fact, the designer of op-amp circuits quite often intends to employ negative feedback, and the circuit oscillates. Then the circuit stability must be analyzed and the feedback properly compensated to produce unconditional stability. The compensation is used to alter the phase of the feedback signal as a function of frequency to maintain stability. It is, of course, the phase of the feedback that is referred to as positive or negative.

Circuits can be designed either intentionally or inadvertently that exhibit marginal stability that will ring on the edges of high frequency pulses or go entirely into oscillation.

The condition necessary for stability is simply that the total phase shift through the amplifier and feedback network must never reach 360° for any frequency where the gain of the amplifier and feedback network is greater than one. Since the inverting terminal of the op-amp produces 180°, the feedback network must provide less then 180° additional phase shift at a loop gain of one. In practice, the phase shift must remain less then 135° to maintain sufficient damping and avoid conditional stability. Nyquist and Bode diagrams are often used to determine the stability criteria and are discussed in most reference books.

The following collection of circuits employ negative feedback, as well as positive feedback to obtain useful parameters. They can be duplicated for testing by any means of construction such as wire wrap, perf-board, or solderless plug-in breadboards. The circuits were constructed with an FET op-amp (such as the TL082) and the component values listed. The power connections for the TL-082 are +15V on pin 8 and -15V on pin 4. The equivalent input circuit is also illustrated, as well as a typical load where applicable.

It should be noted that the Negative Immittance Converter (NIC) circuits utilize about 1K output impedance which limits the current drive and/or voltage swing. It is more difficult to illustrate the AC characteristics such as positive or negative capacitance, whereas the DC characteristics of negative resistance are more easily demonstrated.

Figure 1 illustrates the application of bootstrapping the input bias resistor to achieve high input resistance. A conventional high impedance non-inverting buffer amplifier requires an input resistor from the non-inverting input to ground to furnish a path for its bias currents. If this resistor is made very large, it will degrade performance by introducing large DC offsets due to the bias current.

On the other hand, if a lower value of bias resistance is used, the input impedance will suffer. An alternate design employs feedback so that the signal applied at each end of the input resistor is very nearly equal so that the resistance appears much larger. Without C_2, the input resistance is simply R_1+R_2.

With the addition of C_2, the input resistance becomes $R_1+R_2+(R_1R_2)/XC_2$. Input resistance in this circuit can approach over

The term op-amp, however, refers to ***Operational*** amplifiers that were originally designed to perform mathematical operations in analog computers. They can do more then just amplify.

1000 megohms. R_3 is made equal to R_1+R_2 to balance the voltage offsets produced by bias currents in the input terminals of the op-amp, since the bias currents tend to be similar at each input.

Figure 2 illustrates another non-inverting amplifier with the application of judicious positive feedback to cancel out the input capacitance. Such a circuit can be used to cancel the combined effects of transducer capacitance plus those from the shielded input cable.

A typical input circuit might use a piezoelectric transducer such as a sonar receiver. The transducer can be modeled as a high impedance source that is parallel with a large capacitance that limits the frequency response of the transducer. The non-inverting buffer will provide a high input impedance and the addition of negative capacitance at the input can reduce the effects of the internal transducer capacitance to widen the bandwidth. The value of C_1 should be less than (R_2/R_3)*C_S where C_S is the input source capacitance (the inequality is required to maintain some capacity to stabilize the circuit). It should be noted that the techniques of Figure 1 can also be combined with this circuit to increase the effective resistance of R_1.

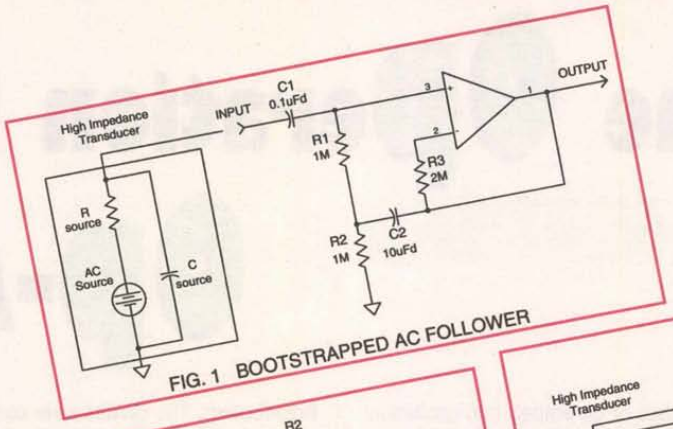

FIG. 1 BOOTSTRAPPED AC FOLLOWER

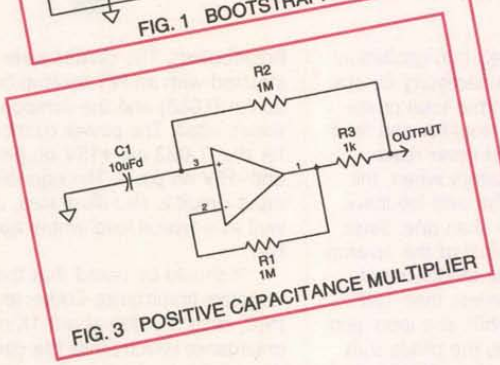

FIG. 3 POSITIVE CAPACITANCE MULTIPLIER

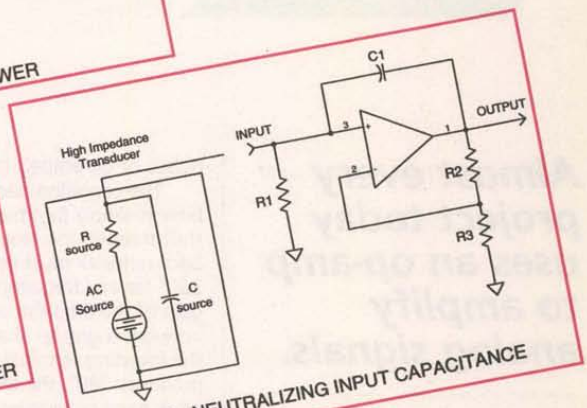

FIG. 2 NEUTRALIZING INPUT CAPACITANCE

Another useful circuit is the NIC. The NIC can be built in two flavors, namely the Current Negative Immittance Converter (INIC) and the Voltage Negative Immittance Converter (VNIC).

Figure 3 is a related non-inverting buffer that can be used to multiply the value of a capacitor. The effect of R_2 and C_2 is to form a low pass filter at the input of the non-inverting amplifier that is coupled back at its output through R_3. R_1 is equal to R_2+R_3 to reduce resultant bias current offsets. The effective capacitance is given as C_2*(R_2/R_3). R_3 is effectively the series resistance of the multiplied capacitance.

Another useful circuit is the NIC. The NIC is a two port device that has the properties that the impedance connected to one port is the negative at the opposite port. The NIC can be built in two flavors, namely the Current Negative Immittance Converter (INIC) and the Voltage Negative Immittance Converter (VNIC). The two port network of the INIC is illustrated in Figure 4A.

The INIC has equal port 1 and 2 voltages with the currents at port 1 and 2 inverted. The INIC can also be recognized as a current mirror with k = 1. When a resistor is connected to port 2, the defined current and voltage designations are constrained to E_2 = -I_2*Z_2. Substituting this expression into the input impedance that is defined as Z_1 = E_1/I_1, we find Z_1 = -Z_1/k. Thus, the input impedance is related to the negative of the output impedance.

The two port network of the VNIC is illustrated in Figure 4B where the voltages at port 1 and 2 are inverted while the currents at port 1 and 2 flow in the same direction. The current or voltage inversion, of course, can be used to transform positive impedances into negative values. In this case, the input impedance is found to be Z_1 = -k*Z_2.

Both the INIC and VNIC are often used in the construction of active filters, but should be recognized as devices that actually generate negative impedance, such as negative resistance, negative capacitance, or negative inductance. Of the two flavors, the INIC is more commonly employed as it is simpler to construct. Although the VNIC is seldom encountered, an example is given later.

Figure 5 illustrates the INIC, where the value of k = 1. In theory, the unity gain INIC will give the same results even if the two ports are reversed. In practice, this is not the case, and stability requirements do not permit the ports to be interchanged.

For stability, the requirement is that $V_1 \geq V_2$. The input port 1 is customarily referred to as the open-circuit-stable port (OCS) while the

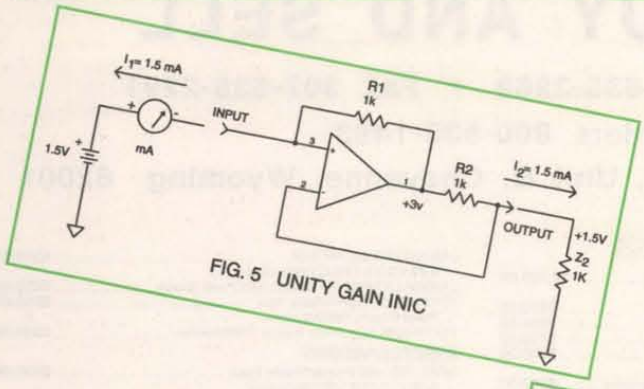

FIG. 5 UNITY GAIN INIC

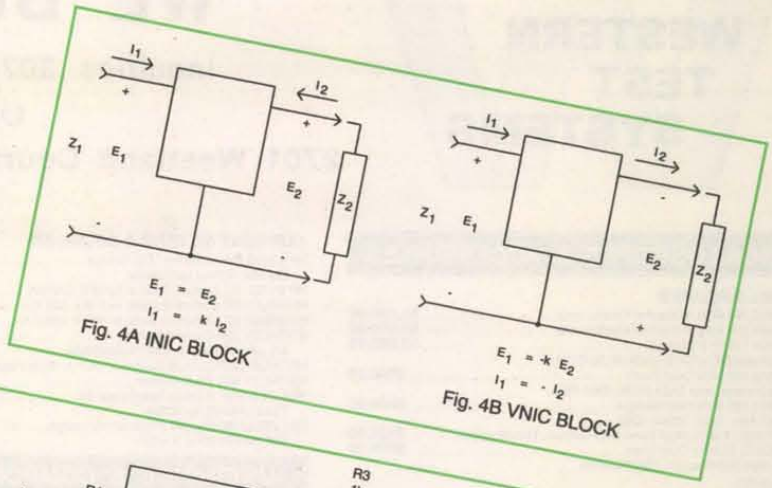

Fig. 4A INIC BLOCK

Fig. 4B VNIC BLOCK

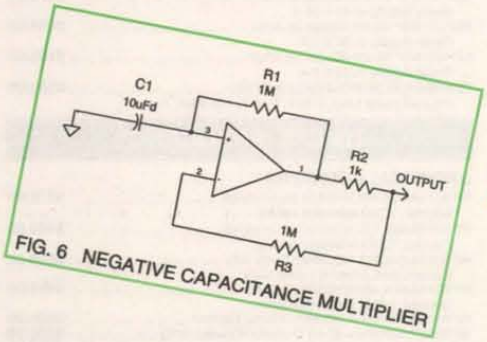

FIG. 6 NEGATIVE CAPACITANCE MULTIPLIER

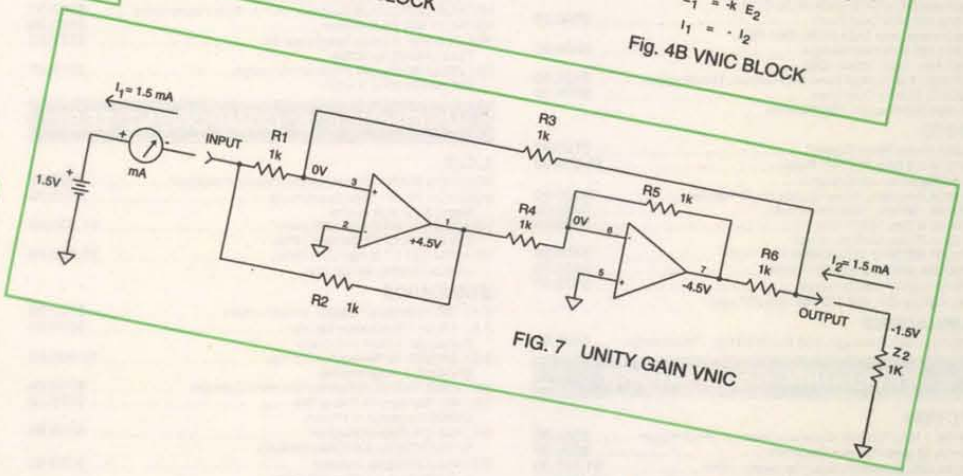

FIG. 7 UNITY GAIN VNIC

output port 2 is referred to as the short-circuit-stable port (SCS). The OCS and SCS port can be easily determined by placing two unequal value resistors on the input and output ports to determine stability. When the smaller value is placed on the SCS port, the op-amp will not reach saturation. Note that the effect of R_2 also gives the INIC a high output impedance that may be loaded by subsequent stages and require additional buffering.

In the example, the input impedance of the INIC is -1,000 ohms. If a +1.5V battery is applied to the input, the circuit will source about 1.5 mA to the battery. A battery is convenient to use in this case as it will maintain +1.5V while sinking current.

It is interesting to measure this effect and convince yourself that the circuit indeed sources current proportional to the applied voltage rather then sinking the current, since this phenomenon is contrary to our normal experiences.

Reversal of the battery will similarly reverse the current flow to maintain negative resistance. A unipolar power supply that can only source current should not be used as the current will continue to charge the output filter capacitor and the applied voltage will continue to ramp up.

Figure 6 illustrates an INIC used as a negative capacitance multiplier. The negative capacitance presented at the output terminal is given as -C1*(R1/R2), where R3 is again made approximately equal to R_1 to reduce the effects of bias currents.

Figure 7 illustrates a design of the VNIC that requires two op-amps. The summing point at the non-inverting input of the first stage is drawn correctly and is also a virtual ground. The voltages indicated make it easier to establish the direction of current flow and circuit operation.

These circuits employ both negative and positive feedback and require some thought, as well as circuit analysis. They can be quite intriguing to electronics students and occupy them for a long time. They can also provide a lot of fun on a rainy day. NV

The OCS and SCS port can be easily determined by placing two unequal value resistors on the input and output ports to determine stability.

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CALIBRATIONS

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- KEITHLEY 227 Current Source, 1 uA-1 A, 0-50 V compliance $800.00
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- HP 5385A-004 1 GHz Frequency Counter, HPIB; OCXO ref. osc. option $800.00

STANDARDS

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- HP 5087A-opt.032 Distribution Amplifier, 12 outputs at 5 MHz $1,750.00

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DISTORTION ANALYZERS

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- TEK DA4084 Programmable Distortion Analyzer $750.00

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MISCELLANEOUS

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- KROHN-HITE 3342R Dual HP/LP Filter, 0.001 Hz-99.9 kHz, 48 dB/octave $900.00

KROHN-HITE 3750 LP/HP/BP/BR Filter, 0.02 Hz-20 kHz, 6/12/18/24 dB/oct. — $600.00
ROCKLAND 852 Dual Highpass/ Lowpass Filter, 0.1 Hz-111 kHz — $900.00
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HP 11970Q WR22 Harmonic Mixer, 33-50 GHz — $1,400.00
HP 11970U WR19 Harmonic Mixer, 40-60 GHz — $1,400.00
HP 70620B Preamplifier, 1.0-26.5 GHz, for 70000 series — $3,900.00
HP 8559A/853A-001 Spectrum An., 0.01-21 GHz, 1 kHz res.,w/rackmount frame — $3,750.00
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HP 85020A Directional Bridge, 10-4300 MHz, N(f) test port — $650.00
HP 85027C Directional Bridge, 0.01-18 GHz, N(f) test port — $1,750.00
HP 85044A Reflection/Transmission Test Set, 300 kHz-3 GHz — $1,500.00
HP 85054A Type N Calibration Kit, for HP 8510 series — $1,800.00
HP 8756A Scalar Network Analyzer — $2,500.00
HP R85026A WR28 Detector, 26.5-40 GHz, for HP 8757 series — $1,200.00
WILTRON 560-98KF50 SWR Autotester, 10 MHz-40 GHz, for Wiltron 560 series — $1,800.00

SIGNAL GENERATORS

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FLUKE 6060A/AN Synthesized Signal Gen.,10 kHz-520 MHz, 10 Hz res.,GPIB — $1,500.00
FLUKE 6060B/AK Synthesized Signal Gen., 0.1-1050 MHz, 10 Hz res. — $1,900.00
GIGATRONICS 1018 Synthesized Signal Gen., 50 MHz-18 GHz, 1 MHz res. — $4,500.00
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GIGATRONICS 900/2-8 Synthesized Signal/Sweep Gen., 2-8 GHz, 1 MHz res.,GPIB — $2,500.00
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HP 8656B-001 Synth. Signal Gen., 0.1-990 MHz, 10 Hz res., OCXO ref. — $2,500.00
HP 8657A-002 Signal Generator, 0.1-1040 MHz, 10 Hz res., HPIB — $3,250.00
HP 8660C/86602B-002 Synth. Sig. Gen., 1-1300 MHz, FM / Phase mod. w/86635A — $2,750.00
HP 8660C/86603A Synthesizer, 1-2600 MHz, AM / FM, w/86633B — $3,250.00
HP 8672A Synthesized Signal Generator, 2-18 GHz, +3 dBm output — $6,000.00
HP 8673D-H16 Synth.Signal Generator, 50 MHz-26 GHz, AM/FM — $18,500.00
HP 8673E Synthesized Signal Generator, 2-18 GHz, +8 dBm output — $9,500.00
HP 8673G-004,008 Synth. CW Signal Generator, 2-26 GHz, >+8 dBm output — $12,500.00
HP 8684B Signal Generator, 5.4-12.5 GHz, AM/ WBFM/ Pulse — $3,500.00

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HP 8350A/83545A-002 Sweep Oscillator, 5.9-12.4 GHz, 70 dB step attenuator — $4,000.00
HP 8601A Generator/Sweeper, 0.1-110 MHz, +20 dBm levelled — $400.00
HP 8620C Sweep Oscillator Frame — $550.00
HP 86222B-002 RF Plug-in, 10-2400 MHz, +13 dBm levelled, 70 dB atten. — $1,250.00
HP 86230B RF Plug-in, 1.8-4.2 GHz, +10 dBm unlevelled — $375.00
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, 5.9-9.0 GHz, +10 dBm levelled — $300.00
HP 86245A-001 RF Plug-in, 5.9-12.4 GHz, +17 dBm levelled — $600.00
HP 86250D RF Plug-in, 8.0-12.4 GHz, +10 dBm levelled — $500.00
HP 86260A RF Plug-in, 12.0-18.0 GHz, +10 dBm unlevelled — $500.00
HP 86260A-H04 RF Plug-in, 10.0-15.0 GHz, +10 dBm unlevelled — $500.00
HP 86290A-004 RF Plug-in, 2.0-18.0 GHz, +7 dBm levelled, rear output — $1,750.00
HP 86290B-004 RF Plug-in, 2.0-18.6 GHz, +10 dBm levelled, rear output — $1,850.00
WAVETEK 962 Sweep Generator, 1.0-4.0 GHz, markers, +12 dBm unlvld. — $1,250.00
WILTRON 6647M Sweep Generator, 10 MHz-20 GHz, +10 dBm levelled — $4,500.00

POWER METERS

ANRITSU MP-81B/ML-83A Power Meter, 75-110 GHz (WR10), -20 to +20 dBm — $2,500.00
BOONTON 42B/41-4E Analog Power Meter, with 1 MHz-18 GHz sensor — $450.00
HP 435B/8481A Power Meter, -30 to +20 dBm, 10 MHz-18 GHz — $900.00
HP 435B/8481B Power Meter, 0 to +43 dBm, 10 MHz-18 GHz — $1,500.00
HP 435B/8482H Power Meter, -10 to +34 dBm, 100 kHz-4.2 GHz — $900.00
HP 436A-022/8481A Power Meter, -30 to +20 dBm, 10 MHz-18 GHz, HPIB — $1,400.00
HP 8477A Power Meter Calibrator, for HP 432 series — $500.00
HP 8900D/84811A Digital Peak Power Meter, 10 MHz-18 GHz, 0- +20 dBm — $2,300.00
HP K486A WR42 Thermistor Mount, 18.0-26.5 GHz, for 432 series — $350.00
HP Q8486A Power Sensor, 33.0-50.0 GHz, WR22, for 435/6/7/8 — $1,500.00
HP R486A WR28 Thermistor Mount, 26.5-40 GHz, for 432 series — $350.00
HP R8486A WR28 Power Sensor, 26.5-40 GHz, for HP 435/6/7/8 — $1,500.00

RF MILLIVOLTMETERS

BOONTON 92B-opt.05 RF Millivoltmeter, 10 kHz-1.2 GHz, 75 Ohms scale — $500.00
RACAL 9303 TRMS Level Meter, 10 kHz-2 GHz, -77 to +23 dBm, GPIB — $875.00

AMPLIFIERS, MISCELLANEOUS

AMPLIFIER RES. 1W1000 Amplifier, 30 dB gain, 1-1000 MHz, 1 Watt output — $500.00
BOONTON 82AD-opt.01A Modulation Meter, AM, FM, 10-1200 MHz, GPIB — $750.00
ENI 1040L Amplifier, 55 dB gain, 10-500 kHz, 400 Watts — $2,750.00
HP 11729C-130,140 Carrier Noise Test Set, AM Noise & Rear Panel Inputs — $9,500.00
HP 415E SWR Meter — $200.00
HP 465A Amplifier, 20/40 dB, 5 Hz-1 MHz, 1/2 Watt/50 Ohms — $125.00
HP 8406A Comb Generator, 1/ 10/ 100 MHz increments, to 5 GHz — $500.00
HP 8447A Amplifier, 20 dB, 0.1-400 MHz, 5 dB NF, +6 dBm output — $375.00
HP 8447E Amplifier, 22 dB, 0.1-1300 MHz, +13 dBm output — $750.00
HP 8447F-H64 Dual Amp., 25 dBG 0.1-1300 MHz & 28 dBG 9 kHz-50 MHz — $900.00
HP 8901A Modulation Analyzer, 150 kHz-1300 MHz — $2,500.00
HP 8901B-1,2,3 Modulation An., 0.15-1300 MHz, rear input, OCXO, ext.LO — $3,000.00
HP 8970A Noise Figure Meter — $4,000.00
ROHDE & SCHWARTZ ESH2 Test Receiver, 9 kHz-30 MHz — $5,000.00

COAXIAL & WAVEGUIDE

AMERICAN NUCLEONICS AM-432 Cavity Backed Spiral Antenna,LHC, 2-18 GHz,TNC(f) *NEW* — $95.00
AVANTEK AMT-400X2 WR28 Active Doubler, 13-20 GHz +10 dBm in, +10 dBm out — $450.00
BAYTRON 3-28-300/10 WR28 Directional Coupler, 10 dB, 26.5-40 GHz — $300.00
BIRD 4410A/4410-3 Wattmeter, 2-30 MHz, 10 W - 1 kW f.s., N(f/f) — $400.00
BIRD 6735-300 1 kW Load, 25-1000 MHz, LC(f), with wattmeter — $650.00
BIRD 8201 500 Watt Oil Cooled Load, DC-2.5 GHz, N(f) — $350.00
CONTINENTAL MW. RAE28-K-M WR28 x K(m) Endfire Adapter — $225.00
FXR/MICROLAB S3-02N Triple Stub Tuner, 200-1000 MHz, 100 Watts max., N(m/f) — $125.00
FXR/MICROLAB SL-03N Stub Tuner,) 0.3-6.0 GHz, 100 Watts max., N(m/f — $75.00
GR 874-LTL Constant Impedance Trombone Line, 0-44 cm, DC-2 GHz — $400.00
HP 11590A-001 Bias Network, 1.0-18.0 GHz, APC7 — $450.00
HP 11636A 2-Way Power Divider, DC-18 GHz, N(m/f/f) — $300.00
HP 11692D Dual Directional Coupler, 22 dB, 2-18 GHz — $800.00
HP 33321K Programmable Step Atten., 0-70 dB, DC-26.5 GHz, 3.5mm — $475.00
HP 33327L-006 Programmable Step Attenuator, 0-70 dB, DC-40 GHz, 2.9mm — $1,000.00
HP 774D Dual Directional Coupler, 20 dB, 215-450 MHz — $275.00
HP 777D Dual Directional Coupler, 20 dB, 1.9-4.1 GHz — $275.00
HP 778D-011 Dual Dir. Coupler, 20 dB, 100-2000 MHz, APC7 test port — $450.00
HP 8431A 2-4 GHz Band Pass Filter, N(m/f) — $150.00
HP 8472A Crystal Detector, 10 MHz-18 GHz, negative polarity, SMA — $175.00
HP 8494G-002 Programmable Step Attenuator, 0-11 dB, DC-4 GHz, SMA — $350.00
HP 8495H-002 Programmable Step Attenuator, 0-70 dB, DC-18 GHz, SMA — $400.00
HP 8496A-002 Step Attenuator, 0-110 dB, DC-4 GHz, SMA — $375.00
HP 8497K-004 Programmable Step Attenuator, 0-90 dB, DC-26.5 GHz — $750.00
HP K382A WR42 Direct Reading Attenuator, 0-50 dB, 18-26.5 GHz — $2,900.00
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 Attenuator, 0-50 dB, 26.5-40 GHz — $2,000.00
HP R422A WR28 Crystal Detector, 26.5-40 GHz — $400.00
HP R532A WR28 Frequency Meter, 26.5-40 GHz — $500.00
HP R752C WR28 Directional Coupler, 10 dB, 26.5-40 GHz — $450.00
HP R752D WR28 Directional Coupler, 20 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 — $750.00
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 45714H-1000 WR15 Frequency Meter, 50-75 GHz — $900.00
HUGHES 45716H-1000 WR10 Frequency Meter, 75-110 GHz — $900.00
HUGHES 45721H-1000 WR28 Direct Reading Attenuator, 0-50 dB, 26.5-40 GHz — $900.00
HUGHES 45724H-1000 WR15 Direct Reading Attenuator, 0-50 dB, 50-75 GHz — $1,000.00
HUGHES 45732H-1200 WR22 Level Set Attenuator, 0-25 dB, 33-50 GHz — $250.00
HUGHES 45772H-1100 WR22 Thermistor Mount, -20 to +10 dBm, 33-50 GHz — $400.00
HUGHES 45773H-1100 WR19 Thermistor Mount, -20 to +10 dBm, 40-60 GHz — $650.00
HUGHES 45774H-1100 WR15 Thermistor Mount, -20 to +10 dBm, 50-75 GHz — $750.00
HUGHES 45775H-1100 WR12 Thermistor Mount, -20 to +10 dBm, 60-90 GHz — $800.00
HUGHES 45776H-1100 WR10 Thermistor Mount, -20 to +10 dBm, 75-110 GHz — $850.00
HUGHES 47316H-1111 WR10 Tuneable Detector, 75-110 GHz, positive polarity — $600.00
HUGHES 47741H-2310 WR28 Phase Locked Gunn Osc., 32.000 GHz, +18 dBm — $2,000.00
HUGHES 47742H-1210 WR22 Phase Locked Gunn Osc., 42.000 GHz, +18 dBm — $2,750.00
HUGHES 47974H-1000 WR15 SPST PIN Switch, 250 MHz speed, 60-62 GHz response — $375.00
KRYTAR 2616S Directional Detector, 1.7-26.5 GHz, K(f/m)/SMC — $200.00
M/A-COM 3-19-300/10 WR19 Directional Coupler, 10 dB, 40-60 GHz — $450.00
MICA C-121S06 Circulator, 17.5-24.5 GHz, SMA(f/m/m) — $75.00
MIDWEST MICROWAVE 3537 DC Block, 0.1-12.4 GHz, SMA(m/f) *NEW* — $40.00
MINI-CIRCUITS ZFDC-20-4 Directional Coupler, 19.5 dB, 1-1000 MHz, SMA(f) — $25.00
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 Power Load, 500 Watts, 2.0-18 GHz, N(m) — $500.00
NARDA 3752 Coaxial Phase Shifter, 0-180 deg./GHz, 1-5 GHz — $1,000.00
NARDA 3753B Coaxial Phase Shifter, 0-55 deg./GHz, 3.5-12.4 GHz — $1,000.00
NARDA 4000-SERIES SMA Miniature Directional Couplers — $75.00
NARDA 4226-10 Directional Coupler, 10 dB, 0.5-18.0 GHz, SMA(f) — $275.00
NARDA 4227-16 Directional Coupler, 16 dB, 1.7-26.5 GHz, 3.5mm(f) — $325.00
NARDA 4242-20 Directional Coupler, 20 dB, 0.5-2.0 GHz, SMA(f) — $100.00
NARDA 4247-20 Directional Coupler, 20 dB, 6.0-26.5 GHz, 3.5mm(f) — $200.00
NARDA 4247B-10 Directional Coupler, 10 dB, 6.0-26.5 GHz, 3.5mm(f) — $200.00
NARDA 5070-SERIES Precision Reflectometer Couplers — $300.00
NARDA 562 DC Block, 10 MHz-12.4 GHz, 100 V max., N(m/f) — $65.00
NARDA 765-10 10 dB Attenuator, 50 Watts, DC-5 GHz, N(m/f) — $165.00
NARDA 768-10,-20 10 dB or 20 dB Attenuator, 20 Watts, DC-11 GHz, N(m/f) — $120.00
NARDA 792FF Variable Attenuator, 0-20 dB, 2.0-12.4 GHz — $375.00
NARDA 794FM Direct Reading Variable Attenuator, 0-40 dB, 4-8 GHz — $375.00
OMNI-SPECTRA 2085-6010-00 Crystal Detector, 1-18 GHz, negative polarity, SMA(m/f) — $50.00
PAMTECH KYG1014 WR42 Junction Circulator, 18.0-26.5 GHz — $250.00
SONOMA SCIENTIFIC 21A3 WR42 Circulator, 20 dB, 20.6-24.8 GHz — $75.00
TRG B510 WR22 Direct Reading z Attenuator, 0-50 dB, 33-50 GH — $1,000.00
TRG B528 WR22 Direct Reading Phase Shifter, 0-360 deg.,33-50 GHz — $1,250.00
TRG V551 WR15 Frequency Meter, 50-75 GHz — $600.00
TRG W551 WR10 Frequency Meter, 75-110 GHz — $750.00
WAVELINE 100080 WR28 Terminated Crossguide Coupler, 30 dB — $200.00
WEINSCHEL DS109 Double Stub **Tuner, 1-13 GHz, N(m/f)** — $150.00
WEINSCHEL DS109LL Double Stub Tuner, 0.2-2.0 GHz, N(m/f) — $150.00
HP 3780A Pattern Generator / Error Detector, 1 kb/s - 50 Mb/s — $1,000.00

COMMUNICATIONS

HP 4935A-001 Transmission Test Set, 20 Hz-110 kHz, battery option — $700.00
HP 59401A HPIB Bus Analyzer — $400.00
TEK 1410R NTSC Gen., w/SPG2 sync. generator, TSG7 color bars — $800.00
TEK 1411R PAL Gen.,w/SPG12 sync;TSG11 color bars;TSG13 linearity — $750.00
TEK 1411R PAL Test Gen., w/SPG12,TSG11,TSG13,TSG15,TSG16 — $1,000.00
TEK 1411R PAL Test Gen., w/SPG12,TSG11,TSG12,TSG13,TSG15,TSG16 — $1,100.00
TEK 1411R-opt.04 PAL Test Gen., w/SPG12,TSG11,TSP11,TSG13,TSG15,TSG16 — $1,400.00
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

FLUKE 2180A RTD Digital Thermometer — $500.00
HP 7090A Measurement Plotting System — $1,500.00
KEITHLEY 705 / 2x7055 Scanner — $400.00
P.A.R. 5206-95,98 Two-Phase Lock-in Amp., 2 Hz-100 kHz, GPIB — $1,500.00
TEK TM5006 5000-series 6-slot Programmable Power Module — $600.00
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

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**

Where can I get HV supplies 0-60KV, 0-10mA variable? I need a source for used induction heaters, water cooled.

9991 **Anonymous**

I need information on IBM OS/1 server connections. What can be done with it?

9992 **S. Grimm**
New Bern, NC

Any suggestions on how to build a reasonably priced speech synthesis board for our BASIC II based robot? (It seems that the SP0256 chip is near extinct on the market right now.)

9993 **Jack Ivory**
New Hartford, NY

I have a very large and "used to be" useful engineering calculations program "ECALC" written in IBM BASICA. It will not run in Windows or even in DOS on the new Pentium processor computers.

The basic problem is that none of them will run IBM BASICA. Compiling isn't a good solution because the program chains to several sub programs to get around the 64K program size limit of BASICA. It also uses the differences in BASIC and BASICA so the BASICA is a must.

How can I get IBM BASICA to run on a Windows machine?

9994 **Harvey Cappel**
Bayou Vista, TX

Two years ago, I mounted an electrical window system to my car. The driver's window used to go automatically up or down — a complete course — at a single touch of the button. When the motor was blocked, it was turning itself off automatically, because of the increased current passing through the alimentation system.

Now, this system is broke. I have to keep pushing the button to completely open the window.

Here is my question: I want to make a simple circuit that would keep the motor running until the window opens completely, and then turn it off. Would it be a kind of short-circuit protection? It must not burn the motor!

9995 **Gil Stoian**
via Internet

I have a NEC model #DX-1000U VCR that has encountered a microprocessor failure. I have a complete service manual and have been able to determine some of the damage.

I am looking for a NEC part #PD7516HCW-2-82. The unit is well- built with features that are just not available today.

Can you direct me to someone who can supply me with old NEC parts?

9996 **Anthony Hanudel**
Williston, VT

Do you know of any services, accepted, hacker, or phreaker to remove the (Automatic Number Identification) ANI from calls to 800 or 900 numbers for home-originated telephone calls, functioning similarly to E-Mail's Anonymzer?

Probably the service would redial the calls and then patch them to the original caller. Consider both POTS and Internet phone calls.

Can you supply contacts or addresses?

9997 **Dave English**
via Internet

I am building a robotics platform using two stepper motors for locomotion.

Is there any formula for figuring how much weight a stepper motor can carry, and what about two together?

9998 **Tzvi Frankel**
via Internet

I always thought that the output impedance of an emitter follower was the resistance of the emitter resistor.

I recently built a class A, two-stage single ended emitter follower transistor amplifier to provide a low Z output. Measurements reveal a lot lower impedance than the 100-ohm load resistor would lead me to believe. Am I missing something?

9999 **John Nelson**
via Internet

Where can I get the plans to build a 6 VDC to 12 VDC converter?

I want to install a new radio into an old (1951) six-volt car.

99910 **Douglas Faubion**
New Palestine, IN

I am a university student currently doing a project involving the usage of MC68HC811E2FN52PLCC. I failed to locate the microcontroller in my country (Malaysia).

Can someone give me any guidance on how to get the MCU?

99911 **Jen Wen Chia**
via Internet

I bought a Toshiba T4600C notebook computer at a local hamfest. The power-on password has been set. I have tried disconnecting the CMOS battery (and the clock battery too, for good measure) and left them unhooked for days. The computer still wants a password when I power it up.

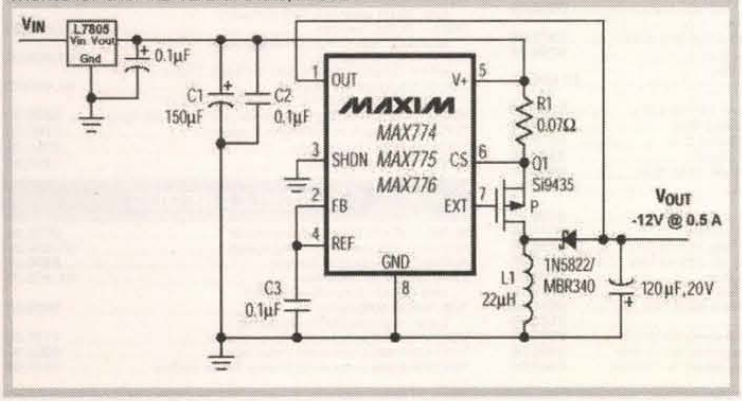
Toshiba said to send it back and

I have a project which requires +12 VDC, -12 VDC, and +5 VDC regulated from a car's cigarette lighter. I managed to find a schematic on the +12 VDC and +5 VDC (the 5 VDC being in the June '99 issue of *Nuts & Volts*), but I am having problems finding how to convert the +12 VDC to -12 VDC. The amperage requirements for the -12 VDC are low, I need 500 mA.

I do have one schematic for the -12 VDC, but I find it a little impractical. There has to be a much simpler way.

I attached the schematic I am talking about.

Vicken Mouradian
via Internet



ANSWER INFO

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

QUESTION INFO

TO BE CONSIDERED FOR PUBLICATION

All questions should relate to one or more of the following:
1) Circuit Design 3) Problem Solving
2) Electronic Theory 4) Other Similar Topics

INFORMATION/RESTRICTIONS

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

HELPFUL HINTS

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

they'll delete the password for a small fee.

99912 **Sam Roberts**
Kannapolis, NC

I am looking for a way to hook up my Apple Personal Laserwriter NT to my new IBM Clone PC running Windows 98. My Apple Laserwriter has a DIN connection on it.

99913 **Susan Mestres**
via Internet

I am looking for a way to keep my car engine at about 1,000 RPMs while I have my A/C on.

My car idles at about 1K RPMs in neutral and goes down to about 850 RPMs when in drive, at idle, and when I have the A/C on. Also, the RPMs drag even lower than I would like.

With the RPM being this low, it's hard on the engine, and the charging of the alternator stops (drops out) until the RPMs come back up. Usually, I put the car in neutral and give it a little gas to get the RPMs up, until the light changes to green, then it's back to drive again.

I need something like a governor to maintain the RPMs regardless of the load, until I press the gas myself, the governor should engage when my foot is off of the gas pedal, and disengage when I press the gas pedal.

My car is a 1977 Plymouth Fury station wagon (land yacht) with A/C. The engine is a 360CC two-barrel carb., eight cylinder.

Every year, I have to put up with a battery going dead because the alternator drops out at low RPMs and the car also overheats due to slow fan when the RPMs are low.

99914 **Ray Samples**
via Internet

I am looking to use a 556 timer IC and two or more bi-color LEDs in parallel (red, green, or yellow/green).

I tried to do this myself, but it just doesn't work right. I connected the outputs pin 9 and 5 to the LEDs, so that when the timing is right, one output will be low and the other will be high, and flip-flop back and forth (polarity switching) causing the LEDs to blink red and green.

I also want this circuit to start blinking red/green slowly and then get faster and faster until its polarity goes null (both outputs go either +,+ or -,- causing the LEDs to go out) then the cycle starts all over again. I have tried this and sometimes it works and somtimes it doesn't. It is unstable.

Can someone tell me how to do it correctly with a schematic?

99915 **Ray Samples**
via Internet

I need to locate a hard drive caddy (the frame/casing which the hard drives mounts in, and which has the connector which mates with the body of the computer) for a Dell Latitude 433MC laptop.

Dell no longer supports this model, and they were not able to suggest any third-party sources that sell this item.

Any suggestions on vendors that I might be able to purchase this from?

99916 **Mike Kluger**
via Internet

A friend of mine has a restored antique automobile with a six-volt electrical system. He would like a source of 12-volt power for a modern radio.

I have been following your switching power supply articles, but he needs a more robust current than your articles suggest.

I believe he needs approximately 5 amperes at 12 volts. Any supply will do, I just want to help him get some tunes.

99917 **Michael P. Koryciak**
Flint, MI

Where can I find a circuit layout to build my own garage door opener?

99918 **Dave Trefry**
via Internet

Where can I find the color controls for the Zenith D & Z lines? The manufacturer does not make them anymore.

99919 **John Brown**
via Internet

I am looking for a keyboard for an old EPSON ActionNote 500C. The plastic foil PCB has broken traces, so the enter key and couple of keys around it don't work.

I need this dinosaurus for work (modem compatibility reason). Epson doesn't carry old parts and authorized dealers can't get them either. I plugged in an external keyboard, but it's not portable PC anymore.

If someone has this notebook with a broken screen and good keyboard, I'm willing to buy it.

99920 **Dusan Benko**
Brooklyn, NY

I am looking for a circuit design for a ISO-9141-2 to RS-232 converter.

This converter will allow me to see the information coming out of the On Board Diagnostic II system found on all '96 and higher Chrysler and import vehicles.

I believe I can handle the software. Does anyone know of such a circuit?

99921 **Joe**
via Internet

I need a thermo switch normally open at 90%.

99922 **Millard Middleton**
via Internet

ANSWERS

ANSWER TO #89912 - AUG. 1999

Recently, the 1.35-volt KX-625 battery failed in my Olympus OM-1 camera.

Since mercury batteries are no longer commonly available, I am wondering if anyone knows of an adaptive circuit I could use, perhaps with an externally mounted six- or nine-volt battery?

(I understand some commercial replacements use 1.5-volt silver oxide batteries which snap into some sort of voltage reducing circuit.) Any ideas?

Lack of mercury batteries isn't the problem it used to be. There is actually a new replacement for the 625 mercury cell. Same voltage as before.

This is essential for some higher priced cameras, since using a higher voltage replacement has actually caused damage.

One source for the ZA625PX (zinc air), which replaces the EPX625, V625PX, H-D, PX13, etc. for $1.95. Call **Wholesale Advantage** at **1-800-574-7253**.

The Wein Zinc Air Cell, which costs about $8.00 and is carried by many camera shops, delivers 1.35 volts and is intended to replace the PX625/13 mercury cells.

Another option is to buy a genuine mercury cell from a Canadian source. **Canadian Quality Concepts**, 101 Fife Rd., Guelph, Ontario, Canada N1H 6X9; They offer the PX625 and PX675 priced at (1-3) $4.69 US.

Rick
via Internet

ANSWER TO #8995 - AUG. 1999

I have the LabTec CS-150 stereo computer speakers. I need the headphone plug for one wire to play the tape cassette or portable radio.

I also need another small headphone, this one connected to the

right speaker from the left amp speaker. I need three in all.

RadioShack has the plugs and cables you need to do this. Take your LabTec speakers down to the nearest dealer, look at the plugs and extension cords they have in stock, and be sure they fit your speakers.

The plugs you need are fairly common items. You'll be better off buying an assembled shielded cable, with a plug on each end, as the plugs are rather small, and it's difficult to solder the wires onto them.

RadioShack also stocks numerous adapter plugs, which you can use to connect to other standard audio sources, such as RCA type plugs, etc. I've been able to adapt several different audio sources to my computer using this method.

You might also want to hook up a small AM-FM radio, (such as a Sony Walkman) to your computer, using such an adapter cord. This will provide a fairly good sounding radio, using your computer sound system. Just remember, the headphone cord

ANSWERS TO #89916 - AUG. 1999

My Caller ID unit sometimes displays Private or Out of Area. Most of those blocked calls are people trying to sell me something.

There are times that my work, or family living outside my area are trying to call me.

I know that it is possible to get the caller info even though it's blocked or out of the area. I was told the 911 operator and Police can see it. How can I see it too?

#1 Contrary to popular belief, there just isn't any "hidden" Caller-ID data for you to use. It is true that the 911 operator, police, and other agencies can identify incoming calls, but they are not using Caller-ID information.

Instead, they rely on other central office technologies that are not available to the general public. Also, you should be aware that any call to a Toll Free number (800, 888, etc.) is always identified to the called party either on their monthly bills or in real time, since they pay for your "free" call.

Calls placed from telemarketers normally originate from large "call centers" and they do not use standard phone lines. Because of their call volume, they use digital T-1 lines or other similar central office connections that currently do not support Caller-ID. These calls are always marked as Out-Of-Area (same as Unavailable or Unknown).

You will also get the Out-Of-Area message from large corporations, some government agencies, and folks calling from areas that have older central office equipment.

Calls that are received as "Blocked" are typically from Caller-ID supported lines, but the caller has elected to mask their identity (either on a per-call basis or permanently via their instructions to the phone company). Again, there isn't any secret data that is sent.

There are Caller-ID display boxes that will help you screen callers. I have used the Bel-Tronics Limited #AD100 ($60.00) and it will automatically answer a "Blocked" call and tell the caller to unblock their number and call back. Although normal calls are not interrupted, unfortunately, so are Out-Of-Area calls.

Ameritech, a midwest telephone service provider, is now offering a nifty service called Privacy Manager. This central office based service interrupts any call that is marked as Out-of-Area/Unavailable/Unknown and requires the caller to identify themselves at the sound of a beep tone. After their name is recorded, you are called in private and asked if you wish to connect the call.

According to an associate of mine that manages a call center, this feature is becoming increasing popular. Perhaps one day it will be licensed for use in other areas.

The Caller-ID data has been discussed in previous Q & A dialogs, but here is a summary.

The first incoming ring, called the power ring, awakens the Caller-ID display unit. Immediately after the ring (and before the second ring), a BELL 202 type 1200 baud modem signal is sent from the central office. But unlike normal modem communications, the receiving end does not seize the line during the broadcast, nor does it communicate back to the central office.

Unless the caller has invoked to block it, the directory information is extracted from phone company records and sent about 1/2 second after the first ring. The Caller-ID signal must finish well before the second ring.

For full details, just search the web. Here is one such link: http://www.repairfaq.org/filipg/LINK/F_CallerID.html

Thomas Black
Folsom, CA

#2 You cannot get the information you want out of the Caller-ID signals because the central office does not send the information down your analog line.

For example, I think you can successfully *69 a phone number that doesn't show up on your Caller-ID box. Clearly, the central office knows the number to call even though that number does not show up on your Caller-ID display.

Yes, 911 operators get all the information — as do 800 numbers. If you want to know everybody who calls you, then get an 800 number.

Things are different if you have a digital phone line such as an ISDN, PBX, T1, or fractional T1 line. Some of the backbone signalling information may be accessible in these systems (it is the LSB of the eight-bit PCM sample), but accessing and decoding it is a significant chore.

Many years ago, RadioShack had a good technical text on the telephone system that ran several hundred pages. It covered many of the exotic features of the phone system, such as frames, their format, and their synchronization. If they've kept it up to date, then it should include some information about ISDN and maybe even DSL.

The book was one of a series; maybe Texas Instruments was the original publisher. I cannot find my copy, so I cannot give you a better pointer. The books are not in my 1999 RadioShack catalog, either, so I presume RadioShack no longer sells them.

The intimate details of the telephone system are described in CCITT standards. Those standards describe fax machines, modems, encoding, and switching systems in more detail than most mortals would ever want.

Individual standards are expensive, so find a good university engineering library where you can browse.

If you don't want telemarketers to call you, start getting on Do-Not-Call lists. There is a national list that should stop a lot of calls, but consumer advocates say it doesn't work well.

Whenever a telemarketer calls and tries to sell you something, ask them to put you on their Do-Not-Call list. Then they should not call you back for the next 10 years. You can also ask them to mail you a copy of their written Do-Not-Call Policy. Also check out www.PrivateCitizen.com. For $20.00 they will shut off 1,500 telemarketing firms; if one of these firms does call you, then you can sue them for $500.00.

Gerald Roylance
Mountain View, CA

TECH FORUM

of most of these portable devices also serves as the receiving antenna for the radio, so the orientation of this cord will affect radio reception. (Don't coil it up, or sit a steel cabinet on it, or you won't receive much!)

I've used a RadioShack audio cable — about four-five feet long — to listen to radio, CDs, and cassette players at the office, using my computer speakers. This works really well, when my favorite team is playing on a day when I have to work.

Dwight Johnson
Booneville, MS

ANSWER TO #7998 - JULY 1999

I need to know if the HP Ergo 1024 (D2805A) color monitors are standard SVGA monitors and, if so, the pinout data to make an adapter cable which will take the DB-9 socket to a standard HD-15 male SVGA connector.

Judging from the connector alone, it's either an EGA or CGA monitor.

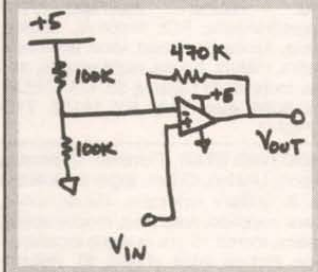
Although this is not a VGA display, it may be possible to make a cable. (Although all digital signals could not be used by the display and the only resolution supported will probably only be 320x240 or 480x640.)

Continued on page 84

ANSWERS TO #89911 - AUG. 1999

#1 *I have a two-axis accelerometer that has an output of 2.5 VDC in the level state. In the pitched up state, the output will go to 2.812 VDC. In the pitched down state, the output will go to 2.188 VDC.*

What can I do to increase the voltage swing without changing the 2.5 VDC center? Example: pitch up 3.5 VDC, pitch down 1.5 VDC?



Here is a simple circuit that will amplify the sensor's output by about 10. The gain is proportional to the 470K resistor, so you can adjust the gain up or down by changing that resistor.

There may be some problems with what you want to do. Accelerometers do not measure pitch, so you may have the wrong sensor or the wrong terminology. An inclinometer measures pitch (or roll).

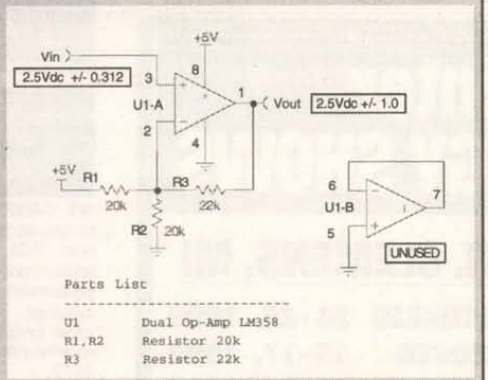
You may also have trouble closing the servo loop. Just matching the sensor signals to the servo motor input voltage does not guarantee a stable loop or good performance.

You may need a lot of gain to minimize the servo error, and then you may have stability problems because the loop is underdamped and sensitive to noise and backlash.

You have a difficult task ahead.

Gerald Roylance
Mountain View, CA

#2 Here is a simple circuit that should convert the voltages for your two-axis accelerometer.



The circuit is a non-inverting amplifier modified to operate off of a single 5-volt supply. The voltage gain of the circuit is R3 / (R1 // R2) + 1 (or 3.2 for the indicated resistor values). Note: The symbol "//" means "in parallel with" where R1 // R2 = (R1 * R2) / (R1 + R2).

For your application, a change of ±0.312 volts at the input should cause a change of ±1.0 volts at the output. The DC offset of 2.5 volts is achieved with R1 and R2.

Stephen J. Bitar
Sutton, MA

#3 Your application is well-suited to what is known as a "low-cost, single-supply differential instrumentation operational amplifier."

Analog Devices AD626 is very compact and easy to use. It works off of a single +5V supply, it has a built-in gain of 10X.

To obtain such parts and simple application notes (included in *Designer's Reference Manual*), contact: **Analog Devices**, 1 Technology Way, P.O. Box 9106, Norwood, MA 02062-9106. Voice: **617-329-4700**, Fax: **617-326-8703**.

Thomas Ng
San Jose, CA

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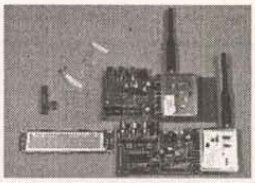

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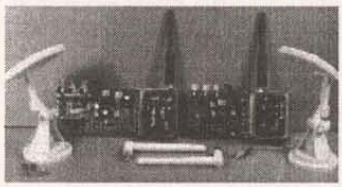

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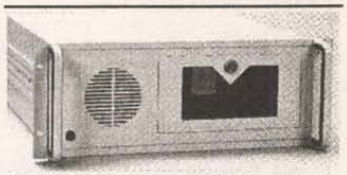

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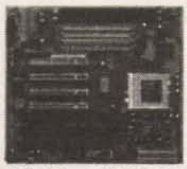

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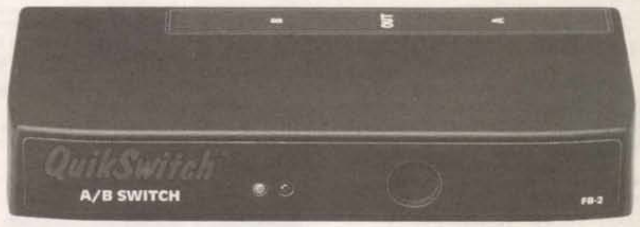

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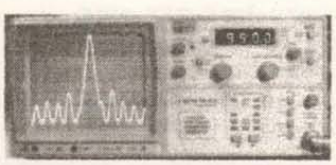

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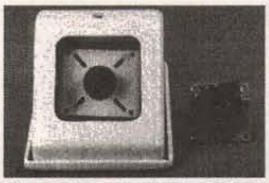

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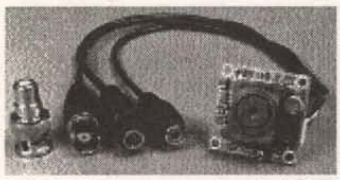

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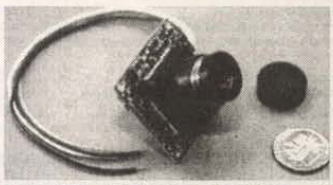

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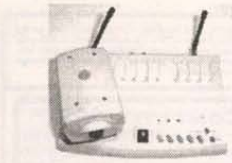

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Lower cost alternative to our high performance transmitters. Great value, tunable over FM band, plenty of power and manual goes into great detail about antennas, range and FCC rules. Handy kit for sending music thru house and yard, ideal for school projects too - you'll be amazed at the exceptional audio quality! Runs on 9V battery or power from 5 to 15 VDC. Add our matching case and whip antenna set for a nice 'pro' look.

FM-10A, Tunable FM Stereo Transmitter Kit.....$34.95
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RF Power Booster

Add muscle to your signal, boost power up to 1 watt over a freq range of 100 KHz to over 1000 MHz! Use as a lab amp for signal generators, plus many foreign users employ the LPA-1 to boost the power of their FM transmitters, providing radio service through an entire town. Runs on 12 VDC. For a neat finished look, add the nice matching case set.

LPA-1, Power Booster Amplifier Kit.....$39.95
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LPA-1WT, Fully Wired LPA-1 with Case.....$99.95

FM Station Broadcast Antenna

For maximum performance, a good antenna is needed. Properly tuned and matched antenna is fully PVC enclosed for weather protection and rugged use. Vertical or horizontal mounting, 'F' style connector, 5' long.

TM-100, Tru-Match FM Station Antenna Kit.....$39.95

AM Radio Transmitter

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AM-25, Professional AM Transmitter Kit.....$129.95
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MFMT-1, World's Smallest FM Radio.....$11.95
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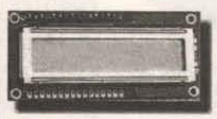

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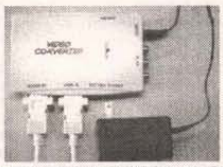

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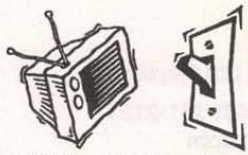

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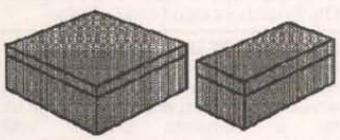

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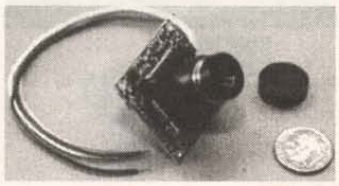

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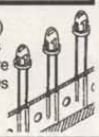

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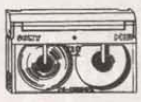

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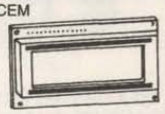

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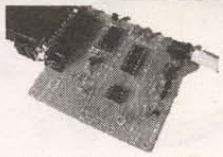

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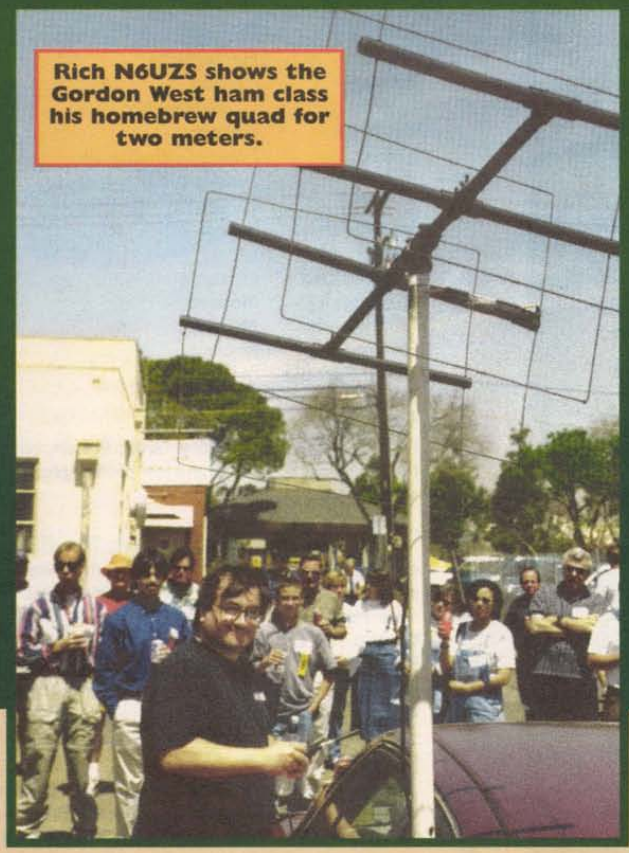

Rich N6UZS shows the Gordon West ham class his homebrew quad for two meters.

Ham radio operators throughout the United States are getting the royal treatment from equipment manufacturers and dealers in preparation for the long-awaited amateur radio service restructuring rules.

Although the Federal Communications Commission (FCC) continues to DELAY their announcement of ham restructuring Docket 98-143, ham equipment manufacturers and ham dealers GO FORWARD with new product technology announcements, some lower prices on existing products to clear the pipeline before the new rules, and plenty of hamfests to keep the excitement UP about all of the NEW PRIVILEGES FOR WORLDWIDE OPERATION to the Technician-Plus operator when the restructuring rules kick in sometime soon.

AT THE FCC

The FCC is behind schedule on several items originally intended for the "fast track" Rulemaking. More important business comes first before the amateur radio hobby service. The FCC is undergoing moving pains — leaving their long-time M Street location to less-expensive digs. The FCC is also focused on the start-up of the Universal Licensing System (ULS) which will shortly eliminate the need for filing complicated forms by snail mail.

The ULS has been a long time coming, and thanks to the amateur radio service, our Volunteer Examiner Coordinators have proved that the system indeed works because ham test bosses have been filing applications electronically (before any other service!) for the last several years with superb results.

But under the new ULS where YOU may get to do your own electronic filing, you're going to need to divulge something that you may have kept secret for some time — your Social Security Number. No one will see it but the FCC, who may share it with government tax collectors, so don't worry about other hams knowing your secret SSN. But if you have been dodging some back taxes, the feds are now comparing electronic applications, and your "number" might be up! Look for ULS going "on line" this month as you read this article.

The amateur radio rules restructuring continues in a holding pattern with the majority of hams hoping it will become law, soon. There is GOOD NEWS for ALL hams when restructuring goes through at the beginning of next year:

1. Technician-Plus operators will gain worldwide radio-band privileges.
2. Proponents of Morse Code will see more No-Code Technician class hams actively learning the code at the required 5 wpm than we have ever seen before.
3. Present General class hams could be grandfathered to the next license class higher with no additional code test.

The teaching of ham operators from start to Technician-Plus (plus the code at 5 wpm) will be a lot easier after the ham rules restructuring. The Novice written examination will probably be eliminated, cutting out 483 questions that need to be memorized. This would leave just Technician class written questions — now 441 with 35 multiple-choice Q & A's on the test — plus the Morse Code. This will allow instructors more time to teach the real world of ham radio operating, rather than the simple memorization of test question answers. And for proponents of all hams knowing the code, General worldwide privileges will certainly cause the new ham to want to learn the code at a basic 5 wpm. And for Technician operators who just want VHF and UHF privileges only, no code is required!

For the present General class operators, chances are they will be grandfathered to the next license class up. And we still don't know whether or not they are going to combine the Advanced class and Extra class into one single license class, nor do we know whether the top class code test will stay at 20 wpm, or drop to 13 wpm.

Right now, no-code ham operators are learning the code at 5 wpm, and passing the code test to become Technician-Plus operators. When the new restructuring rules go into effect next year, they MAY be grandfathered to the 5 wpm new General class license, and may or may not need to take one additional relatively simple General theory test. We must wait until the rules are finally announced before we see the precise details. But if you are a No-Code Technician class operator now, or are thinking of getting your ham license soon, get the 5 wpm code test out of the way and then let the rules catch up to you.

JUST ANNOUNCED — 5 WPM FOREIGN WORLDWIDE APPROVAL

Late-breaking news here! On June 7th, 1999, our

High-frequency privileges to the TechPlus ham means more antennas on the vehicle!

Kid's Day on ham radio, with author West teaching 80 kids ham radio basics.

FCC announced an agreement with European countries to allow USA Technician-Plus hams full worldwide operating privileges when vacationing or visiting the following participating CEPT countries:

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Bosnia	Herzegovina
Bulgaria	Croatia
Cyprus	Czech Republic
Denmark	Estonia
Finland	France (including all possessions!)
Germany	Hungary
Iceland	Ireland
Italy	Latvia
Liechtenstein	Lithuania
Luxembourg	Monaco
Netherlands	Norway
Portugal	Romania
Slovak Republic	Slovenia
Spain	Sweden
Switzerland	Turkey

United Kingdom (including Great Britain, Northern Ireland, Channel Islands, and Isle of Man, plus UK possessions)

At present, your amateur radio Tech-Plus license doesn't afford you all worldwide bands of voice operation in our country — not until the rules change over here sometime this winter. But right now in Europe, you can go over there with your ham Tech-Plus ticket and instantly operate on all worldwide ham bands using voice or any other type of approved emission. And for boaters, this gives you instant operating privileges when cruising some of the French possessions in the South Seas.

And more good news — some Latin American countries are coming onboard with this same type of agreement, too. And for operation in Mexico, a little paperwork and paid pesos down there can also give you instant worldwide privileges with the Technician-class license.

So, it looks like the entire world will soon allow worldwide operating privileges for voice with a maximum required code speed of only the simple 5 wpm level.

INDUSTRY REACTION

Ham radio equipment manufacturers, ham accessory makers, and ham dealers are just as happy as the hams are over the proposed rule restructuring. Even those hams who hold learning Morse Code as a sacred initiation to the hobby concede that they are now seeing their Morse Code learning classes

brim full with everyone looking to pass the ultra-easy 5 wpm FCC code test. "At first I was against a slower code test, but now that I see the popularity of learning the Morse Code coming back, I am beginning to think that 5 wpm is an easy way to pack our classrooms with students who want to learn the code, and many who will continue to go beyond 5 wpm for the higher grade tickets," comments William Alber WA6CAX, an amateur radio code instructor in the San Francisco Bay area.

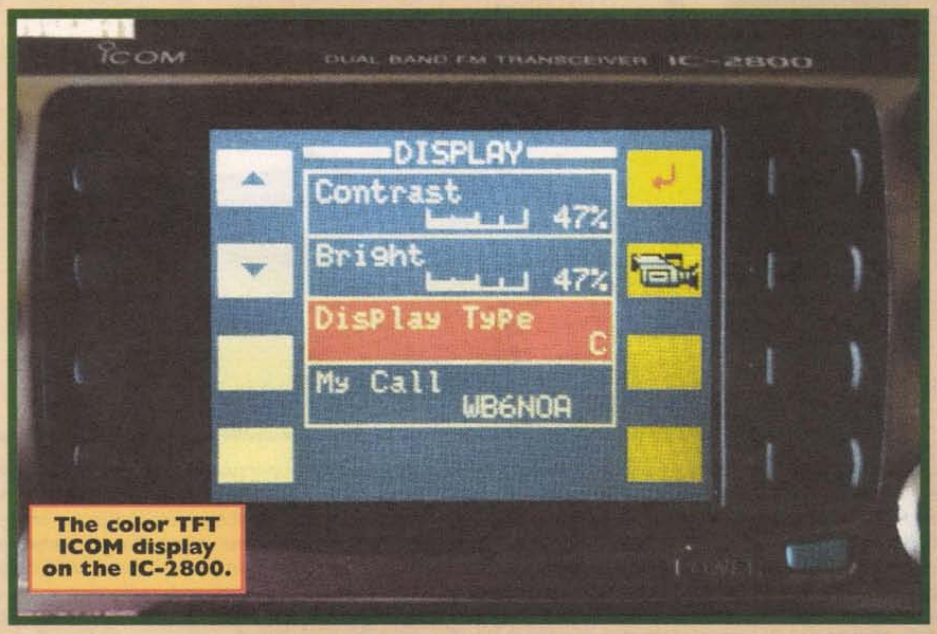
A pro-code group called FISTS indicated their displeasure with the proposed rules and felt that equipment manufacturers were behind the rules to simply sell more high-frequency gear. I can tell you first-hand that equipment manufacturers had NOTHING to do with the proposed Rulemaking. All of the initial proposed Rulemaking and comments to the Rulemaking are in the public domain, and you won't see any of the manufacturers who made any petition to the FCC for changing the ham rules for increased worldwide radio business.

But I can also tell you that they are gearing up for some exciting high-frequency and VHF/UHF equipment sales! ICOM America and Yaesu are battling it out with a $1,349.00 transceiver that goes from 500 kHz all the way up to the 440 ham radio band, multi-mode, full transmit and receive operation, with power outputs to rival separate home-station equipment. For ICOM, it is their new IC-706 MKII-G, and for Yaesu it is their new FT-100. The only ham band they don't include is 222 MHz, and this being only a USA band from an international style radio, we can see why maybe it was left out. But no problem — you get all of the ham 440 MHz for transmit and receive, all of two meters multi-mode transmit and receive, six meters, and all of the HF worldwide ham bands lower in frequency. The equipment is not much larger than a 50-watt mobile single-band ham set, and the equipment can also separate the head from the body allowing for remote installations.

The most often asked question, lately, is which set is better — I am continuously testing both units, and they both are PHENOMENAL!

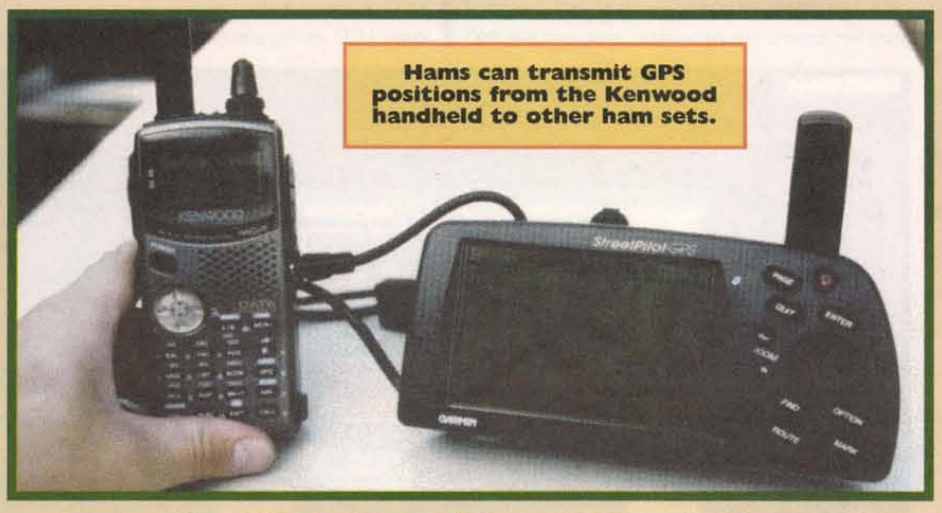
Kenwood continues with their popular TS-50 high-frequency transceiver, and this set has been such an incredible performer for so many years that they will probably keep it in line when the new rules change. And same thing for Alinco — their DX-70 and DX-77 have been around for several years, and continue to be price-busters like the Kenwood equipment seen selling for under $799.00. In fact, at a recent hamfest, I found the Alinco DX-70 selling for an incredible $579.00 brand new, including 10 watts on six meters, too!

And the color LCD thin-film transistor (TFT) panel from ICOM's IC-2800 is making quite a hit. This transceiver covers the two-meter band and the 440 MHz band, and the remote head three-inch TFT color LCD works great under the dash, and can even



The color TFT ICOM display on the IC-2800.


The new ICOM IC-2800 full-featured mike.



take an external video from a VCR or back-up camera and show it on the screen, too. The display could also show a GPS map in conjunction with car navigation equipment, as well!

Premier Communications ADI Company is also poised and positioned to satisfy the anticipated influx of new hams with a new two-meter mobile — the ADI AR-147 — along with ADI Premier handheld accessories including one of the neatest earphone/concealed hand mic systems for any type of HT. The FBI and CIA would be envious where they could see the almost invisible earphone and the concealed hand mic for clandestine HT operation.

Call Ken and Heather at ADI for their fact sheets at 714-257-0300. Also ask to see their catalog on their ultra-small, camouflaged FRS, 14-channel, UHF handie-talkie. By the way, when I get calls from parents who question whether or not their kids might make good ham operators, I tell the parents to get a pair of Family Radio Service handhelds and see how the kids take to operating them. If they try to figure out ways to get further range than the advertised one or two miles from the 1/2-watt UHF output, chances are this tinkering with radio electronics is a good sign that the kids will probably make terrific ham radio operators. Try that trick; it works!

Ham radio accessories giant MFJ Enterprises (601-323-5869) is also gearing up for the influx of new hams entering the hobby, as well as existing hams wanting to upgrade their equipment for high-frequency worldwide capabilities. MFJ has announced some lightweight switching power supplies that can handle up to 45 amps and only weigh in at five pounds! They are low-noise, and work great. I also like the MFJ-259B SWR analyzer that will check out any HF and VHF antenna system from 1.8 MHz to 170 MHz. Just hook up the coax, turn the meter on, and swing it through the bands, and see where you need to do some pruning or lengthening of the antenna elements to bring it into a perfect match.

And speaking of worldwide antennas, there's a great book out there on *Frequently Asked Questions About Wire Antenna Systems* by well-respected ham Jim Thompson W4THU. Jim and his wife run (and own) Radio Works (Portsmouth, VA; 757-484-0140) which specializes in wire antennas and baluns. We recently tried out his CAROLINA WINDOM on high frequency, and Mike and Sally Davis (K7ACM and KK7IO) swear by its operation over a traditional five-band trap vertical.

"When I switched from the vertical over to the Carolina Windom from Radio Works, I can now stay in touch with both long-range DX, as well as locally to my Sky WARN buddies," comments Sally Davis, an avid Sky WARN weather-watcher.

The expected explosion of ham radio recruitment has lead to large telecommunication accessory companies coming up with products specifically for the amateur radio service. Well-known six-meter DXer Tom Glaze K4SUS, has an inexpensive (under $20.00) VHF/UHF compact dipole with a small cable attachment to interchangeable connectors that works great for both classroom demonstrations, as well as in-the-field work. Screw on the specific connector type for your particular handheld, and you are on the air. It also works on land mobile, marine, and aircraft frequencies, too (Antenna World, Miami, FL; 305-471-9507).

OOPS — Here's something that's maybe NOT so great for the ham UHF operator, and that is those wireless weather stations that may be fun to look at, but noisy for the 70 cm band. The problem is where the weather stations transmit their wireless information back to the fancy LCD displays ... around 433 MHz. I recently discovered an irritating once-a-

minute data burst square on the weak signal 432.100 MHz frequency that would just about knock my earphones off when straining to listen to the distant Hawaiian radio beacon. I tracked it down to a water temperature floating sensor on a pool five houses down the street. This is about the extreme range of a Part 15 transmitter, but nonetheless, I had to convince my water-loving neighbor that they really wanted to send it back to the manufacturer for a different frequency because the frequency they were on would probably cause irreparable damage to their VCR library just a few feet away. They bought the warning, and a few weeks later the signal was nowhere to be found on UHF. I suppose those VCR tapes are now "interference free."

We know that the present ham operators with almost any class of license are still hot with their hobby — many going into the all-receive mode when going to ballgames, car races, airshows, or marine stadium events. The Optoelectronics R11 near-field receiver is one of MY favorites because it tunes from 30 MHz to 2,000 MHz and can lock onto a 5-watt 460 MHz frequency as far as 500 feet away in less than a second. Down on 150 MHz, it listens even further! Great stuff from the Opto gals and guys. Look at their web site (Optoelectronics web site www.optoelectronics.com).

I also tried out some of the scanners from AOR USA (Torrance, CA; 310-787-8615), and recently enjoyed scanning in England with the AR-8200 described last month, and now I'm working with their little tiny AR-16; and although it doesn't give me high-frequency scanning, it does a terrific job on the VHF and UHF bands. All the gang at AOR are active hams; and when the new rules hit, they promise me some new and exciting products that will really add to our popular amateur service.

FROZEN POOLS AND HOT OPPORTUNITIES

The pending Rulemaking has caused all of the ham radio written question pools to be frozen. This is good news for those of you preparing for Advanced class — the July 31st, 1999 cut-off date has been thrown out, so your present manual for Advanced and all of the other question pools from beginning to top remain unchanged.

Same thing for the 5 wpm code test — examiners are not permitted to make it any harder even though the applicant will gain additional worldwide privileges after the rules change sometime this winter. This is why I recommend hams with a Technician No-Code license bring in the six-tape code-learning course for anyone tone deaf to dits and dahs. I was in a good mood when I put this one together and, so far, everybody that gets through all six tapes has been 100 percent successful when they sit for the 5 wpm code test that will add to their Tech-license worldwide privileges in Europe right this minute, as well as add to worldwide privileges here in the USA within the next six months. Do it now before the code test gets more complex!

It's going to be a great year for ham radio — everyone is positive with the restructuring rules, the equipment is continuing to stay priced within reach, features are up at steady prices, and the disappointment of bombing an exam at the test center will be way down when new hams will only need to learn half the questions to be able to get the Technician-class privileges. If you are a ham, stay tuned into the ham scene because plenty will be changing within days or weeks, or certainly months. **NV**

GORDON WEST HAS JUST ANNOUNCED A SIX-CASSETTE MORSE CODE HOME-STUDY COURSE SPECIFICALLY FOR PASSING 5 WPM AT ANY EXAMINATION SITE IN AND OUT OF THE COUNTRY. THE COST FOR SIX LONG-PLAY AUDIO CODE-LEARNING CASSETTES IS $35.00 (INCLUDES POSTAGE) FROM GORDON WEST RADIO SCHOOL, 2414 COLLEGE DRIVE, COSTA MESA, CA 92626. CHECKS, CASH, OR MO, PLEASE.

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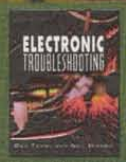

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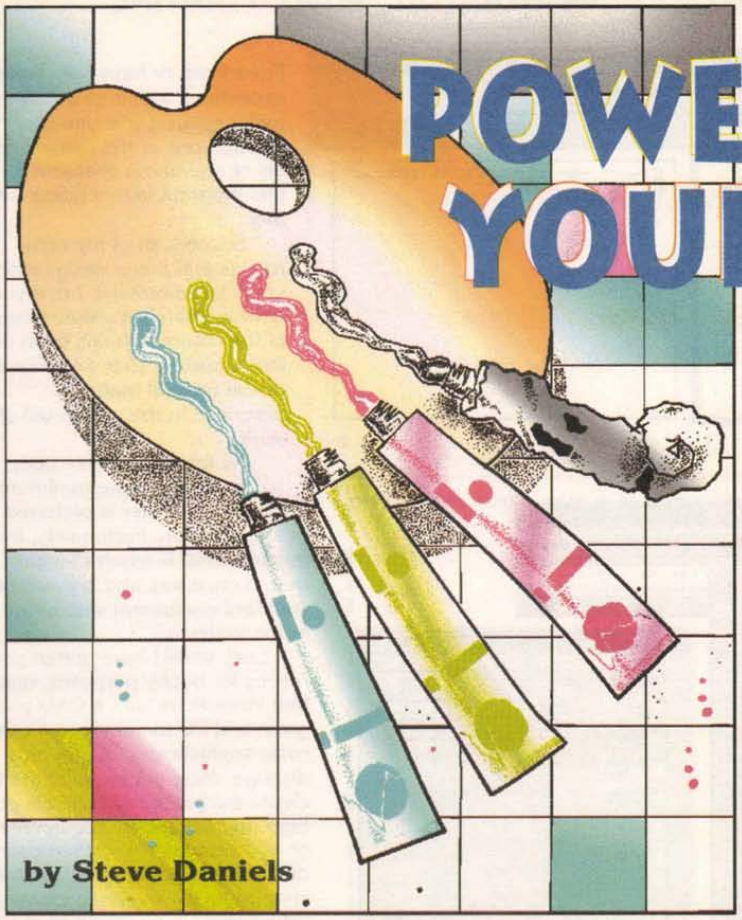


POWERPOINTING YOUR PROJECTS

Part I

This article describes the use of Microsoft's PowerPoint for creating a personalized "palette" of schematic symbols and a "toolkit" for creating PC board drawings.

by Steve Daniels

As an author and hobbyist, I need to create several drawings for every construction project, both for my own reference and to be able to share my ideas with others. For a typical project, I need four drawings: a schematic; a component layout drawing; an etch pattern for making a PC board; and an "x-ray" drawing that shows both the component layout and the PC board traces.

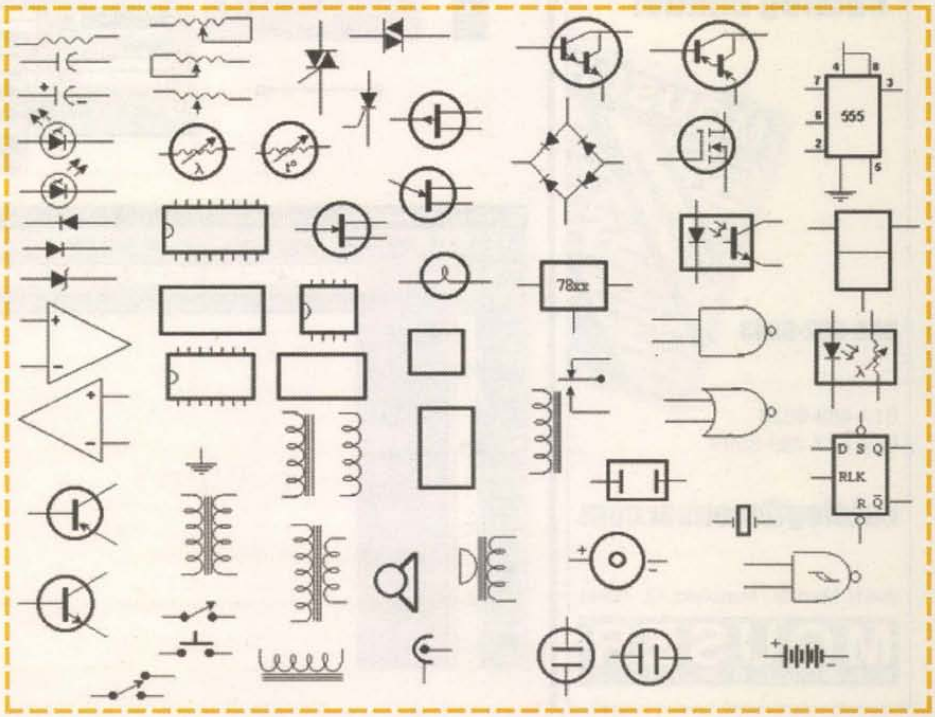
While there are a number of specialized (and often expensive!) software packages available for doing technical drawing, I have long used Microsoft's PowerPoint. This member of Microsoft's Office suite is most commonly used for doing slides for business presentations, but I found that I could adapt it for electronic hobby applications; it offers a large repertoire of standard lines and shapes that can be combined to create schematic symbols, and its precise drawing features make it easy to create accurate, actual-size artwork for transfer to a PC board.

An added bonus is that, as a component of MS Office, it is already paid for. Also, it integrates perfectly with the other members of the suite — Word in particular — for situations in which I want to marry text and graphics.

This article describes the use of PowerPoint for creating a personalized "palette" of schematic symbols and a "toolkit" for creating PC board drawings. We will then go through the complete process of drawing a simple schematic for a two-chip oscillator circuit (suitable for use as a warning or alarm signal). Part II will describe the construction of a second palette and toolkit for creating component layouts and the artwork for a PC board.

A few cautions: First, I am presuming that you are familiar with the basic functions of PowerPoint for drawing lines and simple shapes (with and without the Snap To Grid feature), moving them around, re-sizing and grouping them, and adding text boxes within a slide that contains a drawing. If you have never used

This member of Microsoft's Office suite is most commonly used for doing slides for business presentations, but I found that I could adapt it for electronic hobby applications.



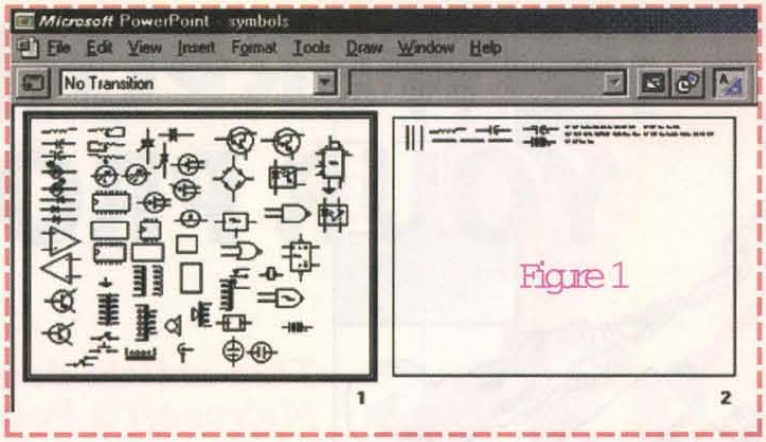


Figure 1

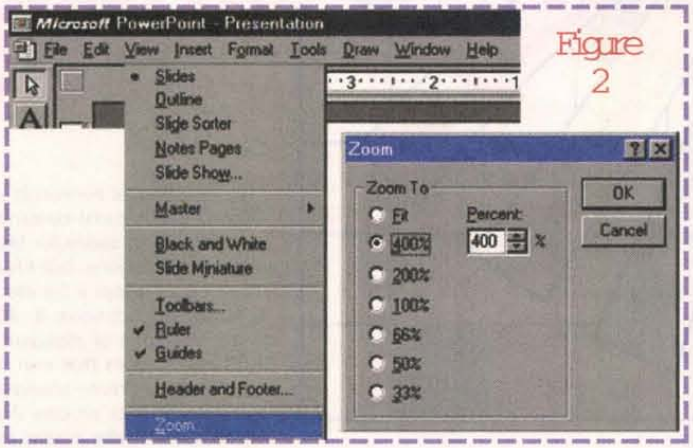


Figure 2

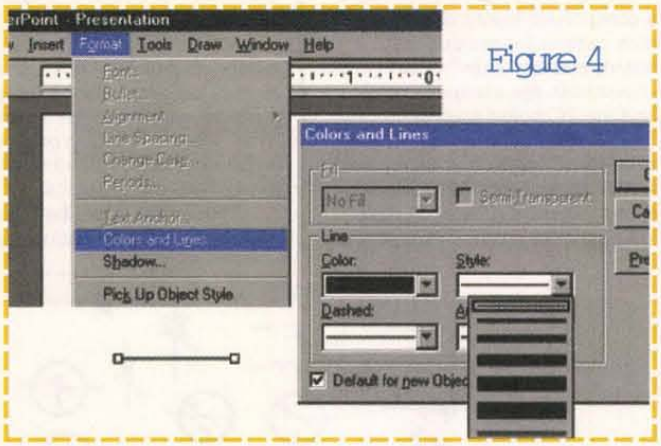


Figure 4

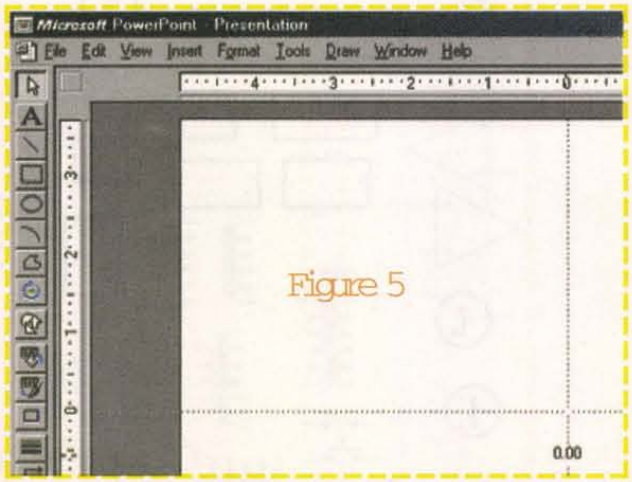


Figure 5

PowerPoint or have only limited experience with it as a drawing tool, I suggest that you go through one of the many tutorials or references available for this program before going further.

Second, all of my commands and menu designations apply to PowerPoint 7.0; if you have a different version, many of the commands will be in different places. That said, however, the general method described in this article will still work.

As far as hardware goes, a 15" monitor is bare minimum and a 17" or better is preferred for this application. Fortunately, the larger format is much cheaper than it once was and is practically standard equipment with new home systems.

Last, while I have gotten good results for hobby purposes, realize that PowerPoint isn't a CAD program and PC monitors aren't the most sophisticated of graphics displays. Most people will have to create the palette of symbols at high magnification — 200 percent or 400 percent — and then zoom down to 100 percent to have sufficient room on screen to create a schematic.

The re-scaling distorts a few lines in the display, but symbols will still print okay. Also, in my experience, complex figures will not always copy perfectly from palette to composition area and will need minor re-touching. If you can live with this, you'll be pleased with the printed results.

The Schematic Palette

Figure 1 shows two slides in Slide Sorter view. Slide 1 is the palette that contains several dozen symbols from which we can choose. Slide 2 is the "composition" area on which new schematics are drawn. For convenience's sake, a few very commonly-used symbols (resistor, capacitor, ground, etc.) and designators (R1, C1, etc.) are placed on the upper edge of slide 2.

To begin creating the palette, make sure that your display resolution is 600 x 800 pixels (for a

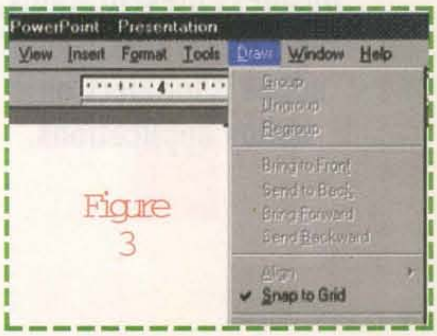


Figure 3

17" monitor) and open a new PowerPoint file. Create two slides in the usual way, and remove the placeholders that PowerPoint inserts by default. The slide orientation (set this in the File menu under Slide Setup, if necessary) should be Landscape; slide size 7.5 by 10 inches for an 8-1/2 by 11 sheet.

Drawing Our First Symbols

Refer to Figure 2. With the palette slide active, set PowerPoint's magnification to 400 percent in the View menu. We will be using PowerPoint's precise drawing features, so make sure that the Ruler and the Guides are checked in the View menu. Snap To Grid (set in the Draw menu, see Figure 3) should not be active for now. The line style (set in the Format menu, see Figure 4) should be at its thinnest setting, and the Default For New Objects box should be checked.

If you have never used PowerPoint's precise drawing features, now is a good time to learn. Having checked Guides in the View menu, you'll notice that the slide is bisected by two dotted guide lines (Figure 5). Move the mouse pointer so that the arrow touches the vertical guide, and then press and hold the left mouse button. The number 0.00 appears, which represents the present centered position of the vertical guide.

If you drag the mouse to the right or left (refer to Figure 6), you will notice that this number increases in increments of .01 inches. Also, an arrow points right if you are right of center and left if you are left of center. Try the same experiment with the horizontal guide; you'll find that it works similarly, but the guiding arrow points up or down. Now return both guides to 0.00. Let's draw a resistor symbol (refer to Figure 7).

Activate Snap To Grid

Draw a line 1/4" long by the ruler, right on the horizontal guide (a). Move the vertical guide to .25" right and leave it there (b). Move the horizontal guide up one "snap" increment to .08" and, from the right end of the horizontal line, draw a line up and rightward toward the horizontal guide (c). The Snap To Grid feature will automat-

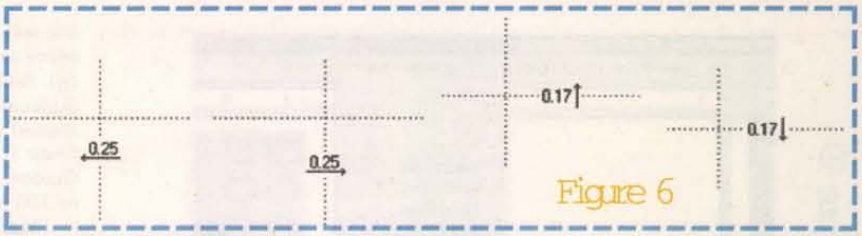


Figure 6


Figure 8

Select these one at a time and move each one a "tick" left.

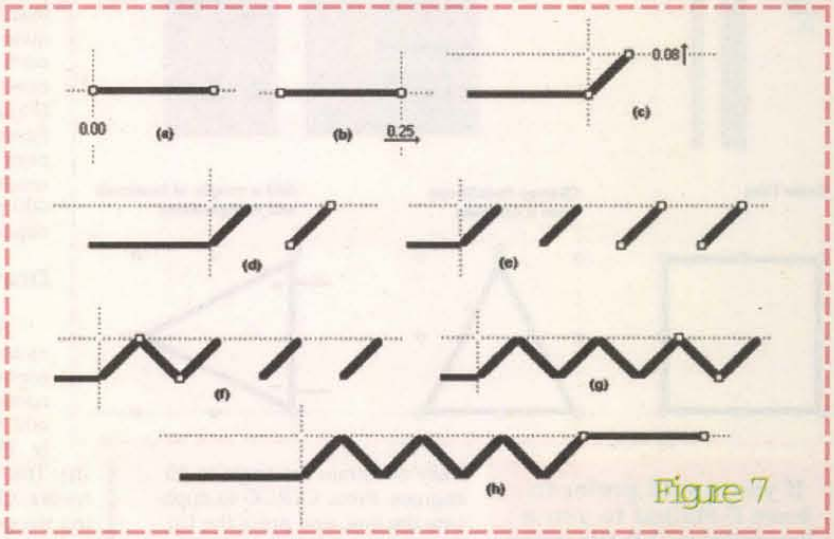


Figure 7

Figure 9

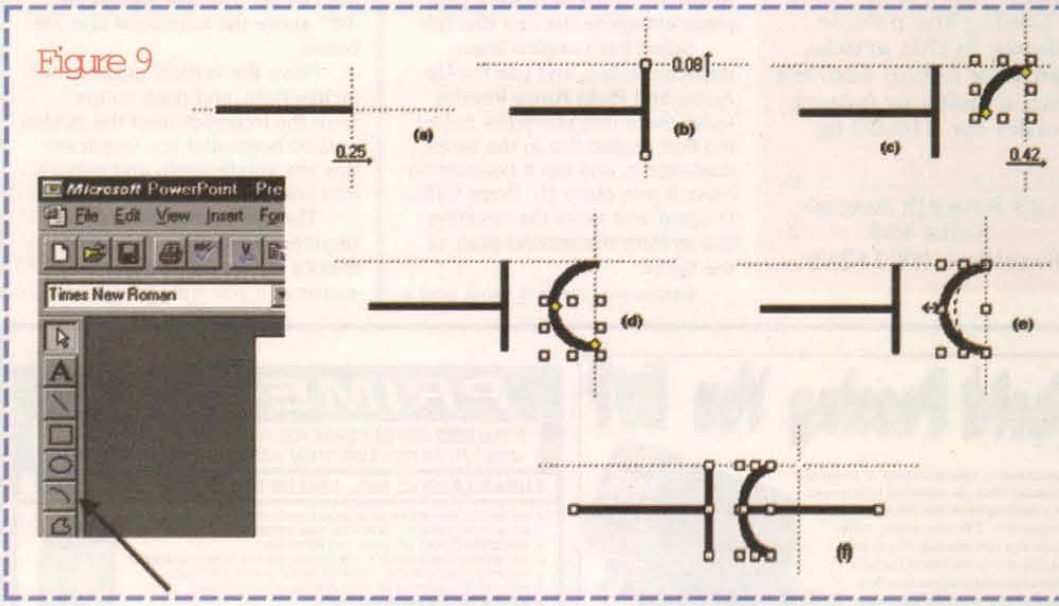
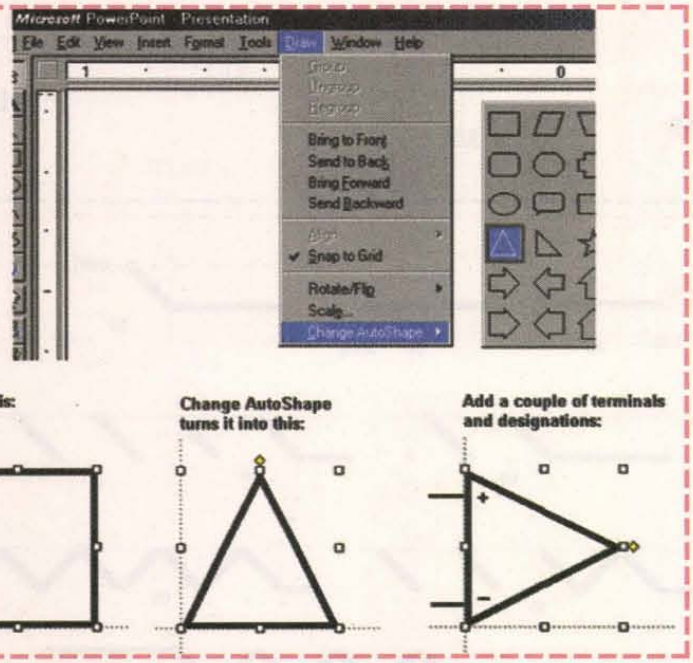


Figure 10



ically constrain the angle to 45 degrees. Press CTRL-D to duplicate the line, and press the Up Arrow key twice to move it into place alongside the first one (d).

Select both angled lines, duplicate again, and use the Up Arrow and Right Arrow keys to move them into place (e). Select the first angled line in the series, duplicate it, and flip it horizontally. Move it into place (f). Press CTRL-D again and move the resulting line to form the second peak of the figure.

Duplicate one last time, and a line will appear in the correct place to form the third peak (g). Add the ending line by duplicating the one that you started with (h). Now turn off Snap To Grid, turn off the Guides, and reduce the Zoom to 100 percent.

You'll notice that the lines that make up the figure don't quite touch. I had to nudge each of the left-leaning lines exactly one "tick" further left (Figure 8), and I had a solid figure. Group all the lines and print the slide to see the result. Restore the zoom to 400 percent, and we'll do a capacitor.

Drawing A Capacitor

Refer to Figure 9. Begin as before with a 1/4 inch horizontal line (a). Raise the horizontal guide to .08 inches. and draw a vertical line exactly .16 inches long as shown in (b). This will be two snap increments. Check the height by moving the guide to measure if you aren't sure. The line should be .08" above the horizontal and .08" below.

Move the vertical guide to .42 inches right, and draw an arc from the intersection of the guides to 0.00 horizontal (c). Duplicate this arc, rotate it left, and move it into place as shown (d).

Though we now have the required curved line, I thought that its arc was a little too extreme. If you want to correct this as I did, first turn off Snap To Grid and group the two arcs together. If you now place the mouse pointer on the left-hand center "handle" of the arc (e), you'll find that the pointer becomes a two-headed arrow. Press and hold the left mouse button, and move it a little to the right to "squoosh" the curve a little. Close up the distance between halves of the capacitor, add a right terminal, and you have the result shown in (f).

To finish this symbol, I moved it next to the resistor to compare it for size. It looked a little small, so I used the Scale function in the Draw menu to increase it to 125 percent of its original size. I then ungrouped, increased the length of the horizontal lines, and grouped everything together again.

I use lots of electrolytics, so I duplicated the capacitor symbol, added polarity markings, and put the result on the palette. The markings are in Arial 12 point bold, and they are separate, single-character text boxes in my version. I found that an underscore character looks better than a hyphen for the negative symbol. You can see my result in the overview of the palette.

How About An Op-amp?

Refer to Figure 10. To create the amplifier symbol, we need to draw a triangle. Unfortunately, this is one function that I know definitely operates differently in other versions of PowerPoint. Check your manual or the Help screens if you need to. In version 7:

Starting from zero horizontal and zero vertical, draw a square 3/4" by 3/4". From the Draw menu, select Change AutoShape and then select the isoceles triangle. Rotate the figure right and add two 1/4 inch long horizontal lines at .17 inches high and at .58 inches high. Turn off Snap To Grid, and add the plus and minus symbols as we did for the electrolytic capacitor. I used 10 point type for this rather than 12 point. Group everything together.

Move this figure next to the others and compare it for size. I scaled the whole thing up to 115 percent of its original size using the Scale function in the Draw menu.

I think you get the idea at this point. Each figure is an inch to an inch-and-a half long, and as wide as needed for pleasing proportional appearance; use your judgement. A few observations that might help as you construct your own additions:

- I have noticed that a line or

lines in a figure that I have built will sometimes get distorted when the figure is copied or rotated or the zoom is changed. No problem — just ungroup the figure, delete the affected line or lines, and re-draw. Don't try straightening lines that have been distorted by re-scaling.

Once you get a drawing that prints cleanly and displays reasonably well at the magnification you typically use for composition, you're set.

• If you need to put one shape inside another (as in the LEDs, for example), realize that the shape that surrounds the other(s) must either be sent to the back or have no fill.

• When you need to orient lines within a figure with respect to the center of the figure, use the guides. Take, for example, the photoresistor symbol. Figure 11 shows how I drew it.

• Snap to Grid is sometimes useful when you are constructing a complex symbol.

• Some complex symbols are drawn by combining standard shapes and hiding parts of them with another shape or shapes; my transformer and coils fall into this category. See Figure 12 for the how-I-did-it. If some figures of this sort display correctly but a part of the figure that should be white prints black, check your printer settings. Some printer drivers (like mine) have a "Print Black and White" checkbox that will override Color and Line settings in PowerPoint.

• You can get the Greek letter lambda (λ), which is used in the symbols of various electro-optical devices, in the following way: Create a text box and type into it a lower-case letter "l." With this text box selected, click Format and then Font. Set the font type to Symbol, select the font size you need, and then click OK. You will find that your "l" has become "λ," and you can move it to where you want it. To rotate it as you see in my examples, select the box, and then either use the Rotate choice in the Draw menu or click the Free Rotate button.

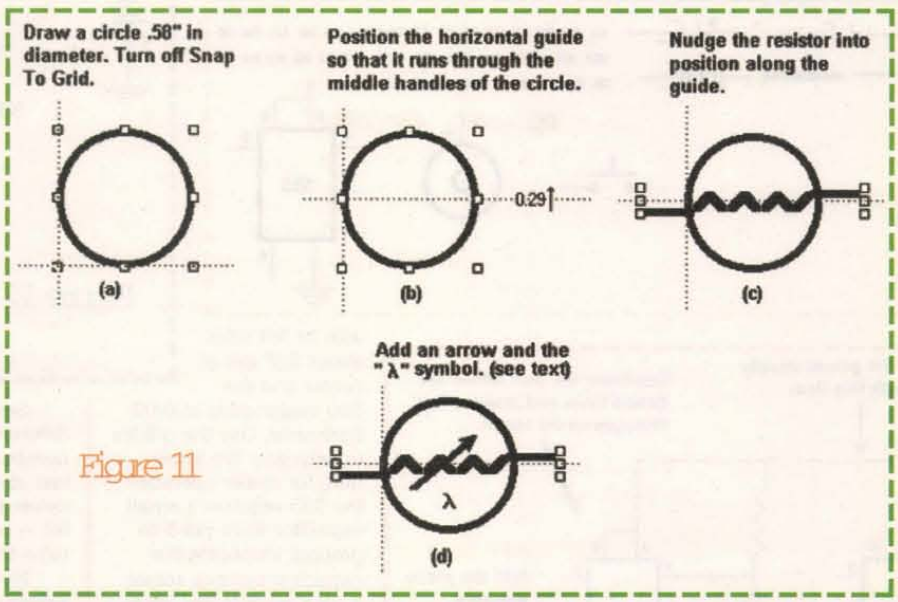


Figure 11

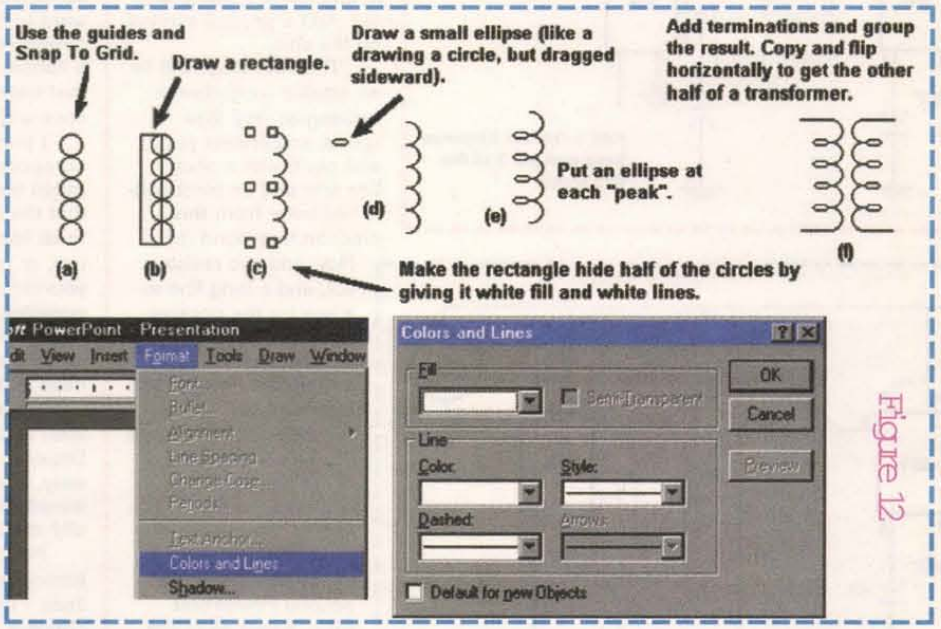


Figure 12

• To get the degree symbol for the thermistor: Start the text box and type the lower-case "t." Make sure that the Num Lock key is active, hold down the Alt key, and type the sequence 0176 on the numeric key pad. The symbol will appear when you release the Alt key.

Now fill the palette with symbols of your own choice. You can use my examples to start and check the pages of this magazine for other ideas. Once you are satisfied with your palette, copy a few of the figures that you expect to use most often across the top of the composition slide. I found that this leaves a maximum of working room for a drawing. Also create the designators R1-R10, C1-C10, etc., as individual text boxes lined up as you see in Figure 13. I found that having this available is a major time-saver over typing individual designations later.

Our First Schematic

As I mentioned earlier, I do my actual drawing at 100 percent. Also, I don't usually use Snap To Grid when

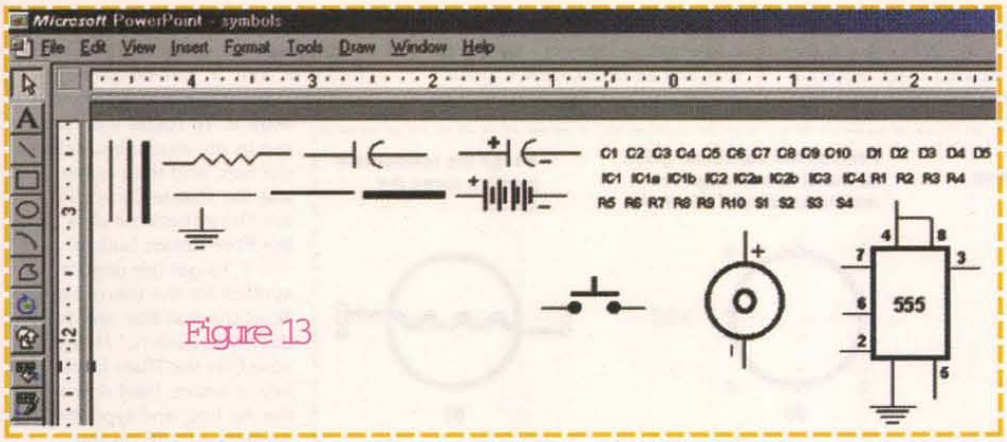


Figure 13

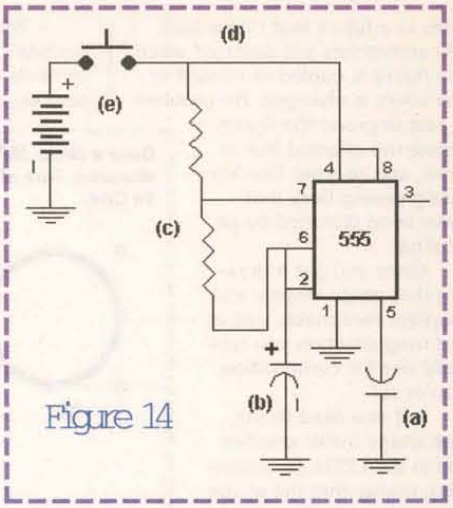


Figure 14

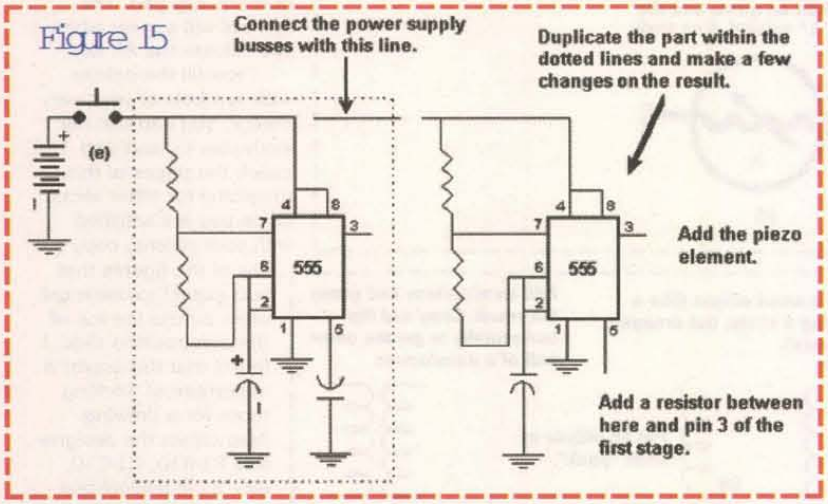


Figure 15

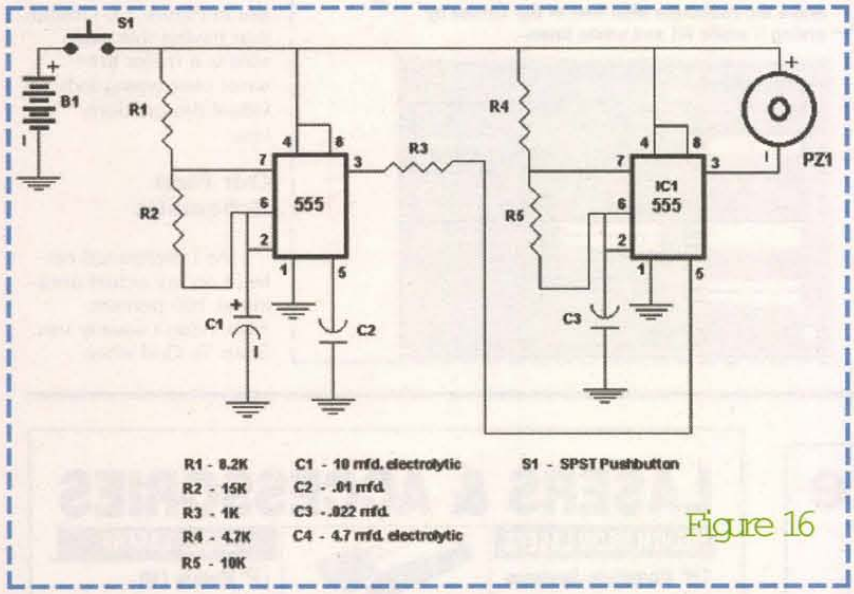


Figure 16

drawing a schematic. Set these parameters to start and see how they work for you.

Figure 13 shows the top of the composition slide, with a couple of additions; 555 timer chips are used a lot in a couple of generic circuits, so I preconfigured one on the palette. To begin, copy this figure to the composition slide along with a piezo element and a push button or toggle switch.

You'll notice that I have a couple of short lines of various widths available in the same area as the common components. To draw a line, I sometimes find it more convenient to duplicate one of these (CTRL-D) and extend it if necessary than to go back to the Line Draw tool.

Figure 14 shows the drawing of the first stage. Locate the 555 with its left edge about 2.5" left of center and the 555 designation at 0.00 horizontal. Use the guides to help you. We know that, for stable operation, the 555 requires a small capacitor from pin 5 to ground. Duplicate the capacitor symbol, rotate it, and move it into place (a). Add a ground symbol on the end.

This first stage will be an astable multivibrator running at very slow speed, so connect pin 2 and pin 6 with a short line and add an electrolytic capacitor from this junction to ground (b).

Now add two resistors (c), and a long line as a bus for the positive side of the power source (d). Add the switch, the battery, and a ground (e).

Now look at Figure 15. The second stage of our circuit is the same as the first except that it runs at a much higher frequency, so let's pull off a serious PowerPoint trick: Select all of the components in the first stage, group them, and then duplicate. Move this second stage into place. Ungroup the electrolytic in this stage, remove its polarity markings and regroup. Remove the capacitor from pin 5 and then connect the two stages with a resistor. The last bit of drawing is adding the piezo element. Pretty easy, Yah?

To finish up, see Figure 16. Do your designations by moving the appropriate component numbers into place, and then clean up any symbols that you're not using. Add the appropriate value to each designation. Done!

Save this presentation under a different name, and delete slide number one. Be careful with this last step! You would not want to delete the palette from its original file — only from the file that contains the new schematic.

Now that you have done one schematic, I'm sure that you will want to try using these tools to develop other ideas. I will mention a couple of other "practicalities" that have come from my experience with them:

I purposely made the passive components a little larger than I might have, because I presumed that the typical drawing would most likely not extend more than two, or perhaps three, stages. If you are doing something more complex, you may want to scale down the "common" components on the composition slide, and perhaps some of the others that you copy there as well, before you start to draw. The PowerPoint Draw/Scale feature makes this easy, and any distortion that it introduces to your models is usually small and easily retouched.

My other comment relates to joining of overlapping component lines. I have noticed that when I connect, say, a terminal line of a capacitor to the line extending from a chip, the lines will sometimes appear to be completely merged on screen but will then print out just slightly out of alignment. I don't know exactly why this happens — it may have do with the fact that I am using this program in a way that its designers didn't forsee — but it's easy enough to deal with if the misalignment is a real problem. Just ungroup one of the figures that you are joining, remove one or the other of the offending lines and redraw as necessary.

Creating the palette is a good deal of work and it requires some skill with PowerPoint, but I think the results are well worth the effort. NV

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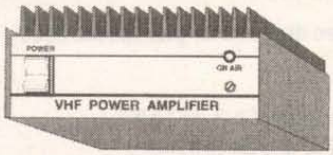

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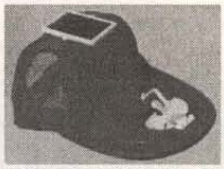

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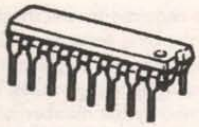

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ELECTRONICS Q & A

With TJ Byers

In this column, I answer questions about all aspects of electronics, including computer hardware, software, circuits, electronic theory, troubleshooting, and anything else of interest to the hobbyist.

Feel free to participate with your questions, as well as comments and suggestions.

You can reach me at:

TJBYERS@aol.com

TJBYERS@juno.com

or by snail mail at Nuts & Volts Magazine, 430 Princeland Ct., Corona, CA 91719.

What's Up:

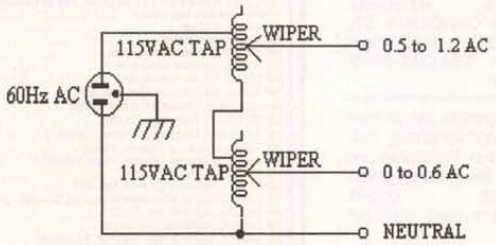
Another look at **surplus Variacs** and **high-power switching regulator ICs**. Looking at and understanding **old ICs**. Theory on **sodium-vapor lamps** and **antennas**. **Computer keyboards, game ports**, and **streaming tape backup**.

Using 400-Hz Variac

Q. I was scrounging through a local military surplus warehouse here in Utah and ran across a small Variac manufactured by General Radio. The box said 120 volts at 2 amps, so I took one home hoping to construct a small variable AC power supply. However, inside the box was a note that said "350 cycles minimum." I tried (briefly) hooking it up to the AC mains in my house — but it got real hot real fast. This Variac was obviously used in an aircraft of some sort, but I need to find a way to use it on the ground. Any ideas?

Garry Iman
via Internet

A. This is a 400-Hz Variac made specifically for WWII planes like the B-29. But I doubt many of them ever flew. Most were used on the ground to bench test and repair the avionics. The power source was probably a gasoline generator or dynamotor. Generally, you can wire two 400-Hz transformers together in series and they will work off 60 Hz without running hot. The problem with wiring a Variac this way is that you can't get the full voltage range from one dial. One dial will vary the output from 0 volts to 1/2 AC and the other will output a voltage from 1/2 AC to full AC. Depending on how you plan to use the Variac, this could be an annoyance or an advantage. Here's how to connect them.



Lightning Observing ... Revisited

Q. In the Feb. '99 issue, there was an article describing an apparatus described by Joe Carr that's used for lightning observing. I'd like to know more about the theory of it's operation and some practical details regarding construction. For example:

1. Why is the coil shielded?

2. My scope (10M inputs) can easily read 15 mV. How much amplification of the signal from the coil is needed?

3. How is the output voltage affected by the size and shape of the coil?

4. The X and Y inputs to my scope share a common ground. Can't I just ground one wire from each coil and amplify the signals from the other two wires?

5. Why does using the Z input remove the directional ambiguity?

Dan North
via Internet

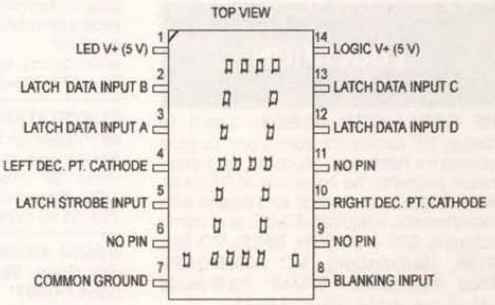
A. The metal shield is required to electrically and magnetically isolate the coils from each other. Without it, the antenna appears as a single-turn of wire that has no value in detecting lightning strikes. Their voltage output is determined by the number of turns; the more numerous the turns, the higher the output voltage. The shape of the coil (round or square) isn't important; the size is — the bigger the better. You can ground one lead from each loop, but it decreases sensitivity and, if the coils are reversed, can null out the signal altogether. A differential amp is more sensitive and provides maximum isolation. The gain of the amplifier depends on several factors, including the number of coil turns, distance from the storm, and the sensitivity of your scope. Basically, you'll have to play with these values. The reason the Z-input provides directionality is because of the cardiod pattern of the antenna. Check out *The Radio Amateur Antenna Handbook*, available from Amazon books (http://www.amazon.com), for more details on antenna theory.

Alphanumeric LED Display Pinouts Needed

Q. I'm hoping you can help me with two different numeric readout semiconductor devices that I have. The first one is made by Texas Instruments and is labeled TIL311. The second is made by Hewlett-Packard and says hpHDSP-A903. This is a small green (5/16 inch), seven-segment, 10-pin DIP package. It also has a decimal point to the right side of the digit, which the TI chip lacks. I bought them at a local hamfest, but I have no pinout information. Can you help me with this?

Jeff Ulich
via Internet

A. The first, the Texas Instrument TIL311 chip, is easy because it's still in production and sells for about $10.00. It's a 14-pin DIP package that contains a four-bit latch, decoder, driver, and 4 x 7 LED matrix display. The data sheet is located at http://www.ti.com/sc/docs/products/analog/til311.html. (BTW, this chip really has two notches on top and one on the bottom.) The second chip was a little harder, but easily found at http://ftp.hp.com/pub/accesshp/HP-COMP/led_displays/hdsp335x.pdf. According to HP, this display comes in four dazzling colors: AlGaAs red, high-efficiency red (HER), yellow, and green.



This TR-3 Isn't a Triumph, It's Travan

Q. I have two Colorado T-1000 tape backup drives that I use on a regular basis. A friend of mine recently gave me several TR-3 tapes to use. However, my tape drives use TR-1 tapes. I've looked at the two tapes and can't see any differences except for the labeling. My question: Is it possible to use the higher capacity tapes in my drives? I also have friends that have TR-1 tapes that they would like to use on their T-3000 drives. Could this also work if they were reformatted?

Bob Drought
via Internet

A. There is a slight difference between these two tape cartridges, even though they might look the same on the outside. First, there's a physical notch that

tells the drive that it's a TR-3 and not a TR-1 cartridge. The technology is called Travan (before Travan it was called QIC, as in QIC-80) and it's now migrated to the NS-20 level (20GB), none of which are interchangeable. Second, we're talking two different languages here, like English and Chinese. It's hard to translate between the two because they're totally unrelated. In other words, there's no way your T-1000 can understand a TR-3 cartridge. It can't even reformat it to work in your drive. However, a TR-3 drive can read your TR-1 cartridge, but not talk (write) to it. So your T-3000 friends are out of luck, too, when it comes to using TR-1 cartridges. Let's do an analogy. Today we have high-resolution digital TV with the same delimma — it's slightly backward compatible with my B&W TV, but my TV isn't forward compatible. Any day now, they will pull the plug on my B&W and I'll have to invest in a color digital TV. Same thing is going to happen with the TR-1 and maybe TR-3. For now enjoy, but realize it's a dead-end solution that sounded good at the time. Check into read/write CDs as a replacement. They're getting cheaper by the minute and are a lot faster.

Dualing Game Ports

Q- Is there a way to connect an A-B box to my computer's 15-pin serial (game) port so that I can use my joystick on "A" and my Nascar wheel control on port "B?" If this is possible, where can I order this kind of A-B box? The one that I ordered has 15 pins alright, but they are in three rows and not the two rows that I need.

D.E. Wright
via Internet

A- Actually, there are two game ports on your PC, which means you don't need an A-B switch. What you do need, however, is a dual game port adapter board like the DPG1 from Jameco (1-800-831-4242; http://www.jameco.com) — catalog number 105515. The price is $12.95 — about the same as for an A-B switcher. Better yet, you don't have to switch between the devices; you can use both at the same time in the same game with a buddy. The A-B box that you have is for VGA video so that you can switch between two monitors.

Shakey Sodium Lamp

Q- The high-power sodium light pole I have is 10 years old and, for the last two years, it has developed a puzzling quirk. It goes off then comes right back on — well kinda. Actually, the light goes down to a dull glow, then the lamp comes right back on. It doesn't go out all the way. It looks very much like the light reduction you get with an incandescant bulb when a heavy load, like a motor, starts up. I've tired replacing the bulb, ballast capacitor, photocontroller, FET driver, and have even switched it over to the other side of the 220VAC line. Still it happens. The strangest part is that it's sporatic. It can stay on for long periods of time between all this. Any clues?

Lawrence Dunlap
Bethany, IL

A- What you describe sounds like an interruption of power to the lamp. Sodium vapor lamps fall into a catagory of lighting called High Intensity Discharge, or HID, which includes mercury vapor and metal halide lamps. Basically, an arc is struck, usually using an inductive kick from a ballast transformer, and the gas begins to grow hot. The hotter it gets, the brighter the light. This can take anywhere from 3 to 15 minutes, depending on the chemistry and geometry of the lamp. If power to the lamp is lost, even for a moment, the arc goes out. Once the arc is extinguished, the gas has to cool before the spark can be reignited because it can't cross the gap due to the higher internal pressure. This can take anywhere from one-half minute for low-pressure sodium types to over seven minutes for high-pressure versions. Typically, it's a wait of a minute or two. During this time, the hot gas is still glowing while the pressure drops. This is the glow that you see. What can cause this you ask? What's

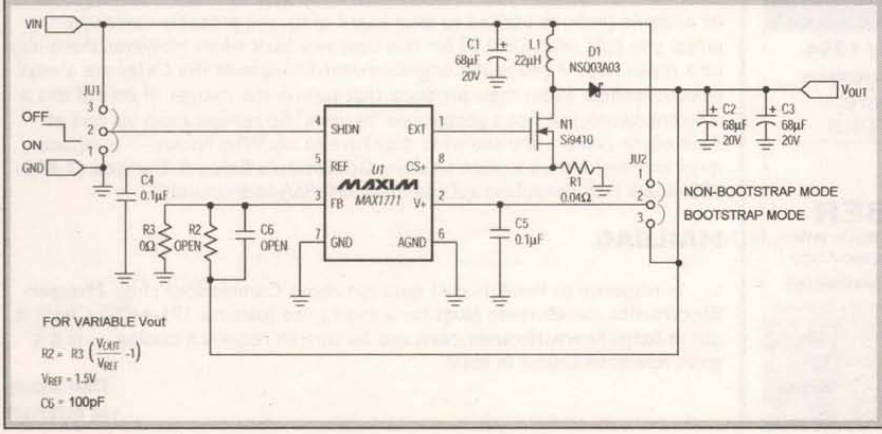
High-Power/Low-Voltage Switching Regulator

Q- The switching regulator article (Switching Voltage Regulator Basics) in the May '99 issue was great. But the examples you provided don't meet my requirements. The LM2577-12 cited has a low start-up voltage limit of 3.5 volts. What I need is a switching regulator that can output 10 volts at 1.5 amps working off a single 3-volt lithium battery. Do you know of any suitable chips?

Jim Halbert
via Internet

A- Well, it wasn't easy because of your power requirements, but I found a chip that will work. The MAX1771 from Maxim (1-800-998-8800; http://www.maxim-ic.com) can deliver 12 volts at 2 amps from a 3-volt input. You can purchase this chip from QuestLink (http://wwwquestlink.com) for under $5.00. The clinker is that you have to use an external pass transistor, which increases the part count and ups the construction cost. Maxim also sells an evaluation kit for this chip. Here's the schematic of the evaluation kit.

In this circuit, the MAX1771 is preset for 12 volts output, but that's easily adjusted via a voltage divider formed by R2 and R3. For a 10-volt output, R3 would be in the range of 150K and R2 would be about 30K. The formula is on the schematic. Don't forget to add C6 if R2 is installed. The 1260.pdf data sheet (available from the Maxim web site) shows the PC board artwork for this evaluation circuit. BTW, I seriously doubt you'll get 15 watts (P = IE = 10V x 1.5A = 15W) from a single lithium battery. You might want to consider alkaline batteries; the start-up voltage of the MAX1771 is 2 volts, well within their lifetime voltage range.



puzzling about this scenario is that it worked flawlessly for eight years, so let me polish off my crystal ball and take a guess. First, the power company may be causing power glitches as it changes its load level from station to station and line to line. Second, the ballast could be bad. This generally happens when a lamp nears the end of life but isn't replaced before it damages the transformer (this is a common problem with fluorescent fixtures). My guess is that the FET itself is getting close to the end of its life. The life of most power semiconductors is about eight years. Another reason may be due to changes in the footing of the lamp. Some lamps can't be moved, tilted or vibrated during operation. If so, the spark goes out, and the above recovery sequence goes into effect. I hope this helps.

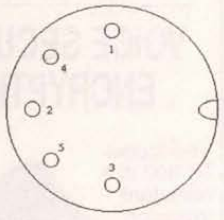
(Note: Mr. Dunlap responded and said the problem was a bad FET. Thanks for the feedback, Lawrence.)

Old Keyboards

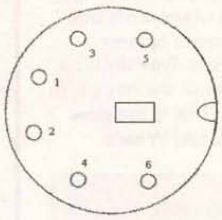
Q. I was given an old IBM keyboard that has 10 function keys which are lined up in a 5-by-2 pattern on the left side of the keyboard. The interface is a six-pin telephone style plug. I'm wondering if it's possible to find or build a converter to use this keyboard with a PC/XT, AT, or PS/2 style computer?

A. This keyboard was made to plug into a DEC AT-compatible computer, and can be modified to work with an AT or PS/2 PC. The two outer wires of your six-pin connector are the power leads, and the inner two are the clock and data. I don't remember the colors (this is 1986 technology and I long ago gave away my DEC PC keyboard), but red should be +5V, black GND, and yellow data — but don't quote me. Anyway, here are the new pinouts.

PC AT 5-PIN DIN



PS/2 6-PIN MINI DIN



PC AT 5-Pin DIN	Function	PS/2 6-Pin Mini DIN	Function
1	CLK	1	DATA
2	DATA	2	---
3	RESET	3	GND
4	GND	4	+5V
5	+5V	5	CLK
		6	---

However, this keyboard may not work with all PCs The polarity of the data signal is inverted between the PS/2 and the AT keyboards. Some motherboards can take either keyboard, some cannot. BTW, not all keyboards that have the function keys on the left follow this formula. Before IBM introduced the AT the keyboard data flow pattern was different and may not be compatible with your current PC.

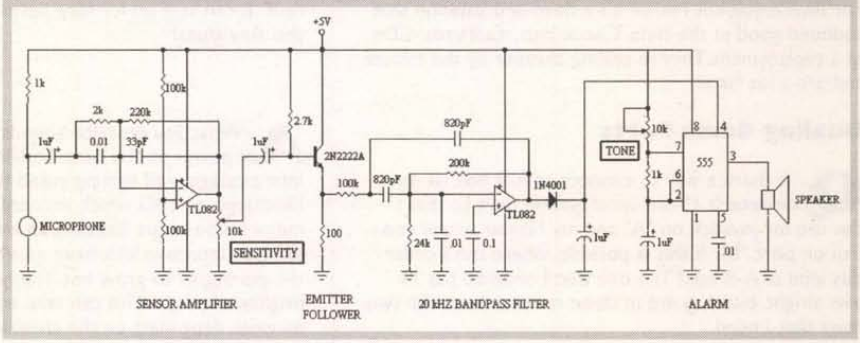
Flush Rush Flow Meter

Q. I need a device that can be installed in a commode water supply line that will detect when water is flowing. It has to be capable of sending the signal over an interface wire of about 150 feet and set off an alarm after a predetermined time.

Edwin Spencer
Burns, TN

A. This is an interesting question because it poses a score of solutions. You can break the water line and insert a pressure sensor, or you can insert a flow sensor that uses a switch, paddlewheel, or propeller to detect water flow. But both force you to know something about plumbing. A better solution is a microphone flow sensor, like the one below.

The nice thing about this design is that you don't have to break the water line. When water flows through the pipe, it makes noise which the microphone picks up and outputs to the op amp. This, in turn, triggers the 555 timer. If the water flow doesn't stop before the timer times out, the alarm screams. To keep the microphone from triggering the timer everytime somebody walks past the bathroom, I've included a high-pass filter with a cut-off frequency of about 10 kHz so that only the sound of gushing water — not thump-thump footprints — will trigger the timer.



Understanding ICs By The Numbers

Q. I'm in need of a part for the wife's kitchen appliance. The microcontroller chip is dead, due to voltage surges caused by the brushes of the motor (cheap engineering at work again). Here are the markings on the chip.

Oster 1981
A7570-12
Mexico B
0110-1(version number)
8529

Harry Shipley
via Internet

A. I'm glad you gave me the model date and IC code numbers, because they say a lot. First, it tells me this is probably an Osterizer blender by the 1981 date. Oster has since been acquired by Sunbeam and has branched out to more low-tech endeavors, like hair clippers and quality toasters. The date code, 8529, is the date the A7570-12 part was made, which is the 29th week of 1985. Mexico B means it was assembled in Mexico, plant B (wherever that is), sometime after that date. The version code probably isn't important; it simply tells you which firmware code is imbedded in the microcontroller's ROM. Now what does all this gain you? It means that a replacement chip is no longer listed or available (nobody I talked to ever heard of it), and probably never was unless you paid over $200.00 for this item way back when. However, there may be a ray of hope if you're the original owner. Companies like Oster are always anxious to hear about their products that survive the ravages of time. If this is a recent failure, and not a garage sale "bargain," I'd contact them via one of their repair centers and see what they have to say. Who knows — a replacement blender? Here's a place to start: **Goodman's Sales & Service (1-888-333-4660**; http://members.aol.com/miami33186/goodman.html).

MAILBAG

In response to Frank Nally's question about Commodore plugs, **Mouser Electronics** carries these plugs for a good price (part no. 171-4405). Check it out at **http://www.mouser.com** and be sure to request a catalog — it is a great reference source in itself.

Dan Jones
via Internet

Build a Photo-Electric Counter

If you want to know how many people or things pass a certain point, a counter is used. Counters are used on production lines, at public events, and at store entrances, among other applications.

This construction project describes a digital counter that counts up to 999 each time a light source is interrupted. A special feature allows you to "cascade" another unit, so you can count up to 999,999.

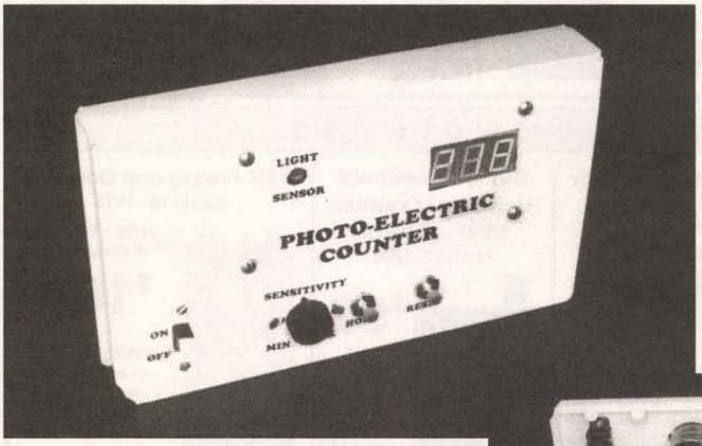
by Fred Blechman

Basically, there are three types of counters: mechanical, electric, and electronic. Some counters are variations and combinations of each of these basic types.

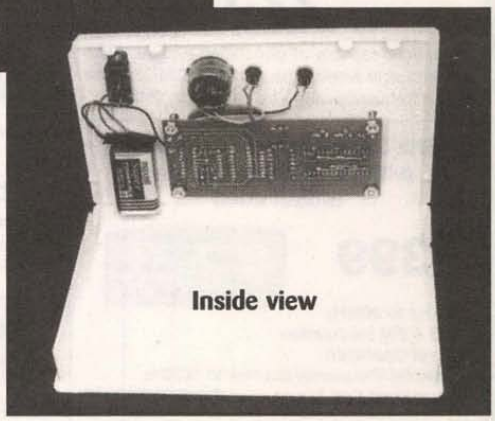
Mechanical counters can be triggered manually, such as the digital counter held in a user's hand, where a button is pressed for each count. This advances the units-counting numbered drum one count each time. As the ones-count digit drum completes a rotation, it advances the 10s-count digit. Similarly, the 100s-count is advanced when the 10s-count completes each rotation, and so forth, up to the maximum number of counter digits. Some mechanical counters operate by direct gearing, such as the odometer on your car, which advances based on tire rotation.

Electric counters are really just mechanical counters that are triggered by switches such as on mats or turnstiles. The switches operate solenoids to advance the digits on the linked rotating drums. Because both mechanical and electric counters are essentially mechanical in operation, they are noisy, subject to failure from wear, and limited in their counting speed.

True electronic counters, on the other hand, are completely silent, and have no moving parts to wear out. They use lighted digits to display the count, and can operate at high speed. While some electronic counters use switches to trigger their counting, the construction project we will describe here uses the interruption of light as its count trigger.



The Photo-Electric Counter can be built into a standard VHS video cassette box with all the controls and light sensor mounted on the cover.



Inside view

Description

The "Photo-Electric Counter," available in kit form for under $25.00, has a three-digit display that counts to 999 before resetting to 000. It uses three integrated circuits to detect and count the interruption of light on a photocell, and shows the total count on three red LED seven-segment digital displays. This counter can be used in business, industry, and security applications to count just about anything, from cartons on a conveyer belt, or copies on a printer, to people moving through a doorway. You can make money building these counters and selling them to stores and companies.

The photo-electric counter (really, a Photo-ElecTRONIC Counter) is completely silent, has no moving parts (except "Hold" and "Reset" switches), and can count at very high speed. We even used it to count the speed of a four-bladed fan by counting the fan blades interrupting a light beam in a given time; try to do THAT with a mechanical or electric counter!

The photo-electric counter can be powered by a regular nine-volt battery for occasional or short-duration use, or a DC wall-plug transformer for extended use. A sensitivity adjustment allows use in various light conditions, and the count can be reset or stopped at any time.

If your need is for more than a count of 999, an "overflow" pulse is provided for clocking additional digits. For example, you can easily cascade additional photo-electric counters for three additional digits each, as described later.

Circuit Description

Figure 1 shows the schematic of the photo-electric counter. The circuit basically consists of three seven-segment LED displays controlled by a counting circuit composed of two integrated circuits (IC2 and IC3) which are triggered by IC1. Figures 2, 3, and 4 show the pinouts of IC1, IC2, and IC3, respectively.

Only one section of IC1, a CD4093B quad two-input Schmitt Trigger, is used. This is a NAND circuit, where the output is the opposite of BOTH inputs. That is, if BOTH inputs are LOW, the output is HIGH, and if BOTH inputs are HIGH, the output is LOW.

This is a Schmitt-Trigger device, so change of state is triggered when BOTH inputs increase SOMEWHAT ABOVE one-half the supply voltage, or decrease SOMEWHAT BELOW one-half the supply voltage. The difference between trigger points (almost two volts with a nine-volt supply) is called "hysteresis," and reduces false response to noisy or slowly changing input voltage levels.

The two inputs, pins 1 and 2, are connected together to a voltage divider at the junction of photocell P1 and resistor R2. Since the photocell has a supply voltage at its top, and R2 is connected through potentiometer R1 to circuit ground, the voltage at the IC1 input depends on the resistance of P1 and the setting of R1.

When little or no light falls on the photocell, it has a very high resistance of several hundred thousand ohms. Since this is considerably higher than the sum of R1+R2, the input to IC1 is at a LOW voltage, so the output of IC1 is HIGH. However, as light falls on P1, its resistance drops drastically, down to

less than 100 ohms in strong light. This causes the voltage at the input to IC1 to increase. When the input to IC1 reaches somewhat above one-half the supply voltage, its output at pin 3 suddenly changes state to LOW.

Potentiometer R1 lets you set the light sensitivity of the trigger point; the higher the resistance setting of R1, the less the resistance of P1 must drop to trigger IC1, and therefore the greater light sensitivity.

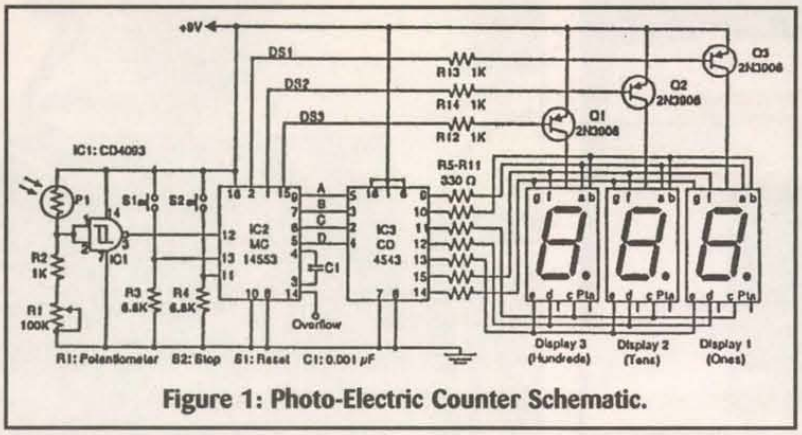


Figure 1: Photo-Electric Counter Schematic.

The negative-going voltage at output pin 3 of IC1 acts a CLOCK pulse to pin 12 of IC2, an MC14553B three-digit BCD counter. This IC is an amazing device. It not only counts upward in BCD ("Binary Coded Decimal") – that is, a four-digit code from 0 to 9 decimal – but it enables the output of this binary code for three digits, one at a time, each for a short duration, using "time multiplexing."

To explain further, if neither push-button switch S1 or S2 is closed, pins 13 and 11 of IC2 are held LOW by resistors R3 and R4. This allows IC2 to accept clock pulses. With each incoming pulse, internal counters create the BCD code for each of three digital displays: DS1, DS2, and DS3. As an example, if the total clock count was 319 decimal, then the IC2 internal count for DS1 (units) would be BCD 1001 (9), DS2 (10s) BCD would be 0001 (1), and DS3 (100s) BCD would be 0011 (3). (If you don't follow this, don't worry about it, but you may want to brush up on the binary counting system.)

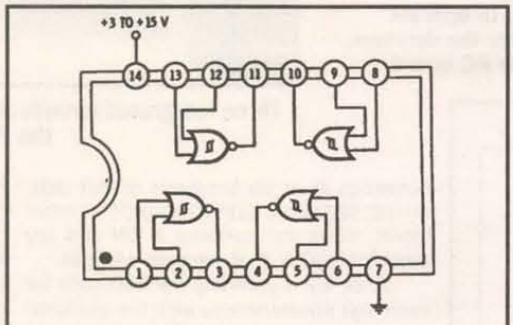


Figure 2: IC1 – CD4093B Quad Two-Input NAND Schmitt-Trigger.

This four-digit binary count for EACH digit is counting may be observed when this push-button switch is pressed. (Preventing this would require additional connections to the other NAND circuits of IC1, and a double-throw switch in place of S2.)

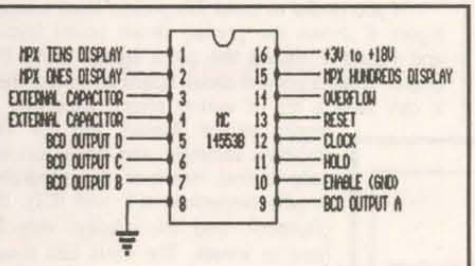


Figure 3: IC2 – MC14553B Three-Digit BCD Counter.

The BCD outputs are multiplexed to IC3, a CD4543B BCD to seven-segment latch/decoder/driver, another amazing chip. As each incoming BCD code is input from IC2 to pins 5, 3, 2, and 4 of IC3, internally the BCD code is latched and interpreted to determine which segments of each seven-segment display should be lighted.

Each display has segments designated A to G, as shown in Figure 5. These digital displays need to have power to light their segments. They are common anode displays, which means the common to each segment LED is positive voltage, and each segment is looking for a ground (LOW) to light. The positive voltage is supplied to each display through separate 2N3906 PNP silicon transistors, Q1, Q2, and Q3.

enabled at pins 9, 7, 6, and 5 (called A, B, C, and D in Figure 1), but only for an instant – about 2.5 milliseconds. Why? Because an internal oscillator switches between the three digital BCD codes at a speed dependent upon capacitor C1, which is connected between pins 3 and 4 of IC2.

With a value of about .001 mF for C1, the IC2 oscillator runs at about 400 cycles per second, changing output state to LOW at pins 2, 1, and 15 in that order. As we'll see later, this multiplexing sets the number to be shown on each of the three digital displays at any instant, although they all appear to be on at the same time. When the count exceeds decimal 999, an overflow pulse appears at pin 14 (normally LOW, goes HIGH), which can act as a trigger to another counter, thus allowing higher counts. More on this later.

When switch S1 is closed, this puts a HIGH on pin 13 – the RESET pin of IC2 – and the internal counters are returned to 000. When switch S2 is pressed, this puts a HIGH on pin 11, the HOLD pin of IC2, and counting stops. Unfortunately, since this switch is not "debounced," some jump in the

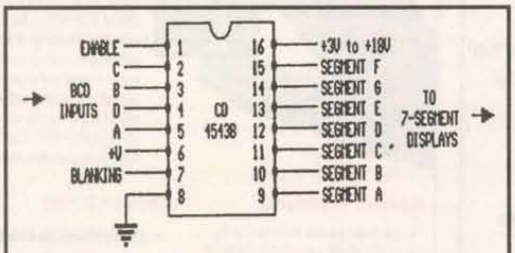
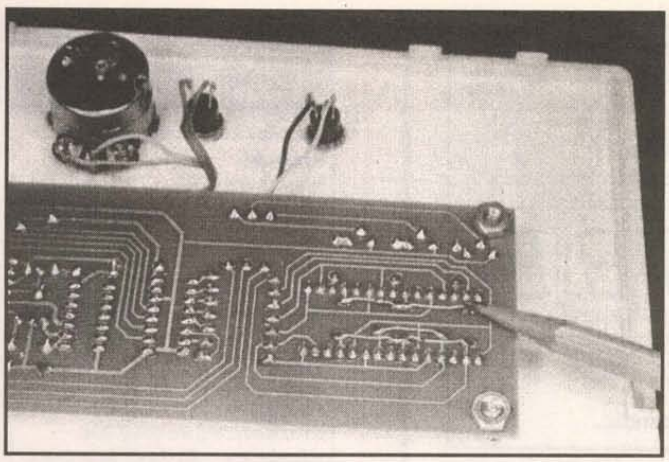


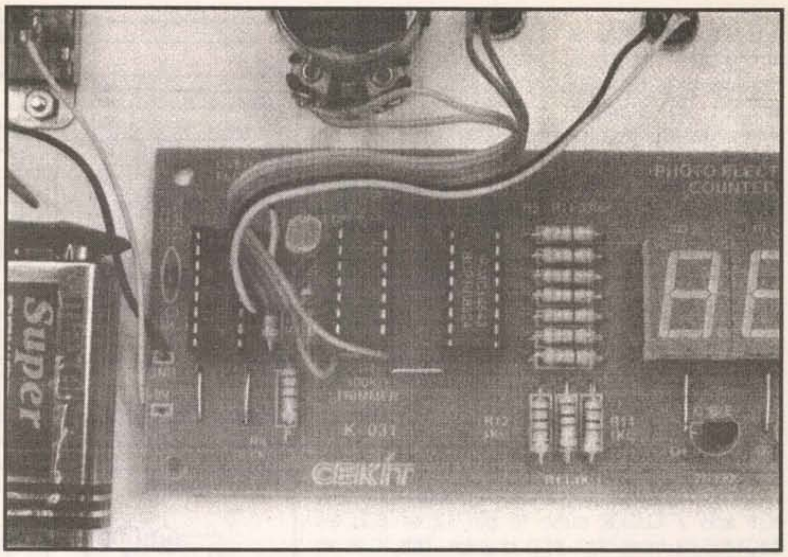
Figure 4: IC3 – CD4543B BCD to Seven-Segment Latch/Decoder/Driver.

In this circuit, these transistors all have positive voltage applied to their emitters, but they will not conduct current unless there is a lower voltage (negative bias) on their base. Looking at Figure 1, we see that pins 2, 1, and 15 of IC2 each go to the base of one of the transistors. When these pins are HIGH, the associated transistor is OFF.

However, as previously discussed, each of



Five jumpers are needed for the displays to operate properly. If you don't put these jumpers under the displays, they may be put on the etched side of the PC board.



Three integrated circuits and a photocell are the brains and trigger of the Photo-Electric Counter.

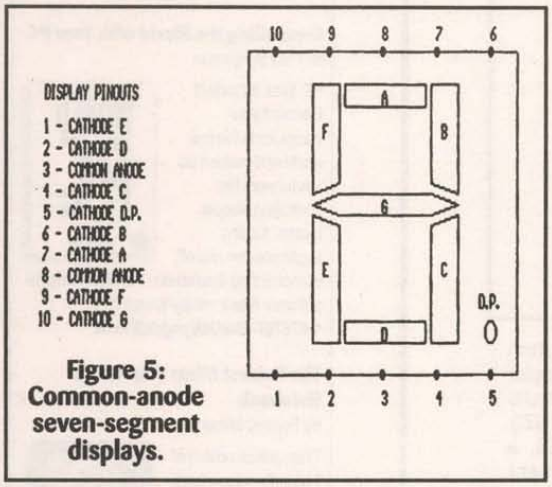


Figure 5: Common-anode seven-segment displays.

these pins goes LOW when they are cycled by the IC2 internal oscillator during the time multiplexing process. As each pin goes LOW, it switches the associated transistor ON, allowing it to conduct current to all of the segments of that digit, IF THE SEGMENT SEES GROUND! In other words, when the transistor is ON and any segment is LOW, that segment will light.

Since IC2 is providing the BCD code for each digit simultaneously with the multiplexing of the transistors, and IC3 is latching and converting this code to the seven-digit segment code in step with the multiplexing, each display lights the appropriate segments for the decimal digit to be shown as its associated transistor is turned ON. The sequence is Display 1, Display 2, Display 3.

Resistors R5 to R11 are used to limit the current to each display segment. Because of multiplexing, each segment is lighted only about one-third of the total time, but the transition between digits is so fast that the eye does not see any flickering. Later, under "Troubleshooting," we'll show how to slow down the multiplexing frequency for closer observation of this action. This all may seem confusing on first reading. Read it again, referring primarily to Figure 1, and it should make more sense. However, the circuit works even if you DON'T understand it!

Assembly

If you purchase the $24.95 kit indicated in the Parts List, all the parts you need – especially the "hard-to-find" parts – are supplied, and an etched and drilled silk-screened printed circuit board is included. This makes assembly a less-than-one-hour job. Also included with the kit are sockets for the three integrated circuits, a nine-volt battery snap, wire for jumpers, and solder, as well as assembly instructions.

If you desire to build this project from scratch, Figure 6 shows the printed circuit board layout, and Figure 7 shows the parts layout using this board. While a printed circuit board is not required, it can save a lot of wiring errors, especially in regard to the displays and ICs. The resistors, switches, and transistors are easy to find. However, the integrated circuits (especially IC2 and IC3), the photocell, and the displays may be hard to locate. The Parts List shows possible sources.

Use care in assembly regarding parts placement and soldering. Many of the pins are only one-tenth of an inch apart, so be careful to avoid unintentional solder bridges. NOTE: Be sure to install all 11 jumpers shown silk screened on the PC board, including five UNDER the displays!

We didn't notice that these jumpers were needed until AFTER the displays were soldered to the board, so we had to figure out where they went and then soldered them on the back (printed circuit side) of the PC board!

When wiring to the potentiometer, R1, you only need to connect to two of the three terminals, since R1 acts as a variable resistor in this circuit. One wire goes to the center terminal. Holding the potentiometer with the back facing you and the terminals at the bottom, connect the other wire to the right terminal. This will give your light maximum sensitivity when the potentiometer shaft – looking from the front – is rotated fully clockwise.

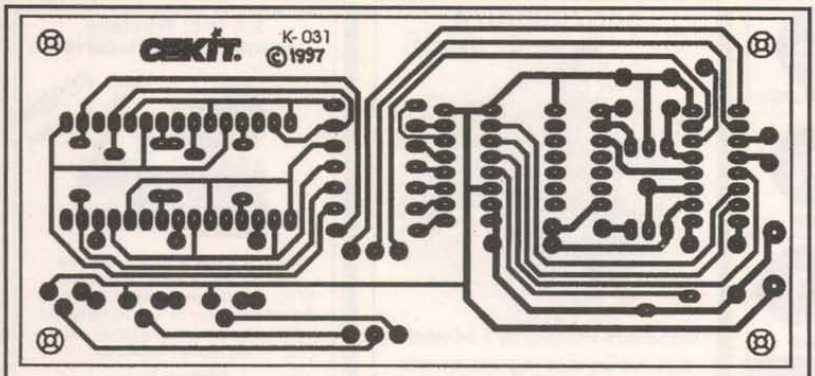


Figure 6: Printed Circuit Board Layout.

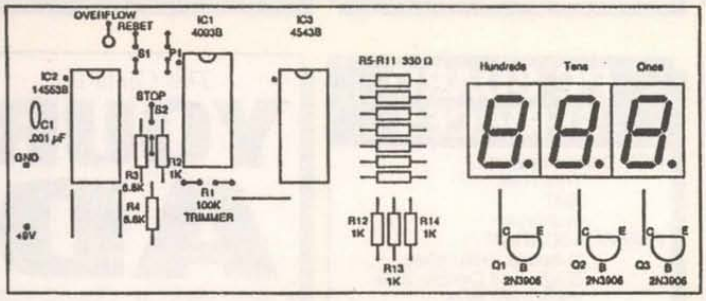


Figure 7: Parts Layout.

Parts List and Sources

C1 - .001 mF 50V ceramic disk capacitor
DISP1, DISP2, DISP3 - Common-anode seven-segment .56-inch high red LED display (NTE3078)
IC1 - CD4093B Quad Two-Input NAND Schmitt-Trigger (NTE4093B)
IC2 - MC14553B Three-Digit BCD Counter (NTE4553B)
IC3 - CD4543B BCD to Seven-Segment Latch/Decoder/Driver (NTE 4543B)
P1 - Photocell (RadioShack 276-1657; five styles/$2.29)
Q1, Q2, Q3 - 2N3906 PNP silicon transistor
R1 - 100K linear potentiometer
R2, R12, R13, R14 - 1K 1/4-watt resistor
R3, R4 - 6.8K 1/4-watt resistor
R5 to R11 - 330 ohm 1/4-watt resistor
S1, S2 - Normally open push-button switch
Miscellaneous: Etched/drilled/silk screened printed circuit board, jumper wires, nine-volt battery snap, one 14-pin IC socket, two 16-pin IC sockets, solder.

ALL of the above parts are included in the "CEKIT #K-031 Photo-Electric Counter Kit" available from **Centerpointe Electronics, Inc.,** 5421 Lincoln Avenue, Unit A6, Cypress, CA 90360, (800) 422-1100. The price is $24.95 plus $7.95 shipping, and 7.75% sales tax for California residents.

Centerpointe offers many other kits. See their web page on the Internet at www.shopsite.com/kits/. This particular kit is shown at www.cpcares.com/prod85.html.

The parts listed above as NTE are available from **NTE Electronics, Inc.** Call (800) 631-1520 for local distributor, price, and delivery.

Packaging

We decided to assemble the printed circuit board into a white plastic VHS video cassette tape case, as shown in the photos. We decided to mount everything on the inside of the case lid. We cut a rectangular hole for the displays, used four mounting screws to hold the PC board in place, and mounted the two switches and the potentiometer. The battery is held in position with double-sided tape.

The battery draws considerable current (about 55 milliamperes at nine volts), so we added a simple slide switch to turn it OFF when not in use. This was more convenient than opening the case and unsnapping the battery connector.

You may prefer to power the counter externally, and this works fine. We found it worked well down to five volts (using only 20 milliamperes), and a regulated power supply was not required. A standard six- or nine-volt DC wallplug type of power supply worked fine.

Testing the Counter

There's nothing much to testing the counter. Connect the battery or external power and all three digits should light, showing "0" for each digit. This tests all the LED segments except the center bar, G.

Dim the lights, or go in a closet, and use a flashlight for testing. The digits should increase one count each time the light shines on the photocell. Note that counting occurs NOT when the light beam is broken, but when the beam strikes the photocell again. It is easy to verify this. Shine a flashlight beam on the photocell, then cover the photocell with your finger (no count), and then uncover the photocell so the beam shines on it again (up one count).

The potentiometer has a definite effect on the counter's light sensitivity. Turn it clockwise to MAX sensitivity for a weak light source, counterclockwise to MIN for a strong light source. Watch the digits until they advance reliably after each resumption of the light path after interruption.

High ambient light can make counting unreliable since the photocell is very sensitive. It is best to use a light source aimed directly at the photocell. If ambient light remains too high, and interruption of the light source does not trigger a count when the interruption is removed, extend a one-inch long black tube over the photocell to shield it from external ambient light.

The HOLD button may cause the digits to advance several counts whenever it is pressed. This is most common when the photocell is in complete darkness, or when the sensitivity control is turned to minimum sensitivity with some light on the photocell. This effect can be used to advance the digits manually to test all digit segments. The RESET button returns all digits to zero.

More Digits?

As mentioned earlier, an overflow condition (the next count after 999) causes pin 14 of IC3 to go HIGH. If this pin is connected to pins 2 and 3 of IC1 of an identical photo-electric counter using a common power supply, this will allow you to count up to three additional digits (999,999). The first three digits will be the added counter. Since the added counter ALSO has an overflow, you can add three MORE digits in the same manner with a third photo-electric counter, for a total count of 999,999,999!

Troubleshooting

Suppose, when you add power, none of the digits light! Check the wiring to the switches and potentiometer to see that you don't have them mixed up. Careful as we were, this happened to us! We moved the wires to the right place and some display segments lighted, but others didn't. This is when we discovered – by tracing circuit paths on the PC board, and referring to the display pinouts shown in Figure 5 – that we had omitted five jumpers that should have been put in place under the displays.

Of course, other things can go wrong. Be sure the transistors and ICs are oriented properly, and that the right values of resistors are where they should be. Voltage and ohmmeter checks can be useful. An oscilloscope can be used to see the multiplexing action on pins 2, 1, or 15 of IC2.

If any of the displays are not lighted, check the path from IC2 pins 2, 1, and 15 through transistors Q3, Q2 and Q1 to see if the multiplexing signal is switching between displays. To slow this action down so you can see the switching of each display, temporarily put a .22 mF capacitor across C1. If you use a 1 mF capacitor across C1, you can see each display light separately for several seconds.

If any segment does not light for ALL three displays, trace the path for that segment back through its current dropping 330-ohm resistor to the proper output pin of IC3. Look for poor solder joints or solder bridges. Generally speaking, unless badly handled or treated, the ICs, transistors, or displays are most likely NOT at fault. **NV**

Continued from page 10

REQUESTED
HIGH "TEC" REFRIGERATOR SOURCES FOR THE TEC DEVICE

After receiving several inquiries about where author Kenton Chun purchased his TEC device from for the August '99 article, we asked Kenton to put together a list of sources.

Dear Nuts & Volts:

Here are some surplus dealers known to carry Peltier modules. If you need one or two modules to experiment with — these outfits may be easier to buy them from than from the manufacturers. But don't be surprised if you can buy new modules from a manufacturer for the same or even lower prices than from the surplus outfits.

All Electronics, 1-800-826-5432, FAX 818-781-2653. E-Mail: allcorp@allcorp.com, Web: http://www.allcorp.com. Fall 1996 catalog 596 shows two 127-couple devices. One is 1.18" square for $17.00. The other is 1.57" square for $26.00. No minimum order. Takes charge cards.

Alltronics, 408-943-9773, FAX 408-943-9776. E-Mail: ejohnson@alltronics.com, Web: http://www.alltronics.com. Catalog 961 shows a 1.1875" square unit for $24.95 and a 1.56" unit for $34.95. Specs are not listed.

American Science & Surplus, Skokie, IL; 847-982-0870, FAX 1-800-934-0722. Catalog 100 dated 1/97 shows two units, 3-12VDC, #22627 1.17" sq. x 0.12" thick $25.00, #89143 1.56" sq. x 0.15" thick $35.00.

Gateway Electronics, 8123 Page Blvd., St Louis, MO 63130; 1-800-669-5810, 314-427-6116, FAX 314-427-3147 (10/97). Web: http://www.gatewayelex.com. Web site shows 127-couple modules, documentation included. Small module $20.00 (approximately 1.17" x 1.17" x .12"). Large module $29.50 (approximately 1.56" x 1.56" x .15").

Javanco, Nashville, TN; 615-244-4444, FAX 615-244-4446. E-Mail: javanco@javanco.com. Web: http://www.javanco.com. Web site catalog lists a 71-couple unit, 8V, 3.4A, 59C Temp differential, 18W, for $16.95.

Marlin P. Jones, Lake Park, FL; 1-800-652-6733. Web: http://www.mpja.com. Catalog 1996 shows a 71-couple, 8V, 3.4A unit for $16.95.

Shreve Systems, 1200 Marshall St., Shreveport, LA 71101. 1-800-227-3971, Fax 318-424-9771. Web: www.shrevesystems.com. 1-3/16" x 1-3/16", $10.00 each or three for $25.00.

Kenton Chun

Continued on page 83

Servos, Steppers, and Optical Encoders — Part 2

by TJ Byers

Which one works best in your robotic or R/C project? Here's everything you need to know. This month: Bipolar stepper motors.

Whether you play with robots, model planes, or boats, there are motors inside which supply the muscles and habits that make them go. Choosing the right motor for your project, though, can be a daunting experience. Motors that provide locomotion aren't the same as those that move robotic arms or pilot a plane.

Basically, controller motors come in three flavors: servos, steppers, and encoders.

Last month, I did an in-depth study of servos. In that article, you discovered that servos are actuators — motors that move robotic elbows and grippers — whereas stepper motors are free-spinning, like car engines. This month, we look at bipolar stepper motors — the movers and shakers of robotics and R/C.

Stepper Motors

Stepper motors are often used in robotics and R/C models to provide locomotion for the device. Stepper motors are preferred over standard hobby motors because they can be precisely controlled. The speed and torque of a hobby motor is directly proportional to the applied voltage — the higher the voltage, the faster it spins and the more power it can deliver.

Stepper motors, on the other hand, are digitally controlled. The speed and power is proportional to a digital input code. Stepper motors are used in applications where precise torque and motor speed control are required, as in:

- Robotics locomotion
- R/C aircraft/boat propeller speed
- X/Y positioning
- Tool feed for lathe and milling machines
- Disk drives

There are two basic types of stepper motors: permanent magnet and variable reluctance. Permanent magnet motors are further divided into bipolar and unipolar types. Both permanent-magnet motor types consist of a rotating magnet, attached to a rotor shaft, surrounded by a circle of stator coils (Figure 1).

When a coil is energized by running current through it, it creates an electromagnet in that particular stator pole. This causes the permanent magnet to spin and align with the electromagnet, where it stops. By properly sequencing the polarity of the electromagnets, we can make the rotor spin — one step at a time. Hence the name, stepper motor. The speed at which this sequencing takes place controls the speed of the rotor. The stepper motor type — bipolar or unipolar — is determined by the way the coils are wired together.

Before the advent of high-power ICs, the unipolar stepper motor almost exclusively dominated the stepper motor market because of its simpler controller electronics. Today, that scenario has changed, and bipolar stepper motors are all the rage for several reasons. That's not to say that unipolar steppers are out of the running, because they're not. They are every bit as popular as ever. But bipolar motors have several advantages over unipolar, and are gaining ground. Table 1 shows how they compare.

Bipolar Stepper Motors

Bipolar stepper motors are so named because of the way the electromagnetic stator polarities are sequenced. The stators are wired according to Figure 2, where coils A and B are in series, and coils C and D are in series.

Basically, there are three ways to spin the rotor: One-Phase-On (full-wave), two phase, and half step. All three modes use the wiring configuration shown in Figure 2.

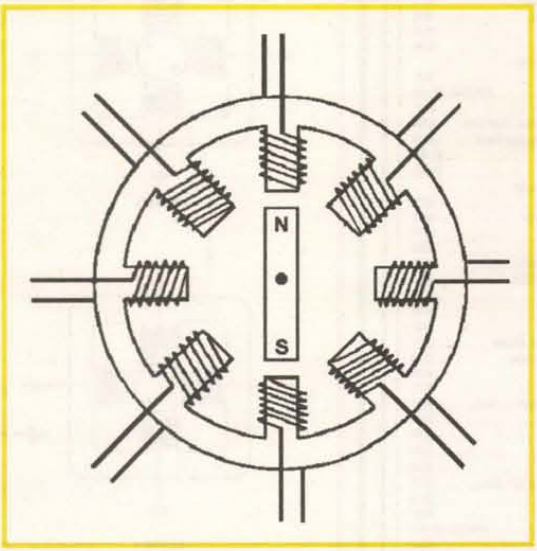


Figure 1. Permanent-magnet stepper motors consist of a rotating magnet surrounded by a circle of stator coils.

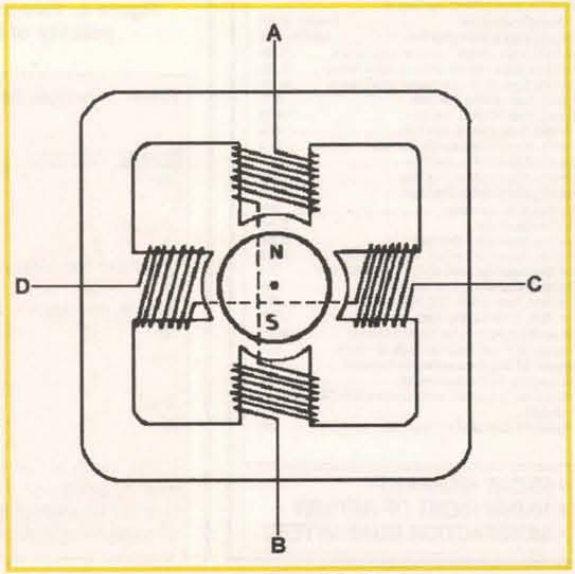


Figure 2. In bipolar stepper motors, the stators are wired so that coils A and B are in series, and coils C and D are in series.

Full-Wave Step

In the One-Phase-On (full-wave) mode, current initially flows through coils A and B, which are wound in such a way that the top stator is polarized south and the bottom stator is polarized north. The rotor magnet aligns itself with the south pole up and the north pole down (Figure 3). Coils C and D are disconnected — or off. This is Phase 1.

In the next phase (Phase 2), A and B are turned off, and C and D are energized to create a north pole on the right and a south pole on the left, causing the rotor magnet to rotate clockwise by 90 degrees.

Phase 3: C and D are turned off, and voltage is applied to the A and B coils — in the opposite polarity of Phase 1. This forces the magnet to rotate another 90 degrees clockwise. Notice that the rotor magnet is now facing the opposite direction of Phase 1. The next, and final step (Phase 4), is to disconnect A and B, and energize C and D with an opposite voltage. The sequence then repeats itself with Phase 1.

Two-Phase Step

In the Two-Phase mode (sometimes called the Normal mode), both the AB and CD coils are energized at the same time. While the number of steps are the same as for one-phase-on — four per rotation — the angle of the rotor magnet is at the corners of the compass rather than the up-down orientation outlined above. This mode produces the highest torque — obviously, because you have twice the current flowing through the motor. The sequence is as follows (Figure 4).

Positive voltage is applied to both the AB and CD coils, which polarizes both of their upper-right stators north. Without a clear loca-

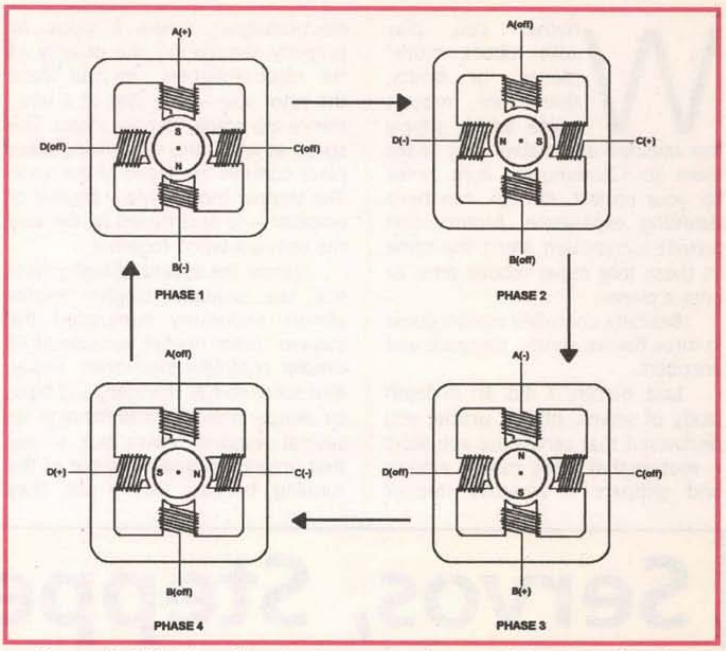


Figure 3. Full-Wave bipolar stepper motors work by reversing the polarity of the drive voltage across alternate stator coils.

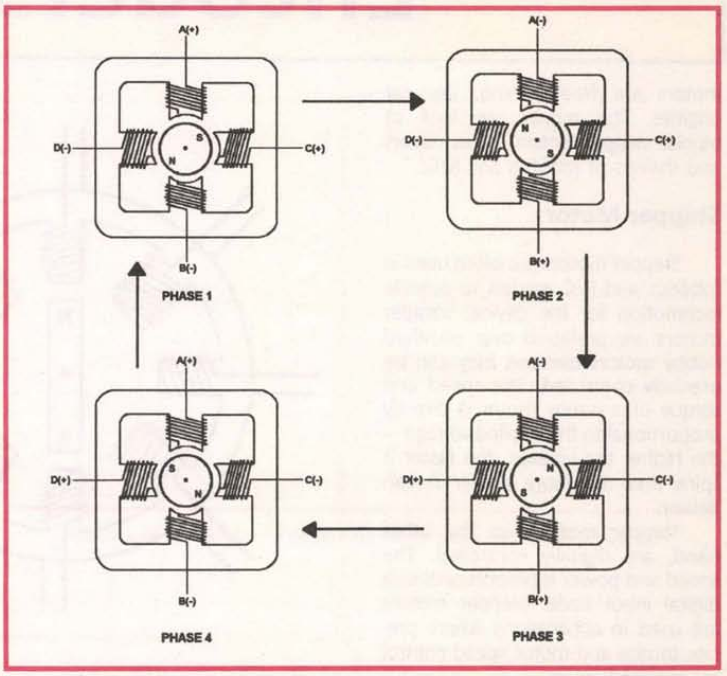


Figure 4. Two-Step bipolar stepper motors work by reversing the polarity of the drive voltage across adjacent stator coils.

Table 1. Stepper Motor Comparison

Bipolar	Unipolar	Variable Reluctance
Speed		
5	5	10
Torque		
10	5	4
Controller complexity		
5	10	10
Position stability		
10	10	3
Price		
7	5	10
Total		
37	35	37

The numbers are on a scale of 1 to 10, with 10 being best. For example, the bipolar (10) stepper has twice the torque of a unipolar (5) stepper motor.

tion to lock onto, the rotor magnet seeks out a middle ground, which is halfway between the poles. This is Phase 1. The A and B coils now reverse polarity (Phase 2), which forces the rotor magnet clockwise to 4:30 o'clock. Phase 3 reverses the C and D coil polarity, and we end up at Phase 1 with the next voltage polarity reversal.

Half-Step Operation

While the Two-Phase stepping mode provides a huge gain in torque, it still lacks resolution. Like the Full-Wave mode, the best you can do is control the motor in increments of 90 degrees.

For many applications, this is too

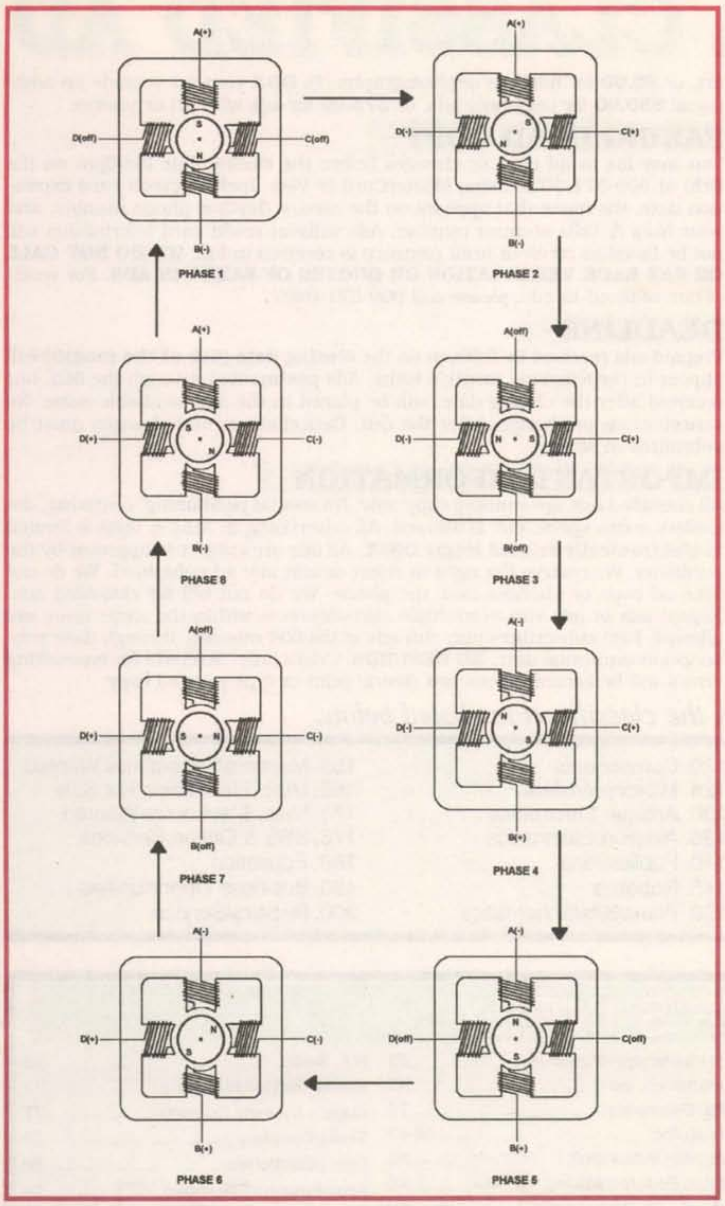


Figure 5. Half-step operation provides the highest resolution.

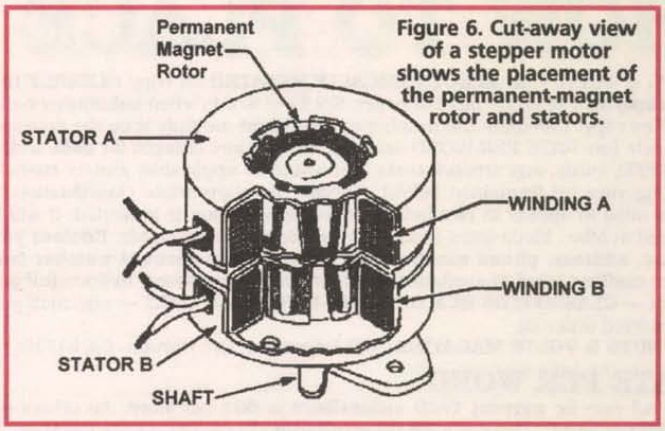


Figure 6. Cut-away view of a stepper motor shows the placement of the permanent-magnet rotor and stators.

coarse. What we need is a way to increase the number of steps per revolution. Enter the Half-Step controller. Basically, Half-Step operation is a combination of Full-Wave and Two-Phase. It goes like this (Figure 5).

Phase 1: Coils A and B are energized, coils C and D are off. The rotor magnet points to 12:00 o'clock. Phase 2: Coils AB and CD are energized at the same time. The rotor magnet points to 1:30 o'clock. Phase 3: Coils C and D are energized, coils A and B are off. The rotor magnet points to 3:00 o'clock.

Phase 4: Coils A and B reverse polarity. The rotor magnet points to 4:30 o'clock. Phase 5: Coils A and B are energized for opposite polarity of Phase 1, coils C and D are off. The rotor magnet points to 6:00 o'clock.

Well, you get the pattern. Using this method, the number of steps per revolution is increased from four to eight.

Of course, these examples were selected for the sake of argument only. Real world stepper motors have far more steps per revolution —typically in increments of 7.5 and 15 degrees, with some steppers having a resolution as high as 0.9 degrees per step.

The number of steps is determined by the construction of the motor, which has more than four stator poles (Figure 6). The principle of operation and drive sequences remain the same, though.

Coming Next Month

That's all the room I have for this month. Next month, I'll describe the electronics needed to make these motors spin. Stay tuned, there's a lot more to come. **NV**

Table 2. Permanent-magnet stepper motor operating modes.

Operating Mode	Comments
One-Phase-On (full-wave)	Easy to implement, lowest torque
Two-Phase (normal)	Easy to implement, highest torque
Half-Step	Highest resolution, medium torque

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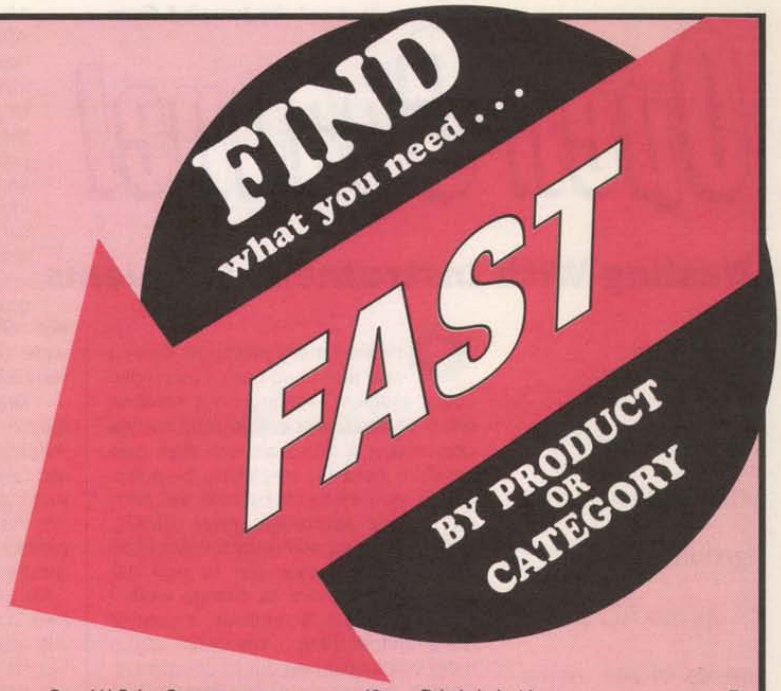

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by Joseph J. Carr

Open Channel

Dealing With Instrument Problems

My problem was that I relied on the ground connection in the AC power cords of the instruments. After all, it seems to make sense, doesn't it? The third-wire ("green") inside the power cord is connected to ground in the AC outlet and to the chassis in the equipment.

One time many years ago (so long ago that I had hair), I had a particular problem working on a sensitive piece of medical-scientific instrumentation. It was a microvolt level high gain amplifier used for amplifying biopotentials. I was trying to balance the common mode adjustment ratio (CMRR), but kept getting odd results. It would be in balance and then not so well balanced, and seemed to change while I was watching it. Sometimes, it seemed like a random thing ... the CMRR adjustment would just pop out of adjustment. Darned disconcerting, but there was a solution.

The main problem was that the grounding of the instruments being used was defective. Figure 1 shows the basic set-up, but with correct grounding. To make a CMRR adjustment on a differential amplifier (one would not make such an adjustment on a single-ended or unbalanced amplifier), it is necessary to tie both inputs together, and connect them to the output of a signal generator. This is done because the CMRR is the ratio of the differential gain to the common mode gain, and common mode signals are those which affect both inputs equally.

The signal generator output is set to some convenient high level (e.g., 100 mV, 500 mV, or 1 volt), and then null the output signal on an AC voltmeter or oscilloscope. The procedure is repeated several times at increasingly sensitive settings of the meter or 'scope input channel until no further improvement is possible.

My problem (stupid me!) was that I relied on the ground connection in the AC power cords of the instruments. After all, it seems to make sense, doesn't it? The third-wire ("green") inside the power cord is connected to ground in the AC outlet and to the chassis in the equipment. The problem is noise on the ground line and ground loops. As the AC loading changes, the amount of leakage current flowing in the ground line also changes. Because the amplifier was so sensitive, these tiny little ground loop currents gave rise to non-common mode signal voltages that were right in the range the amplifier wanted to see.

Drat! Actually, I knew better. The reason why the manufacturers of the medical equipment and the bench instruments I used to make the adjustment provide chassis ground terminals on the front panels (sometimes rear panels) is to help dummies like me. The ground scheme shown in Figure 1 is a "star ground." The attribute of interest here is that the chassis grounds and signal commons of all instruments – including the amplifier under test – are grounded to a single point. Make the ground wire as heavy and as short as possible.

The lesson of star grounding also should apply to operation of an instrumentation system. I've seen medical and scientific researchers plagued by noise and other problems that were easily avoidable. Sometimes, when you connect a group of very good instruments together improperly, grounding problems make them behave poor collectively.

Preamp Goes a Long Way

One physiologist I worked with was using a small strain gauge sensor to measure the contractions of a guinea pig heart. The sensor was calibrated in force units of one to two grams maximum. What? You say grams as mass not force? In that instrument the gram-force unit was used, i.e., the force of gravity on a mass of one gram (about 960 dynes). The innards of the sensor was a set of piezoresistive strain gauges in a classical Wheatstone bridge. It has a sensitivity of 20 µV/gm-force. The typical deflection was about 0.2 gm-force, so the output voltage was typically about 4 µV.

The good doctor was taking the 4 µV output of the sensor through a pair of shielded cables to the differential input of a high gain oscilloscope. Actually, the amplifier was the normal two channel oscilloscope vertical amplifiers, and he used it in the A-B mode, simulating (but not exactly) differential operation. The CMRR was atrocious, and he was showing a large 60-Hz hum on the output trace. He asked us to fix the problem.

My solution was to build a simple DC differential preamplifier from an

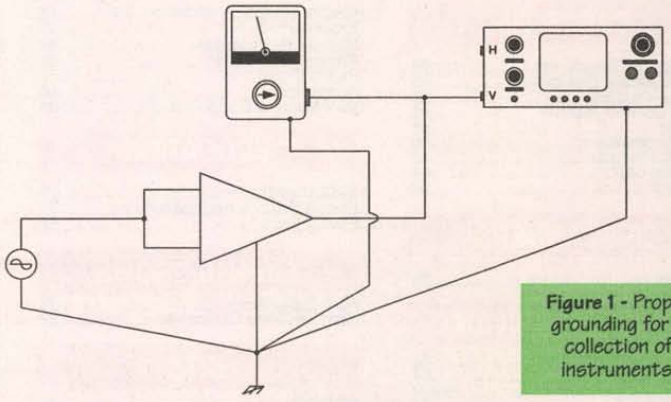


Figure 1 - *Proper grounding for a collection of instruments.*

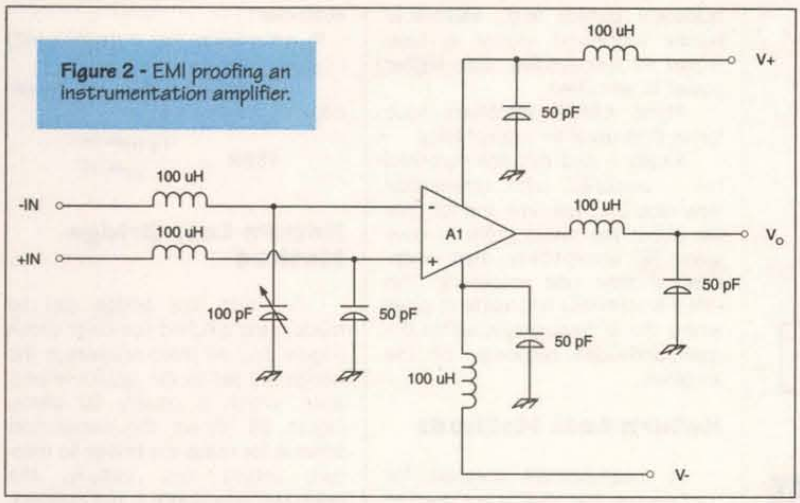


Figure 2 - EMI proofing an instrumentation amplifier.

op-amp. With a gain of X200, it boosted the 4 µV output of the sensor to about 800 µV. Still small, but good enough. With the preamplifier mounted right on the sensor body (through a common connector), the signal could be sent single-ended through shielded cable to the oscilloscope ... and the 60 Hz disappeared.

A couple weeks after I solved the problem (for about $50.00 in parts and shop labor), the scientist called me and asked for a technical description. I typed up about a half page and gave him a hand drawn schematic. He then asked me for "... a bit more ... maybe four or five pages." Hmmmm ... how do you cram half a page worth of text into four or five pages?

Well, you spend a lot of time talking about basic op-amp theory. About a year later, he handed me a pile of reprints "... from our article." It seems that "we" had published a technical note in a physiology journal. I protested that it was too simple, and most hobbyists could easily do that chore for him. His reply: "... but most physiologists couldn't ... they would've spent $1,900.00 for the correct preamplifier from a scientific supply house ... and I didn't have the money in my grant."

Power Line Noise

In the same medical center, we once flunked the entire freshman class of medical students on their physiology exam. Also failed were all of the basic sciences (i.e., PhD) students and allied health students (e.g., nurse anesthesia, nurse practitioner, physicians assistant). Those people are about "up-to-here" with stress their first year in medical school so the profs hoped that the results would not get out until we solved the problem. It turned out to be power line noise.

In those days, computing was mainframe computing. The examination was taken on "mark sense" optical scanner paper. You know the stuff ... "use a No. 2 pencil and completely blacken the desired box." In our case, the optical scanner was connected to a keypunch machine. To younger readers: A keypunch was a noisy, clunky machine that looked like a typewriter on steroids that punched the holes in old-fashioned computer cards. The cards were then taken to the computer center for processing overnight. When the computer print-out paper was returned, the grades were recorded (manually!) and the paper posted for all to see.

The problem came to light when one of the engineers I worked with noticed that one column on the computer card had all digits punched out. There is no EBCDIC code that has all digits punched out in a single column. The problem was traced to high-voltage power line transients arising from loading shifting switching gear in the basement. It seems that the local power company gave the university a two-percent break on the electric bill if they installed equipment that would periodically balance the load between the three phases (which makes for more efficient operation). Unfortunately, the triac switches tossed huge (>2KV) transients that averaged 50 to 100 microseconds.

The solution to the problem (we couldn't rewire the building or turn off the load switchers) was to place a Topaz isolation transformer between the power line and the optical scanner and keypunch machine. These transformers are specially designed to snuff power line noise (today, we might use a computer surge suppressor for many such applications).

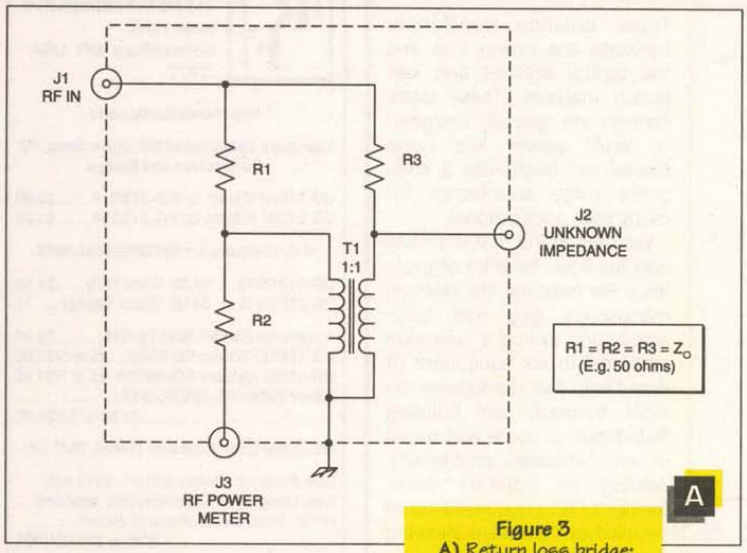
We then found that the noise was the basis for a lot of problems. For example, the electron microscope guy had been attempting to find a "vibration problem" in his equipment (it didn't help that the subway ran right beneath our building foundation ... so he was tuned in on "vibration problems"). Adding an isolation transformer to his equipment cured the little glitches that were showing up in the pictures he took.

Still another guy was almost comical. He was a hematology researcher, i.e., he knew more about human blood than anyone else. He had a high-priced microscope that had a special light source. It was a glass tube that had been evacuated, and then refilled with a special combination of rare gases that each gave off a different color light when ionized. There were about a half dozen electrodes on the tube that each had to see a different voltage.

The poor guy had to spend 45 minutes anytime he wanted to use the microscope balancing the voltages on these interactive electrodes ... it was a touchy thing, I suspect. Once in awhile, usually (as Murphy's law dictates) when he could ill afford the time, a power line transient would commutate the tube, extinguishing the light. After cursing and yelling at his Graduate Research Assistant (GRA), he would spend another half hour to 45 minutes redoing the job. When we gave him an isolation transformer, it solved both his technical problem and the GRA's blood pressure problem.

EMI Problems

A large number of scientific



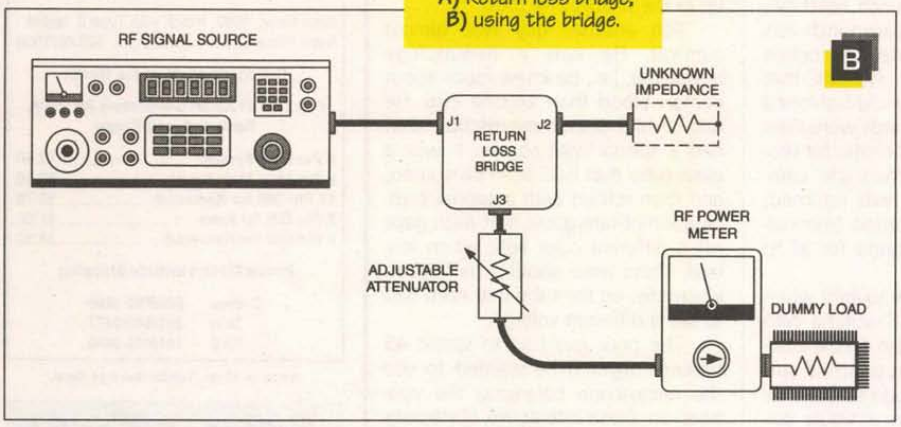


Figure 3
A) Return loss bridge;
B) using the bridge.

instruments use differential amplifiers in the front-end. Figure 2 shows some of the things one can do to protect these amplifiers against electromagnetic interference (EMI). The inductors and capacitors form L-section low-pass filters. Each consists of a 100 µH inductor and a 50 pF capacitor. The capacitors should be placed as close to the pins of the IC amplifier as possible. Note that one of the input line filters contains a variable capacitor. This is a trimmer capacitor and is used to balance the circuit for minimum output voltage offset when an interfering RF signal is applied to the inputs.

A friend of mine in the semiconductor industry provided the circuit in Figure 2, along with some advice on circuit design features that help reduce the susceptibility of the amplifier to electromagnetic interference.

First, if the internal circuits of an amplifier are biased close to one end of their ranges, then EMI susceptibility is increased. The solution is to select circuits in which the transistors are biased in the middle of their ranges. There is less likelihood of the circuit being driven into nonlinearity.

Second, IC amplifiers with low quiescent current (e.g., low-power bipolar amplifiers) appear to have higher RF susceptibility than higher power IC amplifiers.

Third, CMOS amplifiers have lower than usual RF susceptibility.

Finally — and this one surprised me — amplifiers with symmetrical slew rates (i.e., rise time and fall time are about the same) seem to have lower RF susceptibility than asymmetrical slew rate amplifiers. This effect is especially noticeable in cases where the RF frequency is within the gain-bandwidth response of the amplifier.

Return Loss Methods

A measurement method for transmission lines that is not used as often as VSWR measurements is return loss. Return loss is the comparison of the forward and reflected signals, as expressed in decibels (dB). It compares an unknown impedance with a known impedance, and then reports the degree of mismatch or match in both phase and magnitude. When the match is perfect, then the return loss is infinite and, when all of the forward power is reflected (as in a shorted or open load), the return loss is minimized ($P_r = P_R$). In addition, the same method is used for characterizing filters and other load-sensitive circuits.

Power Meter Method

The definition of return loss is given by:

$$Return\ Loss = 10\,LOG\left[\frac{P_F}{P_R}\right] \text{dB}$$

This equation suggests a simple method for measuring return loss: Compare the forward and reflected power using a directional RF wattmeter. The actual return loss of the load is the indicated return loss less twice the known transmission line loss (when return loss is measured at the transmitter end of the line).

Return loss can also be used to determine reflection coefficient and VSWR. We can write the return loss expression as:

$$Return\ Loss = 20\,LOG\,|\Gamma|$$

To determine reflection coefficient, we need only solve for Γ:

$$|\Gamma| = 10^{(RL/20)}$$

Where:
Γ is the voltage reflection coefficient
RL is the return loss in decibels (dB)

To determine VSWR from knowledge of the return loss:

$$VSWR = \frac{1+10^{(RL/20)}}{1-10^{(RL/20)}}$$

Return Loss Bridge Method

A return loss bridge can be made using a hybrid combiner circuit (Figure 3A). All three resistors in the bridge are set to the system impedance, which is usually 50 ohms. Figure 3B shows the connection scheme for using the bridge to measure return loss. Initially, the unknown impedance is not connected to the UNKNOWN IMPEDANCE port (J2) of the return loss bridge. An RF signal source is tuned to the frequency at which the measurement is made.

The signal source might be a signal generator, a special high power source, or a transmitter. The idea is to get enough RF power to the RF power meter so that small levels of reflected signal power can be measured on the selected meter. A step attenuator is in the line between the RF POWER METER port (J3) of the bridge and the RF watt-meter. Set the power level from the source so that a relatively large amount of attenuation is required to bring the watt-meter to some value in the upper half of its scale.

With the unknown impedance disconnected, measure the RF power appearing at the RF POWER METER port (J3). Once this value is recorded, connect the unknown load impedance (which might be an antenna) and again measure the RF power. When measuring this reflected power, it may prove necessary to adjust the step attenuator to get a good reading. The value of the attenuation must be accounted when making this measurement.

An equal deflection method could also be used in this measurement. Set the attenuator to a high value that produces a reading at a recognizable point on the meter (e.g., a calibration point, full-scale, or some other repeatable point). Note the amount of attenuation required. Connect the unknown impedance to J2 on the bridge, and the power indication on the meter will drop. Adjust the attenuator until the meter again reads the same value as before. The difference in the settings of the attenuator required to make the two readings is the return loss. **NV**

Connections ...

I can be reached by snail mail at P.O. Box 1099, Falls Church, VA 22041, or via E-Mail at CARRJJ@AOL.COM.

Events CALENDAR

Continued from page 20

MO - ST. LOUIS - Hamfest. St. Louis ARC & Gateway to Ham Radio Club, Steve Welton WB0IJN, 314-638-4959. E-Mail: slw@partyline.net
OH - MARION - Hamfest. Marion ARC, Karen Eckard N8KE, 740-499-3565.
E-Mail: meeker@gte.net
OH - MASSILLON - Hamfest. Stark County Fairgrounds. Talk-in: 147.18+ & 442.85. Massillon ARC, Don Wade W8DEA, 330-497-7232.
E-Mail: marc.hamclub@juno.com

NOVEMBER 1999

NOVEMBER 6

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
FL - SORRENTO - Hamfest. East Lake Chamber of Commerce Bldg. VE Exams. Talk-in: 147.255. Lake ARA, John Wentz W8HFK, 352-728-2615.
E-Mail: capias@gate.com Chuck Crittenden KE4EXM, 352-669-2075
IN - FORT WAYNE - Hamfest & State Conv. Allen County War Memorial Coliseum Expo Center. Sat: 9am-4pm, Sun: 9am-3pm. Talk-in: 146.88-. ACARTS, 219-484-1314.
Web: http://www.pipeline.com/~dagagnon/
KY - HAZARD - Hamfest. Kentucky Mountains ARC, John Farler K4AVX, 606-436-5354. E-Mail: jfarler@mis.net Web: http://www.geocities.com/SilliconValley/2564/kmarc.ht
NH - MANCHESTER - Hamfest. St. John Church. IRS, Paul K1LLX 603-432-1538.
E-Mail: K1LLX@juno.com
SC - MYRTLE BEACH - Beachfest '99. Old Myrtle Beach Air Force Base. 7am-2pm. Talk-in: 147.120 +600. Grand Strand ARC, Jim Wood KF4CJE, 843-238-0800. E-Mail: kf4cje@juno.com
Web: http://www.w4gs.org

NOVEMBER 6-7

GA - LAWRENCEVILLE - Hamfest. Gwinnett County Fairgrounds. Talk-in: 145.45- (PL 107.2), 444.25+ (PL131.8), 146.76- (PL 107.2). Alford Memorial RC, Hotline: 770-410-3989.
E-Mail: hamfest@totrbbs.radio.org
TX - ODESSA - Hamfest. West Texas ARC, Robert Jordan N5RKN, 915-335-7980. E-Mail: n5rkn@apex2000.net Web: http://www.wt5arc.org
Web: http://nonprofit.apex2000.net/hamfest/

NOVEMBER 7

KY - HAZARD - Swapfest. Hazard High School
MI - ST. JOSEPH - Hamfest. Blossomland ARA, Duane Durflinger KX8D, 616-982-0404.
E-Mail: comdac@comdac.com
Web: http://www.comdac.com/bara
WI - KAUKAUNA - Hamfest. Starlight Club. VE testing. Talk-in: 146.52 simplex. Fox Cities ARC, Chad Pennings N9PRC, 920-993-0485.
E-Mail: n9prc@kb9yq.ampr.org
Web: http://www.w9zl.ampr.org

NOVEMBER 13

AL - MONTGOMERY - Hamfest. Garrett Coliseum, South AL State Fairgrounds, Federal Dr. 9am-3pm. FCC exams. Talk-in: 146.24/84, W4AP. Montgomery ARC, Phil Salley K4OZN, 334-272-7980 after 5pm CST.
E-Mail: wb4ozn@worldnet.att.net
Web: http://jschool.troyst.edu/~w4ap/
CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves
NM - SOCORRO - Hamfest. Socorro ARA, Al Braun AC5BX, 505-835-3456.
E-Mail: ac5bx@juno.com Web: http://www.ees.nmt.edu/sara/homepage.html

NOVEMBER 13-14

IN - FORT WAYNE - IN State ARRL Convention & Hamfest. Allen County AR Technical Society, Doug Jones N9NNT & Jim Boyer KB9IH, 219-484-3317. E-Mail: djones2233@aol.com
Web: http://www.pipeline.com/~dagagnon/

NOVEMBER 14

NY - FARMINGDALE - Hamfest. Radio Central ARC, Neil Heft KC2KY, 516-737-0019. E-Mail: nheft@ibm.net Web: http://www.li.net/~n2mdq

NOVEMBER 19-20

MS - OCEAN SPRINGS - Hamfest. St. Martin Community Center. Fri: 5-9pm, Sat: 8am-2pm. VEC testing Sat: 11am. Talk-in: N5OS 145.11-. West Jackson County ARC, Phil Hunsberger W9NZ, 228-872-1499. Stan Hecker N5SP, 228-875-0222

NOVEMBER 20

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
CO - GOLDEN - Hamfest. Jefferson County Fairgrounds, 15200 W. 6th Ave. 8am-2pm. VE testing. Talk-in: 144.62/145.22. Rocky Mountain Radio League, Inc., Ron Rose N0MQJ, 303-985-8692. E-Mail: n0mqj@arrl.net
MA - NEWTONVILLE - Auction. Masonic Hall, second floor, 460 Newtonville Ave. 11am-4pm. WARA/1200 RC, Eliot Mayer W1MJ, 617-484-1089. E-Mail: W1MJ@amsat.org Web: http://our world.compuserve.com/homepages/emayer/auct
OH - GEORGETOWN - Hamfest. Grant ARC, Gordon Neal W8YGW, 513-379-1659.
E-Mail: wb8ygw@juno.com
Web: http://www.qsl.net/~n1djs

NOVEMBER 20-21

FL - TAMPA - Suncoast Hamfest, FL State ARRL Convention. State Fairgrounds, Expo Hall. Florida Gulf Coast Amateur Radio Council, Jean Endicott KC4KZU, 727-525-5178. E-Mail: swaps@fgcarc.org Web: http://www.fgcarc.org

NOVEMBER 27

NC - GREENSBORO - Hamfest. Greensboro Coliseum Special Events Center. GGH, 336-851-1676. Web: http://www.sabwc.com/gsohamfest

NOVEMBER 28

CA - SANTA ANA - Swapmeet. ACP parking lot. Mary Russo 714-558-8813
NY - PATCHOGUE - Hamfest. Mid-Island ARC, Mike Grant N2OX, 516-736-9126. E-Mail: global cm@erols.com Web: http://www.qsl.net/mid-islandarc/hamfest.html

DECEMBER 1999

DECEMBER 4

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
GA - CLAXTON - Hamfest. Claxton ARES, John Perkins W4HYU, 912-739-4589.
E-Mail: w4hyu@juno.com
LA - MINDEN - Hamfest. Minden ARA, Lowell A. "Dusty" Collins KB5WFE, 318-371-0636.
E-Mail: dustyc@microgear.net Web: http://www.microgear.net/gwinford/mara.htm

DECEMBER 5

IN - GREENFIELD - Hamfest. Greenfield Central High School Pavilion, N. Broadway St. Talk-in: 145.330, 444.725. Hancock ARC, Tom Donaldson N9LFU, 317-326-3168

AMATEUR ROBOTICS NOTEBOOK

by Robert Nansel

This has been one long summer. I didn't discover until just before leaving on vacation that the code listings for my June column were omitted. Those of you who wrote to find out about TestA.asm, TestB.asm, and TestAB.asm will be glad to know you can download them from the MacRobotics website (www.MacRobotics.com).

I still don't have the I2C code for Breadbot working yet, though I do have a better appreciation of the amount of work it will take.

I just keep telling myself this multimaster I2C network idea is just too cool not to work, that it will ultimately simplify things, and I'll be able to build even cooler robots as a result.

Right now, though, it's made hash of all my scheduled projects. It seems a good idea to talk about my motivations for going through all this grief. First, some background.

Why Multimaster?

Life is pretty simple with single-processor robots — until you try to make them do anything modestly interesting or useful in anything like real time. With more complicated tasks, you quickly find out that mobile robots are inherently multitasking creatures that must juggle dozens of functions at once in order to do the job.

The controller must regulate motor speeds, process sensor data, and make high-level decisions on what to do next. Single-processor code that does all this tends to be complex — buggy spaghetti code that breaks when even minor changes are made to it.

One way to deal with this complexity is to factor out the separate functions, write code modules to handle each function, and then run each module as a separate process within a realtime operating system (RTOS). Depending on the RTOS and the robot, this may be the best approach provided the processor has enough horse power to handle the task-switching overhead.

Another way to approach the complexity problem (the one I've chosen) is to use separate, loosely-coupled processors to handle the individual modules. This has the advantage that you can completely isolate the behavior of each module from all the others.

Adding new modules won't directly affect the execution time of other modules, and you can use specialized processors tailored for certain tasks.

A disadvantage is that each processor must devote resources to interprocessor communications. Also, a module may depend on data that must come from another processor (and the sending/receiving delays that entails), and the system can be more complicated to develope code for and to debug.

Multiprocessor systems can be hard to program because defining exactly how the processors should interact with each other is not trivial.

The simplest multiprocessor system is a processor and coprocessor combination where the coprocessor performs well-defined operations in response to commands or data from the main processor and returns data to the processor indicating the results of the operations and the status of the coprocessor.

An MPU with a separate math coprocessor chip is an example of this type of system. A much simpler example is the microcontroller in every PC keyboard.

The defining characteristics of such coprocessors are they use dedicated ports to interface to the host processor, the interface protocol is point-to-point, and the protocol is very simple, typically involving simple hardware handshaking.

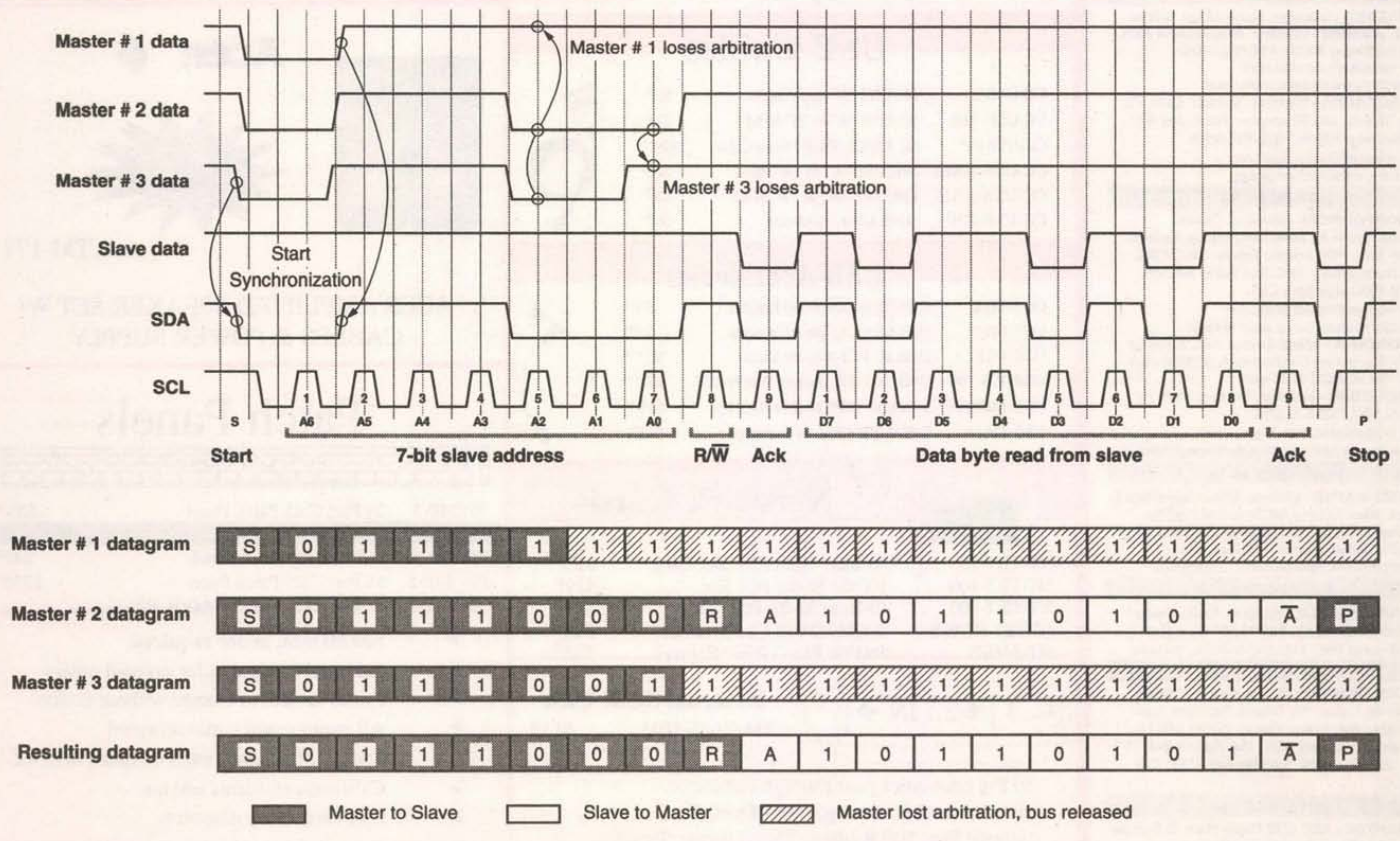


Figure 1: I2C Bus Multimaster Arbitration

Ties that Bind

Such tightly-coupled systems require the developer to know intimately the code and hardware of every processor in the system. Establishing the logical connection between the data one processor provides and another processor consumes is called binding.

In general, binding can occur at any stage in a system's development from initial design – early binding – to field configuration – late binding. Because processor/coprocessor architectures require very early binding, adding additional coprocessors always means a substantial code rewrite.

But what if you want a system that allows arbitrary expansion without rewriting code every time you add a new coprocessor module? Any early-binding system won't get you there unless you program it to handle every possible coprocessor add-on that you or others might devise; an unlikely prospect.

This applies to any tightly-coupled multiprocessing scheme regardless of the interface technology and is a direct consequence of early binding. In essence, early binding requires every module to know too much about every other module.

Publish and Subscribe

If early binding won't do the job, what about late binding? Late binding doesn't entirely remove the need for modules to know – or at least assume – details about each other, but it does reduce the amount and specificity of knowledge required. Such data hiding is highly desirable for systems where modules from different developers will be combined.

The ideal is a peer-to-peer network architecture where each processor is treated equally. It's not enough, however, for a module to conform to the interface protocol, to know how to send data to and receive data from the network. It must also know the logical interpretation of the data.

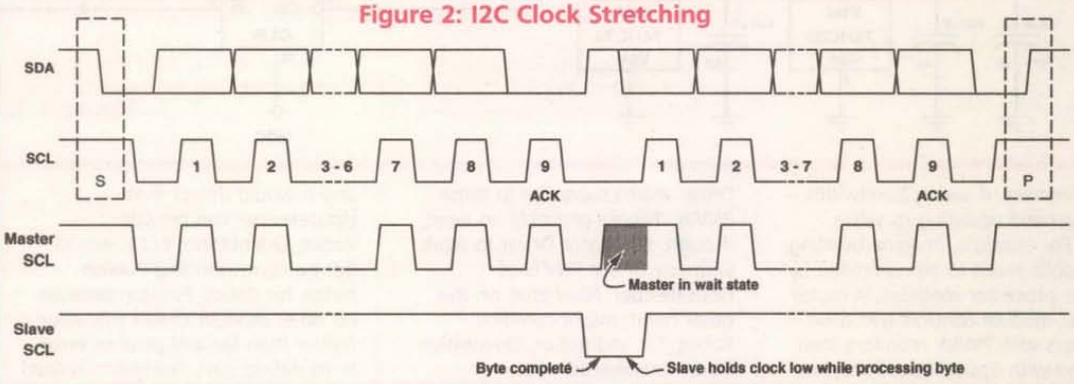
In the case where every module is developed by different people, this can be a very difficult job indeed unless there are some data conventions agreed upon ahead of time. First, you need the idea of a network variable, a data abstraction similar to data types in structured programming languages; one node provides the value of the network variable and one or more nodes can use that value in their operation.

Implementing such network variables requires a common set of predefined procedures in each module for defining and initializing network variables, for binding data sources with data destinations, and for transparently propagating the values of network variables across the network. Along the way, it's handy to come up with a set of predefined network variable types ("PNVT," pronounced "pinvit") which any module knows how to interpret.

Any module with data another module needs "publishes" that data in the form of assignments to PNVTs, and any module that requires information from outside itself must "subscribe" to the relevant PNVTs. Neither the publisher nor the subscriber needs to know very much about each other, only what PNVTs they have in common.

If there are no modules subscribing to a certain PNVT, then the module that would otherwise publish that PNVT could decide – in

Figure 2: I2C Clock Stretching



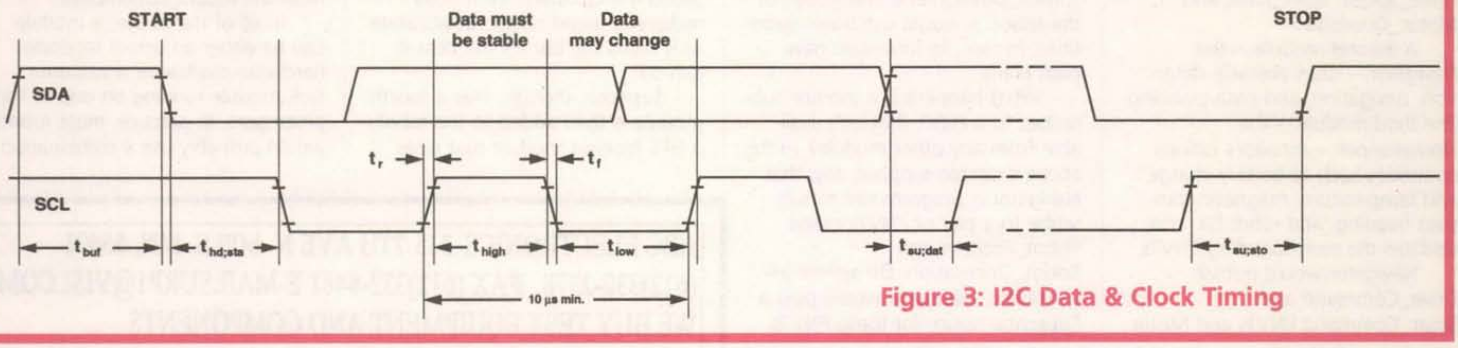


Figure 3: I2C Data & Clock Timing

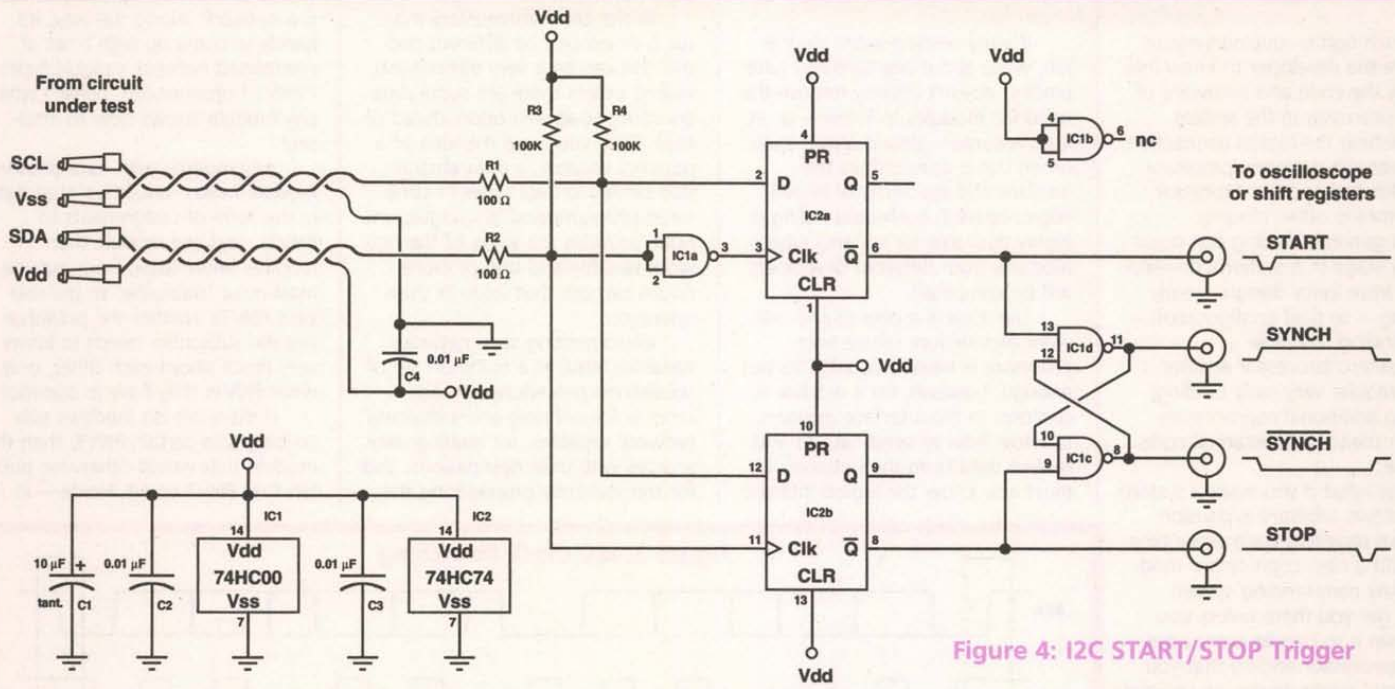


Figure 4: I2C START/STOP Trigger

the interest of saving bandwidth — to suspend updating its value.

For example, imagine building a mobile robot to be controlled by three processor modules. A motor driver module controls two drive motors with PWM, monitors their speed with optical encoders, measures the motor currents, and periodically updates three PNVTs: Drive_Speed, Steer_Rate, and Motor_Overload.

A second module — the Navigator — does obstacle detection, navigation, and path planning. The third module — the Housekeeper — monitors various quantities such as battery charge and temperature, magnetic compass heading, and robot tilt, and updates the corresponding PNVTs.

Navigator would publish Drive_Command and Steer_Command PNVTs and Motor Driver would subscribe to those PNVTs. There's probably no need, though, for Motor Driver to work with any of the PNVTs of Housekeeper. Navigator, on the other hand, might combine Robot_Tilt and Robot_Orientation from Housekeeper with Drive_Speed and Steer_Rate from Motor Driver to dead reckon the current position and orientation of the robot. It would use these quantities, in turn, to formulate new path plans.

What happens if a module subscribes to a PNVT that isn't available from any other module? In the above example suppose, say, that Navigator is programmed to subscribe to a pair of PNVTs called Robot_Position and Robot_Orientation. On system initialization, Navigator would post a Subscribe notice for these PNVTs, and it would detect that Housekeeper can provide Robot_Orientation, but it would get no corresponding Publish notice for Robot_Position because no other module knows this value. Rather than fail and post an error to its debug port, Navigator instead falls back on the dead reckoning algorithm mentioned above. The position it calculates with dead reckoning might not be as accurate as it could be, but it's the best it can do.

Suppose, though, that a fourth module is then added to the robot, a GPS receiver module that does nothing but publish Robot_Position. When GPS initializes and posts a Publish Robot_Position PNVT, Navigator would detect this and switch to getting Robot_Position directly from GPS. Likewise, if a gyrocompass module were added, Navigator might choose to subscribe to Gyro's Robot_Orientation PNVT instead of the one derived from the magnetic compass.

In all of the above, a module can be either an actual separate hardware module or a real-time task module running on one of the processors. In practice, most robots would probably use a combination

of the two module types. In defining a Publish and Subscribe network variable architecture, it's important for future flexibility to make sure that Publish and Subscribe work the same between tasks running on the same processor and tasks running on separate processors communicating over a network interface.

For the time being, though, I want to concentrate on implementing PNVT Publish and Subscribe in a networked multiprocessor environment. Because I2C is low-cost and has clearly defined multimaster capabilities, it lends itself well to this project.

Multimaster I2C

Very few systems I've seen actually exploit the full multimaster capabilities of I2C – most I2C systems consist of a single master and a small number of slaves. You can find example code for lots of single-master I2C systems on the web, but I've yet to see a complete multimaster implementation. Multimaster mode is quite a bit more complicated to figure out and program, but the rewards of multimaster mode are compelling. So, how exactly does it work?

Figure 1 shows three masters attempting to access the I2C bus simultaneously. With most bus systems, this would spell disaster without some sort of arbitration mechanism built in to sort out which master would actually get to use the bus.

By its nature, I2C automatically takes care of most of this by mandating open-drain drivers for each node connected to the bus. After asserting a valid START condition, any node can output a logical one or a zero during each bit time but, if it outputs a one, it must always look at the SDA line afterward to make sure that SDA actually does go high.

If it does, all is well, and the node may continue sending data bits (I say "data," but what the bits represent in the datagram is of no consequence; address or data, it doesn't matter, they are treated equally).

If, however, the SDA line is low when a node has just output a logic high – and there's been enough time for the line to be pulled high (this can take as long as a microsecond) – then the node must stop sending data on the bus because it has just lost arbitration with another node.

The first time I read about I2C bus arbitration, I couldn't understand how it could be possible for two or more nodes to try to transmit at the same time without the data of all of them getting corrupted. The key to understanding how it works is that arbitration takes place sequentially as each bit is placed on the bus. Any number of nodes can output high levels on SDA, but if just one node outputs a low, that is the level SDA will take.

For every bit sent, therefore, a transmitting node is obliged to check that the level of SDA matches the level the node sent. For a low level it should always match (unless there is a short circuit somewhere) but, for a high level, it will only match if no other node is sending a low level.

Table 1: I2C Bus Specifications

PARAMETER	SYMBOL	Min	Max	UNIT
SCL clock frequency	f_{scl}	0	100	kHz
Bus free time between START and STOP	t_{buf}	4.7	—	µs
Hold time START condition	$t_{hd;sta}$	4.0	—	µs
LOW period of SCL	t_{low}	4.7	—	µs
HIGH period of SCL	t_{high}	4.0	—	µs
Data set-up time	$t_{su;dat}$	250	—	ns
Rise time for SDA and SCL	t_r	—	1000	ns
Fall time for SDA and SCL	t_f	—	300	ns
Set-up time for STOP	$t_{su;sto}$	4.0	—	µs
Capacitive load for each bus line	C_b	—	400	pF

And the Winner is ...

Let's tie all this together by following the bit arbitration process as it unfolds in Figure 1. Three masters are attempting to access the bus: Master #1 wants to send binary 0111100 in the address field of its datagram; Master #2 wants to send 0111000; and Master #3 wants to send 0111001. Note that Master #3 asserts START a smidgen before the other two, and the time of the falling edge of SDA is thus determined by Master #3.

The first bit sent is the MSB of the seven-bit address, which is zero for all three masters. The next bit is a one, again the same for all three masters. Notice Master #1 is the last to release SDA to assert logic one in this example, so it determines the time of the rising edge of SDA. Bits 3 and 4 (A4 and A3) are also ones for all three masters. None of the masters are aware that any other master is trying to use the bus because the bits sent so far have been identical when SCL goes high.

With bit 5, though, the situation is different. Master #1 wants to send a one, but the other two are sending zeros. Since the SDA line is open drain with only a passive pullup resistor, a zero output

by a node always overrides a one output by any other node.

After Master #1 asserts one, it therefore detects that the SDA line doesn't go high, and it must abort its transmission by leaving its SDA output high for the rest of the datagram.

The same thing happens to Master #3 when the seventh bit (A0) is sent, leaving Master #2 in sole control of the bus. If all three masters had been sending the exact same address, then arbitration would continue to the ninth bit, R/W. If Master #3 intended to write data to the addressed slave and the others intended to read, then Master #3 would win the arbitration because it sends a zero during the R/W bit time to indicate a write operation, while the others would send one.

What if all three masters were to attempt a write operation to the same slave? Simple. Arbitration would continue for each bit of the data byte until one master or another sends a one when the others send a zero. And what if the byte they are sending is identical? None of the masters would ever know that it wasn't the only one transmitting, right? Even in this unlikely case, everything still works out fine because the data value each of them wanted to send is what the slave receives. Neat, huh?

Clock Stretching

So far, I haven't said anything about the clock line, SCL. SCL is always generated by the master on an I2C bus, but in a multimaster system, there can be more than one master attempting to transmit at once, and each is generating its own clock. How does this affect the bus?

First, remember that SCL must be driven with open-drain drivers, just like SDA. As above for SDA, the time of the falling edge of SCL is determined by the first master to pull SCL low, but the rising edge is determined by the last master to release SCL. In this way, the slowest master determines the period of time that SCL stays low, while the fastest master determines the period that SCL stays high. But that's not all.

In some circumstances, a slave can hold SCL low, too. Figure 2 shows a slave pulling SCL low right after receiving a byte from a master. The slave holds SCL low until it has finished processing the byte just received from the master.

After the master releases SCL, it detects that the line is still low and is obliged to go into a wait state until the slave releases SCL. This mechanism can be used by any node, master or slave, to ensure no transmission goes faster than the node can follow. The maximum clock rate for standard-mode I2C is 100 kHz. In practice, though, the bus only goes as fast as the slowest node on the network.

Trigger Happy

There are a lot of subtleties in the I2C system. Writing a software-only multimaster compatible master is exacting but not difficult because the data timings are all quite relaxed (see Figure 3 and Table 1). Software slaves, however, are another story. At first glance, it seems that to catch a START condition at full speed, a slave must sample the SCL and SDA lines at least twice every 4.7 microseconds during the bus free condition; this is less than 12 processor cycles for a 10 MHz PIC16F84. I don't yet know how to write a program that does this while doing any other useful work, such as generating control pulses for servos.

I'm taking things by stages, therefore, and the first stage is to write multimaster-aware code for a master. As part of debugging, I need to be able to look at the waveform my code generates to check timing relationships. The problem, however, is how to get my scope to reliably trigger at the right place on the waveform; I2C waveforms are complex and offer no convenient trigger signatures to trigger on with a simple analog 'scope. Figure 4 shows a circuit I built that solves this problem.

Since a START is defined as SDA going low while SCL remains high, all that is necessary is to use SDA to clock the state of SCL into a D-type flip-flop. You want to clock on the negative-going edge of SDA, but since the 74HC74 dual D flip-flop clocks on positive-going edges, you must invert SDA. The STOP condition is detected with the second D flip-flop in the HC74; no inversion of SDA is needed since the STOP condition is defined as SDA going positive while SCL is high.

I used one gate of a quad 74HC00 NAND to do the inversion for the START detector, and two more NAND gates to form a simple SR flip-flop. The pulse lengths of the active-low START and STOP outputs depend on the data pattern being transmitted. The SYNCH pulse output (and its inverted version), however, will always be the same length as the I2C datagram itself, regardless of the data pattern being transmitted.

I provide all four signals on BNC connectors for maximum flexibility. I can directly hook any one of them up to the external trigger input of my 'scope. All my software has to do is send the same datagram often enough that I can see the datagram on the scope without flicker. The circuit could also be used with shift registers and latches to directly capture datagrams if you don't have an oscilloscope, or if you want to capture one-shot events.

The circuit draws its power from the circuit under test and was built on a RadioShack protoboard (#275-150). The test probes are clip-ons, also from RadioShack. As the I2C spec calls for, I twisted SCL with Vss (ground) and SDA with Vdd (power) to reduce noise pickup. C4 decouples Vss right at the point where the wires leave the circuit board, and C1 through C3 decouple the ICs.

I also included 100-ohm resistors to protect the inputs from voltage transients and weak 100K pullup resistors to ensure valid logic levels when nothing is connected to SDA or SCL. Layout isn't critical, but do keep all test leads shorter than 12 inches.

Once I have this code running right, then I'll tackle the harder problem of the slave code.

Two Tiny Teeth

Whew! The weather has started to cool to tolerable levels around here, and my son Yonatan finally cut his first two teeth. There was a while last month when I wasn't sure either event would ever happen. Then, too, I also got my Linux box up and running, almost as excruciating a process for me as teething was for Yonatan. Definitely a five-beer project, and I'll tell you all about that and more next time. NV

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

Continued from page 68

Dear Nuts & Volts:

There are worse things than not getting the answers requested in a Tech Forum question — that is getting incorrect information. Chris from Bieber, CA provided multiple incorrect answers to two different questions.

In the answer to question #7994, in the US standard television system, the number of total scan lines is 525, not 480. Depending on the exact number of lines devoted to retrace blanking, vertical synchronization, test signals, closed captioning, etc., the actual number of visible scan lines range from 483 to 487.

The 480 lines that Chris refers to is actually the number of visible vertical pixels in the VGA computer screen and has no relationship to a television signal. This is the first error in providing incorrect information. All video cameras used in a US television system would have 525 scan lines. Exactly one-half of these lines are scanned in approximately 1/30 of a second with an interlaced set scanned in the next 1/30 of a second.

The basic question in television camera specification is the vertical lines of resolution in the horizontal axis. In the conventional manner, this is defined as the total number of alternate black and white vertical lines that can be resolved by the eye in the central 3/4 of the width of the screen. This is usually performed by viewing a standard test target having resolution wedges with varying the density as it would be too cumbersome to count the lines individually.

A good black and white tube camera (with a high quality black and white monitor) would be expected to have a resolution of around 600 lines. Color systems have a resolution generally in the range of 330 to 450 lines. Moderately priced CMOS or CCD cameras generally do not have this resolution.

The number reported in the advertisements should report resolution in this manner — equivalent to the number of vertical black and white lines in a width equal to the height of the screen. It is unknown if any of them actually do. The comment by Chris about a 410 line camera having less information than a 480 line system is totally incorrect.

The CMOS cameras have another characteristic — the actual number of image capturing pixels in both the horizontal and vertical dimensions. A camera actually having a resolution of 410 lines as specified above would have 547 pixels horizontally and 410 vertically for a total of approximately 224,000. This assumes an optical system with no defects. Most cameras advertised in *Nuts & Volts* do not specify the number of pixels in either axis.

The unit of illuminance is the lux which is defined as the illumination provided by an incident intensity of one lumen per square meter. The illuminance provided by a full moon is approximately 0.3 lux. The ability of a camera to see an object with this illuminance depends on the reflectivity of the object, the color of the object, and the spectral sensitivity of the camera.

It is unknown to me what is the spectral response of these cameras although all of the black and white CMOS cameras do have some sensitivity in the infrared range. The statement of .3 lux being equal to 0.3 candle per cubic meter of space is total gibberish. Lower lux numbers do indicate that the camera will provide some kind of a picture at lower light intensity.

The dimension usually given in millimeters (mm) is the focal length of the lens, not the width. Lower numbers indicate a wider view while higher numbers indicate a narrower view (more telephoto). However, the f number of the lens must also be taken into consideration in order to maintain the lux sensitivity. The f number is the ratio of the focal length to the diameter. As the focal length of the lens increases, so must the diameter for the same sensitivity. Also, longer focal length lenses generally must be adjusted for correct focus while the wide angle lenses (under say 4mm) generally are in focus from relatively close in to infinity.

In the answer to question #7992, the first sentence is double talk — impedance is a function of the winding and frequency, not an inherent characteristic, but altering the frequency will not necessarily overheat the windings unless the frequency is made much too low.

What is true is that the normal single phase induction motor will not work correctly due to the failure of the eddy current induction in the rotor at low frequencies. Note, however, that many modern locomotives are now using AC synchronous motors with a DC excited rotor and variable frequency stator drive for wide speed control.

A so called "universal motor" such as that used in most portable electric tools will work even down to DC. These motors have the rotor connected in series with the stator through a commutator and brushes. A variable width, fixed frequency pulsed waveform will nicely control these motors. See how a variable speed drill works. If your motor has brushes, give the light dimmer (or drill motor speed control) a try.

An induction motor will not behave so nicely. As the voltage is lowered, the motor speed will fall but the torque will fall off faster, the back EMF will fall off, the current will rise, and the motor will stall. These motors are essentially designed to run at a constant speed with a designed voltage and do not behave well at drastically lowered voltage.

A Variac© does not consist of transformers that move in relationship to each other but is rather an autotransformer (with only one core and winding) and a movable sliding tap. It is like the AC equivalent of a potentiometer except that the output voltage can be greater than the input with the proper configuration of winding and taps.

In any event, there is no way a Variac could maintain a totally constant current while lowering the voltage even if this would control the motor speed in the desired manner.

I would hope that some of the responses from readers would have some reality and accuracy check before publication. These answers were unbelievable. I think that I have seen some questionable answers from the same Chris before. If this is true, I suggest that you check his qualifications before publishing his answers. I am a retired Electronics Engineer with extensive analog, video, and RF experience and have been a licensed radio amateur since 1953. While my new home is under construction at the present time, I do not have any convenient E-Mail or Internet access, so I must rely on the snail mail.

John E. Lemmer
Willits, CA

Dear Nuts & Volts:

I'm sorry to have to inform you that virtually everything in the answer published to question #7992 in your Aug. '99 issue, is misleading or plain wrong.

A variac is an autotransformer, but everything else said about it is incorrect. It is totally unsuited for speed controlling a single-phase motor, as is a light dimmer. Speed controlling a single-phase AC motor is possible, but so difficult that it is rarely done. That is why treadmills are made with DC motors. I would have suggested that the questioner look for a treadmill motor, and, ideally, a matching controller.

Robert Via Internet

TECH FORUM

Continued from page 31

Fifteen inch VGA monitors are a dime a dozen nowadays and it would probably be easier to buy a new or refurbished one. But, if you still want to make a cable, I have included the pin-outs for EGA and VGA (which is also the same for SVGA and all types of Ultra VGA).

The CGA pin-outs are the same as the EGA with a few exceptions. Pin 2 is also Ground, pin 7 is not used, and pin 6 is Intensity.

EGA pin-outs:

PIN	SIGNAL
1	Ground
2	Secondary Red
3	Red
4	Green
5	Blue
6	Secondary Green Intensity
7	Secondary Blue/ Mono Video
8	Horizontol Sync
9	Vertical Sync

VGA pin-outs

PIN	SIGNAL
1	Red
2	Green
3	Blue
4	Monitor ID Bit 2
5	Digital Ground
6	Red Analog Ground
7	Green Analog Ground
8	Blue Analog Ground
9	not used
10	Sync Return (GND)
11	Monitor ID Bit 0
12	Monitor ID Bit 1
13	Horizontal Sync
14	Vertical Sync
15	not used

Chris
via Internet

ANSWER TO #8999 - AUG. 1999

I need information on how to hook up a "Rustrak" model 288 strip chart recorder. A current address for this company would be helpful, too.

Richard can contact the company at **Gulton Rustrak**, 1015 E. Chapman Ave., Fullerton, CA 92831. **714-879-6385**.

Bob Morrissette
via Internet

ANSWER TO #89918 - AUG. 1999

I have a Dentron linear amplifier that is no longer in production. I fixed the problem that caused arcing between the plates of the variable capacitor, but they keep arcing. I tried to file them smooth, but they still arc, so I tried looking for another variable capacitor, to no avail.

Perhaps the variable capacitor is not the problem. Your antenna or another part of the matching network may have failed, causing a large mismatch. The large mismatch

ANSWERS TO #8992 - AUG. 1999

I have an IBM Thinkpad computer. The hard drive is missing and I cannot get into CMOS. How I can tell it that it has no hard drive and boot on a floppy?

Also, where can I find a hard drive?

#1 I enter my IBM Thinkpad boot sequence control by pressing and holding F1 while turning on power. This should get you to "Easy Setup" where you can select the "Start Up" control section.

Ed Bell
Colchester, VT

#2 Depends on the model of your Thinkpad, but the hard drive should be a 2.5 inch drive. They can be found on the Internet or from a supplier such as **"MegaHaus" 1-800-786-1153**.

You should also then go to IBMs tech support on the Internet and download the set up for your Thinkpad (www.pc.ibm.com/us/thinkpad/index.html).

I bought a Thinkpad at the Dayton Hamvention and had to do the same as you need to do.

Bob Boehm
Cincinnati, OH

ANSWERS TO #7997 - JULY 1999

I have an 800 number on which I would like to deliver a three-minute message to callers, with a hang up at the end. The machine would not accept any incoming messages. Any ideas?

#1 Most answering machines can be set to "Answer Only" which will cause the machine just to play an outgoing message and then hang up. You may, however, have to do some shopping around to find an answering machine which allows you to record a three minute outgoing message.

Most machines limit the outgoing message to a minute or less. If you are expecting lots of calls to be made to your 800 number, I recommend that you consider only tapeless digital answering machines for more dependability.

John W. McMichael
via Internet

#2 I recommend that you use a digital announcer. These tapeless telephone message repeaters are available from several sources. Here are two possible units:

1. Racom Products, Inc., Model 900L, www.racominc.com, 1-800-722-6664.

2. Viking Electronics, Model DVA-3003, www.VikingElectronics.com 715-386-8861.

Thomas Black
Folsom, CA

TECH FORUM

would create the high voltages that cause the arcs. Check all the components, and then try out the amplifier with a dummy load. You might also clean everything.

Variable capacitors are pretty simple, so I would expect you could repair one as long as the bearings were still intact. A file is a bit crude and will not leave a smooth surface, so you might touch things up with fine sandpaper, but the file or the sandpaper will wreck any silver plating.

The capacitor should not be so close to the breakdown voltage that a little roughness matters. That's why I suspect other problems.

Gerald Roylance
Mountain View, CA

ANSWER TO #89913 - AUG. 1999

Is there a way to connect a phone hand-set to a computer to take the place of the microphone and speakers when making an Internet call?

Most telephones use carbon microphone elements, so you will need to build a circuit to power the carbon element, however, most of the really "cheap" phones and many "electronic" phones (the type used with electronic KSUs or PBXs) use a dynamic microphone and speaker. I used a cheap handset that had a dynamic mic and speaker for my computer phone.

The connection is a narrow RJ-11, the mic connection is the two outside pins and the speaker is the two inside pins. That equates to pins 1 and 4 to the mic and pins 2 and 3 to the speaker, polarity is not important and pins 3 and 4 may be connected together if you need mic-speaker-ground.

Bob Boehm
Cincinnati, OH

ANSWER TO #8997 - AUG. 1999

I have scrapped out several loads of computer boards for the gold in them.

I was told that there is a place that buys the programmable chips and reuses them.

Here are two companies that recycle ICs on a large scale:

Fox Electronics
686 North King Rd.
San Jose, CA 95133-1709
(408) 929-4369
(408) 929-4373 fax
http://www.foxelectronics.com

Krueger Company
1544 W. Mineral Rd.
Tempe, AZ 85283
(800) 245-2235
(602) 820-5330
(602) 820-1707 fax

They pay a bit more than scrap value, but don't set your expectations too high.

David DiGiacomo
San Francisco, CA

ANSWERS TO #7999 - JULY 1999

I changed out the video head on my VHS VCR. The picture had horizontal noise lines. This resulted in a picture that was normal on the bottom third of the screen. The top two-thirds of the picture was half-washed, blurry, with about 20 snake-like waves moving up the screen.

What is the cause and remedy to this problem?

#1 There are many factors that stop a VCR head from operating properly. Physical alignment of the mounting springs, worn bearings in the motor, magnetized head, belts slippage in the capstan wheel causing a timing error, and the list goes on.

There are many things that you can do to fix these problems from degaussing the head to checking the bearings that support the head. But the list is long and these checks may or may not fix the problem simply because the head may be physically worn out (missing some chrome plating).

Your best bet is to purchase a service booklet for any brand VCR and go down the list as instructed and learn as you go.

What you have to consider most when working on a VCR these days is the complete replacement price of the VCR versus the total repair price.

Unfortunately, the manufacturer wants you to buy a complete new unit and thus they price their parts way out of proportion so that you will buy a complete unit rather than fix the old.

Chris
Bieber, CA

#2 Before changing the video head, I hope you checked the following:

1. The tape itself. **2**. Clean heads first. **3**. Check video cables for breaks from TV to VCR. **4**. Check VCR jacks and TV jacks.

If you did, you should next check connection to video head to circuit board making sure you connected the heads properly so there are no shorts.

With troubleshooting, always check from the outside first. Check the obvious first and the difficult last. If the connection is okay, next check the tracking system, because more than likely it will need an adjustment if the heads were bad. Check the drive tire or belt tire for slipping, inspect for wear. Check tape guide, brake, and capstan.

If tracking is all okay, check board with voltmeter. You may need to get a manual for this. This procedure is to find the problem.

Mike Clemente
Mays Landing, NJ

Newsbytes

Continued from page 16

Laurinburg, North Carolina.

http://www.rostra.com
910-276-4853 Voice
910-276-1354 Fax

DEVRY INSTITUTES AWARD SCHOLARSHIPS TO COMPETITION WINNERS

As part of an ongoing effort to address the shortage of qualified technicians in the consumer electronics (CE) industry, the DeVry Institute is continuing its support of the Skills USA Championships, Electronics Applications Competition.

Kevin Boswell and Jeff See, the first-place winners of this year's championship held in Kansas City, MO on July 1, 1999, each received a $30,000.00 scholarship donated by DeVry.

"We are happy to be involved with Skills USA and with similar industry efforts because we see the shortage of technically qualified workers as a very serious problem," explains Ellen Derwin, manager of outreach services for DeVry. "Awarding scholarships is a way for us to encourage students to get the education necessary to pursue a high-paying and exciting career in technology."

The Consumer Electronics Manufacturers Association (CEMA) sponsors the annual competition in an effort to attract and foster talented technicians. "The CE industry relies heavily on skilled technicians," said Don Hatton, vice president, CEMA Technical Education and Services. "Skills USA and the DeVry scholarships provide contest winners an opportunity to develop their skills through education."

A long-time supporter of the competition, DeVry has donated nearly $250,000.00 in scholarships to the contest winners during the last four years, and has made continuing education a possibility for many students who may not have had the opportunity.

"The scholarship to DeVry has really helped me get training that I would not have otherwise received," explained 1998 Skills USA Championships winner, Jeff See. See, who is currently studying at the Kansas City campus of DeVry Institutes and hopes to work in the research and development department of a major electronics firm, would not have been able to attend DeVry if he had not won the scholarship. "I can't begin to think of what else I could be doing," said See. "I would probably end up making a lot less doing something I didn't like."

The Skills USA Championships are held annually to recognize the achievements of vocational students and to encourage them to strive for excellence and pride in their chosen occupations. Working against the clock and each other, the contestants prove their expertise in job skills for occupations such as electronics, technical drafting, precision machining, medical assisting, and culinary arts.

The Electronics Applications competition consists of five troubleshooting sections, a soldering/desoldering section, and a written exam. The exercises are designed to simulate real-world conditions and emphasize the quality, efficiency, and safety of the competitor's work.

The DeVry Institutes, founded in 1931 by Dr. Herman DeVry, have a combined enrollment of more than 33,000 full- and part-time students and 16 campuses, making it one of the largest private higher-education systems in North America. DeVry offers several associate's and bachelor's degree programs and provides curricula in electronics, computer information systems, business, telecommunications management, accounting, and technical management.

CEMA is a sector of the Electronics Industries Alliance (EIA), the 75-year-old Arlington, VA based trade organization representing all facets of electronics manufacturing. CEMA represents more than 500 US manufacturers of audio, video, accessories, mobile electronics, communication, information technology, and multimedia products that are sold through consumer channels.

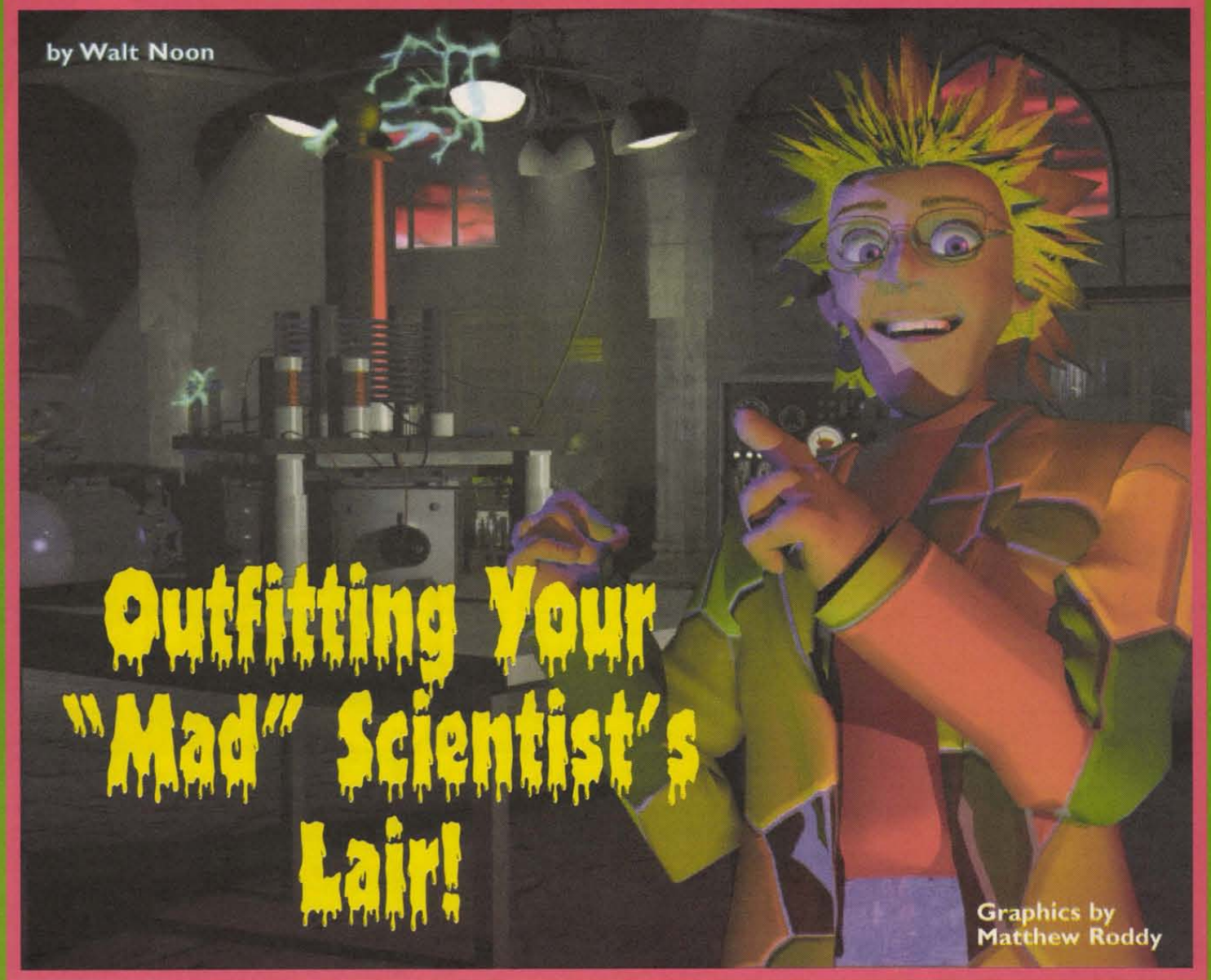
CEMA also sponsors and manages the International CES — Your Source for Workstyle and Lifestyle Technology℠. All profits from CES are re-invested into industry services, including technical training and education, product promotion, engineering standards development, market research, and governmental and legal affairs support. As the first major technology event of the new millennium, the 2000 International CES is the launch pad for 21st century technology.

UPCOMING EVENTS

Digital Hollywood
September 27-30, 1999;
Los Angeles, CA
DTV Summit, held in conjunction with Digital Hollywood
September 28, 1999;
Los Angeles, CA
EIA/CEMA Fall Conference
October 24-28, 1999;
Palm Springs, CA
The 2000 International CES — Your Source for Workstyle and Lifestyle Technology℠
January 6-9, 2000; Las Vegas, NV
Digital Hollywood at CES
January 6-8, 2000; Las Vegas, NV

 Write in 90 on Reader Service Card.

by Walt Noon



Outfitting Your "Mad" Scientist's Lair!

Graphics by Matthew Roddy

This Halloween is your time to cackle, throw back the curtains, and reveal wild arcs of electricity surging through your house!

Well, unless I miss my guess, that time of year is coming again. The time of year when it's possible to let the real "mad scientist" in you out, and not worry about the neighbors having you committed. A time when you can let your technical skills place you where you really belong; not behind a computer screen or over some smoky perf board, but in the electrical wizard's role!

This year is your time to cackle, throw back the curtains, and reveal wild arcs of electricity surging through your house!

Even though you find yourself in a burned lab coat, even though your hair may be standing on end, and even as you go wild with laughter, with two simple words with which you CAN'T be blamed! Repeat after me: *"Happy Halloween!"*

That's right, it's the perfect excuse to build that wonderful gadget you've always wanted to — a Tesla Coil!

I warn you now, these coils are *dangerous*. Not so much because they produce large electrical arcs in open air (that when properly handled are remarkably safe), but because these devices can be so exciting to build that they can become an **OBSESSION**. You may well be at risk for continuing your mad scientist activities beyond ...

Remember — using your Tesla Coil this Halloween will produce one other type of magic, one that it has for more than 100 years ...

While the parents may jump out of their socks, the children will light up with delight and interest!

You and I can smile knowing that we may have just added some future "mad scientists" to our ranks!

The Tesla Coil

The coil featured in this article is a classic, and a real performer for its size! In fact, though the secondary coil stands at just 12" high and 3" in diameter, it will easily produce 70,000-volt sparks arcing 4" even with a LOW POWER input transformer (such as an automotive coil or equivalent).

You can step the power up considerably with a larger input transformer and produce as much as 250,000 volts! At these voltages, sparks are thick, brilliant, and noisy, and discharges of half a foot are possible. Sparks of this order are suitable for terrifying the staunchest of trick-or-treaters.

When operating, many special effects are possible: The coil will light a florescent light bulb held in your hand with no wires attached! It will drive plasma displays, and cause other florescent or tube lights in the room to flicker.

If you're REALLY of the mad scientist variety, the arc can be taken to a metal object held in an outstretched hand. (This coil is high frequency, and will exhibit the "skin" effect in which the electricity can travel over your skin without shocking you. However, you MUST read the safety tips for doing this later in the article.)

Though you are free to build the coil "as is," I'd like to briefly go over each component and give you some design philosophy. Significant increases in output and efficiency can be had with some thought on your part. And, that's what these coils are all about!

Important Sources

Later in the article, I'll give some sources for parts, and my web address where you can download free design software for altering the dimensions of your coil and even trying out your own designs on screen before building them!

How it Works

There are only five basic components in simple Tesla coil design (see the schematic in Figure 1). These are: the line transformer, capacitor, spark gap, primary, and secondary windings.

You'll notice that in the design we're using there are also a pair of radio frequency chokes and a second spark gap for safety. (The second spark gap is not absolutely necessary for operation, in fact, many coil designers leave it out. However, it can be important for coil longevity. The secondary gap protects your line transformer.)

Most of the components of the coil can be made by hand. I'll give you a brief description of each part, what it does in the circuit, and what options are available.

The Line Transformer

The line transformer boosts the voltage from your wall current to between 2,000 and 10,000 volts depending on the transformer you decide to use (2,000 volts is about as low as you can go and still have a useful spark). Things don't really pick up with this coil until you get to around 6,000 volts on your line transformer.

Many Tesla builders feel that the size of the secondary coil and type of discharge terminal are the keys to a big spark, but even with some of the interesting trade-offs you can make in design, you can't escape the fact that you can't get more out than you put in, so, this is where you can make the biggest difference.

A neon sign transformer rated at 9,000 volts or better and around 30 milliamps is ideal. Neon transformers are nice because they can be dead-shorted without damage, though, transients in a Tesla circuit can still harm them over time. The more power you draw from your neon transformer, the less efficient it becomes. This can cost you a little at the output side as well, and is why some Tesla purists steer away from neon transformers.

People often use oil furnace ignition transformers with similar ratings, and even automotive coil type transformers (see details on this at the end of the article).

The automotive coil is nice because it's cheap and the sparks are safe, yet still impressive and entertaining. I often operate my coil for extended periods of experimentation with an auto coil type set-up. In a darkened room, the blue corona glow and subtle steamers of electricity are beautiful to watch. However — for special effects — your coil's output will be modest if you use an auto coil as compared to a neon transformer.

New neon transformers are relatively expensive, however, by poking around the Internet and Tesla groups (mentioned later), you can find some real bargains. Big Tesla systems use distribution transformers (as seen on your local telephone pole) which produce 17,000 volts or more, but you'll need a whole new design for that!

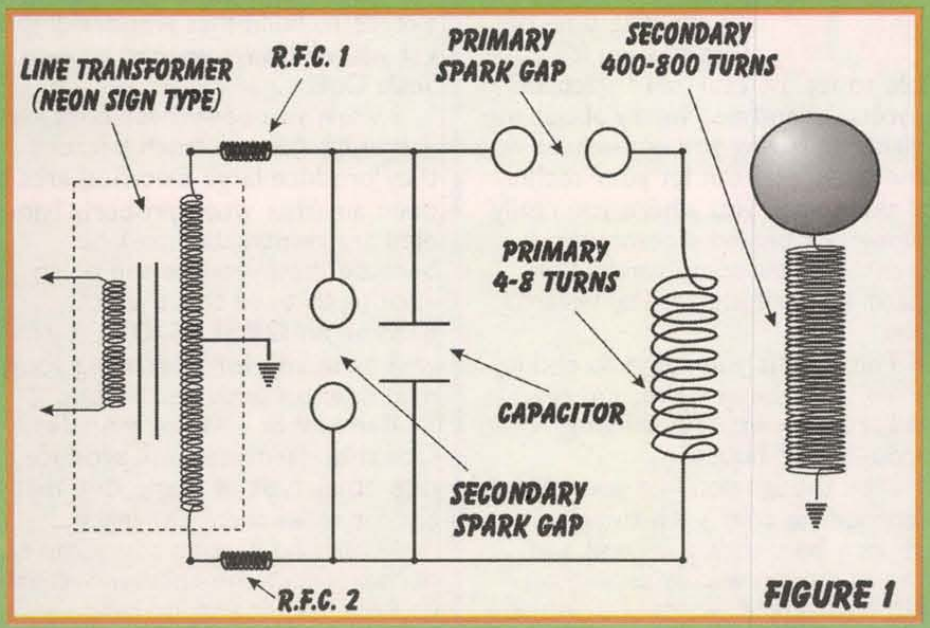


FIGURE 1

The Jacob's Ladder!

Before we go on, I should describe a quick stunt with a neon transformer that could be "must-have" equipment for your Halloween's lair.

Figure 2 shows a neon sign transformer. Connected to the transformer are two metal rods angled close together at the base and then slanting apart. (I usually use welding rods.)

This is a classic "Jacob's Ladder" in which a spark will form at the narrow point and rise with a loud crackle to the top and then repeat.

This is a simple, mesmerizing effect. Just make sure your transformer is grounded, and keep people clear of this somewhat dangerous spark. (The metal rods can be placed inside a large plexy tube for safety.)

The High Voltage Capacitor

The high voltage from the line transformer is

needed to supply enough energy to the capacitor so that it can "kick" out pulses at a very high speed (600 kHz is common) and not be depleted. The idea is that as a charge builds up in your capacitor, it eventually becomes large enough to arc across the spark gap.

For this coil, we'll assemble a capacitor rated at .0052 uF and at least 15,000 volts.

Commercial caps of this voltage are the best, but tend to be expensive. So, most builders create their own. See Figure 3A for a simple capacitor plan. (Figure 3B shows an exploded view.)

The capacitor is made by alternating five sheets of .032" polystyrene and four sheets of 10" square metal. Note in the "top view" that each metal plate does not go all the way across the polystyrene.

Copper or aluminum foil can be glued down and used for the plates. I personally use thin sheets of aluminum such as those used to patch the roof.

To keep my capacitor together, I glue it and sandwich it between two pieces of wood mounted under the coil.

Other configurations of this capacitor are possible so that its size and dimensions can be changed to fit your coil's housing. Other homemade high voltage capacitors are also possible using everything from rolled plates in PVC and oil to beer bottles. Handy calculations for all these caps are provided in the free software.

The Spark Gap

The spark gap acts as a high voltage switch (Figure 4). When energy in the capacitor is sufficiently high, it arcs across the gap and supplies power to the Tesla primary winding. This partially depletes the capacitor and thereby quenches itself, restarting the cycle.

The spark gap shown is the simplest, and works well. It's made from two bolts and two rounded screw-on caps. By threading the bolts back and forth, you can adjust the gap. The ideal gap for this coil should be around one millimeter, however, changing the gap will get wildly different results and I encourage you to do so!

The spark gap is a key place where coil efficiency can be improved. The faster the spark is quenched after firing, the better the Tesla secondary will oscillate! (A sloppy spark will cancel out some of the secondary coil's output.)

To quench the spark, many experimenters apply a blast of air from a compressor across the gap to literally blow out the spark. Others use a "multi gap" spark gap by having several points the spark must leap to in crossing the gap(s). I have heard of exotic spark gaps inside of vacuum chambers that increase efficiency by 50%!

I usually just use a gap as shown and it works quite well. Due to the heat and damage that an arc can do to a steel bolt head over time, I often make a trip to the welding store and use Tungsten welding rods instead of steel bolt heads.

The Primary Coil

The primary coil is just a few turns of heavy gauge wire. I like RadioShack's catalog #15-035.

Since this wire is bare, you will be able to tune your coil by sliding a wire along it until a point is found where the coil fires most efficiently.

To get nice even circles, I first wrapped the heavy gauge wire around a cylinder, then removed it and threaded it through the PVC posts seen in the photos.

In the photo, you'll also notice I had 12 turns of wire. This was simply for experimental purposes as I was playing with a wide variety of components. The coil was "tuned" with less than six windings, so I suggest you limit your primary to 6-½ or so windings. The spacing between each winding was approximately 2/16 of an inch.

The Secondary Coil

In my mind, this is where much of the magic happens!

Unlike a conventional transformer, a Tesla coil's output is not only related to the ratio of turns in the primary and secondary windings. In fact, the primary coil acts as a tuned radio transmitter, and the secondary a tuned radio receiver. When the high frequency wave emanating from the primary strikes the secondary — if they are properly in tune — the secondary will begin to oscillate powerfully.

This has been described to be like the effect of a child on a swing. If the child is pushed at just the right moment, the swing will gain in amplitude. If pushed at the wrong time, however, the swing will be deadened. (This is why quenching the gap and good tuning on the primary are so important.)

The secondary coil is simply a long winding of wire (typically 500 turns) wound tightly on a cylindrical form.

PVC is typically used, or very dry cardboard tubing with a few coats of shellac. Actually, the thinner and more electrically inert your form can be, the better. Many Tesla purists have attempted (and some succeeded) to wind a coil and remove the form altogether.

In the Tesla coil shown, I used a very thin butyrate tube from a local plastics store. It consists of 424 windings of #24 enameled wire tightly wound along a tube three inches in diameter and 12 inches long.

The top of the coil will have high energies so, the last few windings at the top are spaced slightly apart and can optionally be covered with a little corona dope. This prevents arcing between coils which can damage your secondary.

To protect the windings, I gave the coil several thick coats of epoxy, rotating it while the epoxy cured for an even finish. Shellac or varnish can also be used.

Odds and Ends

For a top discharge terminal, I used a smooth brass doorknob. All rough edges were coated with corona dope. An optimal discharge terminal should be at least the same diameter as your secondary coil, so I fell a little short here, but it worked well. Using a torroid-shaped top terminal instead of a sphere can make a dramatic improvement, as well. For the radio frequency chokes, I simply used 21 turns of #18 enameled wire on a common 1-½ inch diameter PVC tube.

Final Assembly

Assembly is straightforward from the schematic in Figure 1, and components are placed as shown in Figure 5. I used simple PVC pipes with end caps, and screwed the end caps to the board. This included the Tesla secondary coil for which I found a three-inch end cap to seat it in

The primary coil should have at least 2-½ inches of spacing between it and the secondary coil all the way around. Electrical strikes from the primary to the secondary can damage a coil over time. A ground rod should be attached to allow sparks to have a place to fly. It can be connected

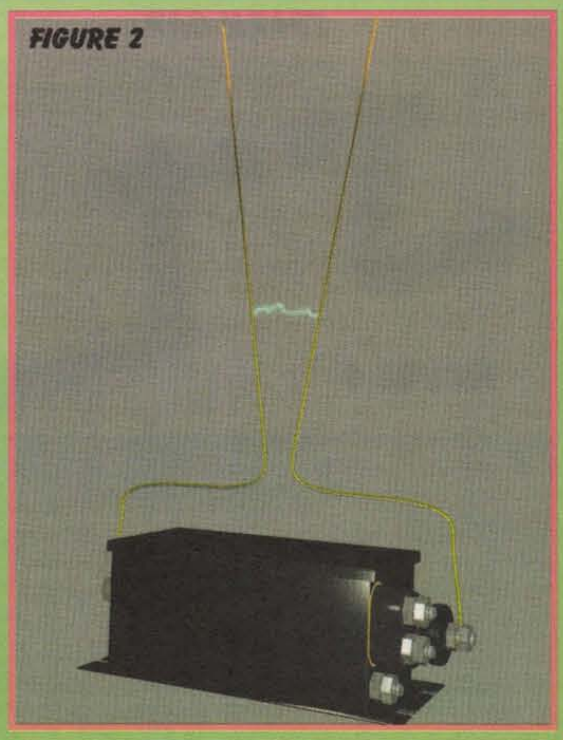


FIGURE 2

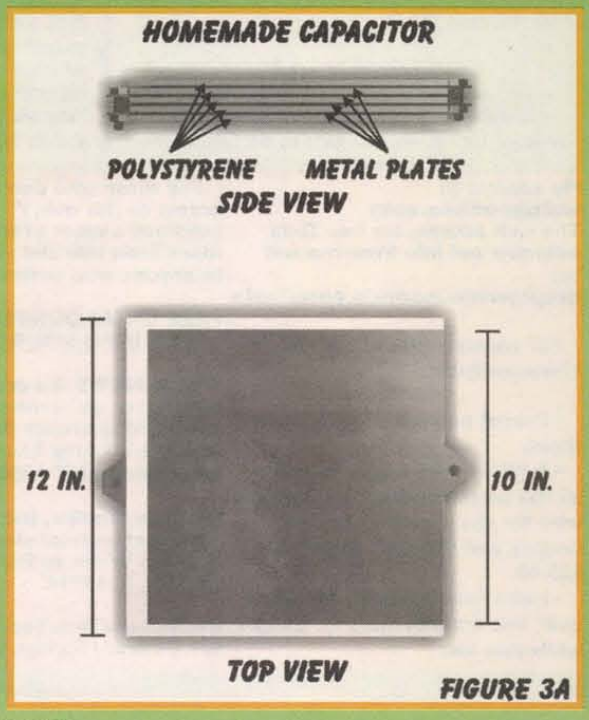


FIGURE 3A

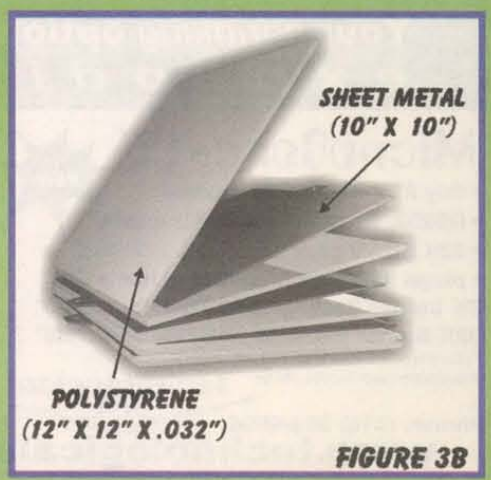
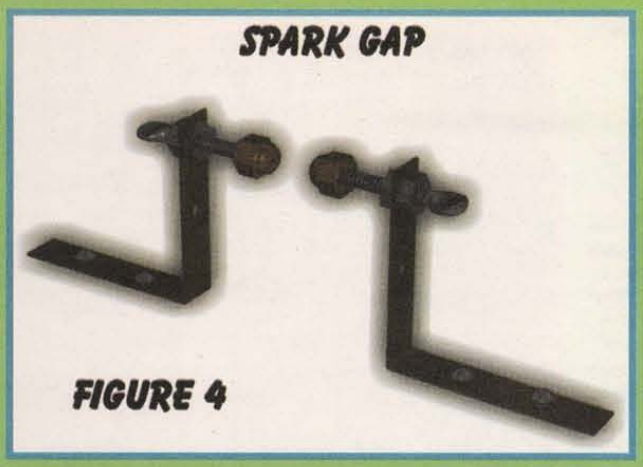


FIGURE 3B



to the wire leading from RFC 2 to the primary. It can be bent in, to around four inches from the top discharge terminal.

If using a neon transformer, it is very good electrical practice to run your neon transformer from a variac (one rated at five amps would suffice) so that you can do low voltage testing, and control the output of your coil. A variac is simply a variable transformer that connects between the wall and your transformer and allows you to control power output. Several *Nuts & Volts* vendors advertise them, or look around the net to pick one up for less than $50.00.

Firing it up!

Now the fun begins! Your coil is complete except for tuning, which is easy to do. One of the wires attached to your primary coil should be movable. Often an alligator clip is used. Attach this wire about 5-½ turns away from the other wire attached to your primary. Briefly run the coil and observe the spark length and character.

By moving this wire along your primary coil, you'll find a sweet spot where "spark" is at a maximum. This — and playing with spark gap distance — is all that is required to get the effect you want.

Tip: In the schematic, the bottom of the secondary coil is shown grounded. You can increase spark length by instead attaching this wire to the wire connecting RFC 2 and the primary. However, this makes the spark *dangerous*.

Let the Experiments Begin!

The stunts that can be pulled with your Tesla coil are endless. The simplest and most fun for this Halloween might be to hold a florescent tube in your hand and have it light with no wires when passed near the coil which is blasting away! You can create a stunning "electric chair" with sparks flying from the coil behind you while your victim's scream!

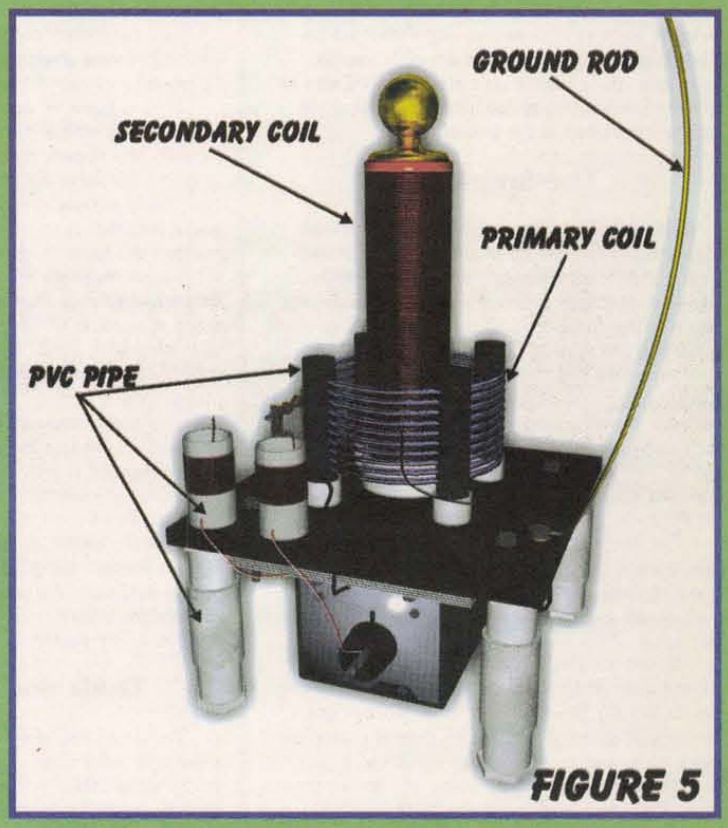
If you are using a low input coil like an auto coil or equivalent driver, sparks of four inches can be taken to the hand painlessly! Remember that you should have metal thimbles on your fingers or be holding some metal object since the sparks themselves can be warm.

Remember good electrical practice when doing any high power work. Tesla wore thick rubber sole shoes, and kept one hand in his pocket!

If you get the Tesla bug, many serious and bizarre experiments are possible from wireless power transmission, to passing a million volts safely through a person! I have even read accounts of temporarily, painlessly scrambling a person's nervous system.

If you visit the web page soon, I'll set up a mailing list for *Nuts & Volts* readers to keep you informed of upcoming Tesla events.

So, let's get winding our coils, and give our neighborhood friends a REAL shock this Halloween! NV



My address is:
walt@noonco.com
The web address for free Tesla software and info from me will be:
http://www.noonco.com/tesla

For construction of the article, I have available:

- **Precut polystyrene, $1.25 per sheet.**
- **A "Wire Kit" which includes all the wires needed, including the wire for the primary, the secondary, and the RFC chokes for $25.00.**
- **I also have a few of the "auto coil" line transformers for $34.00 *while they last.***

For those who don't have access to the web, I'll be happy to send out a sheet of sources with more Tesla info and experiments to anyone who writes by E-Mail.

FREE CATALOGS/FURTHER TESLA INFO SOURCES

TCBA NEWS is a practical newsletter on homemade coils published quarterly by Harry Goldman, 3 Amy Lane, Queensbury, NY 12804.

Lindsay Books, Inc., has many Tesla and unusual electrical reprints. Write to P.O. Box 538, Bradley, IL 60915.

International Tesla Society, P.O. Box 636, Colorado Springs, CO 80931.

Wireless pet-containment breakthrough

Computerized collar creates world's first radio-controlled dog?

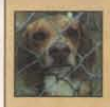
Small U.S. company develops technology that uses radio waves and a microprocessor on your dog's collar to replace expensive fencing, cruel chains and leashes...keeping your dog safe and free!

by Guy Yeadon

Some of the hottest products in recent years have been electronic pet containment systems. Unfortunately, they require wires that have to be buried in your yard to create a boundary and communicate with the dog's collar. This makes them a nightmare to install and subject to damage from lawnmowers, shovels... even other dogs! One of the major manufacturers in the industry, Radio Systems Corporation, asked its team of engineers, "How can we eliminate the wires?" That's how Instant Fence was born.

Instant Fence's breakthrough design took 3 years and $2 million of research to develop...

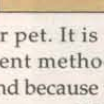
- **Wireless.** No more digging up your yard to bury wires. Just plug it in.



- **Affordable.** Costs significantly less than other containment options.

- **Totally portable.** Take it with you wherever you go.

- **Safe & Secure.** Keep your dog in your yard—safe and out of trouble.



- **Hidden barrier.** Without fences, posts or wires, only your dog will know it's there.

Smart collar. Instant Fence gives you the ability to set up a safe and secure area for your pet to play, without the time and expense of conventional fences. Most fences can cost thousands of dollars and can affect the appearance of your property. In many new neighborhoods, they aren't even allowed. Electronic fences that use wires and special collars can cost nearly as much to have professionally installed, usually well over a thousand dollars. Instant Fence is a revolutionary new concept that is clearly the best value in pet containment.

Safe, secure and totally portable. This is the safest, most secure fence you can buy for your pet. It is far superior to alternative containment methods, because there are no wires to bury and because the pet cannot "run through" the warning zone. When the collar picks up the signal from a buried wire, a stubborn or poorly trained dog can learn to break out. With Instant Fence, there is no "other side" to run to, since the only safe area lies inside the containment circle. Compared to conventional fences, which dogs can jump over or dig under...Instant Fence is unbeatable.

What's more, it's totally portable. You simply unplug it and take it with you to your new house, while visiting friends or even while traveling. No more ties, cages or boarding costs—your pet can enjoy vacations as much as you.

The humane solution. Instant Fence will provide greater happiness and freedom for you and your pet. No more cages, dog runs or tie-outs. No more waiting for you to go for a walk on a leash. Your dog will be able to run and play throughout the yard.

Easy installation, simple training. Instant Fence emits a radio signal that extends up to 90 feet from the transmitter. While the signal area forms a circle, you can adjust it to keep your pet in your yard. While your dog may not be able to roam every square inch of your property, it can have over a third of an acre in which to play. The system has a variety of safety features to protect your dog. Patented coding in the software prevents any accidental electric pulse in the event of a power shortage. The boundary area remains stable, never fluctuating with disturbances within the signal area. If your pet is poorly trained and gets out of the containment area for over 30 seconds, the correction pulses will cease and the receiver will revert to a beep. Training is simple and a video is included to walk you through the process. Once you have adjusted the signal to the desired strength, mark the boundary by placing the small training flags at the edge of the signal area. The training takes only minutes a day, and dogs generally learn their boundary within a few weeks. After thirty days, you can begin to remove the flags gradually.

Instant Fence includes everything you need:

- Transmitter with AC adapter
- Receiver collar and batteries
- Boundary flags
- Training manual and video

Installs in seconds—just plug it in!

It's risk-free...and only Comtrad has it. Why wait to take advantage of this breakthrough technology? Instant Fence comes with a one-year limited warranty from Radio Systems, and it's backed by Comtrad's exclusive risk-free guarantee. Try it for yourself, and if you are not satisfied, simply return it within 90 days for a full "No Questions Asked" refund.

Exclusive limited time offer! Order today and get a factory-direct discount on Instant Fence.

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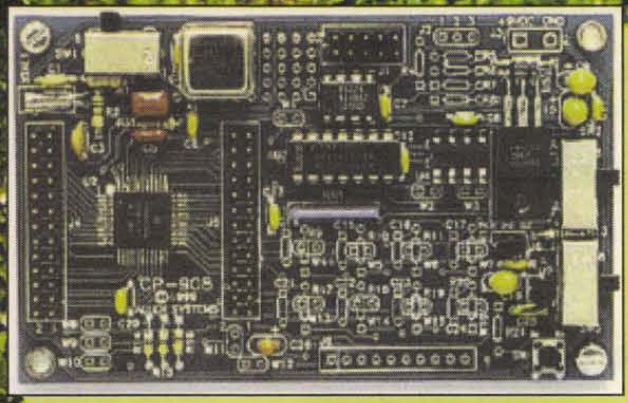
Instant Fence—Breakthrough Engineering and Design

The Instant Fence Transmitter emits a radio signal around your home, so all you do is plug it in somewhere inconspicuous. Your dog wears a lightweight receiver collar that picks up the signal—up to 90 feet from the transmitter. As long as the receiver is in range, your dog is free to run and play. When it approaches the boundary of the signal area, the dog will hear a warning beep. If the dog continues, it receives a light static energy pulse, which is startling but not harmful. After only a little training, your dog will learn the boundaries of the system. The system is totally adjustable for smaller areas.

New Product News



CP-908

The CP-908 is a single board computer based on the 68HC908 microcontroller. The 68HC908 is a member of the 68HC08 family and has 20K of on-chip Flash for program storage. A variety of control-related resources are also integrated into the chip. These include an eight-channel, eight-bit A/D converter, eight keypad interrupt inputs, eight general-purpose I/O lines, built-in monitor ROM, SCI (asynchronous) serial port, SPI (synchronous) serial port, timer interface module, and 512 bytes of RAM.

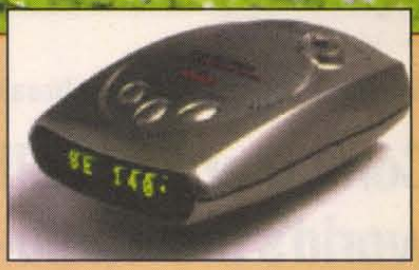
A unique feature of the 68HC908 is that its Flash memory is "in-system" programmable. Because user software can erase, write, and read the Flash, it can be programmed in the standard user mode. However, a special "monitor mode" is also available on the 68HC908. This mode allows the user to perform various low-level operations on the 68HC908 without executing user code.

The CP-908 is priced at $149.00.

For more information, contact:

ALLEN SYSTEMS
2346 BRANDON RD., DEPT. NV
COLUMBUS, OH 43221
614-488-7122
E-MAIL: allensys@aol.com
WEB: http://members.aol.com/allensys

RX5000



Precision Navigation, Inc. introduces the first radar/laser detector with a built-in digital compass, the RX5000 for use in autos, RVs, and SUVs.

The RX5000 brings together state-of-the-art technologies in one small six-ounce unit designed to provide all types of drivers with the most accurate radar/laser/safety and compass combination on the market today.

Ideal for long-distance drivers who find themselves in new cities, the RX5000 not only alerts the user to all bands of radar, 360 degrees of laser protection and VG-2, it also functions as a safety device informing drivers of road hazards such as approaching emergency vehicles, roadwork, and upcoming train crossings with an illuminated eight-digit text display.

The digital compass displays directional information with numeric digits and cardinal points. Its magnetic distortion detection and correction elements means it operates without the worry of interference from outside metal sources like traditional compasses.

Designed to be very user-friendly, the sleek profile of the 4-1/2" x 3" metal-finish unit mounts easily to any windshield with suction cups and is powered by a 12-volt cord that plugs into the car lighter. The easy-to-read display has four city modes, brightness and volume controls, a mute button, and can withstand operating temperatures from -14 degrees to 158 degrees.

The RX5000 can be purchased at specialty retailers and from catalogs at a suggested retail price of $199.00.

For more information, contact:

PRECISION NAVIGATION, INC.
5550 SKYLANE BLVD., STE. E, DEPT. NV
SANTA ROSA, CA 95403
707-566-2260 FAX: 707-566-2261
E-MAIL: csherer@precisionnav.com
WEB: www.precisionnav.com

New Product News

MULTI-SENSOR VEHICLE COMPASS

Designed to give drivers a variety of essential trip information, the V5000 Series multi-sensor vehicle compasses integrate state-of-the-art sensor technology to provide directional readouts, the inside temperature of the car, automatic trip timer, digital clock, outside temperatures, black-ice warnings, altimeter readings, trip logs, and "SMART" sensor features such as an auto shut-off when the car is not in use after 10 minutes, magnetic distortion detection, and correction elements that tell when the compass reading may be affected by an outside source, and a multiple trip log that stores and records time and temperature information, as well as the time traveled, for up to three trips.

Prices for the V5000 Series range from $79.95 to $129.95 and can be purchased at specialty retailers and from catalogs.

For more information, contact:

PRECISION NAVIGATION, INC.
5550 SKYLANE BLVD., STE. E, DEPT. NV
SANTA ROSA, CA 95403
707-566-2260 FAX: 707-566-2261
E-MAIL: csherer@precisionnav.com
WEB: www.precisionnav.com

IC-2800H DUAL BAND

Icom's new IC-2800H has a unique full color LCD display with user-selectable modes and video capabilities. With durable construction, installation flexibility, a bandscope function, 9600 bps packet, independent tuning controls, convenient memory editing, and much more. The IC-2800H offers advanced functions, convenient features, and superior performance.

The IC-2800H has a 3" TFT color LCD remote control head that gives a wide angle viewing for flexibility and all-around usability. The high visibility screen offers a wealth of information: scope, S meter, memory names, scan condition, and more.

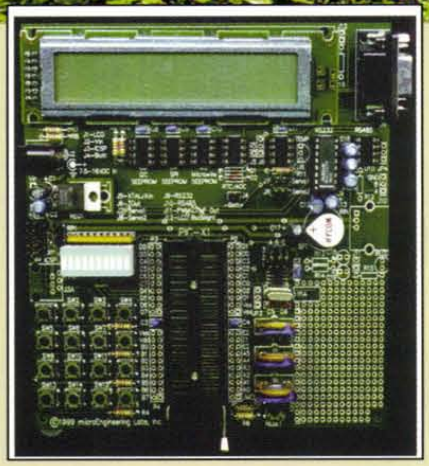
With optional and/or third-party equipment, preview real-time VCR or digital camera images, monitor TV broadcasts with a TV tuner, display GPS maps, and more.

The IC-2800H transmits 50 watts on 144-148 MHz, and 35 watts on 430-450 MHz.

A tuning dial, AF gain, squelch level control, and four function control switches are available for each band.

For more information, contact:

ICOM AMERICA, INC.
2380 116TH AVE. N.E., DEPT. NV
BELLEVUE, WA 98004
425-454-8155 FAX: 425-454-1509
WEB: www.icomamerica.com



PICMICRO EXPERIMENTER/LAB BOARD

The new PIC-X1 is microEngineering Labs first pre-assembled experimenters platform for the Microchip Technology PICmicro microcontrollers. While our PICProto boards allow you to create your own projects with a minimum of hassle, the PIC-X1 goes one step further. It provides an assembled testbed containing most of the circuitry commonly used with PICmicros.

The PIC-X1 contains the circuitry required by the PICmicro to operate: five-volt power supply, oscillator, reset circuit, as well as additional application circuits. The crystal controlled oscillator includes jumpers to set the speed between 4 MHz and 20 MHz.

Application circuits include a switch matrix, potentiometers, LEDs, LCD module, serial EEPROMS, real-time clock, temperature sensors, servo connectors, RS232 interface, RS485 interface, IR interface, and speaker. A prototyping area is also included in case we missed your favorite circuit.

All of the PICmicro I/O pins are brought out to headers next to a 40-pin ZIF socket. This allows connection to off-board circuits, as well as allowing on-board circuits to be connected to other PICmicro pins, if desired. The PIC-X1 is designed to work with 40-pin PICmicros, but may be jumpered to work with smaller devices.

The PIC-X1 is available in either bare PCB, kit, or assembled form. A parts list and schematic along with PicBasic Pro example programs, are included.

For more information, contact:

MICROENGINEERING LABS, INC.
P.O. BOX 7532, DEPT. NV
COLORADO SPRINGS, CO 80933
719-520-5323 FAX: 719-520-1867
E-MAIL: info@melabs.com
WEB: http://www.melabs.com

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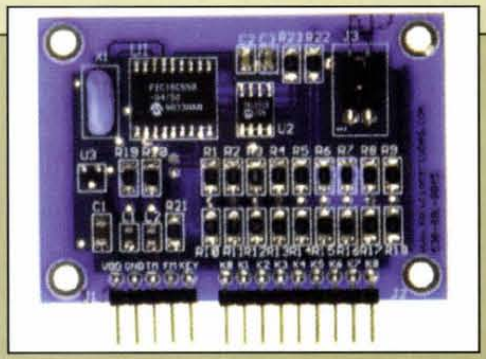

MEMKEY

The MEMKey is a fully programmable keypad encoder. Using a jumper, the MEMKey supports either a simple serial communication protocol or the standard PC/AT communication protocol. In either communication mode, it can decode key matrixes of up to four columns by five rows. The rows and columns can be programmed to match the row-column configuration of any off-the-shelf keypad.

The value returned by the MEMKey can be programmed to any standard value. In addition, the debounce time and typematic rate are fully programmable. All programmable values are stored in non-volatile memory so they are saved when power is off.

When operating with the serial protocol, the MEMKey communicates at 2400 baud, 8N1, LSB first, asynchronous. This can be either a one-wire or a two-wire interface.

In addition, there are 64 bytes of EEPROM memory which is made available to the user as scratch pad space.

The MEMKey's small size and connection scheme allow the device to be inserted directly into circuit boards for production runs, or into breadboards for easy prototyping.

Complete data sheets and application notes are available.

The MEMKey comes in a 1.6" x 2.25" SIP module, and sells for $36.00 (quantity 1).

For more information, contact:

SOLUTIONS CUBED
3029 ESPLANADE STE. F, DEPT. NV
CHICO, CA 95973
530-891-8045 FAX: 530-891-1643
E-MAIL: lon@solutions-cubed.com
WEB: www.solutions-cubed.com

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VM1030PA-B 30mmx30mmx25mm, Pinhole lens with audio, 12V — $49.00 any qty.

VM1035A 42mmx42mmx25mm Standard lens with audio, 12V with back light compensation — $59.00 any qty.

VM1036A 32mmx32mmx25mm Standard lens with audio, 12V, reverse mirror image feature — $59.00 any qty.

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VM3011-A 45mmx40mmx24mm Standard lens with audio, single board — $99.00 any qty.

VM3010-A 33mmx33mmx32mm Standard lens with audio — $129.00 any qty.

Detailed Specs on the Web

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VMBLT3025W Digital Color, Weatherproof 20mm(D)x83mm(L) — $189.00 any qty.

VMBLT1020W B&W Weatherproof 21mm(D)x58.5mm(L) — $79.00 any qty.

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Detailed Specs on the Web

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Part No.	6510	6506	6504	6502
Bandwidth	100MHz	60MHz	40MHz	20MHz
Vert. Sensitivity	1mV/DIV to 5V/Div	1mV/Div to 5V/Div	1mV/Div to 5V/Div	1mV/Div to 5V/Div
Max Sweep Rate	2nS/Div to 0.2S/Div	0.1µS/Div to 0.2S/Div	0.1µS/Div to 0.2S/Div	0.2µS/Div to 0.5S/Div
Delay Sweep	YES	ALT-MAG	ALT-MAG	ALT-MAG
Vert. Mode Trig.	YES	YES	YES	YES
Cursor Readout	NO	NO	NO	NO
CRT Volts	12KV	10KV	10KV	2KV

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VMCW-H12A 32mmx32mmx19mm, Color CCD with pinhole lens, pre-wired cabling for video/audio, 12V DC Power Input — $149.00 $139.00 5 or more

Detailed Specs on the Web

VMPS-718A 25mmx25mmx30mm, B/W CCD with standard lens, pre-wired cabling for video/audio, 12V DC Power Input — $69.00 $59.00 5 or more

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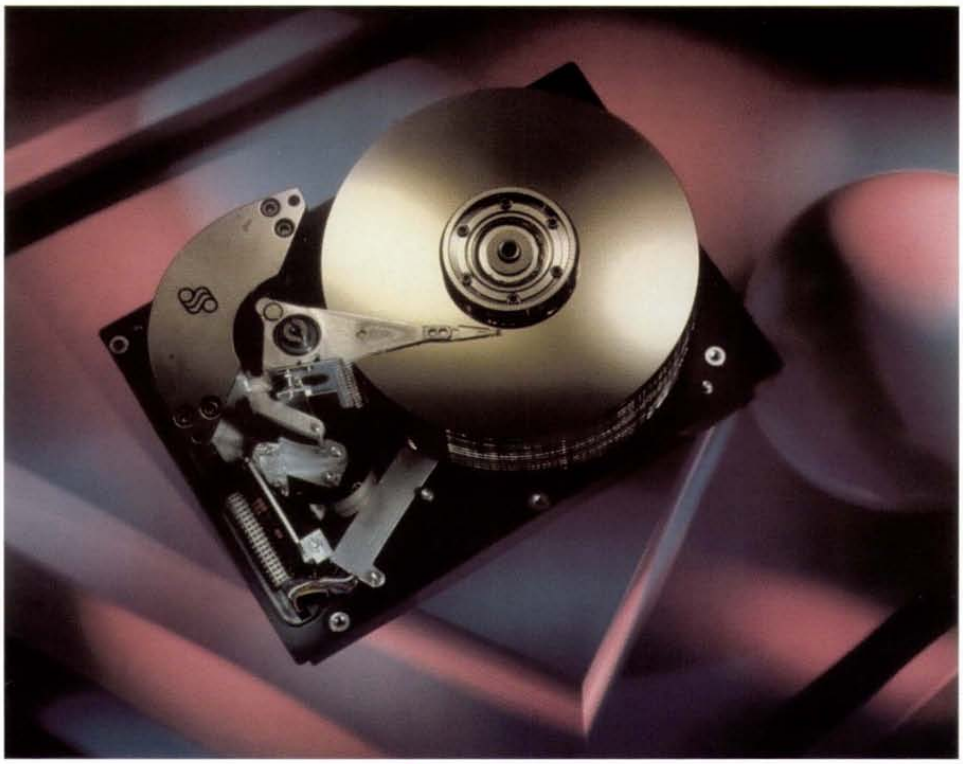

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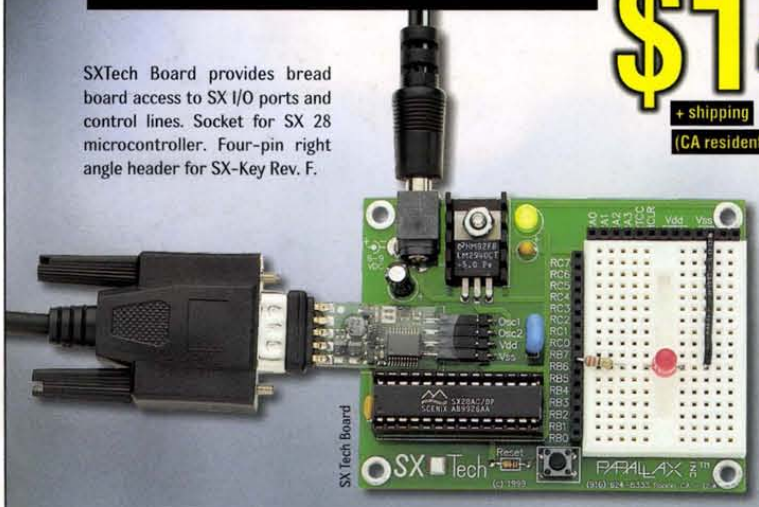

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