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Volume 19 No. 10 • OCTOBER 1998

Contents

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Deadlines should be discussed in advance with the editor, but generally all material should be submitted two weeks prior to the 1st of the month for the next month's issue.

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EMERGENCY TODDLER FINDER

by Kenton Chun

If you have one or more toddlers in your family, you probably have experienced the terror of going to the shopping mall or a family outing and temporarily losing a child. This happens far too often and too easily for comfort. Perhaps you are involved in a store display and in a moment of inattention, the child wanders off. Sometimes the child will outrun the parent. It happens to everyone.

Unfortunately, many children have been abducted or injured after getting lost in this manner. According to some sources, there are more than 100,000 reported attempted child abductions a year in the United States alone.

In many cases, the lost child is not very far away, and the frightened parent actually makes things worse by going into a panic and placing more distance between themselves and the lost child by engaging in a random search pattern.

Nobody likes to admit they make mistakes like this, and usually a meticulous job of managing children will prevent an episode. But as children mature, they want more freedom and will sometimes go out of their way to explore on their own.

It simply is not possible for a parent to always know exactly where the child is at every second. When a child gets lost, every second counts if the child is in any kind of danger.

This month's project is an electronic toddler finder which will locate a lost child if he or she is within several hundred yards of the parent. It can be used as a means of last resort for locating a lost child in the (hopefully unlikely) event that the child is at risk.

The project is essentially an interface which you can build to allow you to connect an ordinary pocket pager to a personal attack alarm (PAL). A personal attack alarm is a small device about the size of a pack of cigarettes, which emits a piercing audio alarm in excess of 140 dB when a lanyard is pulled out of it. It can be heard for distances of nearly a mile in quiet conditions.

When a child is deemed lost and in possible danger, all the parent need do is to take their cellphone out and dial the number of the pager/PAL combo that the child is carrying. The PAL will sound and allow the parent to quickly locate the missing child. The design has the added benefit that if the child is in the process of being abducted, when the alarm sounds, the abductor is likely to discontinue the abduction for fear of attracting too much attention.

While I do not suggest that everybody use pagers and personal attack alarms in this fashion, it is a last resort method of locating a lost child when the threat of injury or abduction is deemed possible by the parent. Responsible use of this technology will save lives. Misuse of it will result in just another mindless public irritation, like the bleating car alarms in the mall parking lot. Please remember this if you decide to construct and use this project.

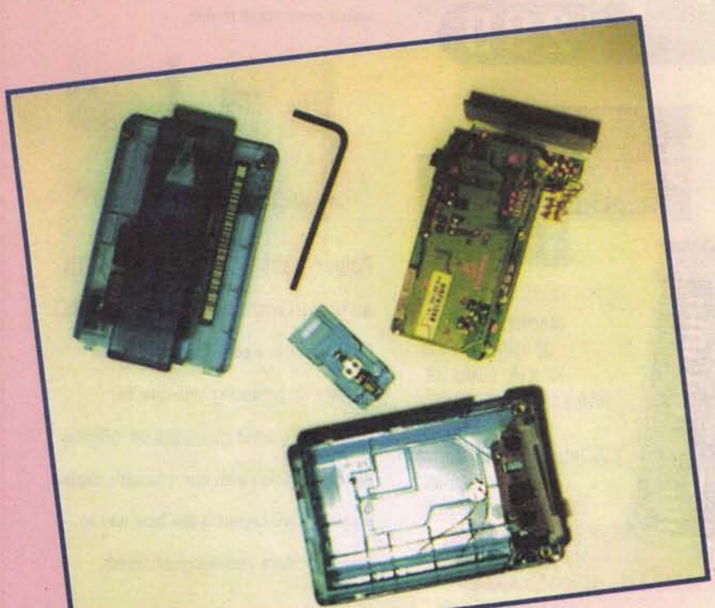


Figure 1
Disassembling the Pager

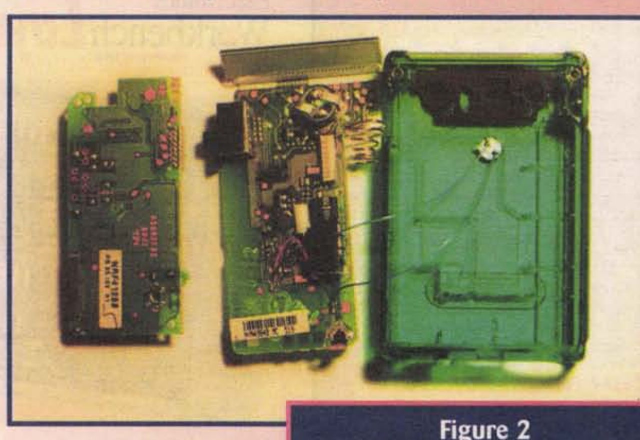


Figure 2
Modifying the Pager

Design and Implementation

There are many different pagers and PALs on the market today. I decided to use a project implementation which would work on virtually all pagers and PALs, however, this means it is possible the experimenter will have to do some testing and tweaking of their implementation to verify that it works properly and reliably.

In addition to this, I wanted an implementation which would allow the pager and the PAL to be used for their original purposes and not be permanently connected together as a dedicated toddler alarm. Toddlers after all, eventually grow up.

I chose to use an infrared optocouple which allows the two devices to be easily interfaced, and still fit the design criteria mentioned above.

Infrared Optocouplers

An optocoupler consists of a light-emitting diode (LED) and phototransistor pair. The LED emits light in an extremely narrow band in the infrared wavelength of the light spectrum, usually in the range of 880 to 940 nM or so. The light output is not visible to the naked eye. This is good for several reasons.

One is that it allows essentially invisible operation. Another is that infrared (IR) LEDs can emit 10 or more times the output of a visible LED as they are more efficient in the infrared spectrum.

The most important to our

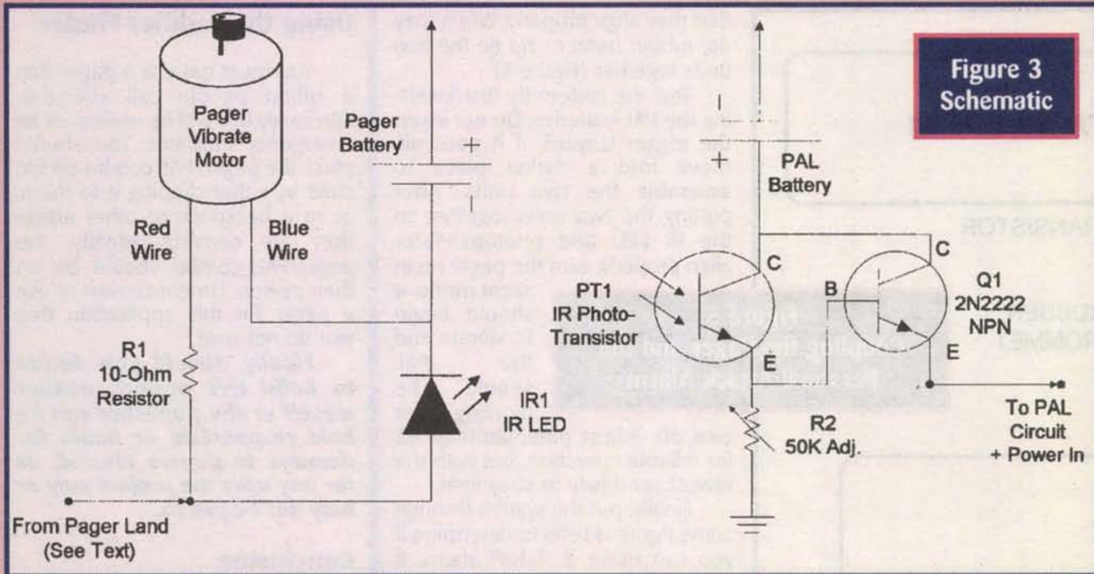


Figure 3
Schematic

project is that they begin to operate at forward voltages of 1.2 volts, which is just about all we have available in a standard "cheapie" pocket pager running on a single AA pen-cell.

The phototransistor is usually matched to be sensitive to the same wavelength of light emitted by the IR LED. This increases sensitivity to control signals, and reduces the chances of a false signal from spurious light sources.

The most common is an NPN junction transistor with a large base region exposed to the outside world. Photons entering the device through a small lens replace the base-emitter current of ordinary bipolar NPN transistors, switching the device on.

Optocouplers come in many configurations, and are generally used to provide extremely high electrical isolation between circuits. Other types are arranged to have an accessible gap between the LED and phototransistor in order to "sense" objects or to count events.

Getting Started – Prepare the Pager

Begin by acquiring the IR LED and phototransistor pair. I used a General Electric L14F1123 and LED which come as a matched pair from Radio Shack. Almost any IR LED can be used, however, it must begin to output infrared at 1.2 volts, or the device will not work in this application. Generally, the more sensitive phototransistors have three leads (base lead exposed) instead of two.

Next, open up the pager. Remove the battery. Remove the two hex allen screws at the top of the case and lift the back away. With a small screwdriver, carefully pry out the white plastic keeper that holds in the LCD display.

Then, carefully pry out the plastic tang at the bottom of the case which locks the PC board down enough to free the board. Don't break it or the LCD display! The entire PC board and LCD assembly should now lift out (Figure 1).

Drill a hole in the center of the front of the pager case which will accommodate the IR LED you are using. You want it to fit through the hole snugly. It should stick out of the front of the case. If you are a master craftsman, you can use a Dremel tool and, with a fine cutoff wheel, cut the IR LED as close to the array junction as you dare.

If you do this right, you can actually mount the IR LED inside of the pager case. If the pager case is a semi-transparent plastic, it will actually work without a hole.

Next, mount the IR LED with a dab of epoxy or Super Glue. Make sure that the back of the LED will clear the circuit board before gluing it down! Trim the leads close to the LED and quickly solder a length of fine insulated wirewrap hookup wire to each lead.

The pager PC board assembly actually consists of two small circuit boards connected by an eight-pin header connector. Separate the two boards by carefully prying them apart at the header connector. Be careful not to break the boards. On the lower board, you will see a small motor with a weight attached to the shaft. This is the "vibrate" pager motor.

When the beeper is in silent mode instead of the audible alarm, this motor whirls a small eccentric weight around the shaft causing the pager to vibrate. It will have two wires, red and blue. The red wire is positive, the blue negative. You can confirm which wire is which because one of them will go directly to one of the battery terminals.

Unsolder the red motor wire. Solder a 20-ohm resistor to the terminal land the red motor wire was on. Re-solder the motor wire to the other lead of the resistor. I used two 10-ohm surface mount resistors (SMTs) in series.

There is plenty of space for a conventional 1/8-watt carbon or epoxy resistor, if that is all you have. Solder the anode wire of the LED to the positive or red wire terminal. Solder the cathode wire of

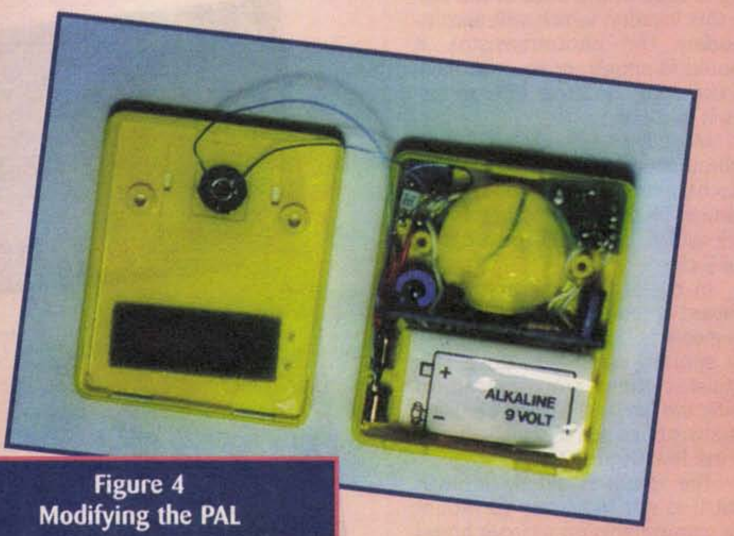


Figure 4
Modifying the PAL

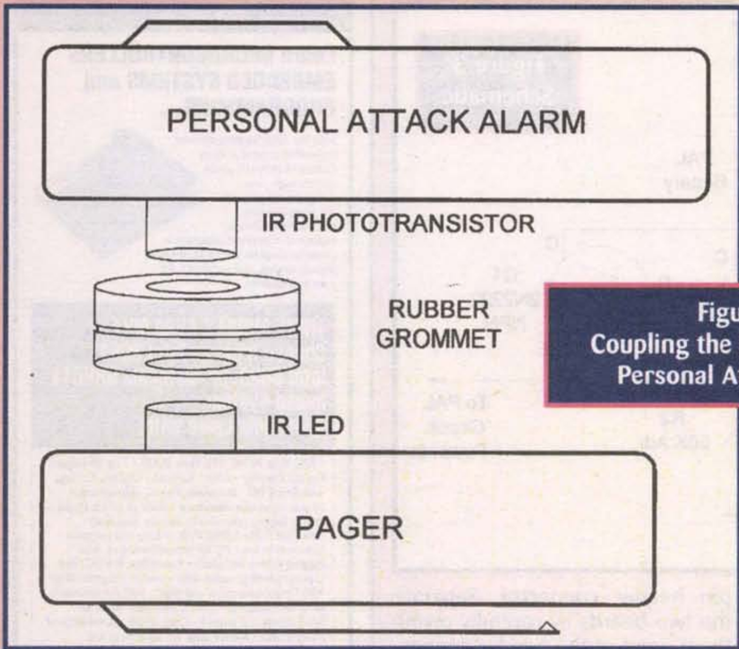


Figure 5
Coupling the Pager and the Personal Attack Alarm

the LED to the negative or blue wire terminal. In my pager, this is also the negative battery contact. You should end up with something that looks like (Figure 2).

Re-assemble the pager, making sure not to break or cram any of the components. Re-insert the battery and turn the pager on. Usually, pagers have a test mode at turn-on time. You can test for proper operation of the IR LED by turning the pager on in vibrate or silent mode and watching it with a night vision scope. It should light up like a Christmas tree.

If you do not have an IR night vision scope, connect your phototransistor to an ohmmeter and hold it next to the pager case when the vibrator is activated.

You should see a noticeable drop in resistance across the phototransistor's emitter and collector as it begins to conduct. The 20-ohm resistor will not have any noticeable effect on the operation of the vibrator, except that perhaps the pager will no longer jingle your keys. The resistor is necessary to leave enough current to drive the IR LED, however.

Prepare the PAL

Remove any clips from the back of the PAL. It must fit snugly against the front of the pager. Good quality PALs have removable clips. If you are using a "cheapie" PAL, you may need to cut the clip off. Line the pager and the PAL up, and mark exactly where the LED is pointing at the back of the PAL. Drill a hole in the back of the PAL at this location which will accommodate the phototransistor. It should fit snugly, or you will have to use epoxy or Super Glue to fasten it in place.

Most PALs employ a shorting subminiature jack as the trigger mechanism. A lanyard with a dummy plug is inserted in the PAL jack which opens the contacts in the jack.

In the event of an attack, the lanyard is jerked and the dummy plug comes out of the jack causing the shorting contacts to close. This activates the alarm. Instead of using the lanyard, we will be using a transistor switch to supply power to the PAL (Figure 3).

The circuit is simple enough that it is not necessary to mount the components on a circuit board – it will suffice to find any empty space in the PAL case and mount them by soldering them point-to-point. When the phototransistor PT1 is switched by the incoming IR beam from the pager, it turns on NPN transistor Q1 which supplies power to the PAL.

Depending on the way your particular PAL is designed, it is possible to wire the transistor switch in parallel with the PAL trigger jack. I choose to switch the PAL power supply instead because this method should work for all PALs, irregardless of their trigger design (Figure 4).

Parts List:

R1	10-Ohm 1/8-watt Resistor or SMT
R2	50-Kohm Potentiometer
Q1	2N2222 NPN transistor
IR1	Infrared LED (See Text)
PT1	GE- L14F1123 IR Photo Transistor (See Text)

Putting It All Together

Depending on how much your LED and phototransistor stick out, you may need to use a rubber grommet or an "o" ring as a spacer and coupler between the pager and the PAL. What is important is that they align properly. When they do, rubber band or zip tie the two units together (Figure 5).

Test the system by first inserting the PAL batteries. Do not insert the trigger lanyard. If it goes off, move into a darker place to assemble the two units. After putting the two units together so the IR LED and phototransistor align properly, turn the pager on in silent mode. It should begin to vibrate and the PAL should be blowing your ears off. Adjust potentiometer R2 for reliable operation, but with the lowest sensitivity to stray light.

Finally, put the system through some rigorous tests to determine if you can make it "false" alarm. It may be possible to have false alarms if too much light is allowed to leak into the phototransistor from outside sources. Placing the project in direct sunlight is a good test. It should NOT go off.

Depending on the quality of the transistor you use, there should be less than 30 microamps of current drawn on the PAL battery when the units are coupled together. The standby current draw will be practically zero if the IR LED and phototransistor are coupled properly, and there is no light leakage from the outside (Figure 6).

Figure 6
The Finished Project

Using the Toddler Finder

You must not use a pager that a zillion people call everyday. Obviously this will be useless as an emergency indicator. You should place the pager/PAL combo on the child by either clipping it to them, or in a backpack or other article they are carrying. Ideally, the pager/PAL combo should be on their person. Do not convert or use a pager for this application that you do not own.

Finally, should you decide to build this project, neither myself or the publisher can be held responsible or liable for damage to pagers altered, or for any uses the project may or may not be put to.

Conclusion

The Emergency Toddler Finder should only be activated if you believe your child may be in imminent danger. It should not be used as a substitute for attentive parenting. It will provide a last-resort indication of where your lost child is and may even save their life. It is my hope that I never hear one of these go off at the mall!

Remember to have fun, whatever you do! **NV**

ATRV-2

Real World Interface, Inc. announces their second All Terrain Robot Vehicle – the ATRV-2.

The ATRV-2 is designed to provide the robotics researchers and scientists who are pioneering tomorrow's rovers with a vehicle capable of supporting demanding missions including security, land mine detection, reconnaissance, surveillance, and remote operation in hazardous areas.

ATRV-2 is a rugged four-wheel drive, differential steered, all terrain robot vehicle. With 40 cm all terrain tires on four aluminum wheels, the ATRV-2 has excellent off-road traction and can traverse asphalt, grass, rocks, and sand with ease. The fully enclosed rugged aluminum body protects electronics from the elements.

The ATRV-2 features an internal PC that provides an ideal interface for a wide range of sensors including: laser range finders, stereo vision, and more more of your choice.

For more information, contact:

REAL WORLD INTERFACE, INC.
32 FITZGERALD DR. P.O. BOX 375
DEPT. NV, JAFFREY, NH 03452
603-532-6900 FAX: 603-532-6901
E-MAIL: lwoodbury@rwii.com
WEB: http://www.rwii.com

COLOR VIDEO PEN CAMERA

American Innovations, Inc., announces the release of their new VP-300 Color Video Pen Camera. To the casual observer, the unit looks like an ordinary pen in your pocket. Hidden inside is a micro-miniature color CCD camera that delivers unparalleled picture quality.

Images can be recorded using a standard portable video recorder or fed into a video transmitter for remote real-time recording and/or observation.

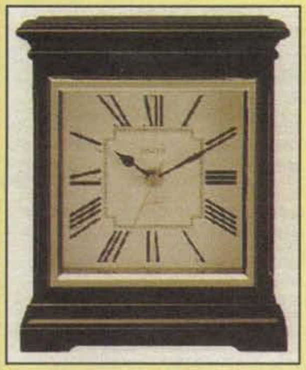
Perfect for Law Enforcement operations, private investigators, and undercover news reporters, this unit is the most revolutionary way to record live events that require the utmost discretion.

All optional components (Sony 8 mm video recorder, battery pack) fit neatly into a small waist pack so there is no cumbersome video equipment to carry. This unit is so small and easy to use, you will keep it on hand every day. Set up takes seconds.

The VP-300 Color Video Pen boasts over 330 (H) TVL resolution, low two-lux sensitivity, and delivers 92 degree FOV through its 3.6 mm pinhole lens. By incorporating special engineering and advanced circuitry, the video pen can also capture video in low light settings.

The special introductory price for the VP-300 is only $2,400.00.

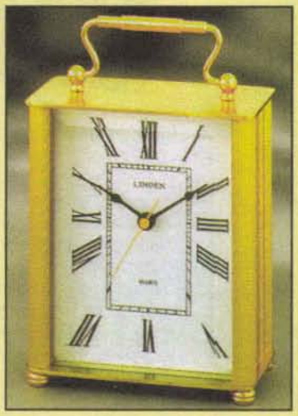
I-SPY CLOCKS



The MC-985 Mahogany Clock Cam and the CL-985 Carriage Clock Cam are the two latest I-Spy cameras manufactured by American Innovations, Inc.

These clocks blend into any home or office setting making them ideal for every undercover operation.

Each covertly conceals a 380 (H) TVL resolution color camera, with a super low two-lux sensitivity rating.



These cameras also have built-in backlight compensation thus enabling the color camera to function in a room with minimal lighting. The custom designed pinhole lens offers an astonishing 92 degrees FOV through an opening measuring only 2 mm!

The MC-985 Mahogany Clock Cam and the CL-985 Carriage Clock Cam were designed for use in the office to monitor employee's performance; place them in a store to protect your merchandise and your profits. These cameras are perfect for the working parent who wants to keep an eye on their nanny and/or housekeeper while they are away or at work.

Since the camera utilizes standard video signals it can be connected to your own TV or VCR. You can set the timer function on your VCR to monitor an area at predetermined times and/or intervals.

The special introductory price for these two I-Spy Color Clock Cameras is only $350.00.

For more information on these products, contact:

AMERICAN INNOVATIONS, INC.
119 ROCKLAND CENTER, Ste. 315, DEPT. NV, NANUET, NY 10954
914-735-6127 FAX: 914-735-3560 WEB: http://www.spysite.com

SVR8-T SERVO CONTROLLER

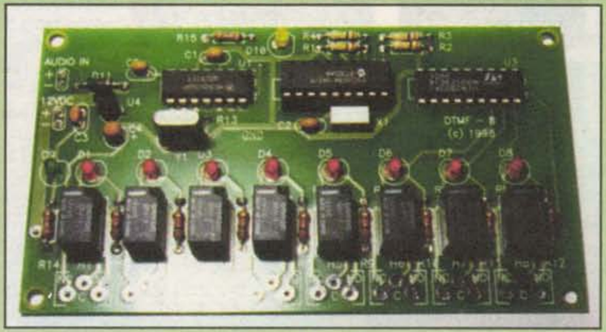
The SVR8-T provides eight channels of standard PWM servo control along with eight channels of 16-bit torque feedback using standard unmodified hobby servos. This patent-pending technology enables new or existing devices which utilize servos for motion control to be enhanced with the sense of touch without adding any additional sensors.

Examples of feedback systems include: 1. Low-cost servo walker that can adapt to the terrain. Sense and avoid a drop-off, all without adding a single sensor. 2. Low-cost servo gripper that can sense an object's presence and/or weight and only apply the correct amount of pressure to grab the object. 3. Multi-axis arm or leg that can sense and adjust to its own or external forces.

The SRV8-T sells for $99.95.

For more information, contact:

NETMEDIA, INC.
10940 N. STALLARD PL., DEPT. NV, TUCSON, AZ 85737
520-544-4567 FAX: 520-544-0800
http://www.web-hobbies.com



DTMF-8 DECODER BOARD

The DTMF-8 board is great for remotely controlling most equipment like a repeater via radio or any other audio source with its eight relay outputs.

Relay contacts are rated at one amp and can be programmed for momentary, latching (or combination), or mutually exclusive one of eight.

Password programming adds security and allows multiple DTMF-8 boards attached to the same audio source to control even more equipment.

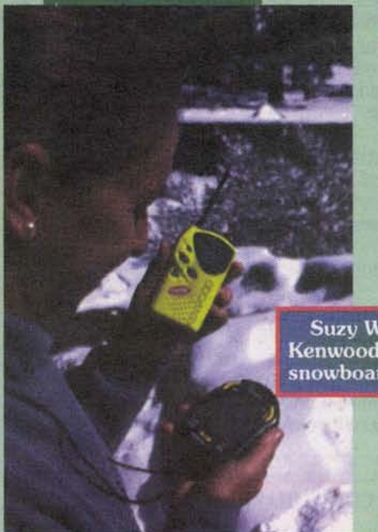
Requires 12 to 14 VDC at up to 250 mA.
The cost is $119.00.
For more information, contact:

INTUITIVE CIRCUITS, LLC
2275 BRINSTON AVE., DEPT. NV, TROY, MI 48083
248-524-1918 E-MAIL: sales@icircuits.com
WEB: http://www.icircuits.com

Continued on page 100

FAMILY RADIO SERVICE RADIOS — FACTS AND MUCH FICTION

by Gordon West



Suzy West operates a Kenwood FRS radio while snowboarding last winter.

The Family Radio Service (FRS) is almost two years old, and founder Bob Miller K3RM, of RadioShack is quite pleased on how his simple proposal to the Federal Communications Commission (FCC) has revolutionized the way that we can now stay in touch. No license required. Fourteen channels of FM quality communications. And everybody getting into the act producing little FRS radios to help our economy.

And little lightweight transceivers that have been documented as lifesavers in several emergencies throughout the United States.

Yes, FRS on its second birthday is working just fine as envisioned by Miller and RadioShack.

The Oregon Scientific two-way radio.

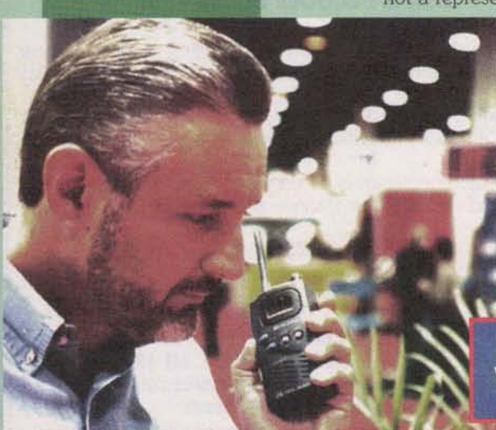
The small FRS transceiver is ideal for boat-to-car communications during launching.

Before we talk about some of the slightly misrepresented claims about the equipment and what it can and cannot do, plus some of the things that people have been doing with the equipment that Miller hadn't even thought of, let's take a look at what FRS is, and a little about what manufacturers are doing to maneuver themselves in the marketplace.

. . . 14 frequencies times 32 privacy codes may not lead you to "hundreds" of vacant channels. Advertisements for one- and two-mile range are indeed accurate, but 10-mile to 20-mile range is quite common . . .

The FRS is governed by the FCC under the Code of Federal Regulations, Title 47, Part 95 — Personal Radio Services. The FRS's general provisions are found in Subpart B, specifically Rules 95.191, 95.192, 95.193, and 95.194. The simple rules say that you can use these little radios as long as you are not a representative of a foreign government. You must also share the 14 channels with other users.

The rules also state that you can use these radios anywhere the FCC has jurisdiction, but you cannot use them aboard a boat or aircraft without the permission of the captain. You cannot cause intentional interference, either.



The small FRS radios work well inside metal buildings.

You may not use these little sets to commit a crime. You will use these sets to conduct two-way voice communications with someone else, and the FRS is not intended as a one-way broadcasting service to play talk show host. You cannot tie your FRS into a telephone system, either.

The rules also state you cannot go inside your little FRS set and jack up the power, or make modifications to its required built-in (only) antenna.

But the rules leave wide open all of the neat LEGAL things that you can do with this equipment, realizing some of their inherent limitations by design to keep this radio system short-range.

Compact FRS transceivers can communicate over 50 miles under the right conditions!

- Effective radiated power output shall not exceed 1/2 watt.
- Deviation must not exceed ±2.5 KHz.
- Audio frequency response must not exceed 3.125 KHz.
- No external antenna connections are allowed.
- Frequency tolerance required is .00025%.

These little handhelds operate on interstitial frequencies to the more powerful general mobile radio service. Channels 1 to 7 fall between powerful GMRS output frequencies, and FRS Channels 8 through 14 fall between sensitive GMRS repeater input frequencies.

FRS CHANNEL FREQUENCIES

FRS Channel #	MHz
1	462.5625
2	462.5875
3	462.6125
4	462.6375
5	462.6625
6	462.6875
7	462.7125
8	467.5625
9	467.5875
10	467.6125
11	467.6375
12	467.6625
13	467.6875
14	467.7125

And here is something they probably didn't tell you in the brochure that comes with FRS equipment — on FRS 462 MHz Channels 1 through 7, you share your channel with mobile and base station GMRS system users who could run up 10 times more power and twice as much modulation bandwidth as your little tiny handheld. FCC Rule 95.29(f) gives GMRS licensed users full access to these same "interstitial" channels to talk simplex. Now you are beginning to understand why you might have been drowned out when you are trying to use your little handheld in the local shopping mall — a powerful voice came over your channel, and that was that. It's legal.

But take heart — you still have FRS Channels 8 through 14 to use. But if you're out on a hiking trip, and you get close to that big mountain peak where there are a lot of powerful

Motorola's TalkAbout Plus two-way radio.

repeater stations on that peak, refrain from using FRS Channels 8 through 14. The reason is because many of those GMRS repeaters may be operating in the GMRS service, and talking from your little 1/2-watt set close to these repeaters and their sensitive input frequency could wipe out legitimate FCC-authorized GMRS calls. So stay off of the otherwise quiet FRS Channels 8 through 14 when hiking among the trees and big repeater aluminum towers.

And speaking of hiking, is there a common FRS channel in case of an emergency? Nope, not at all. Your best source of getting help in an emergency over FRS would be to dial through the channels and try to break into an ongoing conversation that you may hear loud and clear.

A year ago, you could go to the top of most buildings or hills, and spin through the channels and not hear much. But now the channels are beginning to blossom with activity, so chances are you could break in for some help if the two folks communicating leave a couple of seconds between their ongoing conversation. In fact, anyone out in the wilderness should always pause a couple of seconds before resuming a conversation for that purpose of letting someone else come in with emergency traffic.

I suggest using the international distress word, "Mayday," which in almost any language means stop transmitting and handle my emergency call. Say it three times and hopefully someone will hear a call for help.

On less expensive FRS equipment, you won't have the luxury of dialing around to find an either open or occupied channel. Some sets only come with one channel, and there appears to be no set channel that is a single channel unit. Most single-channel sets cost around $59.00. Two-channel sets cost around $69.00 each, and 14-channel sets cost about $149.00 each. I think this is more a marketing ploy than what it costs to produce a 14-channel set versus a two-channel set, but nonetheless, these are the latest price points observed.

And the most channels there are will be 14.

38 TALK GROUPS COMBINED WITH 14 CHANNEL CAPACITY OFFERS 1,064 PRIVACY CIRCUITS TO COMMUNICATE.

Other ads tone it down a bit and indicate their privacy codes combined with "all frequency capabilities" may lead to hundreds of private "channels." Not really.

The privacy codes are the common EIA CTCSS sub-audible tone codes. Many multi-channel FRS handhelds feature full decode CTCSS capabilities. I can begin to see the advertising logic — if everyone out there has a different channel dialed in and a different CTCSS encode, YOUR likelihood of having someone come through loud and clear over your specific channel that is on tone decode is rather remote up to maybe 1,000 tries. And you could even increase your odds of no one else coming over YOUR set by using equipment with voice scrambling to further reduce the likelihood of some stranger coming over your

TWO-WAY COMMUNICATION FOR MOTORISTS?

by Robert Leef

Just about everyone is interested in cars. It's only a short jump from automobile interest to transportation, and from there to communications. Historically, one has led to another in the development of our country. The Pony Express, telegraph, Henry Ford's invention, and our highway system are all connected. But has one aspect of the picture fallen behind by about 90 years?

Motorists come into contact with some form of communications every day. In the most simple way, it's the broadcast radio we listen to while driving. Besides this "one-way" radio — and possibly a mobile scanner — the vehicle may also be equipped with two-way radio such as business band, CB, amateur, GMRS, cellular, and maybe others.

Each of these pieces of equipment is designed to establish contact with another unit like itself, and usually with a specific person at another location. Herein lies the problem. None of these mobile two-way communications devices connect with all other nearby vehicles on the road. Private airplanes communicate with each other, and so do most boats. Why don't cars?

Instead, we use hand signals, flash the lights, or yell to try and convey important information to another driver. We travel along in our steel and plastic cells in a kind of frustrated solitary confinement, unable to talk to the person in the car right next to us!

In the 1970s, we seemed to be headed in the right direction with CB. Sales were high. Approximately one out of every 10 cars and trucks had that kind of radio, and it was growing. Many motorists could talk to each other, or just listen to what was going on around them if they preferred. Even General Motors was an active participant with CB. However, due to a number of reasons, it never reached all vehicles and now is basically flat or even in decline in some areas.

THE NEED

As it is now, we're unable to communicate properly with almost all nearby drivers. Messages that might be passed include:

a) A traffic problem ahead.
b) Giving warning of a dangerous road condition (fog, etc.).
c) Asking for help.
d) Requesting directions.
e) Advising the driver in front he has a tire going flat, or something else out of the ordinary.

We might even see a restoration of civility and courtesy between drivers.

THE DETAILS

If there is to be communication between all drivers, a two-way radio must be in all cars, and left on. Or, if left off, it must be automatically turned on and tuned to the "emergency and assistance" channel by receipt of a signal. The "advanced alert system" is already used in Europe. It sends out broadcast signals in the FM band that automatically turn on car radios to inform drivers of road hazards. Technology from this, and possibly our own commercial sources, would undoubtedly lead to a "smart" two-way radio.

Such a radio would not be a costly car accessory. One source estimates less than $100.00 and, with an adapter, it could use the car's existing AM/FM antenna. Would there be a big sales loss for CB marketers? Probably not. These companies could contract with the automakers to supply their assembly lines with this new concept radio as a required factory installed item. Either coming as standard equipment in new cars or available in aftermarket for existing vehicles through electronics retailers, public safety and convenience would be enhanced significantly.

This past winter, there were numerous cases of motorists trapped in deep snow, and unable to summon help. This and other kinds of weather-related emergencies happen every year. Not everyone wants or can afford a cellular telephone, and CB is not dependable. No product has focused on the universal need of a required common communications device.

This new kind of two-way wouldn't have to be a replacement for CB. Some drivers, and many truckers, still need or want the capability of talking longer distance. And, beyond this — for 50 to 75 mile range — another choice still remaining would be the General Mobile Radio Service with its repeaters. These and other easily obtainable services would not be displaced.

SPECIFICATIONS

a) FM, 1/2 watt except 2 watts on channel 9.

b) Automatic squelch; controls for channel selection, off-on-volume.

c) Button for 38 CTCSS tones. May be enabled or disabled.

d) Monitor button. Used if CTCSS is enabled.

e) Busy scan feature. May be enabled or disabled.

f) Mobile and handheld models.

g) MOBILE: If factory-installed, coupled to existing car antenna. If sold in aftermarket, coupler or separate antenna available. HANDHELD: Built-in antenna included. Capable of external antenna.

h) Automatic transmitter identification ("ATI"). When radio is keyed, it sends its own distinctive code. This would be a deterrent to misusage.

i) Available accessory to decode above ATI. REACT and other public service organizations interested in maintaining the integrity of the service would want to buy this in order to identify troublemakers. There would be a structure for handling misusage rather than the current extremes of being unconcerned or having vigilantes as in CB. The system would be similar to the "Official Observor" program in amateur radio.

j) 1. A $5.00 license fee collected at point of sale and mailed by seller to the FCC.

2. License application to be short and simple: name and address of buyer, verified by driver's license or other document. License to be good as long as buyer owns radio. (RADIO is licensed.)

3. License application to be packed with radio and show ATI code. Last four digits will be radio owner's on-air identification.

k) Frequencies: (All are transmit and receive except 9.)

CHANNEL	MHZ
1	462.5625
2	462.5875
3	462.6125
4	462.6375
5	462.6625
6	462.6875
7	462.7125
8	462.6750 short-range emergency and assistance
9	467.6750 transmit, 462.6750 receive (repeater)
10	467.5625
11	467.5875
12	467.6125
13	467.6375
14	467.6625
15	467.6875
16	467.7125

l) Channel 9 operates through a repeater — already operational on GMRS throughout many areas of the US, and is recognized as the emergency and assistance channel for long range.

m) When radio is on ("awake"), channel 9 will be scanned for priority. A "Defeat" button will take it out of priority after 10 seconds of pause on a received transmission on 9. It must be "defeated" for additional 10-second intervals as long as the listener does not want to hear the transmission on 9.

n) When the radio is off ("asleep"), there is automatic turn-on if a signal is received on channel 9. After 10 seconds, it automatically turns off if not manually turned on.

CONCLUSION

The type of radio being proposed wouldn't need a lot of development. We're already using a low-power handheld on the new Family Radio Service (FRS) frequencies which are the same as those being suggested except for channels 8 and 9. Performance has been good. With a little redesign for car use, a new "Driver's Radio Service" could be a prompt reality.

The safety aspect alone should get the attention of some agency such as the National Highway Transportation Safety Administration, the US Department of Transportation, the Federal Highway Administration, or others. The commercial aspect should be attractive to opportunistic companies.

Some new cars have GPS and a display that shows road maps. This satellite-based technology is great. But it appears we have skipped over a more basic and widespead need for a number of years. A "Driver's Radio Service" would be the answer. NV spouse's handheld and carrying on an illicit conversation. Yup, I can see there might be more than 1,000 combinations to lock everyone else out.

But I wouldn't necessarily advertise them as private channels. Maybe a thousand different ways to make YOUR conversation private among yourselves.

But even if you do transmit with full CTCSS encode and decode, it doesn't mean that your conversation won't be overheard by anyone else with a simple FRS 14-channel set. While you might not hear anyone else on channel, someone running open squelch will definitely hear YOU on channel.

But Kenwood Corporation has gone one positive step forward to minimize eavesdroppers — a Kenwood radio UBZ-LF14 incorporates digital speech scrambling, and only another Kenwood radio can descramble the call if they're on the right frequency and have their tone decode circuit shut off.

"At the push of a button, Kenwood transmissions will be electronically altered so that casual listeners with other brand FRS radios cannot understand your conversations while your Kenwood friends and family can," comments Paul Middleton of Kenwood Corporation. "When combined with the 14-channel capacity, and the 38 talk groups, scrambling gives Kenwood owners 1,064 ways to communicate strictly between themselves," adds Middleton. Okay, I can buy that. Good feature.

The rules also permit brief tone calls over the airwaves. Many FRS radios may carry up to four unique user-programmable call tones that may ring the other person's FRS radio to let them know there is incoming traffic. Cobra, the king of CB 27 MHz radios, has a terrific feature called "Vibralert" that physically vibrates the FRS radio when it receives an incoming page call. They also advertise 532 CTCSS "sub-channels," but I think they are using just the regular 30-some CTCSS tones, and multiplying by the number 14 to come up with "sub-channels." But I like the Vibralert Cobra FRS equipment — it's a little smaller than most other FRS sets, and indeed it does its thing when an incoming specific call is received.

Midland also joins in on the circuit with 14-channel access with 38 privacy tones that "... give 532 channel/code combinations to eliminate crosstalk and interruptions." Maybe. Even though you may be decoding for a specific tone, someone else closer on the same frequency CAN interrupt the incoming call so all you hear is nothing. It's called capture effect — and even though the closer signal won't pop through your decode circuit, the station you do want to hear is effectively blocked from coming through. I wouldn't say that CTCSS may eliminate crosstalk or interruptions. You just won't know that you are getting jammed out!

Motorola does a good job of describing their Talk About handheld CTCSS "interference eliminator codes." They say, "It is a sub-channel code that lets you customize channels. When you select a channel, lots of other people may be using it, too. When you set a code, you tailor the channel to filter out other people's messages," writes Motorola. This is to lead to greater "flexibility" claims Motorola when operating the radio in congested or busy areas. Well, maybe.

If you're operating the radio on the same channel as someone else nearby, having your set on CTCSS full decode may lull you into thinking there is no one calling you, when actually the congestion is so heavy there indeed may be the kids screaming "Mommy, I'm lost." Something to think about. I would prefer to operate without my decoder turned on. This way, I'll recognize that the channel may be a popular one for a specific shopping mall, and have everyone in my party switch over to a slightly quieter frequency.

When it comes to maximum range, manufacturers and advertising agencies have been remarkably restrained. Most won't claim any greater range than one to two miles. Every now and then, you may see an ad saying "under optimum conditions up to three miles line-of-sight." This is a very conservative estimate when you consider signal propagation at 462 MHz in the summertime.

A 1/2-watt on 462 MHz might go as much as 100 miles when looking at free space attenuation tables. If the signal path is visible from mountain peak to mountain peak, and if there is no one on the same channel as the two of you are on, I would indeed expect the capabilities of establishing a narrow-band FM communications path. But to get a 100-mile path line-of-sight range, each of your minimum elevations will need to be no less than 2,500 feet up. And nothing in between. And not raining or snowing. And on a hot summer day when the wind is not blowing.

It's quite common for UHF signals to get ducted well beyond the calculated line-of-sight horizon. Ducting of FRS signals occurs when a widespread temperature inversion associated with a high-pressure system overlays you and the other FRS operator on a distant mountain top. When the temperature inversion reaches 10 degrees or greater, the refractive index is suitable for bending 1/2-watt UHF signals well beyond the normal line-of-sight range. Over water, the furthest record I have heard of using FRS equipment has been 160 miles between a mountain top in Ventura, CA, to another FRS operator on a small fishing boat well south of the Mexican border. And they indicate their signals were full quieting, which leads me to believe the range could have easily been extended if the channel remained clear of other FRS traffic.

Down in the shopping malls and at street level, the little FRS radios won't go much beyond a couple of blocks. Simply too much metal. While signals on 462 MHz take some good bounces within a building, usually the third bounce will do them in. It just depends on how much metal is between you and the other operator, and exactly where you have positioned your equipment.

I am told that security guards at a Chicago high rise can always make contact by operating their equipment near the elevator shafts. Whether the doors are open or not, the signals seem to propagate best near the elevators.

Worst range? 462 MHz does not work well in foliage. Hikers report that big pine trees will literally eat up the signal after about a half mile. Same thing with a rocky terrain — granite tends to absorb the signals, rather than reflect them. And this winter when out skiing or snowmobiling, an incoming snowstorm can put you off the air quickly when your distance exceeds about 3/4 mile on an absolute line-of-sight basis.

But on the other hand, if you get buried in an avalanche, hold onto your radio and continuously squawk for help. Ski patrols say that the little FRS signals can easily get out from under the snow 10 to 15 feet below. I wonder when we will see ski patrols announce a specific frequency for emergency use only to receive calls for help by injured or partially buried skiers?

In fact, here in Southern California, Bob Leef of Crest REACT has some very good ideas on how we might make better use of the 462 MHz-467 MHz band and come up with specific channels for highway and byway use with some of these little 1/2-watt communicators. (See his mini-article included here.)

Finally, no one has come up with any magic way to dramatically increase the capabilities of range on these little 1/2-watt communicators. Attempts to inductively couple the antenna to a larger antenna proved cumbersome, and hardly worth the effort. I did see one ingenious set-up of two FRS transceivers hooked up to voice-operated headsets and operating on channel extremes (1 and 14) as a quasi-voice-activated repeater. It required everyone to transmit on one frequency, and then listen on another, and the system was more complicated than useful.

I have also heard some extremely loud conversations coming over the FRS channels, not necessarily from GMRS radios on the lower seven channels. This leads me to believe modified ham radio equipment at 5 KHz deviation is finding its way onto the splinter FRS frequencies, and this is well beyond the intended use of the limited number of FRS channels.

The number of "saves" through the use of FRS equipment is fast coming to the attention of public safety officials. A boater was able to call out to some fishermen using FRS on a breakwater that he was taking on water and sinking fast. Luckily the breakwater fisherman had a cellular phone, and ultimately the Coast Guard came to the rescue of the sinking boat owner.

Plenty of "saves" on the ski slopes. Other FRS users would overhear someone talking about an ankle that is definitely going in the wrong direction, and summoned ski patrol officials that finally were able to track down the injured party. While there are indeed 462/467 MHz Doppler automatic direction-finders, I doubt that you'll find many of these in service to track down the local FRS signals.

If I were running a ski patrol or boat rentals out on a lake where there was a lot of FRS use, I would buy myself a simple ham radio three-element beam for 70 cm and use the simple three-element beam to help track down lost signals.

FRS is good. And talking to Bob Miller, it's actually exceeded his wildest expectations when it comes to public acceptance and the variety of equipment now available. Certainly RadioShack stores have the lion's share of selling FRS, but you can find FRS transceivers just about everywhere and in the mail order catalogs.

But take some of the ads with a grain of salt — powerful transmitters, hundreds of channels, absolute privacy, and calling out in an emergency may slightly over-embellish the FRS as it is today. But useful it is; and if you have a scanner, and if your scanner can tune in interstitial frequencies 12.5 KHz off of the regular channels, then take a listen for yourself.

There is plenty of activity, and you may never be ALONE with a small FRS transceiver. **NV**

LITTLE RADIOS INTERFERE WITH LICENSED REPEATERS

FCC-licensed GMRS repeater users are having interference problems because of FRS units using CTCSS on encode. Tests show an alarming problem with any FRS radio encoding tone. When the FRS handheld is keyed on a frequency adjacent to an FCC-licensed GMRS repeater input frequency, using a tone known to be in the repeater, the repeater will key up. Although voice won't necessarily pass through the keyed-up repeater, the interference takes the form of the repeater cycling on and off. This is a serious condition when one of the repeaters was activated at a whopping seven miles from where the FRS set was operated, and another repeater triggered up 13 miles away.

I encourage everyone operating FRS to stay off of Channels 8 through 14. These are the channels that are interstitial to GMRS repeater inputs. A real problem is that casual FRS users will probably never know that they may be interfering with licensed GMRS repeater operation. We strongly encourage everyone using FRS to stay on Channels 1 through 7, so as not to risk interference with repeater inputs.

Bob Leef KB6DON
28826 Paseo Malaga
Mission Viego, CA 92692

Questions & Answers
TECH FORUM

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

QUESTIONS

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

I have inherited three Fortune Systems Corp. 1000 terminals. They all have switches on the back for int. video/ext. video presumably so you could use them also for monitors. Well they work good in the ext. video mode as monitors.

What I would like to know is what the dot pitch is on these monitors? They all have the same picture tubes #R14APDB-DH.

I want to do some PC board designing on them and was wondering if the dot pitch is fine enough?

10981 **Joseph W. Baldwin**
Warren, MI

My Bel-Tronics Caller ID automatically gives a message saying we don't accept anonymous calls to those who call block. Unfortunately, many government and business numbers simply show up as unknown. How can I send a similar message to these unknown numbers i.e., Caller ID addition or answering machine, or a message stating identify yourself with a return number?

10982 **Grant Maxwell**
British Columbia, Canada

I would like to make the VT 420 interface to an 8051 project using RS232. There is a "com" punch out on the back for a D-type connector or something.

The VT 420 circuit board has a strange pattern of plated through holes for a connector with 90° pins adjacent to the comm punch out.

Also what interface is the other DEC-type connector?

10983 **Bill Jackson**
Kensington, MD

I would like to use the serial output port of one computer to input the keyboard input of a second computer in a universal kind of LAN. I envision using a UART to receive the serial data and through a ROM converting the binary characters to their equivalent character code numbers, entering the keyboard of a second computer in parallel with its own keyboard.

10984 **George Bateman**
Winter Park, FL

I have a Magitronic A-PI0411C-A, model 486-PI02, DOC 14580. It has award bios chip 486DXAWARD Software, Inc., FA263867 1.121BI01.

I need the information on jumper settings JC1, JC2, JC3, JC4, and JC5. All other settings are marked on the board.

10985 **Robert W. Ritchey**
Vandalia, IL

I have an old TV antenna rotor, but lost the controller. From the rotor is a cable with five wires: brown, white, black, green, and red.

I would like to know which wires take the 24 VAC and how to use the remaining three wires to indicate direction?

10986 **work@salus.uvm.edu**

I need an IC 8909-02A (8908-02A) for a Goldstar 14" TV. I haven't been able to find one.

10987 **Peter Decarolis**
Buffalo, NY

I noticed the memory expansion on my Hewlett Packard Laserjet II has a proprietary connection. Is there a board that will connect to this memory expansion slot that will use SIMMs?

10988 **Scott Edwards**
Mona, UT

I am a student of MSC Applied Physics in Karachi University (Pakistan).

I am going to design a "universal IR remote receiver." I need help from someone who knows about the data format of IR remote or any ICs used in that type of work.

10989 **Riaz Ali Khan**
via Internet

I am looking for a schematic for a circuit to convert an IDE interfaced hard drive to a parallel port interface, so I can hook up a hard drive to one of my parallel ports for more storage space. I realize they make such kits, but I want the knowledge of how it works, plus I can't afford such kits, at this time.

109810 **D. Gross**
Via Internet

I would like to build an "amplifier power output meter." Along the lines of a meter LED or panel for each channel i.e., L, C, R, LR, RR speaker output.

Any ideas or directions for information?

109811 **Manuel R. Sandoval**
via Internet

I need a transistorized switch that will transfer my backup battery instantly to the DC bus when power fails.

I have a 12V gel-cell with a float charger. The power supply is 12.0 volts and, now when the transfer relay drops out when the power supply fails, there is a momentary power loss while the relay's contacts change state. This causes my gentran switch PLC to hang up and have to reboot. I only need to switch 2-3 amps at 12V.

109812 **Brent Miller**
via Internet

I need "voice" or "audio" frequency readout for a Yaesu FT1000D. The operator is partially blind and needs "voice" readout for HF radio.

109813 **David M. Schertzer**
via Internet

How do I de-compress a hard drive? I recently upgraded my 540 MB drive with a 2.1 GB drive. The problem is that the new drive was compressed somehow in the data transfer, and I don't need to have the new one compressed because there is more than adequate space.

109814 **Al Gordon**
Del Mar, CA

I intend to write a VB program that uses the microphone (or line) input from my Soundblaster compatible card to obtain weather satellite images from a SSB receiver.

I have the schematics for the electronics required, but now I want to digitize the analog signal using my soundcard.

I am desperately looking for a way to read incoming data from the DSP chip on my 16 bits Soundblaster under Visual Basic.

In the old days, using DOS and Professional Basic, I could do this using the INP and OUT instructions to certain ports. VB does not have these instructions, but I found a DLL which could do the job. The only problem is that I do not receive anything but 128 or 255, no matter what signal comes into the soundcard.

109815 **Hans Middelbeek**
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.

ANSWERS

ANSWER TO #89813 - AUG. 1998

It is my opinion that 2.88 floppy drives never really took off because CD-ROM drives were introduced around the same time. All the major

Continued on page 87

reader FeedBack

Dear Nuts & Volts:

Several months ago, author Gordon West wrote an excellent article about GPS equipment and the included inland mapping from flash memory. West brought up several good points about what flash memory mapping can and cannot do. I wish to amplify on one of those points about embedded land maps for use out on the water.

I purchased a Garmin GPS III (Serial No. 40130662), as an aid to navigation in my small boat. I was led to select this unit over other models because of its display of some of the significant rivers and lakes that I use in this boat, as well as other bodies of water that I may wish to use. It came well recommended for the display of shoreline data.

For this capability, I paid a considerable premium over the otherwise similar GPS II or other units having a lesser display capability.

Before purchasing this unit, I put it into Simulator mode and reviewed the display of several bodies of water and was generally satisfied with the level of detail provided. I did not expect the level of detail provided in a CD-ROM or C-Map cartridge unit.

After using this unit in a number of bodies of water, I find that it substantially mislocates shoreline features in most every place I found myself in so far. In many cases, the actual shoreline was represented on the GPS III screen up to 1/2 mile from the actual shoreline. This was not simply a matter of GPS selective availability as the position location was repeated over several days in all cases.

The problem appears to be in the representation of the shoreline in the land data provided. For reference, the unit that I purchased has software version 2.04 and the land data is version 1.03.

I offer the following examples:

1) The Colorado River where it provides the boundary between the states of Nevada and Arizona between the latitudes of N35° 15' and N35° 45'. The river (and Lake Mojave) in this area is between 1/2 and 3 miles wide, but the display often shows the west shoreline between 1/4 and 1/2 mile east of its actual location. Thus, while the boat is positioned on the west bank of the river (or lake), the GPS position arrow may show up to 1/2 mile inland and, while the boat is positioned on the east bank, the GPS position arrow shows it still to be in the water by a substantial margin.

2) Lake McClure in California between N37° 35' -N37° 42' and W120° 07'-W120° 18'. The same problem with misplaced shoreline representation occurs with this body of water as was found in case 1.

In addition, the GPS III shows the head of lake navigation to be at N37° 40', W120° 74' whereas, with the lake at least 20 feet below the high water mark, the head of lake navigation is upriver to at least N37° 36', W120° 06'. The display shows the lake as it would be if its level were 150-200 feet below the high water mark.

3) New (sic) Don Pedro Reservoir in California between N37° 41'-N37° 53' and W120° 19'-W120° 25'. The same problem with misplaced shoreline representation occurs with this lake as was found in cases 1 and 2.

It appears that the shoreline of all three bodies of water mentioned

Continued on page 94

News Bytes

Check out some neat stuff to use on your computer ...

CREATE GIFTS OR START YOUR OWN BUSINESS WITH ANIMATED SCREEN

PY Software, Inc., has released Animated Screen for Windows 95/NT, a program that lets you create Windows screen savers and stand-alone presentations that you can give to your friends, employees, customers, and colleagues. You can also use Animated Screen to start your own screen saver business, selling custom shareware screen savers, with your company listed as the author. There are no distribution fees and, as an Animated Screen owner, you can distribute the screen savers that you create in unlimited quantities, royalty-free.

When you purchase an Animated Screen home license for $49.00, you can sell or give away the screen savers that you create, but they will list PY Software as the author in the program's "settings" box. When you purchase the Animated Screen commercial license for $99.00, you can enter your company into the program's "settings" box, and create shareware screen savers with shareware reminders, registration names, and registration keys that allow users to register your screen savers with your company. Site licenses are also available.

You can look at sample animations, or download a fully-functional trial version of Animated Screen from http://www.pysoft.com. In the United States, the program can be purchased from Kagi Shareware at (510) 652-6589.

C-COVER 4.0 MAKES CODE COVERAGE MEASUREMENT EASY

Bullseye Testing Technology has released C-Cover 4.0 for Windows NT and Windows, a full-featured code coverage analyzer for C++ and C.

This version contains new features aimed at making code coverage analysis easier and more productive than ever before. A new graphical coverage viewer gives developers and testers a hassle-free way to find untested code.

For more information or to receive a free evaluation copy of C-Cover, contact Bullseye Testing Technology, on the web http://www.bullseye.com, by E-Mail info@bullseye.com, or by phone 1-800-278-4268.

SPACE WATCH V3 — PIN DOWN SPACE USE QUICKLY AND EASILY

SharpeWare has released Space Watch v3, a program that lets PC and network users search and analyze disk space use quick-

Continued on page 90

Open Channel

by Joseph J. Carr

Some More Tools for RadioScience Observers

The only topic that generates more E-Mail from readers than the distance learning topics are the various radioscience observing pieces that I've done. There are some ideas and circuits that can be of use to anyone doing that type of work. This month, we will look at some of the analog signal processing circuits that can be used in radioscience observing.

"Analog, did he say?" I know it's the computer age, but a large percentage of the radioscience observers out there use analog setups. Indeed, the noise generated by computers raises hob with some radioscience observing set-ups. At VLF through HF, for example, computer-generated hash often makes the receiver unusable.

Rectifier-Integrators

An integrator is a circuit that performs the mathematical operation called integration on an input waveform. The output of the integrator is a voltage that represents the time average of the input signal. When designed and used correctly, the integrator can detect and track changes of the applied signal level.

Figure 1 shows two integrators that can be used on receivers that have an audio output jack. These circuits are based on similar circuits made popular by Jeff Lichtman of Radio Astronomy Supplies (190 Jade Cove Drive, Roswell, GA 30075; E-Mail jmlras@juno.com, website http://nitehawk.com/rasmit/jml0.html).

The version shown in Figure 1A is the simpler of the two. It consists of a half-wave voltage doubler circuit (D1/D2/C1/C2) that is driven by the audio output of the receiver (applied to V_{IN}). Capacitor C2 also sets the time-constant (T) of the integrator. This parameter determines the manner in which the integrator tracks input signals. The higher the value of C2, the more sluggish the integrator.

The idea in many circuits (where filtering is sought) is to find a value that will allow gradual changes to appear in the output, but high-frequency noise to be ineffective.

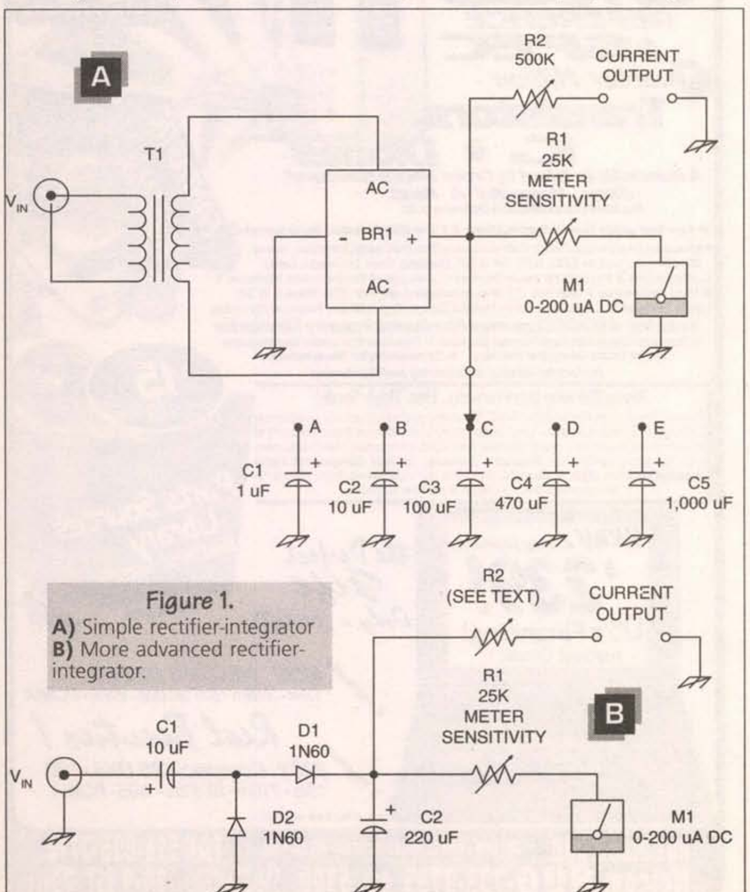


Figure 1.
A) Simple rectifier-integrator
B) More advanced rectifier-integrator.

There are two outputs from this rectifier-integrator. One output is a DC meter movement (M1). The meter movement that I used was a 0-200 µA, but anything from 0-50 µA to 0-1 mA can be used with suitable changes in the value of R1. Keep in mind, however, that the full-scale range of the meter movement sets its sensitivity. The potentiometer R1 is used to set the output to "near full-scale" when the strongest normal signal is present. This is a subjective determination, and you will have to find the setting empirically.

The other output is a current output that is used to drive a current-input strip chart recorder such as the Gulton. Selection of too low a meter full-scale rating can adversely affect the operation of the circuit ... the meter will be pegged much of the time.

The diodes (D1 and D2) used in this circuit can be silicon 1N4148 style devices, but the germanium 1N60 devices are a bit more practical. The reason is that the junction voltage is lower.

Another version is shown in Figure 1B. This circuit is transformer coupled (T1) to the audio output of the receiver. The transformer can be a 600-Ω:600-Ω line transformer, or something similar (e.g., 8-Ω:600-Ω, 50-Ω:1000-Ω). I have seen the use of 8-Ω:1000-Ω transformers in this application, but the output voltage may be too high in some cases. The 8-Ω winding is connected to the receiver output.

The rectifier, in this case, is a bridge rectifier stack (BR1). These devices have four silicon diodes inside. The ends of the transformer are connected to the "AC" terminals of BR1. These terminals are sometimes marked with the sinewave symbol. The negative (-) terminal of BR1 is grounded, while the positive (+) terminal is connected to the integrator.

The integrator of this circuit has five different capacitors, representing five different time constants. The capacitors are selected by a single-pole-five-throw rotary switch. The shortest time constant is at position "A," while the longest is at position "E."

Integrator Circuits

There are times when you might want to use an integrator without the rectifier. In this section, we will take a look at some simple integrator circuits. The circuit shown in Figure 2 is a simple resistor-capacitor (R-C) integrator. The time-constant of this integrator is:

$$T = R \times C \quad [1]$$

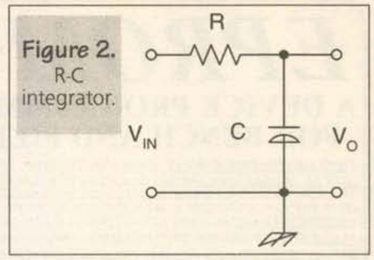


Figure 2. R-C integrator.

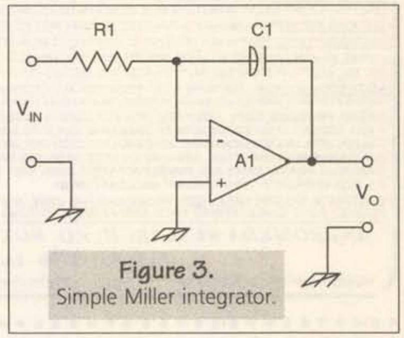


Figure 3. Simple Miller integrator.

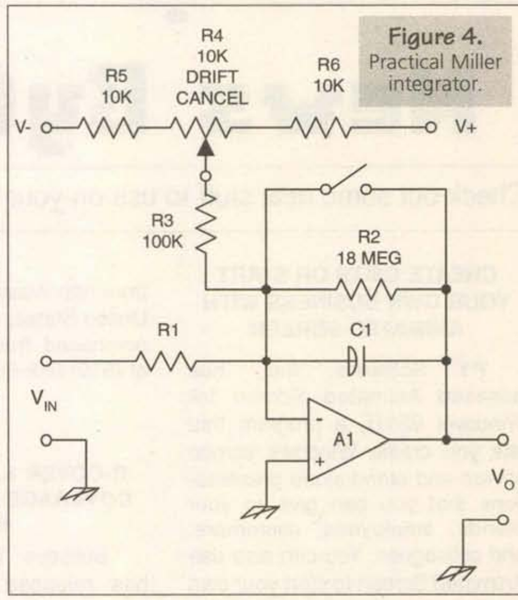


Figure 4. Practical Miller integrator.

Where:

T is the time-constant in seconds (s)
R is the resistance in ohms (Ω)
C is the capacitance in farads (F)

The general rule for selecting a time-constant is to make it greater than, or equal to, the period of the lowest frequency waveform applied to the integrator input (V_{IN}).

Time constants for radioscience observing tend to be rather long. For example, for solar noise integration it is 15 seconds or so. For a 15-s integrator, a 1-megohm resistor requires a 15-µF capacitor.

Solar noise is often observed in the 150-152 MHz radio astronomy band. A high gain Yagi or similar antenna is aimed at the sun. One radio astronomy club in England uses a 151-MHz receiver with several adjustable bandwidths of 50 to 280 KHz, and an AM detector. The output integrator receives the amplified output of the AM detector.

Figure 3 shows the basic active integrator. The DC power supply terminals are deleted for the sake of simplicity. This circuit is based on the operational amplifier, and is usually called the Miller integrator after its inventor. The equation for this circuit

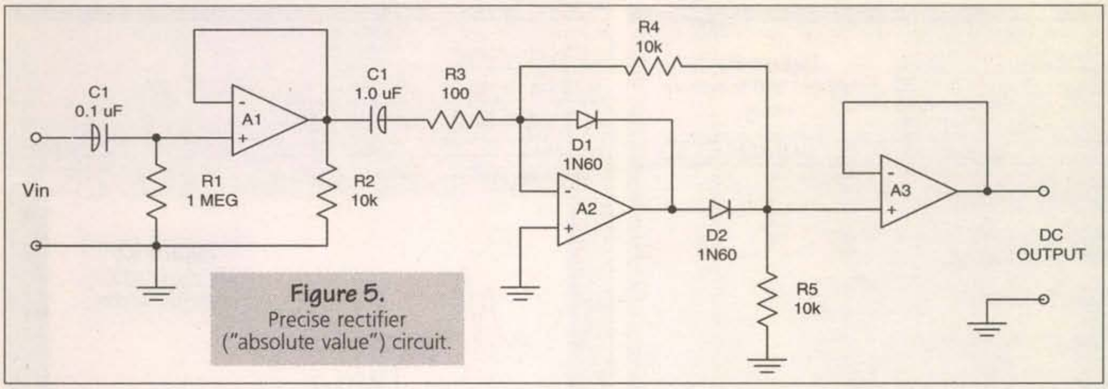


Figure 5.
Precise rectifier ("absolute value") circuit.

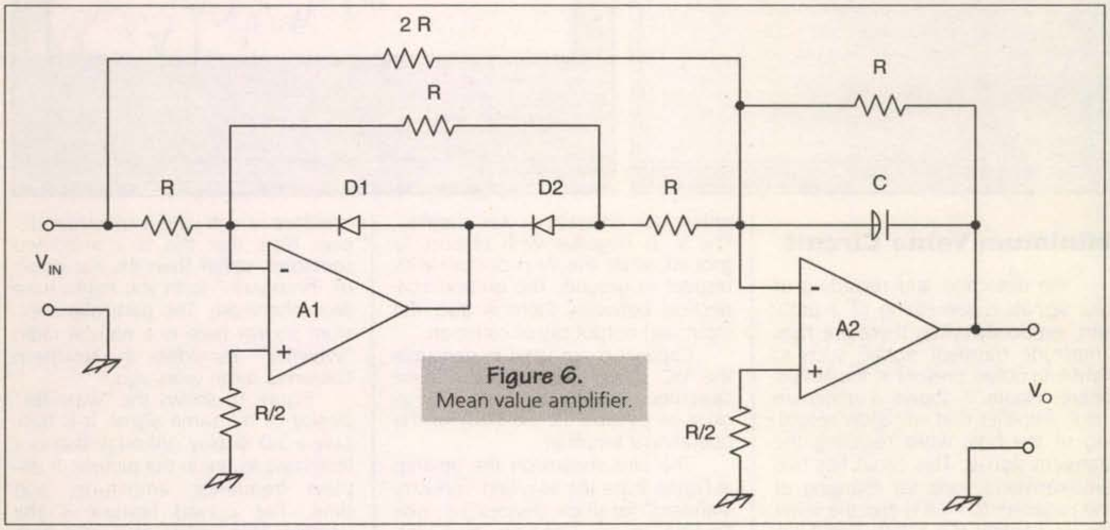


Figure 6.
Mean value amplifier.

is: $$V_o = \frac{-1}{R1\,C1} \int V_{IN}\, dt + V_k \quad [2]$$

Where:

Vo is the output voltage
V_{IN} is the input voltage
V_K is any voltage that was on C1 when the integration began (may be zero).
R1 is in ohms
C1 is in farads

The term "-1" indicates that a phase inversion takes place in the amplifier (the inverting input is used). The term -1/R1C1 is the gain of the device. This term also sets the time-constant of the integrator. However, there is often a trade-off necessary to balance two competing situations.

First, we need an adequate time constant. Second, we need to keep the gain as low as possible consistent with the requirements. Consider the case of a 10K resistor and a 0.01 uF capacitor:

Time-constant = $10^4 \times 10^7$ farads = 0.001 seconds
GAIN = $-1/(10^4 \times 10^7$ farads) = -1,000

The gain of -1,000 can cause a problem. Suppose the operational amplifier is operated from ±15 volt DC power supplies, so will probably output voltages as high as ±14 volts. The input voltage that will saturate the output of the operational amplifier is 14/1,000 = 0.014 volts = 14 mV. If kept under control, however, the active integrator can be a very powerful instrumentation circuit.

There are, however, some other problems. One problem is an undesired DC component stored in capacitor C1. This potential is accounted for by the V_K term in Equation 2. This problem can be overcome by shunting a switch across C1 to discharge it either before the integration takes place, or periodically as the charge on the capacitor accumulates.

The offset voltages of the operational amplifier, or an undesired DC component of the input signal, will tend to charge the capacitor. The result is a rising baseline for the output voltage that is not related to the input signal. The output therefore drifts towards either the positive or negative DC power supply rail.

One solution to the drive problem is to use an operational amplifier with very low input bias currents and output offset voltages for A1. I've successfully used the CA-3130, CA-3140, CA-3160, CA-3240 (two CA-3140 in one package), and CA-3260 in integrator circuits. These op-amps are BiMOS devices, so have extremely high input impedances.

Another solution is shown in Figure 4. Three methods are used in this circuit. First, a high value resistor (R2) is shunted across the capacitor. This resistor bleeds charge, but does not affect the integration sufficiently to be a problem. The second approach is to use an offset null circuit (R3, R4, R5, and R6). The input terminals are shorted together, the switch is momentarily closed and then re-opened, and then potentiometer R4 is adjusted to produce a stable zero output voltage.

It is necessary to perform this adjustment several times to home in on the correct setting. The third approach is the discharge or reset switch shunted across the capacitor (C1).

The capacitor used in any integrator should be a very low leakage type. Select capacitors with polethylene or similar dieletrics. For very long time-constant integrators, tantulum capacitors are better than aluminum electrolytics.

Precise Rectifier (Absolute Value) Circuit

A rectifier is a device or circuit that produces a unidirectional fluctuating DC voltage from a bi-directional AC input signal. The rectifier is also called an absolute value circuit because it produces an output that is the absolute value of the input voltage. An ordinary PN diode can be used as a rectifier (see Figure 1A again).

However, when weak signals are encountered, the non-linear portion of the diodes I-vs-V curve is in effect. The lower portion of the curve is called the square law region because the current through the diode changes as the square of the applied voltage. This region is usually between 0V and 0.3V for germanium diodes, and 0V to 0.7V for silicon diodes. When the applied voltage increases above this point, the I-vs-V curve straightens out and becomes linear. This region is called the linear region or the ohmic region.

The circuit in Figure 5 shows an active fullwave precise rectifier. This circuit is linear throughout its range. The actual rectifier circuit in op-amp

A2 and the surrounding components. Amplifier A1 is an AC-coupled input buffer, while A3 is an output buffer. These amplifiers are used to isolate the precise rectifier from other circuits. It is possible for the diodes of the precise rectifier to distort waveforms in the circuit, so the buffers are highly desirable.

Mean Value Amplifier

The mean value amplifier of Figure 6 couples a Miller integrator with a precise rectifier circuit to form a circuit that outputs the time-average value of the input circuit. The output voltage approximates the root-mean-square (RMS) value of the input signal. The values of the resistors are either R or 2R, with R being determined by the required time constant. The output voltage of Figure 6 is:

$$V_{MEAN} = \frac{-1}{RC} \int_0^T V_{IN}(t)\ dt \qquad [4]$$

Where:

V_{MEAN} is the mean value of the input voltage
$V_{IN}(t)$ is the input voltage
R is in ohms
C is in farads
T is the time-constant (RC)

It is a good idea to use low temperature coefficient resistors for this circuit. The diodes can be 1N4148 silicon diodes, or equivalent.

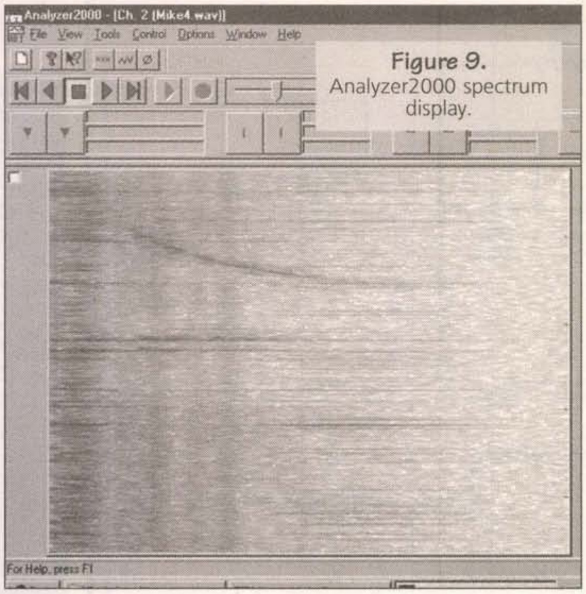


Figure 9. Analyzer2000 spectrum display.

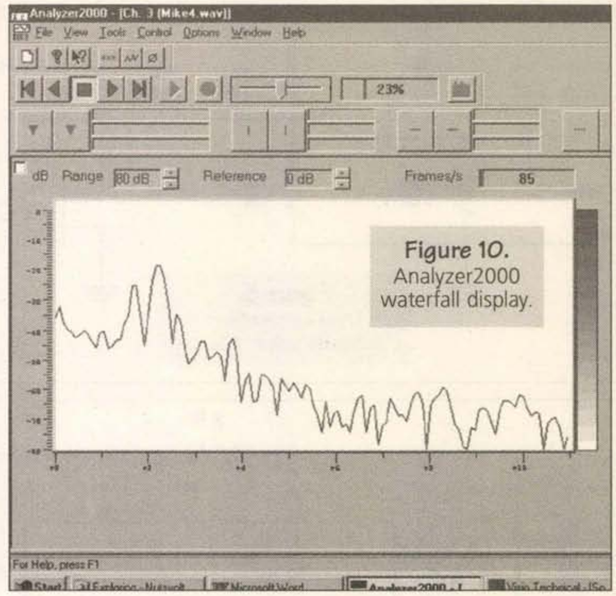


Figure 10. Analyzer2000 waterfall display.

Minimum Value Circuit

The detection and recording of hiss signals is something of a problem, especially when there are high amplitude transient signals such as lightning pulses present in the atmosphere. Figure 7 shows a minimum value amplifier that will allow recording of the hiss, while rejecting the transient signals. This circuit has two time-constants: one for charging of the capacitor (C1 x R1) and the other for discharging (C1 x R2). These values are 0.01 seconds and 20 seconds, respectively.

The resistors setting the gain of the op-amp (R3/R4) can be either equal (gain-of-two or higher as needed. If no gain is required, then delete the resistors and connect the output of the op-amp to the inverting input. This makes the op-amp into a non-inverting unity gain follower.

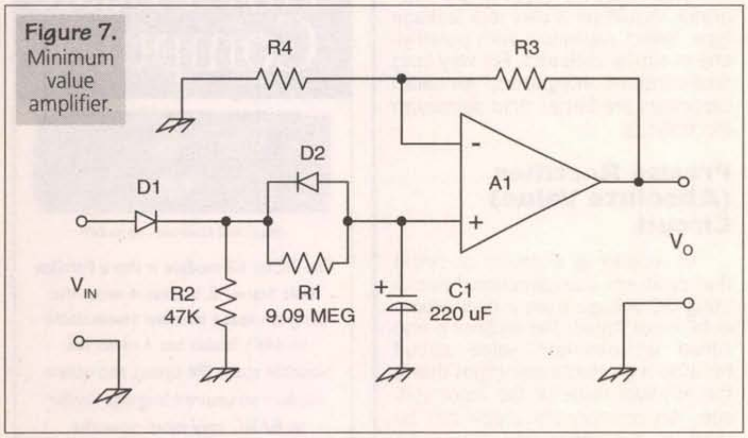


Figure 7. Minimum value amplifier.

DC Power Supply Connections to Op-Amps

Figure 8 shows the DC power supply connections for all operational amplifiers used in the above circuits. These connections were deleted for the sake of simplicity in the other illustrations, but are presented here. The V- and V+ DC power supplies are not two sides of a single supply, but rather two different power supplies. The V- is negative with respect to ground, while the V+ is positive with respect to ground. The ground connection between them is also the input and output signal common.

Capacitors are used to decouple the DC power supply lines. These capacitors should be mounted as close as possible to the body of the operational amplifier.

The pins shown on the op-amp in Figure 8 are the so-called "industry standard" for single devices (i.e., one op-amp in an eight-pin package). Most single op-amps will use this pattern (e.g., 741, CA-3140, etc.).

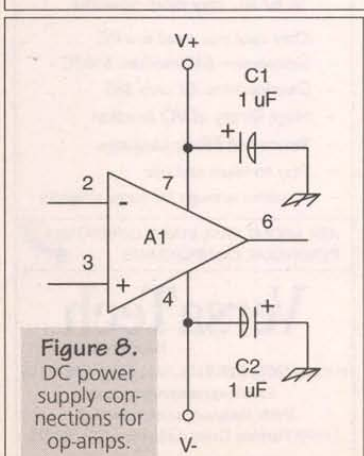


Figure 8. DC power supply connections for op-amps.

Analyzer2000™ Spectrum Analysis Software

There are a number of applications for audio spectrum analyzer software, including radioscience observing. A program I recently obtained looks like it might have real potential: Analyzer2000™ by Brown Bear Software in Germany. It runs on Windows 95 and Windows NT machines. It is a "... fast, high resolution time-frequency analyzer." Features include fast spectral analysis with FFT display for time and frequency variant signals using an inexpensive PC sound card. If your computer is equipped with a Sound Blaster compatible sound card, then no additional hardware is needed. Features include:

- Time Analysis with Oscilloscope Display
- Sonagraphic Analysis with Waterfall Display Measurement
- Tools like markers, frequency rulers, level rulers, time rulers
- Multi channel operation
- Multi morse decoder

You can do simultaneous recording directly from the PC sound card to standard wave (*.WAV) files. The producers claim that it can be used for adapting various DSP hardware running on MS-Windows-NT or MS-Windows95.

Figure 9 shows the user interface screen with a spectrum display. Note that this is a smoothed spectrum, rather than the bar graph or "histogram" form you might have seen elsewhere. The particular spectrum shown here is a natural radio "whistler" recorded in Northern California some years ago.

Figure 10 shows the "waterfall" display of the same signal. It is basically a 3-D display, although that is a little hard to see in the picture. It displays frequency, amplitude, and time. The curved feature is the whistler tone, while the long dark lines are from lightning crashes (the static you hear in your AM BCB radio).

The only criticism I have of the software is the lack of a printing facility. To make a print of the screen you must hit the "Print Screen" button on your computer's keyboard to move the image to the clipboard. You can then paste it to a graphics program. I tried it on both Microsoft Photo Editor and Visio Technical 5.0, and it worked on both. The problem, however, is that you get the entire screen, not just the display. Hopefully, that will be corrected in the future.

The Analyzer2000™ software is obtained by downloading. Two web sites can be accessed: http://members.aol.com/btf1 and http://www.shareit.com/programs/101176.htm. You can download a demo version for free, but it is limited to 30 days and 15 minutes per session. A fee of $98.00 will get you a registration number that frees the demo version for unrestricted use. For support and technical questions contact Thomas Braunstorfinger (**E-Mail: btf1@aol.com**) or for other questions, contact Martin Hisch (**mhbaer@aol.com**). **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.

Write in 81 on Reader Service Card.

SECURITY ELECTRONICS SYSTEMS AND CIRCUITS – Part 9

by Ray Marston

Ray Marston looks at a miscellaneous collection of security circuits in this penultimate episode of the series.

INTRODUCTION

Most of the previous episodes of this series have each looked at a specific class or type of electronic security circuit.

This month's episode looks at a miscellaneous collection of security circuits that can be used in the home or in commerce or industry, but which do not fit into any of the specific classes of circuits described in earlier articles.

These circuits include ones that are activated by the presence of a liquid, steam, or gas, by sound, by the failure of AC power supplies, by the close or near proximity of a person or object, by a human touch, or by the breaking of an ultrasonic beam.

LIQUID- AND STEAM-ACTIVATED CIRCUITS

BASIC PRINCIPLES AND CIRCUITS

Liquid- and steam-activated circuits have several practical applications in the home and in industry.

Liquid-activated circuits can be made to sound an alarm or activate a safety mechanism when the water in a bath or cistern or the liquid in a tank or vat reaches or exceeds (or falls below) a preset level, or when flooding occurs in a cellar or basement, or when an impact wave is generated as a person or object falls into a swimming pool or tank, etc.

Steam-activated circuits can be made to sound an alarm or activate a safety mechanism when high-pressure steam escapes from a valve or fractured pipe, or when steam emerges from the spout of a kettle or container as the liquid reaches its boiling point.

Impure water (including tap water, sea water, and most rain water, and steam) and many other liquids have a fairly low electrical resistance, but normal air has an ultra-high electrical resistance.

Consequently, one of the simplest *electronic* ways of detecting the presence or absence of conductive liquids (or vapors) is to use a pair of metal probes as sensors and to connect their outputs to a resistance-activated 'switch' circuit in the basic way shown in *Figure 1*.

Here, when the liquid is in contact with both probes simultaneously, the probe-to-probe resistance is relatively low and, under this condition, the output voltage of the resistance-activated switch is also low, but when the liquid is not in contact with both probes at the same time, their probe-to-probe resistance is very high and, under this condition, the output voltage of the switch is high. The circuit's output can thus be used to activate an alarm or other device when the liquid (or vapor) is present or absent, or is above or below a preset level.

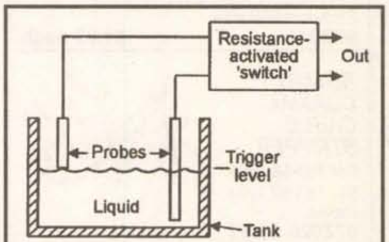


Figure 1. Basic 'electronic' way of detecting conductive liquids via a pair of metal probes.

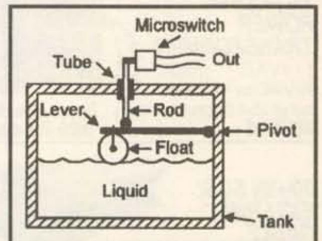


Figure 2. Basic 'electromechanical' way of detecting the critical level of a liquid.

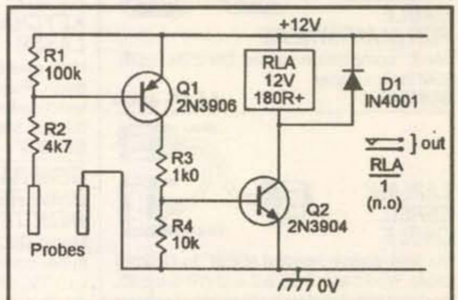


Figure 3. Simple relay-output 'liquid-activated' circuit operates when less than 500K is applied across the probes.

In practice, the resistance appearing across the probes under the 'contact' condition depends on the type of medium that is being detected. In the case of rain or tap water, it may typically be in the range of 1K0 to 10K when the probes are 10mm apart, but in the case of steam or many oils, the resistance may be several megohms or greater. On some applications, the metal container or tank that holds the conductive liquid can act as one of the two metal 'contact' probes.

Note that the above liquid-detection technique is not suitable for use with highly volatile, corrosive, or highly-resistive liquids. In such cases, the presence/absence of the liquid may best be detected by using an electromechanical method, such as that shown in *Figure 2*.

Here, the liquid is contained in a sealed tank, and its level is sensed by a float that is anchored to a pivoted lever that drives a rod that passes out of the top of the tank via a close-fitting tube. The rod thus rises and falls in relation to the liquid level, and activates an external microswitch when the level goes above or below some preset limit.

Figure 3 shows a practical example of a simple non-latching liquid-activated circuit that operates a relay when a liquid with a resistance of less than about 500K contacts both probes simultaneously, e.g., when the water in a

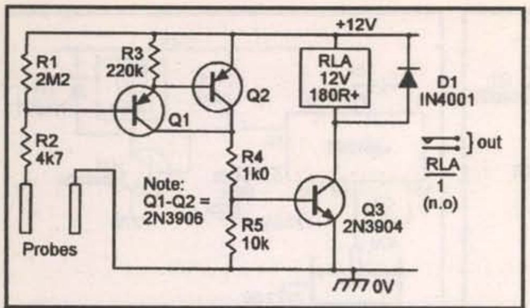


Figure 4. Sensitive relay-output 'liquid-activated' circuit operates when less than 20M is applied across the probes.

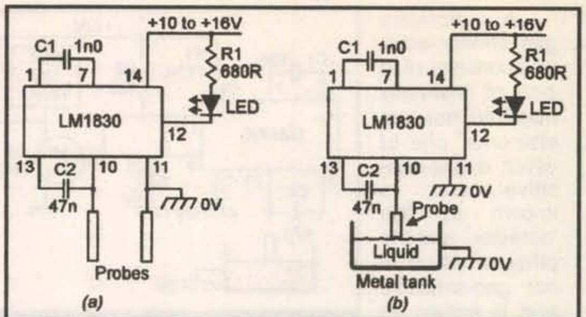


Figure 6. Basic LM1830 low-fluid-level warning circuit with LED output, using (a) separate probes and (b) a single probe.

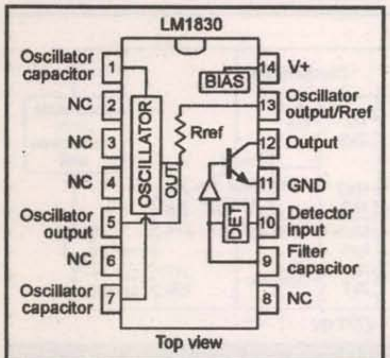


Figure 5. Pin notations and simplified block diagram of the LM1830 'fluid-level detector' IC.

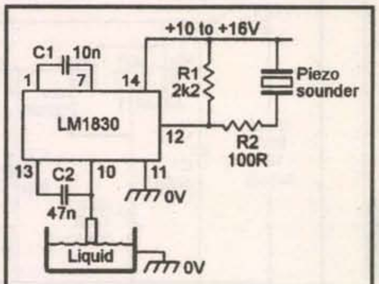


Figure 7. Low-fluid-level warning circuit with 700Hz tone output.

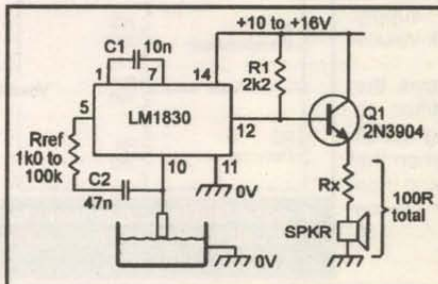


Figure 8. Low-fluid-level warning circuit with external reference resistor and boosted audio output.

bath or cistern reaches a certain level. The circuit uses a 12V supply, and the relay's RLA/1 contacts can be used to activate any type of external electrical device.

When the probes are open-circuit, Q1 and Q2 are cut off and the circuit consumes a standby current of less than 1μA, but when a resistance of less than about 500K is applied across the probes, sufficient current flows in Q1's base to drive Q1-Q2 and the relay on.

Note that the sensitivity of the *Figure 3* circuit can be reduced by simply reducing the value of R1; the *maximum* resistive sensitivity is roughly 18 x R1, and falls below 180K when R1 has a value of 10K, and below 60K at an R1 value of 3k3.

Conversely, the sensitivity can be greatly increased by raising the R1 value and using a super-alpha-connected pair of transistors in place of Q1, and *Figure 4* shows how the above circuit can be modified in this way, so that it can be activated by probe resistances of up to 20M, e.g., by steam or high-resistance liquids.

LM1830 IC CIRCUITS

When in use, liquid-level detector circuits of the simple types shown in *Figures 3* and *4* pass a small DC current through the liquid under test. In theory, this DC current can result in an electroplating action in which metal slowly migrates from one probe to the other, eventually degrading the 'source' probe.

This problem does not occur if an AC test current is used, and a dedicated 'fluid-level detector' IC that uses this technique is widely available, at modest cost. The device is manufactured by National Semiconductor and is known as the LM1830. *Figure 5* shows the outline and simplified internal circuit of the IC.

The LM1830 can be used to detect and indicate the presence or absence of water or any other liquid that presents a resistance of less than 100K between its pin 10 (detector input) and pin 11 (GND) 'probe' points.

The IC houses an oscillator (which gives AC drive to the water-detecting metal probe), a 13K reference resistor, a balance detector, and (available on pin 12) an open-collector npn common-emitter output stage that can sink up to 20mA maximum.

The oscillator frequency is set via an external capacitor (1n0 gives 7KHz operation) wired between pins 1 and 7, and the IC can operate from supplies in the 9V to 25V range and consumes a typical standby current of 5.5mA.

Figure 6 shows the LM1830 IC's basic application circuits as a low-liquid-level alarm with an LED output; note that the *(a)* circuit uses two separate probes, one of which is grounded, but that in the *(b)* circuit — in which the liquid is stored in a metal tank — the metal storage tank is grounded and acts as one of the circuit's two 'probes.' The IC's internal oscillator is set at 7KHz via C1, and the non-grounded metal probe is taken to the pin 10 'detector' input and is AC driven via C2 and the internal 13K reference resistor.

When the liquid level is 'high' (i.e., in contact with the probe), the probe-to-ground resistance is below the 13K reference value and, under this condition, the output LED is off. When the liquid level is low, the probe-to-ground resistance is high (greater than the 13K reference value) and, under this condition, the output LED is driven by a 7KHz squarewave signal and thus illuminates. The basic *Figure 6* circuit can be usefully modified in a variety of ways, as shown in *Figures 7* to *10*. *Figure 7* shows it modified to give an audible 700Hz tone output (set by C1) into an inexpensive piezo sounder.

The LM1830 IC has a mean output current limit of 20mA maximum, and *Figure 8* shows how the available output power can be boosted via an external emitter-follower stage, and also shows how the IC can be used with an external (rather than the internal) reference resistor of up to 100K maximum (1K0 minimum), to enable it to test liquids with resistance values of up to 100K.

Figure 9 shows the circuit modified to give relay output drive via pnp emitter-follower Q1, by using C3 to convert the output-stage driving signal to DC. This circuit also shows supply-line transient protection given to the IC via R1; this modification is recommended for use in automobile circuits, where — under very exceptional circumstances — supply transients may reach peak values of 40-50V.

Finally, *Figure 10* shows the relay-driving circuit modified to give an over-level warning action (in which the relay is off when the liquid level is low) by using npn common-emitter amplifier Q1 as the relay driver.

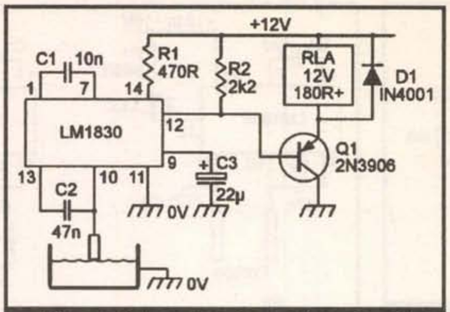


Figure 9. Low-level warning circuit with relay output and supply-transient protection.

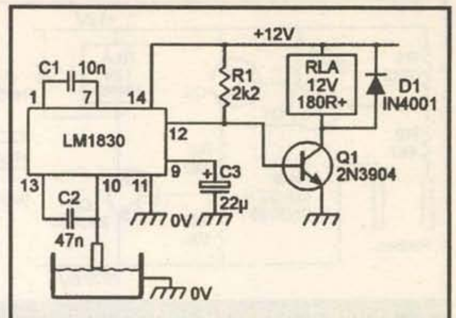


Figure 10. Over-level warning circuit with relay output.

A GAS-ACTIVATED ALARM CIRCUIT

Leaking highly-flammable gases such as isobutane, methane (natural or 'town' gas), hydrogen, and ethanol, etc., all present potentially explosive and life-threatening hazards, but can easily be detected — even in gas-to-air concentrations of less than 0.5% — by a simple and easy-to-use device that is readily available from major component suppliers and is known as a hot-wire gas sensor. The heart of this sensor is a coil of fine platinum wire that is coated with high temperature oxides and a special catalyzer.

A hot-wire gas sensor actually consists of a *pair* of thermally matched hot-wire elements, one of which is gas-sensitive and is known as the 'detector,' and the other of which is not gas-sensitive and is known as the 'compensator.' In some cases, the matched detector and compensator are supplied as individual units, which are each enclosed within an individual fire- and explosion-proof wire mesh, and in others they are combined in a single unit and share a common fire/explosion-proof mesh. In either case, they are meant to be used in the basic circuit shown in *Figure 11*.

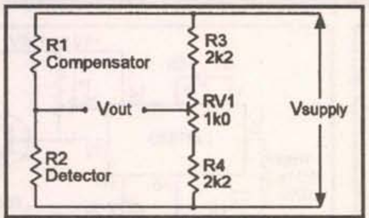


Figure 11. Basic gas detector circuit using 'hot-wire' gas sensors.

In *Figure 11,* the compensator (R1) and detector (R2) are wired in series to form a gas-sensitive potential-divider on one side of a Wheatstone bridge, R3-RV1-R4 form an adjustable potential divider on the other side of the bridge, and RV1 is adjusted so that Vout is normally zero.

The compensator and detector have a low hot-wire resistance and, when wired as shown and powered from a suitable voltage source (typically 2.2V or 3V AC or DC), pass a current (typically 150mA to 400mA) that raises the hot-wire temperature to about 350°C in gas-free air.

The resistances of the detector and compensator both vary with ambient temperature and humidity levels, etc., but are matched so that they vary equally in both devices, so that (when wired as shown in *Figure 11*) they maintain a constant division ratio in the absence of gas.

When gas *is* present, the detector's special catalyzer effectively but safely burns the gas that strays within the safety mesh and which surrounds the hot-wire, thus raising the hot-wire's temperature and resistance, thereby reducing the voltage appearing on the detector/compensator junction and upsetting the balance of the bridge.

This action typically makes the circuit's Vout value fall by about 25mV at gas concentrations of 4000ppm (= 0.4%) with methane, or 2000ppm (= 0.2%) with isobutane.

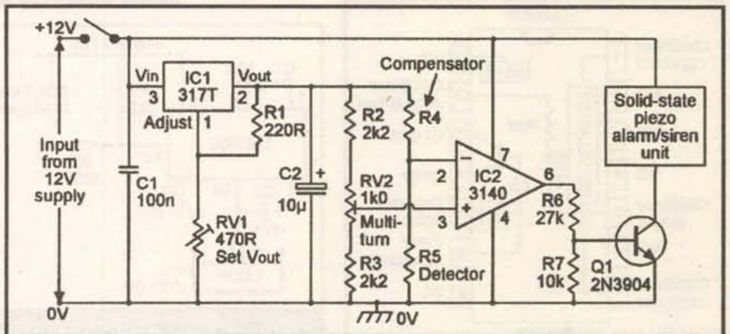


Figure 12. Practical gas-detector alarm circuit, powered from an external 12V DC supply.

Figure 12 shows the circuit of a practical gas alarm that is powered via an external 12V DC supply and which drives a ready-built solid-state commercial alarm/siren unit under the 'alarm' condition. Here, the basic gas detector (which is similar to that of the *Figure 11* circuit) is built around R2-RV2-R3-R4-R5 and is powered via a stable low-voltage DC supply derived from the 12V line via voltage regulator IC1, and has its output fed to the alarm/siren unit via voltage comparator IC2 and transistor switch Q1.

The circuit's action is such that the voltage on pin 2 of IC2 is normally about 25mV above that of pin 3 (settable via RV2) under 'clean air' conditions and, under this condition, IC2's output is low and Q1 and the alarm/siren are off, but the pin 2 voltage falls below

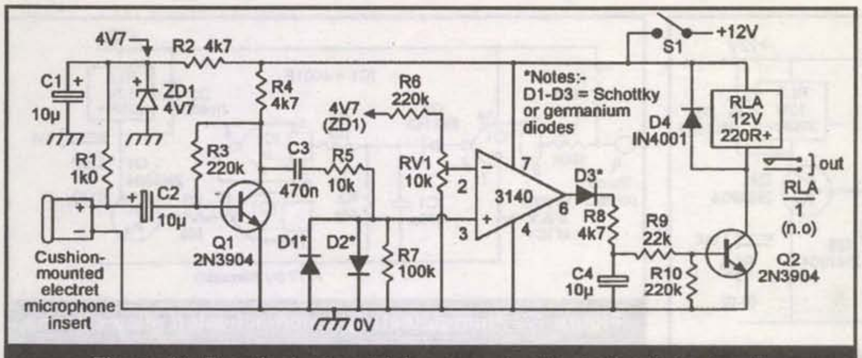


Figure 13. Practical relay-driving sound-activated switch circuit.

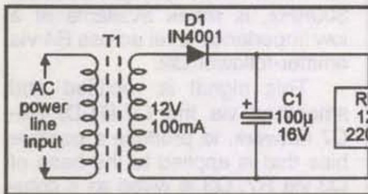


Figure 14. Simple relay-output AC power-failure alarm.

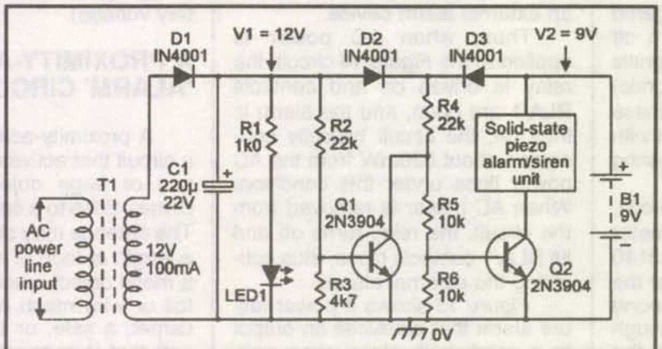


Figure 15. Power-failure alarm with a piezo siren output.

that of pin 3 when significant gas concentrations are detected and, under this condition, IC2's output switches high and drives Q1 and the alarm/siren on.

Before starting to build the *Figure 12* circuit, first locate a suitable hot-wire gas sensor and find out its voltage and current ratings. With that current rating in mind, select a suitable 12V DC power supply. Now — *without wiring the gas sensor in place* — build the IC1 voltage regulator section of the circuit, taking care to fit IC1 to a heatsink that will dissipate 1W per 100mA of working load current, and then power it up and trim RV1 so that (when powering a dummy load) it produces the precise specified working voltage of the gas sensor (usually 2.2V or 3V).

Now build the rest of the circuit, fit the gas sensor in place, power the circuit up, and trim RV2 so that the alarm/siren is off. Let the unit warm up for a minute or two, then — using a high-impedance digital multimeter — trim RV2 so that pin 2 of IC2 is 25mV above that of pin 3.

The unit is now set and ready for use, and should activate the alarm if the sensor is temporarily placed in a box and exposed to a modest concentration of gas (such as a brief squirt of butane gas) for half a minute or so. Note that most flammable gases are heavier than air, and that in normal domestic situations, the gas sensor should thus be mounted a few inches above floor level, in a position where it is unlikely to be damaged by passing feet or by the movement of furniture, etc.

A SOUND-ACTIVATED SWITCH CIRCUIT

Prior to the advent of modern highly-reliable PIR movement detectors, sound-activated alarms were widely used in commercial security systems. Most of these alarms were, however, easily false-triggered by the natural sounds that occur inside buildings (such as the cracks or groans that occur as a building cools at night or warms up in the morning) or that originate outside the buildings but are audible within them (such as loud traffic or aircraft noise or thunder).

In some systems, the latter problem was overcome by using internal and external sound detectors and — by using sound-level comparison techniques — only activating the alarm if the internal sounds were louder than the external ones.

Today, sound-activated alarms are rarely used in security systems, but sound-activated *switches* are widely used. They are used mainly as relay-driving 'precautionary warning' devices that switch on a security light and/or a pre-recorded 'verbal warning' message or activate a sound- or video-recorder system whenever a suspicious sound is heard in a protected area.

In most of these sound-activated switches, the sounds are picked up via a cushion-mounted electret microphone insert (which thus responds mainly to air-conducted — rather than structure-conducted — sounds) and the resulting signals are then amplified, converted to DC via a rectifier and filter, and then fed to a non-latching relay-driver via a special signal-conditioning circuit.

Figure 13 shows a practical relay-driving sound-activated switch circuit that is powered from a 12V DC supply. Here, the cushion-mounted electret microphone insert is powered from a stable 4V7 supply derived from the +12V line via zener diode ZD1, and has its output amplified by common-emitter amplifier Q1 and then passed on to the pin 3 input of the 3140 op-amp via C3-R5. The 3140 op-amp can respond to input signals all the way down to zero volts, and in this circuit is used in the open-loop voltage comparator mode and acts as a super-efficient high-gain signal rectifier that has its 'threshold' level (and thus the circuit's sensitivity) fully variable from zero to +200mV via RV1; note that diodes D1-D2 act as clamps that limit the pin 3 peak-to-peak signal amplitudes to safe values, and *must* be germanium or Schottky (rather than silicon) signal diodes.

In *Figure 13*, D3-R8-C4-R9, and R10 act as the unit's special relay-driving signal-conditioning circuitry. Here, D3 and C4 peak-detect the pin 6 output voltage of the 3140 op-amp, and C4's resulting charge provides base drive to relay-driving common-emitter amplifier Q2.

Note that C4's 'charge' time (which protects the circuit against activation by brief noise transients) is controlled by R8, and its 'discharge' time (which ensures that

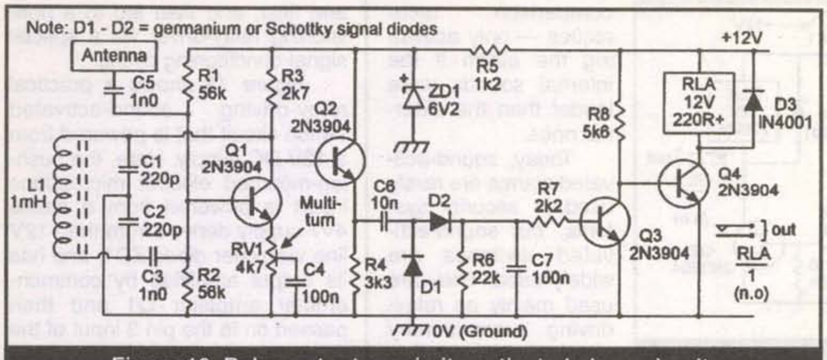


Figure 16. Relay-output proximity-activated alarm circuit.

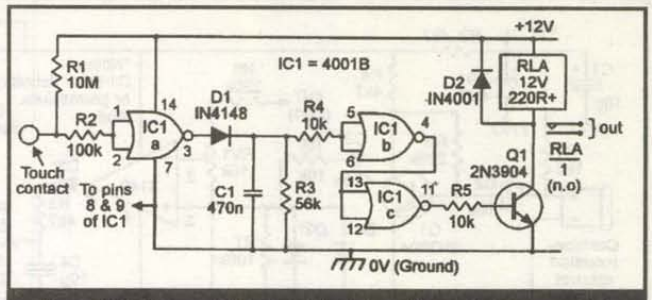


Figure 17. 'Hum-detecting' touch-activated relay switch.

— once they have been triggered on — Q2 and RLA only turn off again when all noise trigger signals has been absent for a few seconds) is controlled by R9, and that these components provide the circuit with good immunity to false-triggering and relay-chatter problems.

To set up the *Figure 13* circuit, connect an analog DC voltmeter between pins 6 and 4 of the 3140 op-amp, then trim RV1 so that the meter reading is zero at low sound input levels, but rises high enough to activate Q1 and RLA at the desired 'trigger' sound-amplitude level.

POWER-FAILURE ALARM CIRCUITS

Electrical power-failure alarms can be made to activate when AC power is removed from a deep-freeze unit, or when a burglar deliberately cuts the AC power lines, or when a machine overloads and blows its fuses. *Figure 14* shows a very simple relay-output power failure alarm that can activate any type of external alarm device via the relay's contacts.

Here, the power-line input is applied to a step-down transformer that gives an output of 12V at 100mA. This output is half-wave rectified by D1 and smoothed by C1, and the resulting DC directly powers the coil of relay RLA, which has a coil resistance of 220R or greater. RLA has one or more sets of n.c. change-over contacts that can be used to activate an external alarm device.

Thus, when AC power is applied to the *Figure 14* circuit, the relay is driven on and contacts RLA/1 are open, and the alarm is thus off; the circuit typically consumes about 820mW from the AC power lines under this condition. When AC power is removed from the circuit, the relay turns off and its RLA/1 contacts close, thus activating the external alarm.

Figure 15 shows a power-failure alarm that produces an output in a ready-built piezo siren unit. Here, when AC power is applied to the circuit, the AC input is stepped down to 12V by T1 and is rectified and smoothed by D1 and C1, and roughly 12V DC is developed on the D1-D2 and D2-D3 junctions, and LED1 is illuminated via R1.

Under this condition, Q1 is driven to saturation via R2, and Q1's collector pulls the R4-R5 junction down to near-zero volts; consequently, zero base drive is applied to Q2, so the piezo alarm is off and no current is drawn from the 9V battery.

When AC power is removed from the circuit's input, R1-LED1 rapidly discharge C1, and the D1-D2 junction quickly falls to zero volts and Q1 turns off. Under this condition, current reaches Q2's base from the 9V battery via D3-R4-R5, and Q2 and the siren thus turn on.

Note that the *Figure 15* circuit can, if desired, be used with higher battery and T1-secondary voltages, provided that the resulting V1 voltage is at least 2V greater than V2 (the battery voltage).

A PROXIMITY-ACTIVATED 'ALARM' CIRCUIT

A proximity-activated alarm is a circuit that activates when a person or large object touches or comes close to a sensing antenna. The antenna may simply consist of a length or loop of wire, or may be a metal object (such as a sheet of foil or wire mesh hidden under a carpet, a safe, or a storage cabinet) that is connected to one end of a wire antenna.

Most proximity-activated alarm circuits work on the capacitive loading principle, in which the gain of an L-C oscillator is adjusted to a critical point at which oscillation is barely sustained and, in which, the antenna forms part of the oscillator's tank circuit and, in which, the circuit's 0V supply line is grounded.

Consequently, any increase in the antenna-to-ground capacitance, such as is caused by touching or nearing the antenna, causes enough damping of the tank circuit to bring the oscillator gain below the critical level, and the oscillator ceases to operate. This cessation of oscillation is then used to make the alarm generator activate.

Figure 16 shows a practical relay-output proximity-activated alarm circuit that uses the above operating principle. Here, transistor Q1 is wired as a Colpitts oscillator, with gain adjustable via RV1, and the antenna is coupled to Q1 base via C5. The output of this oscillator, which operates at about 300KHz, is made available at a low impedance level across R4 via emitter-follower Q2.

This signal is rectified and smoothed via the C1-D1-D2-R6-C7 network, to produce a positive bias that is applied to the base of Q3 via R7. Q3 is wired as a common-emitter amplifier, with R8 as its collector load, and Q4 is wired as a common-emitter amplifier with the relay coil used as its collector load and with Q4's base connected directly to the collector of Q3.

Thus, when the *Figure 16* circuit is operating normally, the oscillator output produces a positive bias voltage that drives Q3 to saturation and thus removes Q4's base drive; Q4 and the relay are thus off under this condition. When the circuit's antenna is touched or externally loaded, however, the oscillator ceases to operate, thus removing Q3's base drive; Q3 thus turns off; with Q3 off, Q4 is driven to saturation via R8, and the relay is thus driven on under this condition.

Note that the Q1-Q2 section of the circuit is powered via a 6.2V regulated supply formed by R5 and ZD1, thus enhancing the oscillator's stability. Also note that D1 and D2 must be germanium or Schottky signal diodes, and that the circuit can — if desired — be used to give a directly-driven 'siren' output (via a ready-built piezo alarm module) by simply using the siren module in place of RLA and removing D3 from the circuit.

To set up the *Figure 16* circuit,

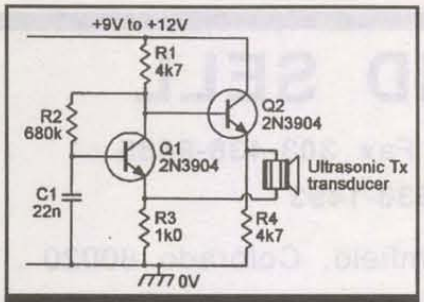


Figure 18. Ultrasonic beam transmitter module.

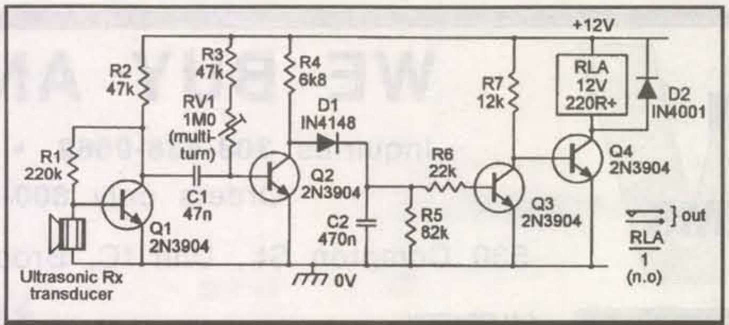


Figure 19. Relay-output ultrasonic beam receiver module.

simply connect a suitable antenna, trim RV1 so that the relay turns on, then back RV1 off slightly so that the relay just turns off again. Check that the relay turns on again if the antenna is touched or closely approached, and goes off again if the touch is removed; if necessary, trim RV1 for maximum sensitivity.

The final sensitivity of the *Figure 16* circuit depends on the setting of RV1 and on the size and type of antenna used. If the antenna is very small, such as a short length of wire, the circuit will act as little more than a touch alarm, but if the antenna is a large sheet of metal foil or wire mesh, the circuit may be sensitive enough to activate when a person approaches within a foot or two of the antenna.

It pays to experiment with different types of antenna, to get the 'feel' of the circuit. Remember, however, that the antenna must be well isolated from ground, and that the circuit's 0V rail must be wired to an effective ground connection.

A TOUCH-ACTIVATED CIRCUIT

Touch-activated circuits are intended to perform some kind of switching action when a person touches a fixed (rather than flexible or mobile) contact point, such as one or more metal studs. The best circuits of this type work on either the capacitive loading principle described in the preceding section of this article or, if they are designed for use only in the general vicinity of AC power lines, are activated by the power-line radiated AC 'hum' that is picked up by an electrical contact when touched by a human finger. *Figure 17* shows a practical circuit of the latter type.

The *Figure 17* 'hum-detecting' circuit activates relay RLA when a finger touches a single metal stud or contact point, and is designed around a CMOS 4001B quad two-input NOR gate IC and transistor Q1. Here, gate IC1a is wired as a simple pulse-inverting amplifier and has its high-impedance input terminal taken to the metal touch contact via R2; the contact is biased high via R1, and IC1a's output is thus normally low.

When a human finger touches the circuit's contact terminal, its induced AC 'hum' signal reaches IC1a's input, is amplified and inverted, and appears as a large amplitude squarewave at IC1a's output. This squarewave is rectified and smoothed via D1-C1-R3, is buffered by gates IC1b-IC1c (which act together as a non-inverting buffer), and then drives relay RLA on via R5 and Q1.

Note when using the *Figure 17* circuit that its 12V supply must be derived (via an isolating transformer) from the AC power lines, that the 0V supply rail must be grounded, that the relay's contacts can be used to activate external circuitry or alarms, etc., and that the circuit consumes a quiescent current of only 1µA or so.

The circuit's touch contact should not be larger than about 10 square centimeters (to avoid unwanted pick-up); if the contact is more than a few inches from IC1a's input terminal, the connecting leads may have to be screened to avoid unwanted pick-up.

AN ULTRASONIC 'BEAM' ALARM UNIT

This unit can be used in the same type of application as an IR light-beam alarm, but works on ultrasonic principles. It consists of an ultrasonic transmitter (Tx), operating at about 40KHz, which is aimed at a matching relay-driving ultrasonic receiver (Rx) unit. When an ultrasonic link exists between the Tx and Rx, the relay is off, but when the link is broken the relay turns on and activates an external alarm or some other electrical or electronic device. This particular unit is a very simple design, with a maximum operating range of only a few yards; it can be used to give security protection to passages and open doorways, etc.

The unit makes use of a modestly priced matched pair of ultrasonic transducers of the type used in many remote-control applications. These devices are normally designed to operate at about 40KHz, and consist of a dedicated Tx transducer and a matching dedicated Rx transducer. Devices of this type are readily available from major electronic component suppliers.

Figure 18 shows the circuit of the unit's transmitter module, which typically consumes an operating current of 2.5mA from a 9V supply or 3mA from a 12V supply. Here, Q1 and Q2 are configured as an emitter-coupled oscillator, with the Tx transducer used as the emitter coupling element, so that the circuit oscillates at the transducer's resonant frequency (about 40KHz) and radiates a matching ultrasonic signal.

Finally, *Figure 19* shows the circuit of the unit's receiver module. Here, the Rx transducer is pointed towards the transmitter and responds to the transmitted signal in much the same way as a directional microphone. The output of the Rx transducer is fed directly to the base of common emitter amplifier Q1, and appears in amplified form at the Q1 collector.

It is then fed, via C1, to the input of an amplifying detector stage that is built around Q2-D1 and C2. Normally, when the beam is unbroken, the output of this detector stage is high, so Q3 is driven to saturation and Q4 and the relay are cut off.

When the beam is interrupted, the output of the detector stage falls to near-zero volts, so Q3 turns off and Q4 and the relay are turned on via R7. An external alarm can be activated by the closing of the RLA/1 contacts. Thus, RLA is normally off, but turns on when the ultrasonic beam is interrupted.

The *Figure 19* circuit consumes a typical current of 5mA from a 12V supply. To set up the circuit, turn off the Tx unit, connect a DC voltmeter (with a sensitivity of at least 20KV) across C2, then trim RV1 so that the voltage just falls to near-zero; RLA should turn on under this condition. Now turn on the Tx unit, aim it at the Rx unit, and check that the C2 voltage rises to at least 2V and that RLA turns off.

If desired, RV1 can be further trimmed to obtain absolute maximum operating range. Next month's concluding episode of this series will deal with electronic security circuits designed for use in automobiles. **NV**

ELECTRONICS Q & A

With TJ Byers

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

What's Up:

Pinouts galore, including Universal Serial Bus. Monitor mania: PC on Mac, TV on PC, PGA, AT&T 6300, and Wyse. How to make a toroidal transformer and two schematic medleys.

Universal Serial Bus (USB) Pinout

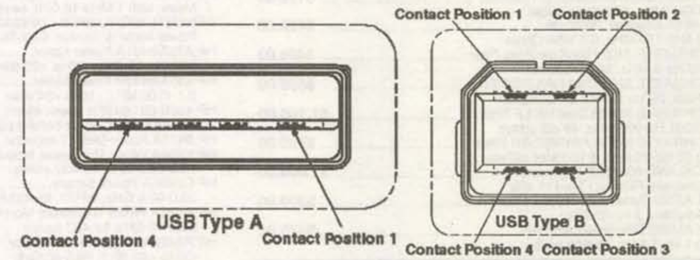
Q. Could you supply me with a pinout of the USB connector for an IBM-compatible computer?

Dennis Volcansek
Lodi, OH

A. *USB (Universal Serial Bus) is an emerging technology which uses just two connector types that take the place of the serial, parallel, keyboard, mouse, and game ports. The two connector types are Series A (Type A) and Series B (Type B). All USB ports on your PC are Type A. Type A is also used on devices in which the external cable is permanently attached, like keyboards and mice. Type B is used in applications which require detachable external cable, like printers, scanners, and modems. Unlike today's PC ports, which sport five or more wires, the USB port has just four wires that are carefully color coded and defined as shown below.*

Signal Name	Wire Color	Pin Number
Vcc	Red	1
- Data	White	2
+ Data	Green	3
Ground	Black	4

USB can support up to 127 devices via hubs or daisy chaining (plugging one device into another) at speeds of up to 12 MB per second (10 times faster then a serial port). You can insert and remove USB devices while your computer is running; the USB bus will configure the change on the fly. USB is Plug-and-Play compliant and is fully supported in Windows 98. Now for the pinouts.



Generally, the USB cable has a Type A connector on one end and Type B on the other. Making your own cable, though, requires special tools and a source for the connectors and special USB cable. You can *find finished cables at most computer stores, but at a premium price. I expect that they'll soon drop in cost and show up in the surplus marts.*

Hush Little Clock

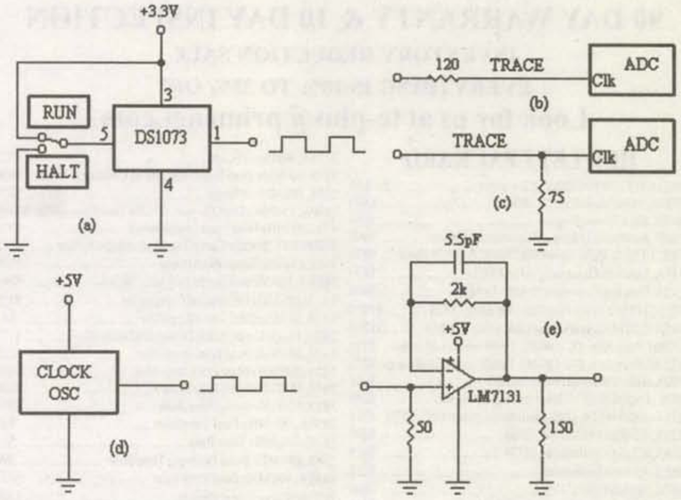
Q. I read your reply in the Mar. '98 issue ("Simple Squarewave Generator") showing some approaches in oscillator circuits. I need a low-noise 2-MHz oscillator — one that's suitable for use as the system clock for a 20-bit ADC. I'm currently using an IC-type clock oscillator housed in an eight-pin metal DIP enclosure. The clock works, but since it has a very fast rise-time it radiates lots of noise. Do you have any recommendations on low-noise oscillators for this type of application?

Steve Roberts
via Internet

A. *This is a typical complaint about system clocks. The problem with a simple repetitive signal – like a system clock – is that all its spectral power becomes concentrated at a relatively small number of discrete frequencies. When these frequencies leak from the package into the outside world, they often raise havoc with radio and TV reception. The modern cure is to modulate, or dither, the clock frequency to break up the accumulated spectral power into a larger number of discrete frequencies, each with a reduced energy content. However, this a complex and expensive solution. If excessive radiation is a problem, you'd be better served using any combination of the following techniques.*

- *Use a ground plane in your PC board.*
- *Use a thinner PC board to reduce the space from the trace to the ground plane.*
- *Use properly terminated transmission lines between the clock and the ADC.*
- *Slow the rise/fall time of the clock driver.*
- *Use surface mount technology, like a SOT-23 package.*
- *Use a lower-voltage 3.3V clock, like the DS1073 from* ***Dallas Semiconductors (1-800-336-6933; http://www.dalsemi.com)*** *or the T-3390 from* ***MF Electronics Corp. (914-576-6570; http://www.mfelectronics.com)****; the ADC voltage can stay at 5V.*

Here are how these techniques can be implemented.



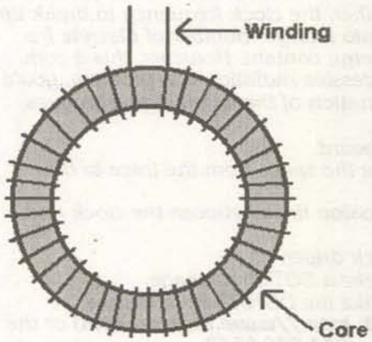
Circuit (a) shows how to substitute a low-voltage DS1073 clock oscillator for your 5V tin can. The lower operating voltage has the advantage of less power dissipation and more rounded corners, which lowers spurious radiation. The DS1073 is a programmable clock oscillator with a frequency range of 30 KHz to 100 MHz. You can easily do the programming yourself using very simple circuits provided in the DS1073 data sheet found on the Dallas Semiconductor Web site. Circuits (b) and (c) show two ways to properly terminate a PC board transmission line. One is series terminated (b) and the other is parallel terminated (c). The series resistor is placed near the clock source and the parallel resistor is placed as near as possible to the ADC clock input. Circuit (e) shows how to increase the rise/fall times of a standard clock oscillator (d). The values shown in (e) are for unity gain (Av = 1) for frequencies up to 4 MHz. For more information on how to push this op amp to 90 MHz, download the LM7131 data sheet from the National Semiconductor Web site (http://www.nation al.com).

Topic Of Toroid

Q. In your Oct. '97 column on building a vacuum-tube power supply, you show a circuit to boost 12 volts up to 400 volts using a toroidal transformer that you say can be salvaged from a defunct PC power supply. I've opened up some defunct PC power supplies and haven't been able to find a toroidal transformer. Can I purchase the transformer from Digi-Key or RadioShack, maybe under the guise of a signal transformer?

Frank Kwok
via Internet

A. *Actually you won't find the specified transformer inside a PC power supply. It doesn't exist. What you will find instead is a toroidal magnetic core with copper-wire windings already on it. A toroidal core is a gray powdered-iron ring about an inch or so in diameter. There are actually three (sometimes only two) toroidal transformers in a PC power supply. You want the biggest one. First, you need to strip the transformer of its copper wires, and start anew using the wire gauges and turns listed in the original diagram, which are repeated below.*



PRI: 12T, CT, #18 AWG
SEC: 275T, #24 AWG
CORE: IND GEN 8231-1

This is the format used by every manufacturer for specifying a transformer. Let's take it apart and see what it means. Starting from the bottom, it specifies a toroidal core type. Depending on the application, it may or may not be critical. In a power-supply application like above, you simply need a core that doesn't saturate under a full load. The core specified was made by Indiana General, who is now out of business. Fortunately, it's an industry staple that measures about 1- 1/2" in diameter that you can get from several manufacturers, including Philips. Start with the secondary winding, which is 275 turns of #24 AWG magnet wire (#22 AWG will work; RadioShack 278-1345). The easiest way to do this is to first wind the wire on a bobbin or shuttle that fits through the hole, and thread the wire through the donut, counting the turns as you go. Over this layer, wind 12 turns of heavier #18 AWG wire. You can recover this wire from the salvaged transformer. After you've done six turns, scrape the insulation off and solder a tap wire – hat's what the CT designation in the formula means; it's a center tap. Coat the splice with clear fingernail polish and continue on to winding 12 and stop. That's it! You've just made a transformer.

PGA What?

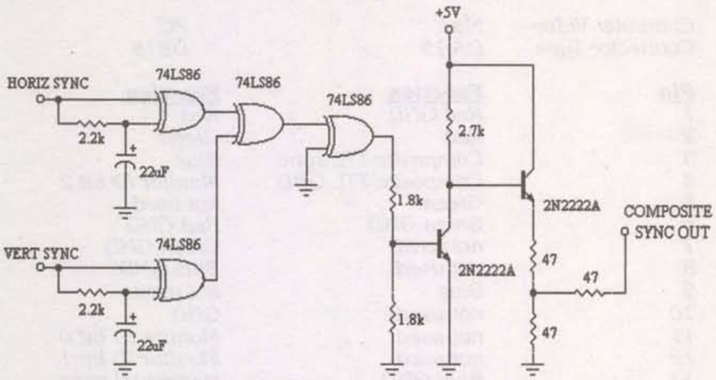
Q. I have a acquired a True Blue IBM Professional Graphics Adapter (PGA) color monitor. This monitor hasn't been used on a system in over 10 years because the original owner couldn't find a PGA card to run it. I know this monitor is an odd duck that takes a special card, but I feel that I can make a modern video card meet its specs. I'd like to use it as a test monitor or on a server that I plan to build for WindowsNT or Win95 (Win98). While I've fiddled with several vintage color cards of one variant or another (MDA, CGA, and VGA), nothing works with this monitor. Do you have a pinout or conversion cable that will work?

Tim Edwards
via Internet

A. *Odd is hardly the word for this lame duck. It was VERY expensive and almost immediately replaced with the 8514/A. Basically, it's an analog monitor with an INTERLACED (can you say interlaced?) scan resolution of 1024 by 768. That puts the refresh rate at about 43 Hz, which flickers like an old Nickelodeon. The dot pitch is just 0.31mm (if I remember right) and it's not something you'd want to use with a WindowsNT system. Still, if you insist on using it, here's the pinout.*

Video Mode Pin	PGA	VGA
1	Red	Red
2	Green	Green
3	Blue	Blue
4	Composite Sync	H. Sync
5	Mode Control	V. Sync
6	Red GND	Red GND
7	Green GND	Green GND
8	Blue GND	Blue GND
9	GND	GND

You see that the PGA connector is very close to that of a nine-pin VGA plug of that era – with a major exception. The sync is composite, not separated into horizontal and vertical sync. Here's a circuit that combines the separate syncs into a composite sync.



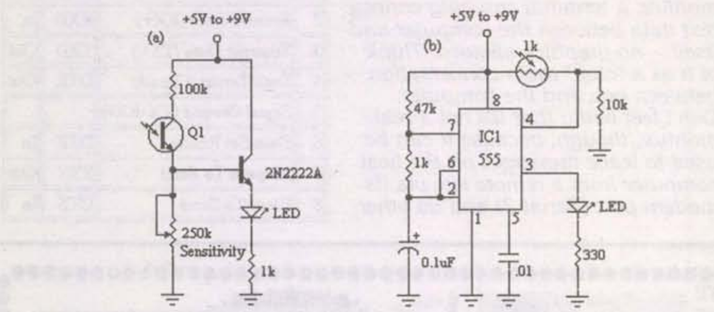
You probably won't find a PGA driver for your software, but an 8514/A driver should work.

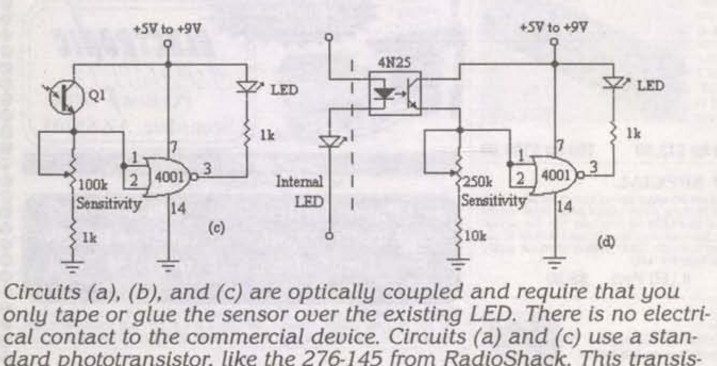
LED Repeater

Q. I regularly come upon situations where I'd like to view an LED indicator at a remote location. For example, my current project is to move the status indicators from my computer's UPS off the floor to a location where they can actually be seen. What I'd like is a generic circuit that would "watch" an existing LED — either electronically or optically — on a variety of devices and simply light a duplicate LED some distance away.

Jeff Rothfus
via Internet

***A.** There are several ways you can do this, depending on your access to the original LED and how you want the new display to look. The simplest solution is to use a fiber optical cable. One end attaches to the LED using a clear glue and the other end goes to your indicator panel. Inexpensive fiber optics can be purchased from Newark Electronics (1-800-639-2759; http://www.newark.com). It requires no power and is easily installed however, the light is less bright than the original LED. In which case, you'll want to use an external LED. Here's a medley of designs that'll work.*





Circuits (a), (b), and (c) are optically coupled and require that you only tape or glue the sensor over the existing LED. There is no electrical contact to the commercial device. Circuits (a) and (c) use a standard phototransistor, like the 276-145 from RadioShack. This transistor works best with red LEDs. I've also had good luck with clear LEDs substituting for the phototransistor. Design (a) uses the phototransistor with a 2N2222A in a Darlington configuration. When light strikes the phototransistor, it conducts – which turns on the 2N2222A and lights the LED. Circuit (c) is basically the same design with the 4001 logic gate replacing the 2N2222A. When the voltage at the gate's input (pins 1 and 2) exceeds about 2.4 volts, the output goes low and lights the LED. There are four gates in the 4001 (a 4011 works, too), which reduces the part count for multiple LEDs. Circuit (b) uses a photoresistive sensor connected between the reset input (pin 4) and Vcc. Again, *light decreases the resistance of the photocell which turns on the 555, causing it to oscillate. This pulses the LED at a greater current than in the two previous designs, which increases the brightness of the lamp without increasing the average current draw from the battery. Finally, if you have access to the LED wiring inside the UPS, the circuit in Figure (d) is the most stable because it's totally immune to ambient room light. To use it you need to break the positive lead going to the existing LED and insert the optocoupler LED in series with the panel lamp. Whatever design you choose, place the circuit as close as possible to the light source to avoid noise interference, and locate the second LED at the remote site (LEDs are current operated, so voltage drop in the cable isn't a factor). The panel and remote LEDs are synchronized to go on and off at the same time by adjusting the variable pot.*

PC Graphics on Mac Monitor

Q. I read your answer to Chuck Karbginsky in the Jun. '98 issue concerning his RGB to SVGA monitor problem. I have a similar problem. I have a Apple Performa Plus Monitor that I want to use on a PC. I know that this monitor has a composite sync, but I don't know if it's sync positive or negative. I got these specs from Apple. Can you make sense of them?

Dan Kilpatrick
via Internet

A. *I took the liberty of rendering down your list of specs to just those we need to discuss. Here they are.*

Input Signals
Video: Analog, modified RS-343
Sync: Composite horizontal and vertical sync
Scanning Frequencies
Horizontal: 35 KHz
Vertical: 66.7 Hz
Dot clock: 31.91 ns

To begin with, you don't have to worry about whether the sync is positive or negative — the RS-343 standard takes care of that. Your worry is whether or not the fixed scanning frequencies of this monitor fall within the range of a PC video standard. Here's a list of the PC video modes that come close.

Mode	*Resolution*	*Horizontal Scan Rate*	*Vertical Scan Rate*
EGA	*640 x 480*	*37.40 KHz*	*72 Hz*
VGA	*800 x 600*	*35.20 KHz*	*56 Hz*
	800 x 600	*37.80 KHz*	*60 Hz*

As with any electronic device, there's always a fudge factor — called tolerance — which may be enough to let your 35-KHz monitor sync at 37.80 KHz. Same for the 66 Hz vertical sync. If it doesn't happen, you might be able to tweak it in using adjustments you'll find under the cover — just be VERY careful! No, I'm not talking about the high voltages (which you have to respect), but your attention to selecting the right control. A couple tweaks in the wrong direction and you may never find your way back home. Of course, you need a composite sync converter, like the one described in the preceding "PGA What?" question. After that, you need a converter cable that mates the PC to the Mac monitor. Here's how they pair up.

Computer Video Connector Type	*Mac DA-15*	*PC DB15*
Pin	***Function***	***Function***
1	*Red GND*	*Red*
2	*Red*	*Green*
3	*Composite TTL sync*	*Blue*
4	*Composite TTL GND*	*Monitor ID bit 2*
5	*Green*	*not used*
6	*Green GND*	*Red GND*
7	*not used*	*Green GND*
8	*not used*	*Blue GND*
9	*Blue*	*not used*
10	*not used*	*GND*
11	*not used*	*Monitor ID bit 0*
12	*not used*	*Monitor ID bit 1*
13	*Blue GND*	*Horizontal sync*
14	*not used*	*Vertical sync*
15	*not used*	*not used*

You can buy Mac to VGA adapters from several sources, including Bottom Line Online (http://www2.blol.com), for about $29.00. Like I say, your worry is the scan rates.

Wyse Terminal Pinout

Q. I have several Wyse WY-150 workstation monitors that have a keyboard connector under the left front and three connectors on the back labeled Serial 1, Serial 2, and Parallel. I assume that the monitor is MDA (monochrome) and that the Serial 1 port carries keyboard and video data to the computer and back. If you are able to provide the pinout for the Serial 1 connector, I believe that I can use these monitors. I think the information might interest other readers, too, because they are readily available at low prices.

L. Hansen
via Internet

WY-150e Serial 2 Port Assignments

Pin	Signal	Mnem	Dir
1	Data Carrier Detect	DCD	In
2	Receive Data (RX+)	RXD	In
3	Transmit Data (TX+)	TXD	Out
4	Data Terminal Ready	DTR	Out
5	Signal Ground (TX-RX-)		
6	Data Set Ready	DSR	In
7	Request To Send	RTS	Out
8	Clear To Send	CTS	In

A. *Well, it's not really a monitor. It's a computer terminal with its own built-in motherboard. Unlike a "real" monitor, a terminal can only convey text data between the computer and itself — no graphics allowed. Think of it as a "chat" room conversation between you and the computer. Don't feel badly that it's not a real monitor, though, because it can be used to leave messages on the host computer from a remote site via its modem port (Serial 2) and do other*

WY-150e Serial 1 Port Assignments (DTE

Pin	Signal	Mnemonic	Direction
1	Ground	FG	
2	Transmit Data	TXD	Out
3	Receive Data	RXD	In
4	Request to Send	RTS	Out
*5	Clear to Send	CTS	In
6	Data Set Ready	DSR	In
7	Signal Ground	SGND	
*8	Carrier Detect	DCD	In
20	Terminal Ready	DTR	Out

Parallel Port Assignments

Pin	Signal	Dir	Pin	Signal	Dir
1	-Strobe	Out	10	-Ack	In
2	+Data 0	Out	11	+Busy	In
3	+Data 1	Out	12	+Paper	In
4	+Data 2	Out			
5	+Data 3	Out			
6	+Data 4	Out	15	-Error	In
7	+Data 5	Out			
8	+Data 6	Out	17	Select	Out
9	+Data 7	Out	18-25	Grounds	

messaging chores over phone lines (they're often used for off-track betting and the like). The parallel port should have been more properly labeled Printer, because that's what it's used for. Anyway, here are the pinouts for all three connectors. For more information on this product, including keyboard commands, contact the Wyse Web site at http://www.wyse.com/terminal.

TV On PC Monitor

Q. I need to find a way to send composite video (like from a surveillance camera or VCR) to a 15-pin color computer monitor. I don't want to use a computer to process the signal, just a direct connection from the camera to the monitor. The composite video is B&W, so I'm not concerned about getting color on the screen.

Dean Thompson
via Internet

*A. Sure, this is an easy thing to do – but it's not a DIY (do-it-yourself) project. It's far too complex for anything short of a microprocessor-controlled converter, like the AVerMedia TVGenie (**http://www.aver.com/lite/index.html**).*

Why? Because the sweep rates of the VCR and PC monitor don't match. The horizontal scan rate of your VCR runs at the speed of a conventional TV receiver, which is 15.75 KHz. PC monitors have a horizontal scan rate between 30 KHz and 70 KHz – far out of the capture range. Furthermore, the TV screen is interlaced whereas the PC screen is non-interlaced. To convert from TV to PC you first have to separate the horizontal and vertical sync signals from the composite. Next the clock speed has to be doubled so that the 15.75 KHz refresh rate of the VCR becomes 31.5 KHz, which is supported by the VGA monitor. The last step is to remap the pixels to fit the new scan pattern – a task that can only be done by storing the pixels in a memory buffer and meting them out as their number is called. That's exactly what the TVGenie does for just $99.00 ($89.00 without the remote). This unique device is available from CompUSA, Good Guys, and many computer retailers.

Continued on page 93

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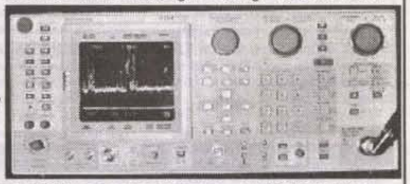

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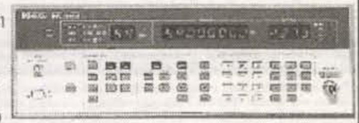

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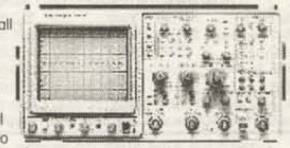

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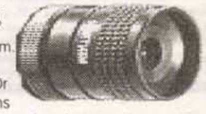

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SPI and the Printer Port

by Karl Lunt

A small DOS-box computer doesn't leave you many options for attaching external devices such as sensors. Basically, you can use the serial ports or the printer ports. The serial ports work best for terminal-type equipment such as modems or RF links, but the printer ports can really shine when you need to hook up several medium-speed I/O devices.

In this article, I'll show you how you can add up to eight devices to a single printer port, using little more than a ribbon cable and some C software.

The SPI

Traditionally, hobbyists have used a printer port to drive ICs such as an eight-bit latch. This simple hookup lets you control eight latch output lines just by writing a value to the parallel port. But if you need more I/O capability, such as more latch output lines or even a few input lines, you end up with a much more complex design. The older parallel ports only had a few input lines, and even the newer Expanded Parallel Port (EPP) units aren't all that easy to use if you need a lot of input lines.

This I/O limitation hasn't stopped hobbyists from developing some clever designs, of course. One of the better projects that I've seen wired into a parallel port was a device that could read and write GameBoy game cartridges. I discussed this project in detail in a past *Nuts & Volts* Amateur Robotics column; you can look through your stack of back issues, or do a web search for GameBoy and ReadPlus (the name of the reader).

But to get the most mileage out of your parallel port, consider using it to drive a synchronous serial bus such as Motorola's Serial Peripheral Interface, or SPI.

Hooking up an SPI device, such as a latch, requires only three lines plus ground; a total of five if you include +5 VDC to drive the device. More importantly, each SPI peripheral needs only one dedicated printer output line. This means you can add up to eight SPI devices to a printer port.

Since the SPI bus is bidirectional, you can use any mix of input, output, or bidirectional devices you need. This means you wouldn't have any problem driving, say, 32 channels of A/D, a couple of eight-bit latches, and a pair of frequency synthesizers off of a single parallel port.

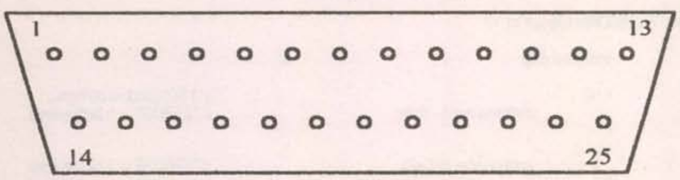
The SPI achieves this high capability because of the way it distributes data. All devices use the same serial input line, the same serial output line, and the same serial clock line; this last signal lets two devices synchronize bus operations. The device controlling the bus — known as the master — uses a dedicated line to each other device as a select line; bringing a select line low activates the device on that line. Only the selected device — known as a slave — will listen or respond to the host.

For example, if the master (your PC) wanted to exchange data with SPI device 3, it would bring printer output port line 3 low, leaving all other output lines high. Then, your PC could freely send commands serially over the common output line; only device 3 would process the commands. Similarly, your PC could receive data from the common input line, knowing that any data received would have been sent only by device 3.

The SPI exchanges data between two devices simultaneously. This means that each time the master sends a bit to the selected slave device, the master also reads a bit from the slave. The master device must provide the serial clock signal used by both devices for synchronizing this data exchange.

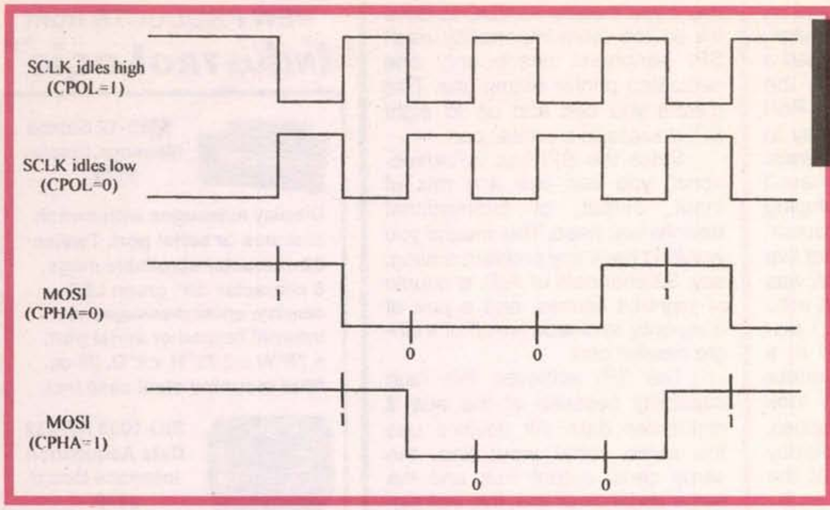
Putting this another way, no

DB-25 male (front view)



Pin	Signal	Direction (from PC)	Port & Bit
1	*Strobe	Output	Control, D0
2	D0	Output	Data, D0
3	D1	Output	Data, D1
4	D2	Output	Data, D2
5	D3	Output	Data, D3
6	D4	Output	Data, D4
7	D5	Output	Data, D5
8	D6	Output	Data, D6
9	D7	Output	Data, D7
10	*ACK	Input	Status, D6
11	*Busy	Input	Status, D7
12	PaperEmpty	Input	Status, D5
13	Select	Input	Status, D4
14	*AutoFeed	Output	Control, D1
15	*Error	Input	Status, D3
16	InitPrinter	Output	Control, D2
17	*SelectIn	Output	Control, D3
18-25	Ground		

THE SIGNALS AVAILABLE ON A PC PARALLEL PORT.



TIMING DIAGRAM SHOWING THE RELATIONSHIP BETWEEN CPOL and CPHA. MASTER SENDS BINARY 1001 TO SLAVE.

data are exchanged unless the master provides the necessary clocking pulses. This means that the master must always send something to the slave, even if the master just wants to read a byte of data.

Note that the SPI format doesn't prevent you from sending commands to more than one device at a time, should that be necessary. Just have the master pull all the necessary select lines low before sending any commands. However, this is a fairly rare occurrence. Generally, your software will deal with only one active device at a time.

There are some subtle timing requirements that you have to respect when using the SPI; refer to the sidebar for details. In a nutshell, though, the above paragraphs show that little is involved in moving data between a host device such as a PC and any of several different SPI devices on a bus. Anyone using the Motorola microcontrollers (MCUs), such as the 68hc11, likely will have already used or read about the SPI; it is built into almost all Motorola MCUs. Other chip makers, such as Atmel, also sell MCUs with built-in SPI.

The printer port

I've discussed the SPI in some detail, now I'll turn my attention to the printer port. In its simplest form, this is a multi-wire bidirectional port to the world; your PC software sees this port as three consecutive I/O registers. The first of these three registers is the data port, a byte-wide output port that your software can write to change the states of eight lines. The next higher register is the status port, a byte-wide input port that your software can read to sense the states of various signals from the printer. Finally, the control port is a byte-wide output port that your software can write to change the states of various signals to the printer.

Each printer port, known to your PC as LPT1 through LPT4, occupies three consecutive addresses beginning at any of three common I/O addresses, \$3bc, \$378, or \$278. For example, if your PC assigns LPT1 to I/O address \$3bc, then your software would use \$3bc as the data port, \$3bd as the status port, and \$3be as the control port. The PC's BIOS

```
#include <stdio.h>
#include <conio.h>
#include <dos.h>
#include <stdlib.h>


#ifndef TRUE
#define FALSE 0
#define TRUE 0xffff
#endif


unsigned int        dataport;
unsigned int        controlport;
unsigned int        statusport;
unsigned char       controlvalue;
unsigned char       datavalue;
unsigned int        waits;
unsigned char       buffer[128];
unsigned char       cpol;
unsigned char       cpha;
unsigned char       MSBFirst;
unsigned int        addata;                                 // returned a/d value
float                           fdata;
float                           fullscale;


void SetMOSI(unsigned char value);
void ForceSCK(unsigned int v);
unsigned char ToggleSCK(unsigned char in);
void DeselectAll(unsigned char value);
void ToggleSelects(unsigned char mask);
void SetFormat(unsigned char phase, unsigned char polarity);
unsigned char ExchangeSPI(unsigned char value);


void main(int argc, char *argv[])
{
        unsigned int                    n;
        unsigned char                   c;

        dataport = 0x378;                                       // assume LPT1
        statusport = dataport+1;
        controlport = dataport+2;
        waits = 0;
        MSBFirst = TRUE;
        fullscale = 4.096;                                      // for max1204 A/D
        if (argc > 1) {
                for (n=1; n<argc; n++) {
                        if (*argv[n] == '/') {                  // if this is an argument...
                                c = *(argv[n]+1);               // get argument char
                                switch (c) {                    // based on argument char...
                                        case 'w':
                                        waits = atoi(argv[n]+2);  // get number of wait
states

                                        break;
                                }
                        }
                }
        }
        DeselectAll(0xff);                                      // all selects are active-low
        SetFormat(0, 0);                                        // format: cpol=0, cpha=0
        while (!kbhit()) {                                      // until user hits a key...
                printf("\r");
                ToggleSelects(0x01);                            // select device 0
                ExchangeSPI(0x8e);                              // chnl 0, uni, single, internal clk
                addata = ExchangeSPI(0x00);                     // get msb of data
                                        addata <<= 8;           // move msb to top
                addata += ExchangeSPI(0x00);                    // add lsb
                addata >>= 5;                                   // finally, align data properly
                ToggleSelects(0x01);                            // deselect the device
                if (addata == 0x3ff) {                          // if all bits set...
                        printf("Overrange!");
                }
                else {
        // no, got valid data
                        fdata = fullscale * ((float)addata / 1023.0);
                        printf("Data: %7.3f ", fdata);
                }
        }
        getch();                                                // clear kbd buffer
        printf("\n");
}


void ForceSCK(unsigned int v)
{
        unsigned char                           n;

        if (v) {                                                // if SCK should be high...
                controlvalue &= 0xfe;                           // *STROBE = 1 (active-low)
        }
        else {
                controlvalue |= 0x01;                           // *STROBE = 0 (active-low)
        }
        outportb(controlport, controlvalue);
        for (n=0; n<waits; n++) {
                outportb(controlport, controlvalue);
        }
}


unsigned char ToggleSCK(unsigned char in)
{
        unsigned char                   v;
        unsigned char                   n;

        if (!cpha) {                                            // if CPHA = 0...
                SetMOSI(in);                                    // need to set MOSI now
                v = inportb(statusport);                        // get value of MISO
        }
        outportb(controlport, controlvalue ^ 0x01);
        for (n=0; n<waits; n++) {
                outportb(controlport, controlvalue ^ 0x01);
        }
        if (cpha) {                                             // if CPHA = 1...
                SetMOSI(in);                                    // need to set MOSI now
                v = inportb(statusport);                        // get value of MISO
        }
        outportb(controlport, controlvalue);
        for (n=0; n<waits; n++) {
                outportb(controlport, controlvalue);
        }
        return (v ^ 0x80) & 0x80;                               // invert *BUSY and strip other bits
}
```

records the assignment of each printer port to its I/O address in a table stored in RAM at address 0040:0008.

To look at the printer assignments of your PC, go to a DOS prompt and fire up the DOS debug program. When you get debug's prompt, enter the command:

```
d 0040:0008 L8
```

debug will respond by printing out the eight bytes of data stored at that address. The first pair of bytes gives the I/O address of LPT1, the second pair gives the I/O address of LPT2, etc. Note that since the PC uses an Intel-style processor, the I/O addresses are stored LSB first, so you will need to reverse the order of the two bytes in each address to determine the true I/O address.

Knowing how to use this table means your software can look up the I/O address associated with any desired LPT port, even if the BIOS or some other program switches port assignments at some time. This is important, because to control SPI devices using a printer port, your software must perform low-level accesses to the I/O registers.

Obviously, you want your software to bang the lines of the correct port, lest your laser printer suddenly go wacko and start spilling paper all over the place.

With most of the basics out of the way, we can start looking at the available lines on the printer port, to assign these lines to the necessary functions we need to support an SPI bus. Refer to the accompanying table of signals available on the printer port for details.

The most important line in the SPI bus is SCLK, which acts as the system clock signal. We will be bit-banging all of the SPI signals from the PC, so we could choose any line we want as our SCLK signal, but probably the easiest to remember is *Strobe. This signal appears on the printer connector as pin 1, and in the parallel port registers as bit 0 of the control port. Note the leading asterisk in the signal name, *Strobe. This indicates that this signal is active-low.

From the software viewpoint, you have to write this bit with the inverse of the desired signal. Thus, to pull *Strobe low, your software must set bit 0 of the control port high. Similarly, writing a 0 to bit 0 of the control port will bring the *Strobe output line high. This can take a little getting used to, but one function will be used for all manipulations of *Strobe, so you only have to get this concept right once, then you can forget about it for the rest of the program.

Next up, we need a signal to act as MOSI, the master device data output line. I chose *AutoFd, which is bit 1 of the control port and pin 14 of the printer connector, for this function. As with *Strobe, discussed previously, this is an active-low signal, so you have to write the inverse of the desired value whenever your software manipulates this bit.

Data Port (I/O address offset 0)
Output only from PC

D7	D6	D5	D4	D3	D2	D1	D0

Status Port (I/O address offset +1)
Input only to PC

*Busy	*ACK	PE	Select	*Error	*IRQ	---	---

Control Port (I/O address offset +2)
Output only from PC

---	---	Dir	IRQEnb	*SelectIn	Init	*AutoFd	*Strobe

THE THREE REGISTERS OF A PC PARALLEL PORT.

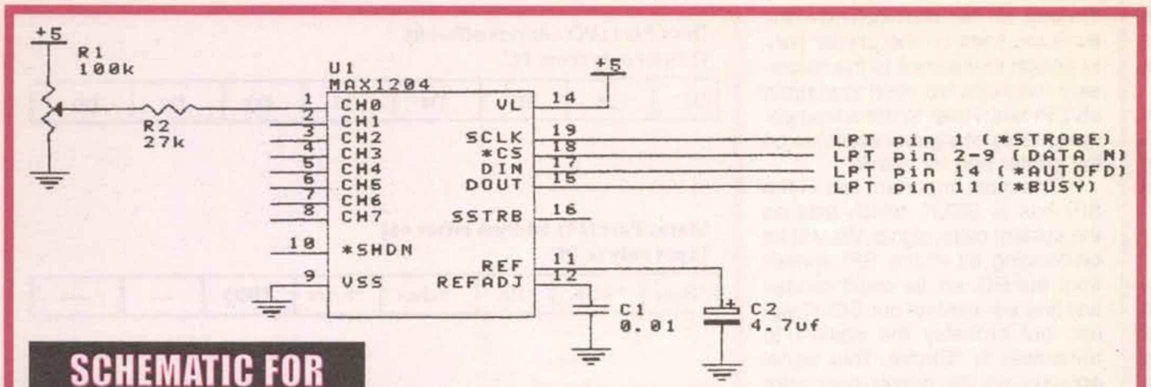
Then we have MISO, the master device data input line. I chose *Busy for this signal because the documentation I was using for my design indicated that this line was active-high, meaning that my software wouldn't have to deal with the inversion discussed above. Unfortunately, the documentation was wrong; *Busy is active-low. I only discovered this after completing the software and seeing the inversion in my tests.

Rather than rewrite the software and mod the hardware at this point, I just added the inversion to the code and left *Busy as my MISO line. If you decide to rewrite my software, you might switch lines for MISO; PaperEmpty or Select might make better choices. For now, my code uses *Busy, which is bit 7 of the status port and pin 11 of the printer connector.

All that remains is assigning the SPI select lines. This software uses output lines D0 through D7 as the eight device select lines

```
/*
 * DeselectAll    bring all chip selects to deselected state
 *
 * This routine accepts an unsigned char that indicates all
 * devices are not selected. After writing this value to the
 * LPT data port, this routine saves the value in a global
 * variable for later use.
 */

void DeselectAll(unsigned char value)
{
        unsigned char                   n;

        datavalue = value;
        outportb(dataport, datavalue);
        for (n=0; n<waits; n++) {                       // for all wait states...
                outportb(dataport, datavalue);
        }
}


/*
 * ToggleSelects    toggle one or more chip.select lines
 *
 * This routine changes the chip select byte written to the
 * LPT data port. Upon entry, the pattern in argument mask
 * is used to toggle bits in the current global value
 * datavalue. This value is then sent to the LPT data port,
 * with waitstates.
 *
 * Note that you don't use this routine to turn bits on or
 * off, only to toggle them. Thus, this routines serves as
 * both a device select and a device deselect routine.
 */

void ToggleSelects(unsigned char mask)
{
        unsigned char                   n;

        datavalue ^= mask;              // set the selected pattern
        outportb(dataport, datavalue);  // set it up
        for (n=0; n<waits; n++) {       // do the waiting
                outportb(dataport, datavalue);
        }
}


void SetFormat(unsigned char phase, unsigned char polarity)
{
        cpol = polarity;                                // record clock idle state
        ForceSCK(cpol);                                 // set clock to proper idle state
        cpha = phase;                                   // record CPHA setting
}


void SetMOSI(unsigned char value)
{
        unsigned char                   n;

        if (!value) {                                   // if sending a 0...
                controlvalue |= 0x02;   // set MOSI to 0 (active-low)
        }
        else {                                          // nope, must be 1...
                controlvalue &= 0xfd;   // set MOSI = 1 (active-low
        }
        outportb(controlport, controlvalue);
        for (n=0; n<waits; n++) {       // wait it out...
                outportb(controlport, controlvalue);
        }
}


unsigned char ExchangeSPI(unsigned char value)
{
        unsigned char                   v;
  unsigned char                 n;
        unsigned char                   indata;

        indata = 0;
        if (MSBFirst) {                                 // if sending MSB first...
                for (n=0; n<8; n++) {   // for all bits in byte...
                        v = ToggleSCK(value & 0x80);    // clock it
                        indata <<= 1;                   // move new data left one bit
                        if (v) indata += 1;             // add the bit we just read
                        value <<= 1;                    // now move out byte left
                }
        }
        else {
                for (n=0; n<8; n++) {   // no, sending LSB first...
                        v = ToggleSCK(value & 0x01);    // clock it
                        indata >>= 1;                   // move new data right one bit
                        if (v) indata += 0x80;          // add the bit we just read
                        value >>= 1;                    // now move out byte right
                }
        }
        return indata;
}
```

C PROGRAM



SCHEMATIC FOR CONNECTING A MAX1204 A/D CONVERTER USING THE PC'S PARALLEL PORT

supported by this project. This makes it easy to remember which device goes to which connector pin. If you need even more SPI devices hooked to your port, you can write extra code that uses the last two control lines, *InitPrinter and *SelectIn, to add two more devices.

Now it's time to get into the software. Refer to the accompanying listing of my C program. This is not a finished piece of software, so I've cut a few corners. I encourage you to build on this program to make it better for your own application.

I compiled this code using Borland C/C++, version 4.52, as a DOS standard application using the large memory model. The only non-ANSI feature that I'm aware of in this program is the use of the outportb() library function, which writes a byte to the desired I/O port, but most compilers support a similar function. Refer to your compiler's manual for details.

The program's main() function begins by assigning default values to several important variables. The variable **dataport** holds the base address of the parallel port's I/O registers. The value written here, 0x378, serves as the I/O address of my system's LPT1. As you can see, I have not implemented the BIOS lookup scheme described above. Feel free to add the lookup yourself, if you choose. If not, at least use a utility such as Microsoft's MSD to locate the I/O address used by your target printer port, and change the value written to **dataport** accordingly.

The variable **waits** is vital to the proper operation of this program, and deserves study. Most SPI devices run at a top clock speed of one to two Mbits per second. The newer PCs, however, can pump data out the printer port at much higher rates than the SPI devices can handle. In order to slow the newer machines down so the SPI devices can keep up, I've added a wait-state feature. **waits** holds the number of wait-states to insert in any SPI bus operation.

On my little 486 DOS-box, which I use for data collection, this program can only change the SPI SCLK line at about 500 KHz, well within reach of most SPI devices. The default value of **waits**, which is 0 in this code, is good enough for my little system. You can change the value of **waits** on the command line by using the **/wxxx** option, where **xxx** is the number of wait-states you want to insert.

Adding wait-states gets a little tricky. You can't use a simple counting loop, as some compilers will optimize out such loops, and the newer machines run too fast to make such loops meaningful.

To insert wait-states, my code simply repeats the most recent I/O operation **waits** times. I/O operations are timed independently of the PC's CPU, so each wait-state will actually occur, and will be of a known duration.

For an example of how the wait-states are inserted, look at the code in ForceSCK(). It is an instructive exercise to hook an oscilloscope to your printer port's *Strobe line, then run this program with different values for **waits** and watch the effect of the wait-states on the SCLK pulse length.

I've included the routine SetFormat() so you can quickly change the active SPI format. You might have devices hooked to your printer port that require different SPI polarities or phases, and this routine lets your software adjust the system's format before beginning a transfer. I've also added routines for controlling the eight printer data lines, used as SPI device select lines.

The function DeselectAll() allows you to write a value to the data port that turns off all SPI devices. Since your design might use a mix of active-high and active-low SPI devices, DeselectAll() allows you to pass a value that constitutes all devices off. Another routine, ToggleSelects(), lets your software change the state of particular SPI device select lines. Note that you don't specify whether the line goes high or low, only that it changes. Your software can blend usage of DeselectAll() and ToggleSelects() to control the SPI devices without having to know what state any device select line should be in.

Taking the bus for a SPIn

All of this software doesn't mean beans until you actually hook up a device. You have a bewildering assortment of SPI devices available to you. Perhaps the most commonly used SPI device is the 74hc595 serial-in/parallel-out octal latch. I've done a couple of articles on hooking this device to the SPI; see some of my earlier *Nuts & Volts* Amateur Robotics columns for details on using this chip to drive, for example, a liquid-crystal display (LCD).

But hooking up yet another '595 seemed so boring, considering the number of other possible choices. So I plugged into Maxim's web site at **www.maxim-ic.com** and started looking around for cheap A/Ds. After a few minutes, I settled on the MAX1204, an eight-channel 10-bit serial A/D that needs a single +5 VDC supply to operate.

Maxim has built some nice features into this chip. One feature I like in particular allows you to configure it as either eight single-ended analog inputs, or four differential inputs. You can even mix and match, should you need, say, five single-ended and one differential.

You can order a couple of these devices directly from Maxim, via their samples desk. The device is also available from Digi-key for about $4.50 each.

Inside the SPI

Motorola's Serial Peripheral Interface (SPI) uses three bus wires and additional chip-select lines to implement a synchronous bus that runs at speeds in excess of one megabit per second. Widely used in the embedded control industry, the SPI makes a good choice for moving high volumes of data across short distances (less than one foot) or among several different devices. The following paragraphs describe the various signals used in the SPI bus.

SCLK (or SCK) is the main clock signal for synchronizing data transfers between the master device and the selected slave device. This signal is provided by the master device. SCLK may idle either high or low. To generate a clock pulse, the master device momentarily brings SCLK to the active state, then returns it to the idle state. Each such clock pulse constitutes a single bit time, used to synchronize the exchange of one data bit.

MOSI (master-out-slave-in) is the SPI output line from the master device. At the correct point in each clock pulse, the master device outputs a level on MOSI corresponding to the bit value to send to the slave device. MOSI is connected to the input lines on all slave devices on the bus. The selected slave device will sample the value of MOSI at the correct point in each clock pulse to determine the value of the data bit sent by the master device.

MISO (master-in-slave-out) is the SPI input line to the master device. MISO is connected to the output lines of all slave devices on the bus. At the correct point in each clock pulse, the selected slave device outputs a level on MISO corresponding to the bit value to send to the master device. The master will sample the value of MISO at the correct point in each clock pulse to determine the value of the data bit sent by the slave device.

***CS** is the chip-select line used by the master to select a slave device. Generally, the master must provide a single chip-select line for every slave on the SPI bus, though some bus configurations can use one chip-select line to control multiple slave devices. By convention, SPI slave devices use an active-low chip-select line, though some SPI devices, such as the Dallas DS1305 real-time clock, use an active-high select line. The master leaves all chip-select lines in their inactive states until a data exchange is required. At that time, the master drives the proper chip-select line to its active state, selecting that slave device. After exchanging one or more bytes of data with the slave device, the master returns that select line to its inactive state, deselecting the slave device.

The timing for data exchange on the SPI bus depends on the SCLK signal and the agreed-upon format between the master and slave devices. The two devices may use any of four different timing formats, based on the idle state of SCLK (either high or low) and which edge of SCLK (either leading or trailing) marks the presence of valid data. Motorola refers to these two criteria as CPOL and CPHA. CPOL, or clock polarity, is 0 if SCLK idles low or 1 if SCLK idles high. CPHA, or clock phase, is 0 if data are valid on the leading edge of SCLK or 1 if data are valid on the trailing edge. Thus, an SPI bus that uses the format CPOL=0 and CPHA=0 relies on SCLK idling low, with data valid whenever SCLK changes from low to high.

As you can see from the accompanying schematic, the wiring is dirt simple; you get eight channels of A/D for little more than a couple of caps and a socket. I've added a trimpot (R1) and current-limiting resistor (R2) to channel 0 so I can dabble a little.

Note that the *CS line — pin 18 — connects to only one of the Dn lines on the printer port connector; if you want to use this schematic with the software listed here, hook *CS to printer connector pin 2 (D0). Also make sure you hook at least one of the ground lines on the printer connector (pins 18 through 25) to the ground line in the schematic. You will also need to supply a source of +5 VDC for this MAX1204; this can be a wall-wart or a set of batteries with a suitable voltage regulator.

The physical layout of this circuit is not critical; you could make up a little printed circuit board (PCB), or just use one of the RadioShack experimenter's boards. I chose to build my circuit on one of those white plastic prototyping blocks, offered by a number of mail-order vendors.

The tricky bit involves hooking wires to the printer connector. I opted to start with a 18-inch long 26-pin ribbon cable, available surplus nearly anywhere for a buck or so; mine even had a female 26-pin IDC connector on one end.

I stripped back the 26th wire from the opposite end of the cable, then pressed a male IDC DB-25 connector onto that end. This gave me a ribbon cable of suitable length, with one end I could plug into the LPT port of my PC and another end that I could plug into a 26-pin male dual-row header.

All that remained was coming up with a dual-row header that I could plug into my prototyping block. I started with a 26-pin wirewrap header gleaned from my junk box. Working carefully with a set of needle-nose pliers, I bent each of the long 26 pins to the proper shape. When complete, I had widened the gap between the two rows of long pins so the header would straddle the wide channel down the center of my prototyping block. When I plug the header into the block, each pin is isolated from the others.

Now I can plug the 26-pin female connector on the end of my ribbon cable into the prototyping block and complete my wiring. Note that such modified dual-row headers are also available from several mail-order houses, if you don't feel like taking the time to construct your own.

With the wiring complete, I just needed to add some code to my program that is specific to the MAX1204 A/D. See the code in routine main() for details. After some setup, all of the code for reading and processing the MAX1204 is handled by the large while-loop at the bottom of main().

To take a reading, my software first toggles select line 0, then uses ExchangeSPI() to send a read command to the MAX1204. The command sent, 0x8e, takes a reading from channel 0 in unipolar, single-ended mode, using the MAX1204's internal clock.

To collect the data from the MAX1204 after it finishes reading, my software must send two bytes of 0 and save the responses. This is done with the two successive calls to ExchangeSPI() and the manipulation of variable **addata**.

Finally, my code examines the value saved in **addata**. If the variable holds 0x3ff (all bits set), the code assumes an overrange and prints out an error message. If the value returned is valid, my code converts it into a floating-point number, scaled to a maximum of +4.096 VDC, and displays the result. This loop of read, collect, and display continues until the user presses a key to halt the program.

That's a wrap

As you can see, hooking SPI devices to the PC's printer port requires very little hardware and only a moderate amount of software. The program given here should get you well on your way.

Originally, I had intended to do a single, general-purpose program that could handle everything, but the different configurations of SPI devices are simply too great. In the end, I chose to do a collection of functions that you could use to accommodate nearly any SPI device. You could also transcribe this code to any of the various dialects of PC BASIC, should you be more comfortable with that language.

The SPI bus is a natural for grafting onto the PC's parallel port. The wide variety of devices, the ability of the bus to handle many different devices easily, and the simplicity of the software involved add up to a potent combination. Give this technique a try on your next data collection or robot control project. I think you'll like the results.

Much of my information on the line-printer port came from a superb web site maintained by Peter H. Anderson, a professor in the department of Electrical Engineering at Morgan State University.

He and his students have developed many different printer-port projects, and their web-site is loaded with terrific information and project designs. You can even buy books and circuit boards for several projects.

Check this page out at **www.et.nmsu.edu/~etti/fall96/computer/printer/printer.html. NV**

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OCTOBER 1998

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

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MS - BILOXI - Hamfest. Point Cadet Plaza, Hwy. 90. Fri: 5-9pm, Sat: 8am-3pm. Talk-in: 146.730. VE Exams. MS Coast ARA, Larry Kiser KC5QFR, 228-463-0407. Doris Miller, 228-539-9929

OCTOBER 3

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

FL - ORLANDO - Hamfest. Bahia Shrine AR Unit, Phillip Stewart KD4CJK, 407-380-2902

IN - PERU - Hamfest. Miami Co. & Cass Co. ARCs, Gary Donaldson N9KQG, 219-382-2203. E-Mail: ccarc@netusa1.net Web: http://www.netusa1.net/~ccarc

KS - WICHITA - State Convention. Cotillion Ballroom, 11128 W. Kellogg (Hwy. 54). 8am-4pm. VE Exams. Stan Weir, 316-524-2568. E-Mail: kb0shb@juno.com Web: http://www.feist.com/~warc

MO - WARRENSBURG - Hamfest. Warrensburg Area ARC, Jim Callon KB8DQB, 660-563-6168

NY - SYRACUSE - Hamfest. Pompey Hills Fire Dept., off Rt. 20. 8am-2pm. VE Exams. Talk-in: 147.90/30. RAGS, Vivian Douglas WA2PUU, 315-469-0590. Web: www.pagesz.net/~rags

PA - WARRINGTON - Mid-Atlantic States VHF Conference. Hampton Inn, 1500 Easton Rd. 9am-9pm. Mt. Airy VHF Radio Club (Packrats), John Sortor KB3XG, 610-878-5674. E-Mail: johnkb3xg@aol.com

SC - FT. MILL - Rock Hill Hamfest & Computer Fair. Knights Stadium, I-77 Exit 88. Talk-in: 147.03 -600. Pete Krenn KC4ZJ 803-366-5932. E-Mail: pete@cetlink.net

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

OCTOBER 4

CA - LIVERMORE - Hamfest. Livermore ARK, Cliff Kibbe KF6EII, 209-835-6715. E-Mail: larkswap@hotmail.com

IN - LAWRENCE COUNTY - Hamfest. Hoosier Hills Ham Club, John Scheiwe KB9LTI, 812-279-0050. E-Mail: jscheiwe@dmrtc.net Web: http://dmrtc.net/~jscheiwe/hamfest.html

MD - FRIENDSHIP - Hamfest. Columbia ARA, Richard Frank W9RZ, 410-531-2933 or 301-314-7806

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

PA - WARRINGTON - Hamarama. Bucks Co. Drive In, Rt. 611. Talk-in: 146.52 simplex. Mt. Airy VHF Radio Club (Packrats), Mark Schreiner NK8Q, 215-497-1414. E-Mail: nk8q@amsat.org Web: http://www.ij.net/packrats

OCTOBER 9-10

NH - ROCHESTER - Hamfest. HOSSTRADERS, Joe Demaso K1RQG, 207-469-3492. E-Mail: klrgg@aol.com

OCTOBER 10

AR - MOUNTAIN HOME - Hamfest. Twin Lakes ARC, Paul Rasmussen KA6VAN, 870-491-5350. E-Mail: rasmussen@centuryinter.net

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

FL - STARKE - Hamfest. Bradford Area ARC, Lev Francis K4SRA, 352-473-3511. E-Mail: afn22489@afn.org

GA - AUGUSTA - Hamfest. Evans Middle School, 4318 Washington Rd. 9am-4pm. VE Exams. Talk-in: W4DV repeater, 145.490-. Terry Brown KE4MHN, 706-796-7635, E-Mail: cricket@gabn.net. Frank Scoggins KS4OC, 706-560-9600, E-Mail: ks4oc@bellsouth.net

GA - BLAIRSVILLE - Hamfest. GA Mountain ARC, Tom Lourigan WA4RBM, 706-745-1282. Web: http://www.stc.net/~jrv/

IN - VINCENNES - Hamfest. Old Post ARS, Doug Herrold KB9ONI, 812-882-4828. E-Mail: dherrold@abcs.com

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WA - BREMERTON - Hamfest. North Kitsap ARC, Susan Johnson AB7MD, 360-697-9379. E-Mail: sujohnso@linknet.kitsap.lib.wa.us Web: http://www.silverlink.net/nkarc

OCTOBER 10-11

FL - TAMPA - Hamfest. 4050 Dana Shores Dr., Unit Bldg. 8:30am-3pm. VE Exams. Talk-in: 147.105. Egypt Shrine Temple ARA, Jay Strom K9BSL, 813-822-9107

TN - MEMPHIS - MemFest '98. 2585 N. Hollywood @ I-240. Sat: 8:30am-4pm, Sun: 8:30-2pm. VE Exams. Talk-in: 146.22/146.82. Greater Memphis Amateur Radio Operators, Lee Bowers KA4KVW, 901-867-3461; Ben Troughton KU4AW, 901-372-8031. E-Mail: lbowers@netten.net

OCTOBER 11

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

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

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

OH - LIMA - Hamfest. Northwest OH ARC, Greg Schwark N8WBD, 419-647-6321

OCTOBER 16-17-18

CA - CONCORD - Hamfest. Pacific Division Convention. Concord Airport Sheraton Hotel. Fri: 8am-7pm, Sat: 6am-7pm, Sun: 6am-12pm. VE Exams. Talk-in: 147.06+. Dick Schulze AA6DL, 510-932-6125. E-Mail: PACIFICON@designlink.com Web: http://www.mdarc.org

OCTOBER 17

AZ - TUCSON - Hamfest. Old Pueblo RC, John Kalmes KC7LIB, 520-296-4182

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

IL - GODFREY - Hamfest. Lewis & Clark RC, Larry Roberts W9MXC, 618-466-0041. E-Mail: helmore@piasanet.com Web: http://www.ezl.com/~lmiller/lcrc.html

MT - BOZEMAN - Hamfest. Gallatin Ham RC, Steve Longacre AB7MV. E-Mail: longacre@montana.campus.mci.net

PA - LEWISBURG - Hamfest. Susquehanna Valley ARC, Bob Stahl WY3M, 717-473-7050. E-Mail: wy3m@amsat.org Web: http://loveland.dynip.com/svarc

PA - PLEASANT HILL - Hamfest. Hanover Area Hamming Assn., Wayne Leister N3MTR, 410-857-0989

TN - GRAY - Hamfest. Kingsport, Bristol, Johnson City RCs. Wendell Messimer K4ZHK, 423-928-4407

OCTOBER 17-18

FL - WEST PALM BEACH - Hamfest. Palm Beach RA, Wayne Cunningham AD4AK, 407-697-4231

OCTOBER 18

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

MI - KALAMAZOO - Hamfest. County Fairgrounds. Talk-in: 147.040 K8KZO repeater. Kalamazoo ARC & S.W. MI AR Team, Gary Hazelton N8GH, 75075 M-40, Lawton, MI 49065. E-Mail: ka8blo@net-link.net Web: http://www.net-link.net/wmat

OH - ASHLAND - Hamfest. County Fairgrounds. 8am-2pm. Talk-in: 147.105. Ashland Area ARC, David Fike N8UCA, 419-289-1082

PA - GREENSBURG - Hamfest. Foothills ARC, Al Compton N3LQX, 724-523-3727. Web: http://www.geocities.com/Heartland/Acres/7896/

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

WA - CHEHALIS - Hamfest. Chehalis Valley ARS, James Kruger KK7AB, 360-748-1930

OCTOBER 23-24-25

OK - KINGSTON - Hamfest. Texoma Hamarama, Herb Sleeper WB5PHM, 940-855-5820. E-Mail: retmarine@cst.net Web: http://www.qsl.net/KC5SIG/HAMARAMA

OCTOBER 24

CANADA - QUEBEC - MONTREAL - Hamfest. Montreal South ARC, Francois Drien VE2FDA, 514-672-9994. E-Mail: ve2fda@amsat.org

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

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

OR - SALEM - Hamfest. Mid-Valley ARES, Tami Burroughs KB7HEK, 503-585-5924. E-Mail: w7lou@goldcom.com Web: http://www.teleport.com/~n7ifj/swaptobe.htm

PA - DANVILLE - Swapmeet & Show. Cloverleaf Barn Antique & Gift Village, 120 McCracken Rd., Rt. 80, Exit 33. Central PA Radio Collectors Club, Frank Hagenbuch, 717-326-0932

SC - SUMTER - Hamfest. Sumter County Exhibition Center, 700 W. Liberty St. 8am-3:30pm. Talk-in: 147.015. VE Exams. Sumter ARA, Steve Heriot KC4ZLB, 803-773-2282 or 803-428-5424. E-Mail: sheriot@ftc-i.net

WA - FERNDALE - Hamfest. Mount Baker ARC, Al Norton K7IEY, 360-354-4622

OCTOBER 24-25

TX - EL PASO - Hamfest. Sat: 8am-5pm, Sun: 8am-2pm. Int'l Hamfiesta Assn. Clay Emert K5TRW, 915-859-5502. E-Mail: cemert@dzn.com Web: http://www.dzn.com/hamfiesta

OCTOBER 25

IN - LEBANON - Boon/Clinton Co. Hamfest. Don Lecklitner K9DFK, 765-249-2020. E-Mail: nella@iquest.net

MD - WESTMINSTER - Mason-Dixon Hamfest & Computer Show. Carroll County Ag Center. Talk-in: CCARC repeater 145.410. VE Exams. Penn-Mar RC & Carroll Co. ARC, George Johns N3JKY, 717-633-6641. E-Mail: gjohns@sun-link.com Web: http://www.qis.net/~k3pzn

MI - WARREN - Hamfest. The Italian American Cultural Society, 28111 Imperial Dr. 8am-2pm. VE Exams. Talk-in: 147.180+ PL 100.00. Chris W8ZNT, 248-541-4623

NY - LINDENHURST - Hamfest. Knights of Columbus, 400 S. Broadway. VE Exams. Talk-in: W2GSB repeater 146.685 -600 136.5 PL. Great South Bay ARC, Peter Portanova WB2OQQ, 516-541-4886. E-Mail: info@gsbarc.org Web: http://www.gsbarc.org

OH - MARION - HamFiesta & Computer Show. Marion County Fairgrounds Coliseum. 8am-3pm. Talk-in: 147.90/30 repeater. Marion ARC, Karen Eckard N8KE, 614-499-3565; Betty Krist N8UDT, 614-387-3533 after 5pm

OCTOBER 31

MN - ST. PAUL - Hamfest & Computer Expo. The new St. Paul Rivercentre (adjacent to the former St. Paul Civic Center). 8am-4pm. VE Exams Fri @ St. Paul Civic Center 6pm. Twin City FM Club, Dale Reak KB0VCV, 612-687-9535

MO - ST. LOUIS - Hamfest. Kirkwood Community Center, 111 S. Geyer. 8am-1:30pm. Talk-in: 146.91 repeater. SLARC & GARA, Dennis McCarthy AA0A, 314-351-3568 or 314-533-0321 xt. 12. E-Mail: mccartdj@slu.edu. Steve Welton 314-638-4959, E-Mail: SLW@surface.com

TN - EAST RIDGE - Hamfest. Camp Jordon. 8am-4:30pm. Talk-in: 146.790- & 444.100+. Chattanooga ARC, Lou Carter KE4DGW, 423-821-4043. E-Mail: LCarter264@aol.com

NOVEMBER 1998

NOVEMBER 1

CA - LIVERMORE - Hamfest. Livermore ARK, Cliff Kibbe KF6EII, 209-835-6715. E-Mail: larkswap@hotmail.com

IA - DES MOINES - Hamfest. Tikva Tracers ARC, Randall Lees N0LMS, 515-279-4241. E-Mail: rclees@raccoon.com

IL - MACOMB - Hamfest. National Guard Armory. 8am-1pm. VE Exams. Talk-in: 147.060/147.660, 444.300/449.300. Lamoine Emergency ARC, Don Johnson KA9SQB, 309-833-4626

Continued on page 51

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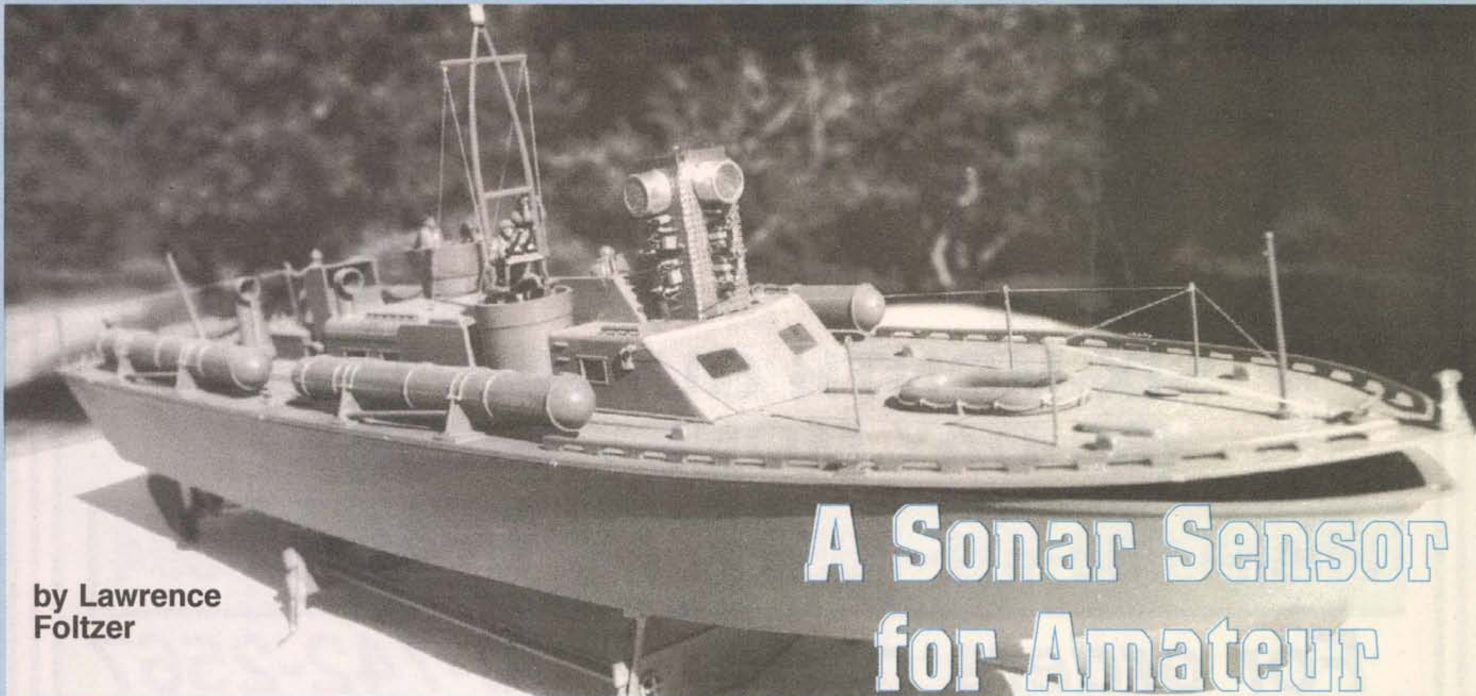


A Sonar Sensor for Amateur Robotic Platforms

by Lawrence Foltzer

Introduction

Two of the things I enjoy doing in my precious spare time are kayaking and building robots, so it was quite natural for me to want to combine the two activities. So, I decided I would build an autonomous boat whose sole purpose in life would be to follow me wherever I paddled, but would not run into me if I stopped to take in the view.

The boat tracks me by homing in on a water-born sonic beacon emanating from my kayak, and to avoid colliding with me or other objects, the boat uses a set of three atmospheric Sonar sensors for obstacle detection.

I initially looked into buying a commercially available Polaroid Sonar sensor, but was discourgaged from that approach because of some of that device's characteristics; most noteable being its high voltage and power requirements, larger size, and cost. I felt I could do better!

So, armed with a handful of Microchip PIC processors to be used as programmable signal sources, I began investigating transducers ranging from small surplus PC speaker elements, piezoelectric ceramic discs, and ultrasonic transducers used in remote control applications.

The first two categories of devices worked surprisingly well, but had resonances in the audio frequency band, a few Kilohertz typically, and fairly high mechanical Qs. These characteristics meant that the transducer would "ring" long after excitiation was removed, causing receiver overload, creating a "dead-zone" proportional to Q/Fo, wherein near-field echoes would be impossible to detect.

There are basically two ways of reducing the dead-zone. One is to reduce transducer Q, the other is to increase the operating frequency. Reducing the mechanical Q of a transducer can be accomplished by loading the element.

However, this is a bad thing to do since it spoils the overall sensitivity of the transducer in both transmit and receive mode. The only load the transducer should have is the medium it drives. This leaves but one degree of freedom ... that of high-frequency operation. So, I turned my attention exclusively toward the 40-KHz ultrasonic sensors I found at reasonable cost in the Mouser Electronics catalog.

As it turned out, the Q of these ultrasonic transducers actually turned out to be somewhat higher than the Qs of the other low-frequency transducers I investigated, but Q/Fo (the ring-down time) was about half that of the other transducer elements I had examined. And, as it also turns out, the high Q of these transducers also translates to higher transmit and receive sensitivity, while providing excellent rejection of out-of-band frequencies.

As indicated earlier, one of the things that turned me away from commercially available sensors was their high-power requirements. So, I initially expected that I would need some sort of power amplifier to generate sufficient drive for the transducer to meet my range requirements. But not knowing exactly what was required, I continued my investigations of the transducer, driving it directly from a PIC microprocessor port that I could put in the high-Z state after transmission to unload it for echo detection.

Much to my total astonishment, I discovered I could detect echoes off walls 50 feet away, and relatively small objects at distances from a few feet, to 20 feet away. I was on the right track!

During the next phase of development, I added time dependent gain (TDG) to the receiver to flatten the receiver's echo amplitude from a "standard target," more or less independent of target range. And to prevent the receiver from going into hard saturation from the transmit pulse which also contributes to receiver recovery time, I added a resistor, diode combination (half a BAV70) at the receive front-end to limit/attenuate the signal level during the transmission sequence. This feature reduced the dead-zone from about three milliseconds to roughly one millisecond.

Other features of the sensor include:

- All surface mount construc-

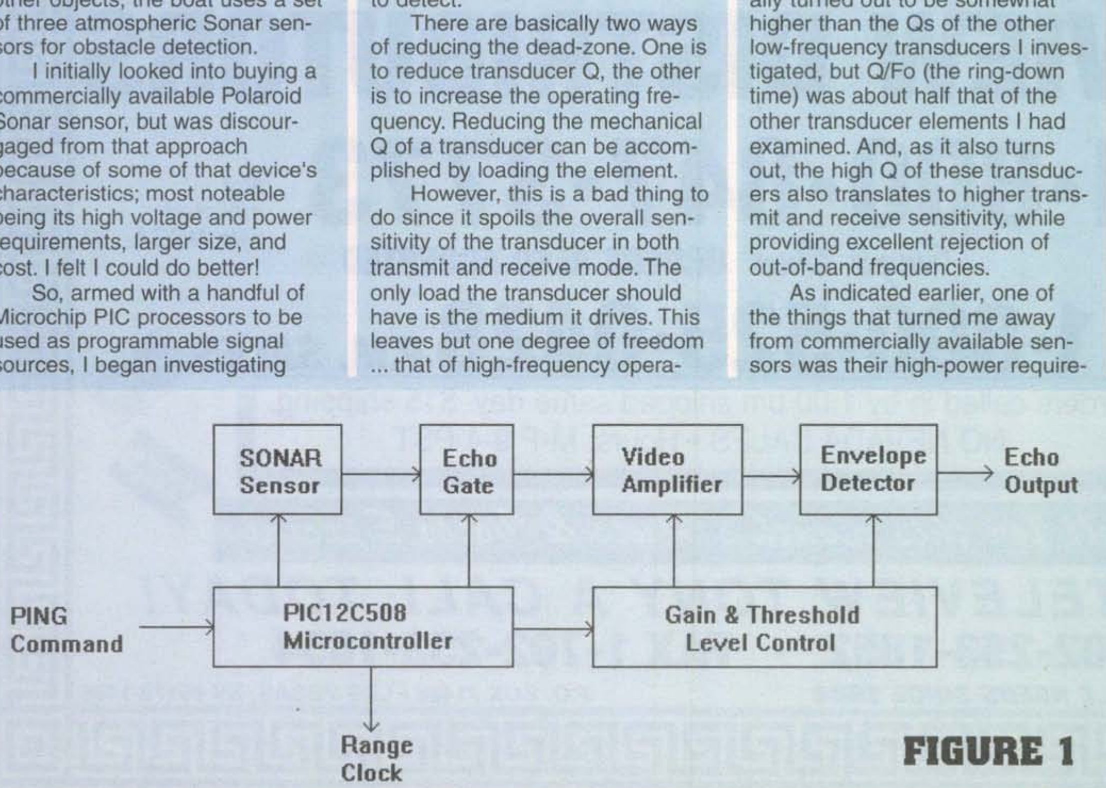


FIGURE 1

tion (less transducer and crystal).

• 1.5" by 3.3" single-PCB construction.

• 9 to 12 volt operation @ 30 milliamperes.

Receiver stays active after ping sequence (until PING command goes low). This allows multiple sensors to act as echo detectors for accurate bearing determination using the method of triangulation.

Circuit Operation

A block diagram of the sensor is shown in Figure 1. Soundings are initiated by a "ping command" issued by the host processor. The sensor is then driven directly by the PIC processor with a 0.5 millisecond long, 40-KHz pulse train.

During the transmit sequence, the sensor's microprocessor mutes the receiver to reduce large signal recovery time ... then gates the received signal to the receiver, starts the time-dependent gain control ramp, and outputs an echo timing clock (2220 Hz) lasting 50 mS.

The 2217-Hz clock period is equivalent to the round-trip propagation time — in air — corresponding to a target distance of six inches. Echo range resolution can be reduced to three inches by observing both edges of the range clock. (Sound travels one inch in air in about 75 microseconds.)

The schematic for the Sonar sensor is shown in Figure 2. The 4.433-MHz crystal is used to generate a symmetrical squarewave near the 40-KHz resonant response peak of the transducer. During the sounding, the RX Mute line is held low causing D1 to clamp the input to the receiver, minimizing overload, receiver recovery time, and short range detection distance.

After initiating a sounding (PING), the driver port is placed in a high-impedance state, unloading the transducer in preparation to receive returning echoes. After a millisecond, the RX Mute line is raised, opening the receiver gate and, at the same time, starting the TDG voltage ramp.

The receiver consists of a two-stage amplifier (Q1 & Q2), with DC feedback used to stabilize collector voltage. As the TDG voltage is increased, collector current and gain increase also. Q3 is a high sensitivity active detector of a type called an infinite impedance detector.

This transistor is biased very near cut-off so that input signals cause a downward modulation of the collector voltage (DC operating point) rectifying the signal. The long time constant of Q3's collector load removes the 40-KHz component of the signal, leaving the echo envelope for subsequent processing.

Figure 3 shows the output of the detector for two values of the detector integrating capacitor, Ci. Note the improved signal-to-noise ratio of the top trace, and the better temporal resolution of the lower trace. You can get the best of both worlds by capturing and averaging several of the high speed traces, but at the expense of effective echo sampling interval. This is no free lunch!

The above traces were captured using a Tektronix TDS 220 oscilloscope as binary files and converted to bit mapped images using a QBASIC program. MS Paint was then used for editing and inclusion in this document.

The output of the detector circuit (Q3) is then turned into a digital representation by the LM311 comparator. The TDG voltage is used here to shift the zero crossing (detection level) point for enhanced sensitivity for more distant targets. The signal slicing level — overlayed on Figure 3 — starts roughly at the mid-amplitude point, and tapers upward toward the 75% amplitude level.

The threshold detected signal, the echo timing clock, and the ping command line make up

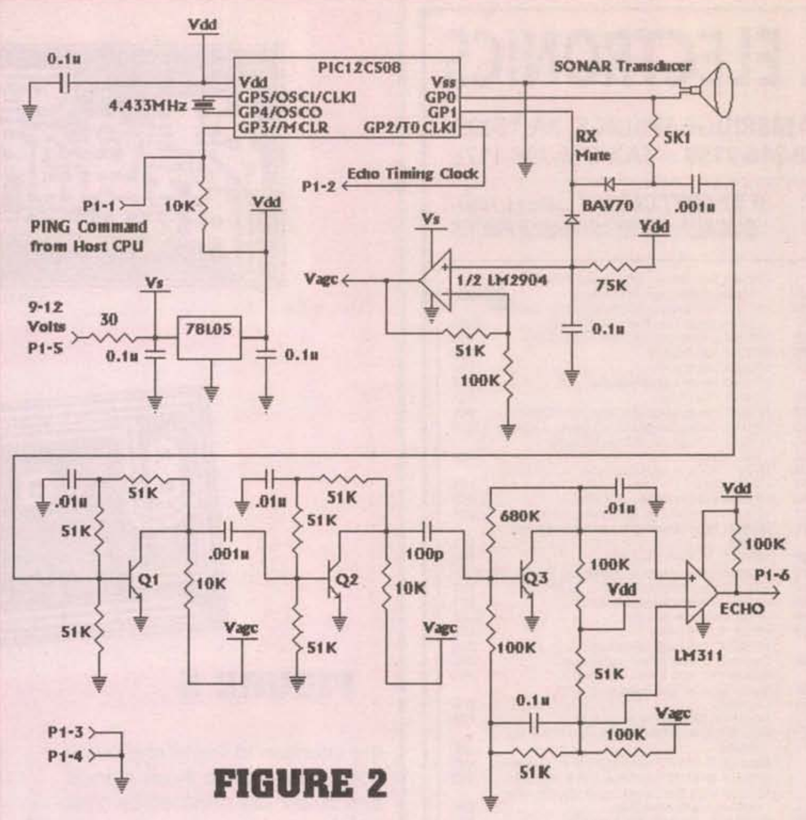


FIGURE 2

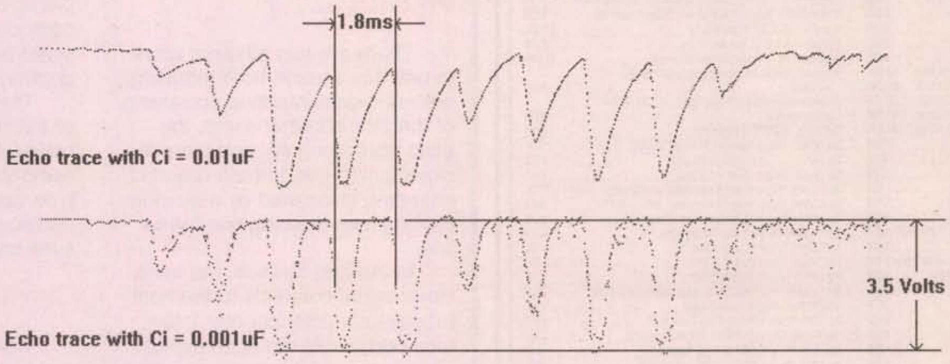


FIGURE 3

Echogram of ten objects spaced at 1 foot intervals.
First object placed 1 foot from sensor.
First six objects are 1.7" diameter cylinders, 1.7" tall.
Last four objects are 1.7" cubes.
Objects sitting on carpeted floor, < 8" from center of beam axis.
SONAR sensor head was 3.5" above floor.

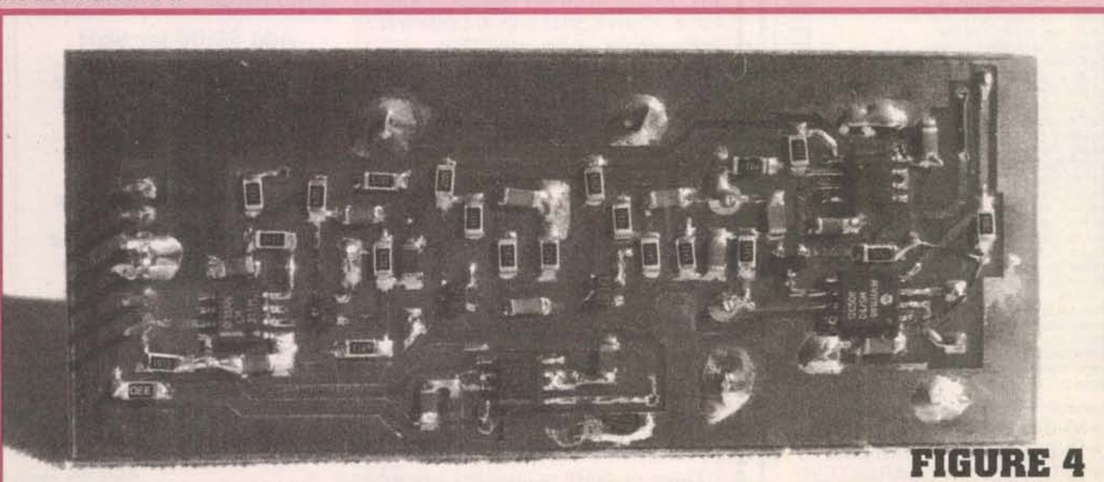
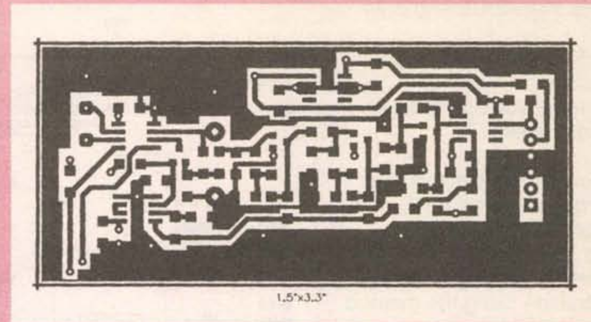


FIGURE 4



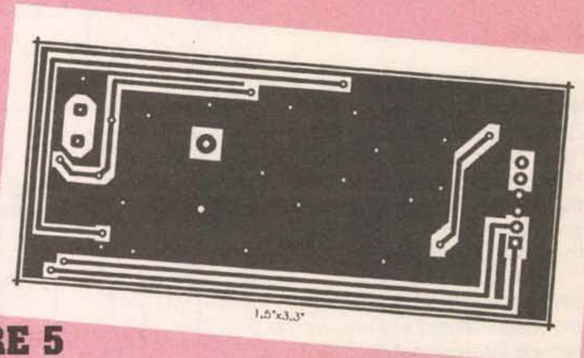


FIGURE 5

the interface to the host processor. Connection to these signals and power are provided by header P1.

Interface to the Host Processor

There are two different ways to use this sensor, both requiring a three-signal interface consisting of the ping command line, the echo detection line, and the echo clock timing line. In both cases, a sounding is initiated by asserting (pulling low) the ping command line.

In the first method, the echo clock signal connects to the host processor's timer/counter interface port, while the echo signal goes to one of the hosts interrupt lines. Target range is determined by reading the counter after receiving the echo signal interrupt.

In the second method, the host processor's interrupt line is driven by the echo clock, causing the host to examine the echo line for a return signal and to update a software range counter. This arrangement is suitable for hosts that do not have an available hardware counter port.

Implementation

Figure 4 is a photograph of the prototype sensor, showing the component side of the board. In the prototype, only the component side of the board was etched, the other side forming a continous ground plane, and wires used in place of vias to the circuit to the plane. One-to-one artwork for the component side of the double-sided sensor circuit board is shown in Figure 5.

The traces on the back side of the PCB (not shown) are for power distribution only. All of the components are surface-mount type, with the exception of the ultrasonic sensor and the processor's crystal.

Conclusion

The boat isn't quite finished yet. I still have some work to do to increase the sensitivity of my home-made in-hull beacon sensor. But, with a little luck, I'll have a reliable boating companion before the summer is out. **NV**

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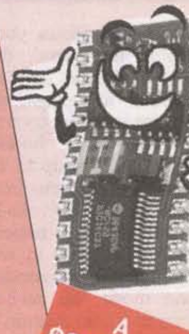

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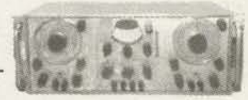

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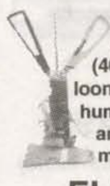

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27C256-15	2.99	2.84	2.56
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7414	.27	.26	.23
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7474	.33	.31	.28

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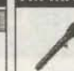

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BUILD THIS STEPPER MOTOR CONTROLLER

by
David
Williams

This project allows you to control the speed, direction, and step size of a unipolar four-phase stepper motor. The controller is capable of handling motor winding currents of up to 1.25 amps per phase and it operates from a single supply voltage of 6-30 volts DC.

A unique feature of this project is that the circuit can operate in either remote mode or stand-alone mode. In the stand-alone mode, an on-board pulse generator and a four-position DIP switch allows you to demonstrate all of the functions without any additional connections. This mode is perfect for demonstrating basic stepper motor control principles. The circuit even has LEDs that show the energized phases for each step.

In remote mode, all motor functions can be interfaced to external logic or a microcontroller. This allows the controller to be incorporated into a robot, an X-Y plotter, or any motion control project you have in mind!

If you're interested in robotics, motion control, or just want to learn about stepper motors, then you should try building this versatile stepper motor controller.

CIRCUIT DESCRIPTION

Refer to the schematic of the stepper driver shown in Figure 1. Power is supplied by a DC wall transformer or DC power supply at P1.

The voltage can be anything from 6 to 30 volts, depending upon the rating of the stepper motor. The stepper motor uses most of the current in this circuit, so it is powered directly from the transformer output through resistors R1 & R2.

These resistors limit the current to the motor and allow the motor to be operated with a power supply voltage greater than the voltage rating of the motor for improved performance.

Stable voltage for the rest of the circuit is obtained by regulating the input voltage down to 5V with U4, a LM78L05 voltage regulator IC. Capacitors C7, C1, and C5 provide additional voltage filtering. U1 is capable of supplying up to 100 mA of current.

The heart of the stepper controller is U1, a UCN5804B stepper-motor translator/driver IC. It contains a CMOS logic section for the sequencing logic and a high-voltage bipolar output section to directly drive a unipolar stepper motor. U1 can generate waveforms for three different sequence modes: (1) FULL-STEP with two phases energized, (2) FULL-STEP WAVE and (3) HALF-STEP. The waveforms for these three sequence modes are shown in Figure 5.

Diodes D1-4 are clamps to prevent damage to U1 if the outputs swing below ground when driving the inductive load of the motor.

Each of the LEDs L1-4 light when the corresponding output goes LOW and are useful for observing the output waveforms. Resistor R3 provides current limiting to the LEDs.

Pins 9, 10, 14, and 15 of U1 are control inputs for phase, half-step, direction, and output-enable. These signals are pulled-down to a logic LOW level by resistors R7-11.

The control signals go to both con-

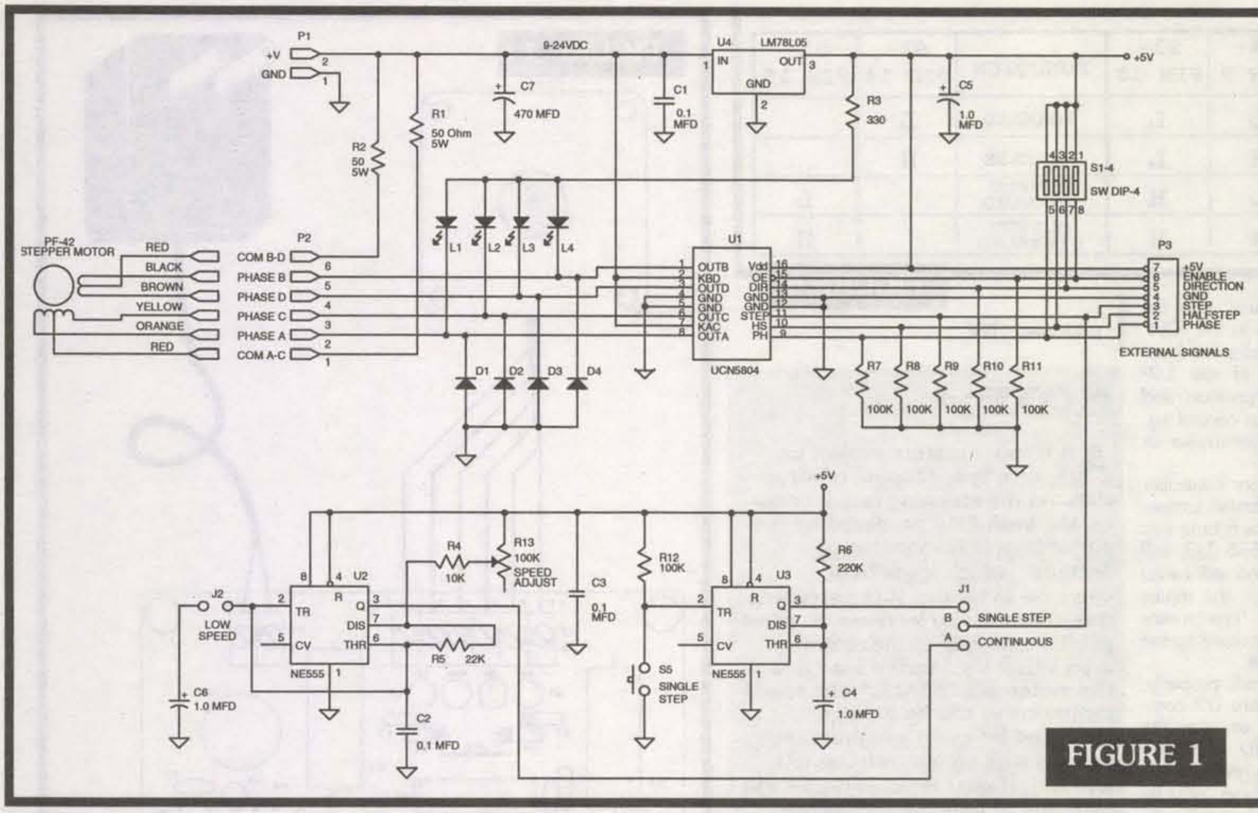


FIGURE 1

nector P3 and the four-position DIP switch (S1-4). Switches 1-4 allow for manual control of each function, or alternatively, connector P3 allows the functions to be controlled by external logic or a microcontroller chip.

The UCN5804B requires an external pulse input on pin 11 to advance the stepper motor. This signal can be supplied by external logic via connector P3 or can be provided by U2 or U3. U2 and U3 are LM555N timer ICs and are used to provide single-step or continuous pulses to U1.

U2 is configured as an astable oscillator that delivers continuous pulses. The pulse rate is controlled by potentiometer R13 and capacitor C2. Jumper J2 connects C6 in parallel with C2 to give a LOW SPEED range. U3 is configured in a monostable mode to produce a single pulse when S5 is pressed. Jumper J1 selects between the single-step or continuous mode.

ASSEMBLY INSTRUCTIONS

The easiest way to build the stepper motor controller is to use an etched circuit board as shown in Figure 2. If you don't want to fabricate your own board, a pre-etched and drilled board can be purchased from the source shown in the parts list.

Locate all the components shown in the parts list and use Figure 3 to determine component placement on the PC board. Begin by using three pieces of solid wire for J1, J2, and J3. Next install and solder the four diodes in place, noting their polarity. Then move on to the resistors and ceramic capacitors.

When installing the 5-watt resistors R1 and R2, leave a small space between the resistors and the PC board to allow for air circulation. Be sure to observe proper polarities when installing the electrolytic and tantalum capacitors and the voltage regulator. Note that it may be necessary to bend the leads of the U4 to fit the PC board.

Now solder IC sockets for U1, U2, and U3 to the board. If you use the switch specified in the parts list for S5, it can be soldered directly on the printed circuit board. Then install the four LEDs as shown in Figure 3.

It is recommended that you use screw-terminal connectors for P1 and P2. Potentiometer R13 can be either PC mount style or panel mount style. To use a panel mount potentiometer, cut three pieces of stranded wire to connect R3 to the PC board. If you plan to use the controller in standalone mode, solder a four-position DIP witch for S1-4. You may omit the DIP switch if you plan to use the P3 connector for remote interfacing.

Next, locate the UCN5804B integrated circuit (U1). Since U1 is a CMOS device, it can be easily damaged by static electricity. Take proper anti-static precautions when handling the chip. Refer again to Figure 3 before installing U1 to make sure of the proper orientation of pin 1, then press the IC firmly into the 16-pin socket. Repeat the procedure with ICs U2 and U3.

FINAL ASSEMBLY

Before continuing, clean the foil side of the PC board with alcohol or flux remover. Then refer to Figure 4 for details on connecting the stepper motor and DC power supply. Note that the wire colors for the stepper motor shown in Figure 4 apply only to the PF-42 motor that is included in the purchased kit. If you use a different motor, you will need to determine the appropriate wire connections to P2. Also note that the circuit is designed to drive six-wire UNIPOLAR motors only. Next, attach the wires from the DC power source to the PC board, observing the polarity show in Figure 4.

OPERATION

To run the stepper controller using the on-board oscillator, install jumper J1 in the "A" position and leave J2 open.

On the four-position DIP switch, set S1, S2, S3, and S4 all to the "OFF" position. Switch the DC power source ON and the stepper motor should start to turn. The speed can be regulated with potentiometer R13. Installing jumper J2 will switch to a low-speed range. If you try to drive a stepper motor too fast or with too large of a load, it can stall (see the note listed at the end of the article).

With the motor turning properly, you can switch S2, S3, and S4 to change the direction, step size, or phasing (see Figure 6). Note that S1 is

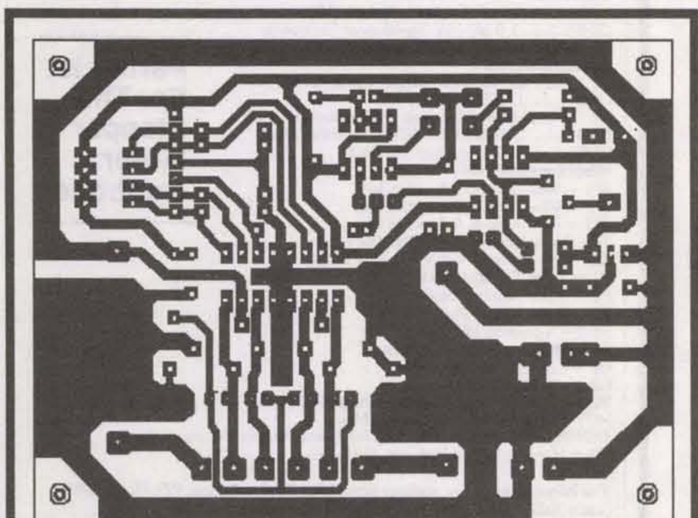


FIGURE 2

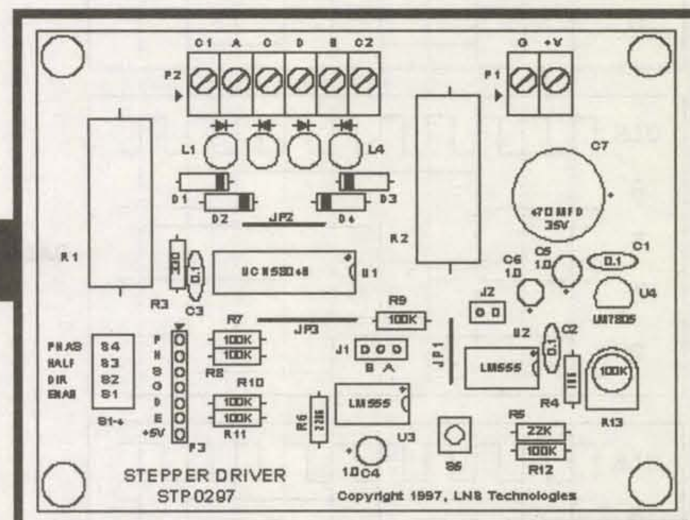


FIGURE 3

FUNCTION	S4-PIN 9	S3-PIN 10	FUNCTION	S2-PIN 14	S1-PIN 15
FULL-STEP 2-PHASE	L	L	FORWARD	L	
FULL-STEP WAVE DRIVE	H	L	REVERSE	H	
HALF-STEP	L	H	OUTPUT ENABLED		L
STEP INHIBIT	H	H	OUTPUT DISABLED		H

FIGURE 6

the output enable and will stop the motor when the switch is in the "ON" position. To control the stepper functions remotely, set all of the DIP switches to the "OFF" position and then use P3 to connect the control signals to an external microcontroller or toggle switches.

To operate the stepper controller in the single-step mode, install jumper J1 in the "B" position. Each time you press switch S5, the LN555 (U3) will produce a single pulse and will cause the UCN5804 to advance the motor one sequence position. The motor sequence will still be determined by the settings of S2, S3, and S4.

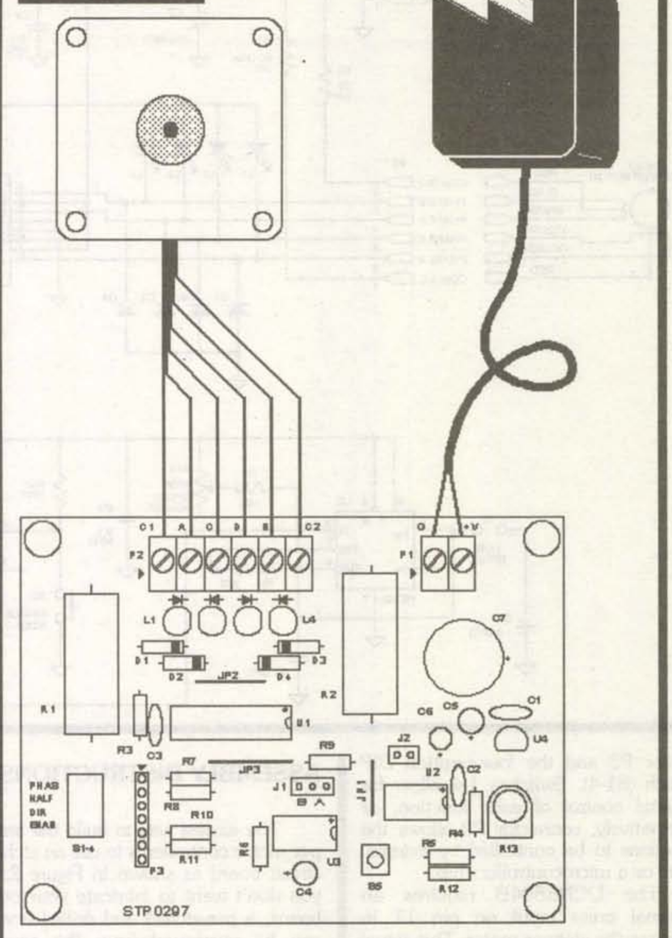
For single-step to work properly, you must release S5 before U3 completes its output pulse or else the LM555 will automatically re-trigger. The single-step mode is a great educational tool because you can actually observe the various step sequences in the LEDs (L1-4).

This controller is a robot builder's dream come true! The kit also makes a great educational project for demonstrating basic stepper motor control principles. **NV**

NOTE:

All stepper motors exhibit an inverse speed-torque relationship. As the stepping rate increases, the back EMF produced by the motor causes the current to decrease, which leads to a decrease in torque. If the stepping rate continues to increase, at some point the torque of the motor will drop below the inertial load and the motor will "STALL." The speed-torque curve can be greatly improved by using a higher input voltage with series resistors (R1 and R2). Higher input voltages will continue to improve the performance until practical power dissipation limits are reached or the voltage/current ratings of the UCN5804B are exceeded.

FIGURE 4



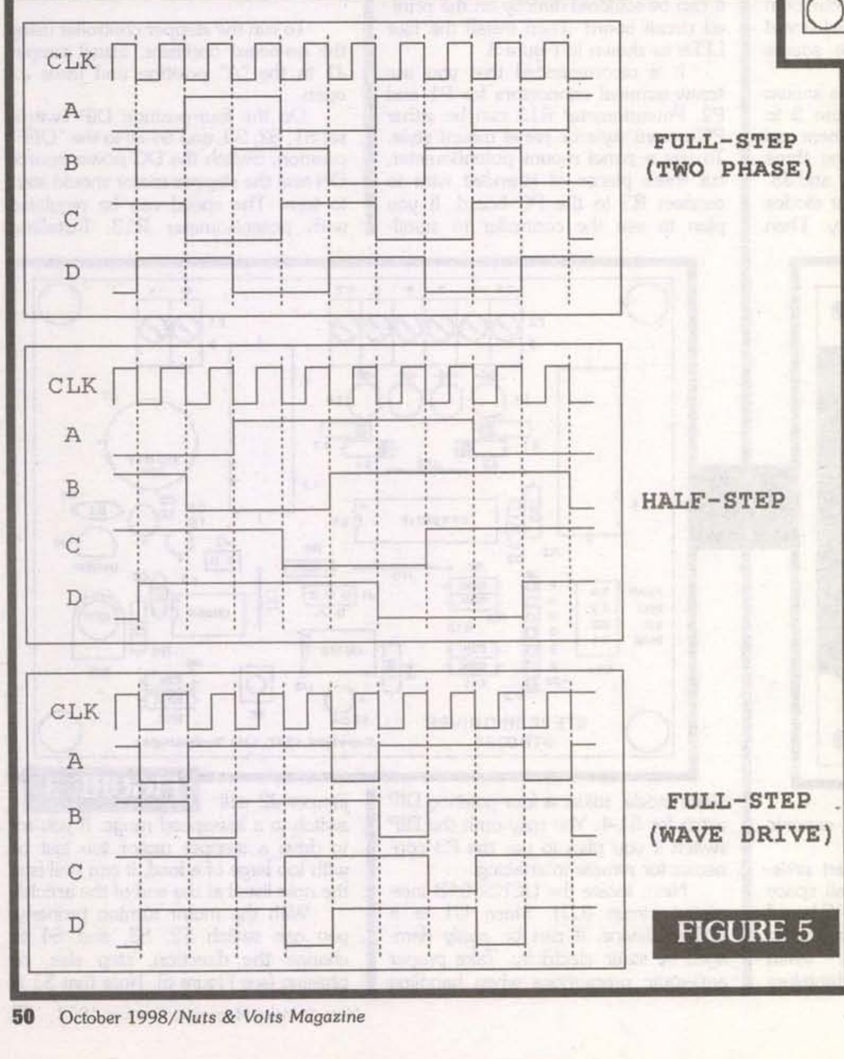


FIGURE 5

Parts List For The Stepper Motor Controller

Resistors (Except where noted, resistors are 5%, 1/4 Watt)
R1,2 ...... 50 Ohm, 5 Watt
R3 .... 330 Ohm (Orange, Orange, Brown, Gold)
R4 .... 10 K Ohm (Brown, Black, Orange, Gold)
R5 .... 22 K Ohm (Red, Red, Orange, Gold)
R6 .... 220 K Ohm (Red, Red, Yellow, Gold)
R7-12 ..... 100 K Ohm (Brown, Black, Yellow, Gold)
R13 .... 100 K Ohm Potentiometer

Capacitors
C1-3 .... 0.1 uF, Ceramic, marked: [104]
C4-6 .... 1.0 uF, 16V Tantalum or Electrolytic
C7 .... 470 uF, 35V Electrolytic

Semiconductors
U1 .... UCN5804B, Stepper Controller IC
U2,3 .... LM555N, Timer IC
U4 .... LM78L05, 5 Volt DC Regulator (TO-92)
D1-4......... 1N4001 (or 1N4004), Rectifier Diode
L1-4......... RED Light Emitting Diode

Miscellaneous Items
JP1 — Wire Jumper, 0.4 inches long
JP2 — Wire Jumper, 0.5 inches long
JP3 — Wire Jumper, 0.6 inches long
J1 — 3-pin Jumper Post & Shorting Blocks
J2 — 2-pin Jumper Post & Shorting Blocks
P1 — 2-pos Terminal Block
P2 — 6-pos Terminal Block
P3 — 7-pin Jumper Post
S1-4 — 4-position DIP Switch
S5 — Miniature Pushbutton Switch
U1 — 16-Pin IC Socket
U2,3 — 8-Pin IC Socket
PCB — Etched Printed Circuit Board (STP0297)
MOT — Unipolar (6-wire) Stepper Motor
TXFMR — 12-14V DC, 500mA Wall Transformer or DC power supply
Misc: Hook-up Wire, Hardware, Solder, Etc.

The following items are available from: **LNS Technologies,** P.O. Box 67243, Scotts Valley, CA 95067, Phone: **(831) 768-9155.**

STEPPER-KIT: Complete kit of parts for the Stepper Motor Controller including etched and drilled printed circuit board, stepper motor, DC wall transformer, ICs, and all other components listed above $39.00. UCN5804B: Stepper Motor Driver IC (U1) $5.00. STEPPER-PCB: PC Board for Stepper Controller Kit $10.00.

Please add $5.00 Shipping/Handling. California residents add 8% sales tax. MC/VISA orders accepted. No COD orders.

The UCN5804B IC is also available from:
Alltronics, 2300 Zanker Rd., San Jose, CA 95131, **(408) 934-9773.**
931002: Stepper Motor Driver IC $4.50.

 Continued from page 42

OH - MASSILLON - Hamfest. Stark County Fairgrounds, 305 Wertz Ave. N.W. Talk-in: 147.18+ repeater. MARC, Don Wade W8DEA, 330-497-7232; Terry Russ, 330-837-3091 before 10pm. E-Mail: MARC.HAMCLUB@JUNO.COM

NOVEMBER 7

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

FL - SORRENTO - Hamfest. Lake ARA, Chuck Crittendon KA4EXM, 352-669-2075

KY - HAZARD - Swapfest. Hazard High School, south end of Rt. 15, Hazard Bypass. 8am-2pm. VEC Exams. Talk-in: 146.07/.67. KY Mountains ARC, John Farler K4AVX, 606-436-5354. E-Mail: jfarler@mis.net Web: http://www.geo cities.com/SiliconValley/2564/kmarc.html

NH - LONDONDERRY - Ham Radio Flea Market. Lions Club, Mammoth Rd. (Rt. 128). 8am-1pm. The Interstate Repeater Society ARC, Paul Gifford, 603-432-1538. E-Mail: k1llx@juno.com

NM - SOCORRO - Hamfest. SARA, TARA, & City of Socorro, Al Braun AC5BX, 505-835-3456 days or 505-835-1061 eves. E-Mail: AC5BX@juno.com Web: http://www.ees.nmt.edu/

OK - ENID - Hamfest. Garfield County Fairgrounds, Hoover Bldg., Oxford & 4th Sts. 8am-5pm. VE Exams. Talk-in: 147.15+ 444.400+. Tom Worth N5LWT, 580-233-8473, E-Mail: N5LWT@HOTMAIL.COM. Fred Selfridge N5QJX, 580-242-3551, E-Mail: FREDNNEL@IONET.NET

SC - MYRTLE BEACH - Beachfest '98. Myrtle Beach High School, 38th Ave. N. VE Exams. Talk-in: 147.12. GSARC, Jim Wood KF4CJE, 843-238-0800. E-Mail: kf4cje@juno.com Web: www.w4gs.org, http://www.qsl.net/kf4hav/hamfest.htm

WI - WAUKESHA - Hamfest. Milwaukee Repeater Club, Mike KB9PHA, 414-258-4435. Web: http://execpc.com/~mrc/friendlyfest.htm

NOVEMBER 7-8

GA - LAWRENCEVILLE - Hamfest. Gwinnett County Fairgrounds. Sat: 9am-5pm, Sun: 9am-3pm. VE Exams. Talk-in: 145.45, PL 107.2 if necessary. Alford Memorial RC, Randy Bassett KR4NQ, 770-410-3989. E-Mail: Hamfest@totr.radio.org

TX - ODESSA - Hamfest. Ector County Coliseum, Exhibit Bldg. D., 42nd & Andrews Hwy. Sat: 8am-5pm, Sun: 9am-1pm. VE Exams. Talk-in: 145.470. West TX ARC, Robert Jordan N5RKN, 915-335-7980. E-Mail: n5rkn@apex2000.net Web: http://www.apex2000.net/personal/wd5cwj/main2.htm

NOVEMBER 8

WI - KAUKAUNA - Hamfest. Starlite Club, Corners of Hwy. 55 & CR JJ. VE Exams. Talk-in: 146.52 simplex. Fox Cities ARC, Chad Pennings N9PRC, 920-993-0485. Web: http://www.w9zl.ampr.org

NOVEMBER 14

AL - MONTGOMERY - Hamfest & Computer Show. Garrett Coliseum, S. AL State Fairgrounds. 9am-3pm. Phil 334-272-7980 after 5pm CST. E-Mail: wb4ozn@worldnet.att.net E-Mail: kf4ilp.arthur@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

FL - PORT ST. LUCIE - Hamfest. Port St. Lucie ARA, Paul Harrison KI4MG, 561-878-2475. E-Mail: julian@ecqual.net

FL - TITUSVILLE - Hamfest. Titusville ARC, Bud Hughes K4CWG, 407-267-3450. E-Mail: bud@expedient.com

LA - WEST MONROE - Hamfest. Twin City Ham Club, Mark Ketchell N5MYH, 318-323-6621. E-Mail: TCHC@iAmerica.net Web: http://cust.iamerica.net/TCHC

NOVEMBER 14-15

IN - FT. WAYNE - Hamfest & Computer Expo. Allen County War Memorial Coliseum Expo Center. Sat: 9am-4pm, Sun: 9am-3pm. VE Exams. Talk-in: 146.88(-). Doug Jones N9NNT, 219-484-3317. E-Mail: djones2233@aol.com Web: http://www.pipeline.com/~dagagnon/

NOVEMBER 15

NC - BENSON - Jarsfest. American Legion Complex, Hwy. 301, N. 8am-4pm. Talk-in: 147.270 + 600. VE Exams. Johnston ARS, Paul Dunn KD4BJD, 919-894-3100 Web: http://www.jars.net

NOVEMBER 18

FL - ST. PETERSBURG - Hamfest. Pelican Chapter #128 QCWA, Jay Strom K9BSL, 813-822-9107

NOVEMBER 20-21

MS - OCEAN SPRINGS - Hamfest/Swapfest. Latimer Community Center, N. of I-10, Exit 50. Fri: 5-9pm, Sat: 8am-2pm. Talk-in: 145.110 N5OS (-600). West Jackson County ARC, Phil Hunsberger W9NZ, 228-872-1499; Harry McLemore KD4AK, 228-872-0732

NOVEMBER 21

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

IL - LITCHFIELD - Hamfest. Central IL/St. Louis Area ATV Club, Scott Millick K9SM, 217-532-3837

NOVEMBER 21-22

FL - TAMPA - Suncoast Amateur Radio & Computer Convention. State Fairgrounds, Expo Hall. Ed Pellenz N4HRN, 813-685-7115 or 813-272-7021 xt. 3320. E-Mail: epellenz@cftnet.com

NOVEMBER 22

IL - WHEATON - Radio Fest, Electronics Flea Market. DuPage County Fairgrounds, Manchester Rd. GMRS of Illinois, Inc., 815-756-3933 or 630-393-3937

NOVEMBER 28

IN - EVANSVILLE - Winter Hamfest. Vanderburgh County Fairgrounds, Exposition Center. 8am-2pm. 145.150- Evansville, 146.925- & 443.925+ Vincennes. EARS, Neil WB9VPG 812-479-5741. E-Mail: EARSHAM@aol.com Web: http://members.aol.com/earsam/

NOVEMBER 29

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

DECEMBER 1998

DECEMBER 5

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

GA - CLAXTON - Hamfest. Veterans Community Center, Hwy. 280 W. VE Exams. Talk-in: 147.075+. Claxton AR Emergency Service, Mr. Ellie Waters WB4CJB, 912-653-4939. E-Mail: ellie@premierweb.net. Wes Kennedy KU4SR, 912-739-2047, E-Mail: ku4sr@mci2000.com

LA - MINDEN - Christmas Hamfest. Civic Center, 520 Broadway. 8:30am-3pm. VEC Exams. MARA repeater 147.300+. MARA, Inc., Dusty Collins KB5WFE, 318-371-0636. E-Mail: dustyc@prysm.net Web: http://www.norwesla.com/mara.htm

NC - GREENSBORO - Hamfest. Coliseum Special Events Center. 9am-3pm. 76 Group, 336-851-1676. http://www.sabwc.com/gsohamfest

DECEMBER 6

CA - LIVERMORE - Hamfest. Livermore ARK, Cliff Kibbe KF6EII, 209-835-6715. E-Mail: larkswap@hotmail.com

DECEMBER 12

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

FL - LAKE CITY - Hamfest & Computer Show. Columbia County Fairgrounds, SR 247, Gateway to FL #4. Columbia ARS, 904-935-2405 6-10pm, 904-755-7969 9am-4pm. E-Mail: wd4eoj@isgroup.net or wa5rkr@isgroup.net

DECEMBER 19

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

JANUARY 1999

JANUARY 9

SC - GREENWOOD - Hamfest & Computer Show. Greenwood Civic Center, 1610 Hwy. 72 E. 9am-5pm. FCC exams. Talk-in: 147.165+ (open) alternate: 146.52 simplex. Greenwood ARS, Frank Kolar WA9FWO, 864-229-5639

JANUARY 23

NC - WINSTON-SALEM - FirstFest. Dixie Classic Fairgrounds, Home & Garden Bldg. Forsyth ARC, Inc., 336-723-7388. Web: http://www.rbdc.com/~kq4lo/farc.htm

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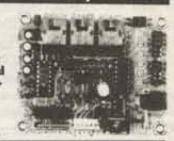

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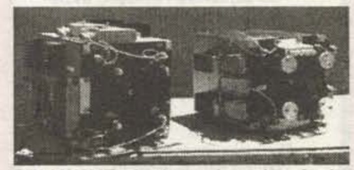

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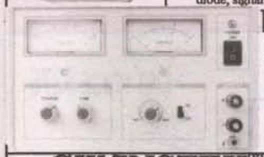

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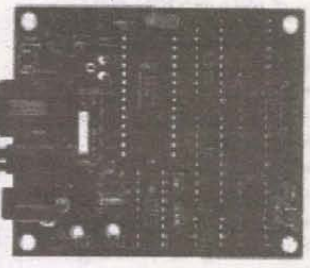

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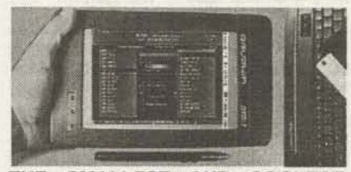

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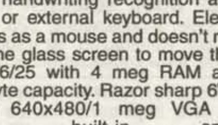

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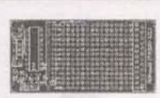

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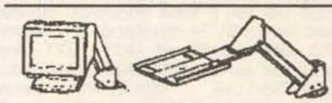

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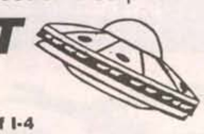

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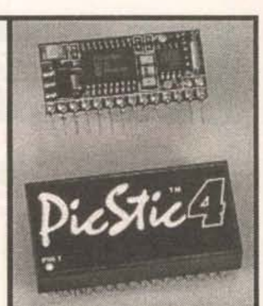

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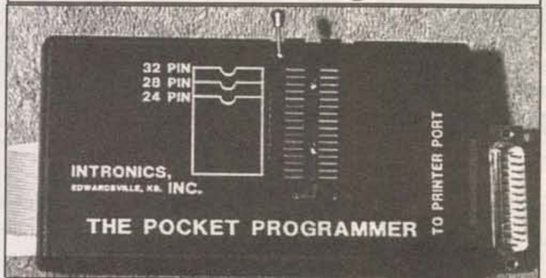

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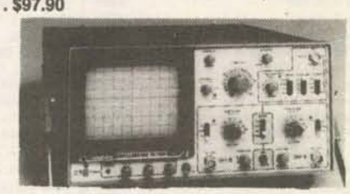

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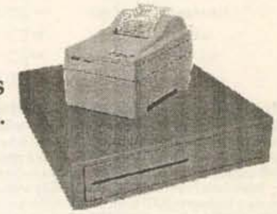

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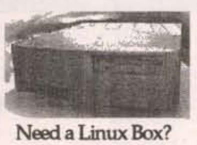

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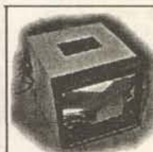

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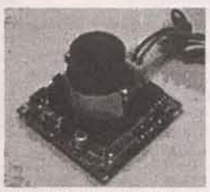

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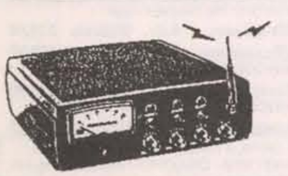

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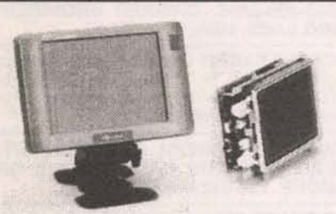

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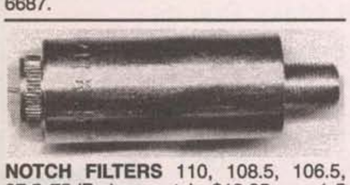

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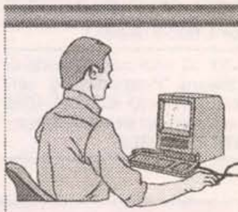

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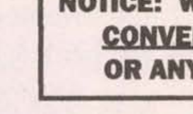

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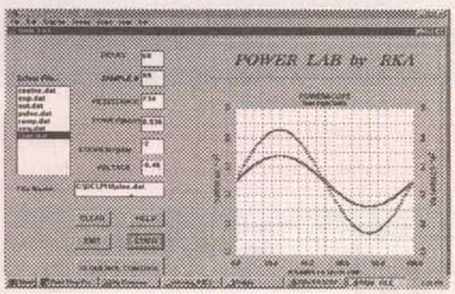

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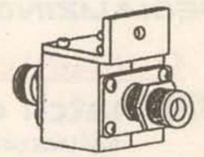

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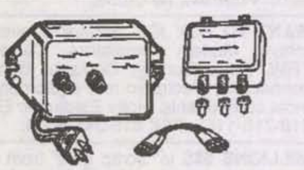

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DCA: *Range:* 25mA, 250mA; *Accuracy:* ±4% full scale; *Protection:* 0.5A/250V fuse.
Resistance: *Range:* **500kΩ (x 1k)**; ±5%.
dB Test: +4 to +56 dB on ACV range; *Accuracy:* ±5% of full scale.
Battery Test: 1.5V and 9V.
Max. Input: 500VDC/AC, or 250mADC.

AUTO. CAPACITANCE METER

CM3300A $139.00 10 ranges, 99.9pF ~ 99.9mF, fully automatic. *Resolution:* 0.1pF lowest, 0.1% full scale.
Accuracy:
0.5% of full scale ±1 digit to 99.9µF,
1% of full scale ±1 digit to 99.9µF.
Display: 3 digit LED.
Unit: pF, nF, µF, mF, Overflow indicator.

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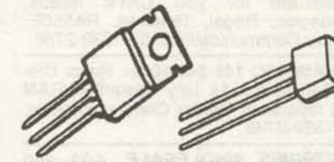
DM-3104A $799.95
DISTORTION MEASURE
Range: 0.01% to 30%, 0.1/0.3/1/3/10/30% 6 ranges.
Freq: 400Hz±10%, 1kHz±10%(HPF).
Input: 3mV~100V; Ratio meas. 20dB.
Auto. Freq. Switching Ranges:
Fundamental Freq. = (fo)±10%;
Fund. Rejection: >-80dB at (fo)±5%; >-70dB at (fo)±10%.
Harmonic Accuracy: ±0.5dB, 1.8(fo)-20KHz.
LEVEL MEASURE *Range:* 0~100V; .03/.1/.3/1/3/10/30/100V;
Freq Response: ±0.5dB/20~50kHz; ±1dB/20~100kHz.
DM-3204 $1,599.00 dual channels; Spec see DM-3104A.

IC PULLOUTS, other components, sold cheap. Buying unused connectors, especially coaxial and "round plugs." www.ncci.net/millermetal

AMAZING! 15¢ ALL ICs. CD4001B, CD4011B, CD4013B, CD4017B, CD4028B, CD4050B, CD4066B, CD4069B, LM324, LM339, LM358, LM393, LM555, LM741, MC1488, MC1489, 74LS174, 74LS244, 74LS245, 74LS374. Brand new parts. 100pcs./package. Add $6 freight. Gateway Products Corporation, PO Box 936397, Margate, FL 33093, 954-974-6864. Fax 954-974-6818. VISA/MC, no CODs.

OLD ICs & TRANSISTORS WANTED: HIGHEST PRICES PAID please FAX your list with part number, quantity & condition of **any semiconductors** to Rick @ ESI, 5363 Broadway Ave., Cleveland, OH 44127. 216-441-8500 FAX 216-441-8503. Since 1946! www.electronicsurplus.com



AMAZING! 10¢ ALL REGUALTORS. All TO92 package: 78L05, 79L05, 78L12, TO220 package for 20¢: LM317T, 7808, 7812, 7815, 7818, 7908, 7912, 7915. Brand new parts. 100pcs./package. Add $6 freight. Gateway Products Corporation, PO Box 936397, Margate, FL 33093, 954-974-6864. Fax 954-974-6818. VISA/MC, no CODs.

WANT TO Buy: ICs, military & aircraft relays, diodes, transistors, Cannon, TRW, Amp, Burndy, Deutsch, Bendix connectors, electronic test equipment & most components. Hoffy Electronic Ent., 818-718-1165, FAX 818-341-5506.

MILLIONS $$$ in "scrap gold" from old computers and electronics junk. Message: 603-645-4776 or www.tiac.net/users/quiksand/goldtek.htm

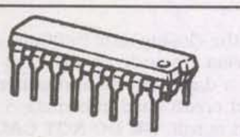
COMPONENTS: MOTOROLA MC6802CP $.50, 74LS166AN 5¢, 74LS00B1 5¢, 74LS240 5¢, Z80 15¢, BOURNES 500 ohm 25¢, 74LS164P 5¢, 74LS165AN 5¢. All parts are unused in tubes, send check or money order to LLoyd's, 27315 Jefferson Ave. Ste. J-17, Temecula, CA 92590. $3 for postage and handling.

AMAZING! 35¢ ALL TOGGLE SWITCHES. Brand new. Rated 6A/125V. Hardware included. 1/4" panel hole. SPDT or DPDT on-on, or on-off-on. Minimum 100pcs./package. Add $6 freight. Gateway Products Corporation, PO Box 936397, Margate, FL 33093, 954-974-6864, Fax: 954-974-6818, VISA/MC, no COD.

MILITARY TRANSISTORS & DIODES & INTEGRATED CIRCUITS WANTED. ELECTRONIC MATERIAL INDUSTRIES 818-769-1002, FAX 818-769-1084.

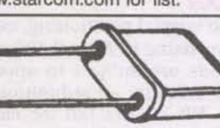
PHOTOMULTIPLIER TUBES, radiosondes, electro-luminescent panels, electronic parts, test equipment. **www.lonemtn.com**

1998 CATALOG: big selection of inductors, ferrites, micrometals toroids, mica capacitors, components, semiconductors, more. Two stamps please. Johnson Shop Products, Box 2843, Cupertino, CA 95015.

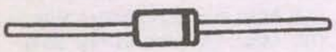


WANTED: EXCESS ELECTRONIC INVENTORIES, ICs, MEMORY, EPROMs, PALs, LEDs, CIRCUIT BOARDS, DIODES, AND TRANSISTORS. CALL ACTIVE MICRO, 562-494-4851 OR FAX 562-494-4913.

SMT COMPONENTS and complete SMT manufacturing system. Closing R&D/manufacturing company. Must sell lots of equipment. Call 1-800-869-7827 or visit www.starcom.com for list.



AMAZING! 4MHz CRYSTAL FOR 30¢. Brand new. 100pcs./package. Add $6 freight. Gateway Products Corporation, PO Box 936397, Margate, FL 33093, 954-974-6864. Fax 954-974-6818. VISA/MC, no CODs.



AMAZING! 10¢ ALL SCHOTTKY DIODES: 1N5817, 1N5819, 1N5820, 1N5821. 100pcs./package. Brand new parts. Add $6 freight. Gateway Products Corporation, PO Box 936397, Margate, FL 33093, 954-974-6864. Fax 954-974-6818. VISA/MC, no CODs.

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RS485 TO BASIC STAMP 2! CONTROL 1 TO 32 BASIC STAMP 2 CHIPS at a distance of up to 4,000 feet. Board includes an interface to RS485, a slot for a BASIC STAMP 2, a 1 amp 5 volt power regulator, and robust screw terminals for easy connections to each STAMP 2 I/O pin. Manual provides a full explanation of how to use the board and RS485, as well as a tutorial with a software example to help you create your own controller/slave system. JD Richards. 530-823-5210. **www.jdrichards.com**

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ANTIQUE RADIO CLASSIFIED. Free sample copy! Antique radio's largest-circulation monthly magazine. Old radios, TVs, ham equip., 40s & 50s radios, telegraph, books & more. Ads & articles. Free 20-word ad monthly. Subscribe today. Six-month trial: $20.95. Yearly rates: $40.95 ($57.95 by 1st Class). Foreign: write. ARC, PO Box 802-G22, Carlisle, MA 01741. Phone: 978-371-0512; Fax: 978-371-7129; Web: www.antique radio.com

WESTERN ELECTRIC WANTED: 1920's-1960's. Amplifiers, mixers, preamps, speakers, tubes, etc. FREE OFFER 1-800-251-5454.

WANTED: FOR historical museum, pre-1980 microcomputers, magazines, and sales literature. Floyd, VA 24091-0341 (540-763-3311/540-382-2935).

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RADIO TUBES and phono. needles. 870-347-2281.

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SYNCHRO RESOLVER test sets, system analyzers, test equipment. **www.lonemtn.com**

BUY, SELL, trade, avionics equipment, Collins, King, Sperry: test equipment, IFR, Litton LTN series INUs. 941-625-3222 P, 941-625-0494 F, E-Mail: avionics@afcon.net

PUBLICATIONS

THE CASE AGAINST PATENTS. Don Lancaster's tested and proven alternatives that work in the real world. $28.50, Synergetics Press, 3860 West First Street, Box 809, Thatcher, AZ 85552. 520-428-4073. synergetics@tinaja.com VISA/MC.

NEW SURVIVAL COMMUNICATIONS BOOK. How to build complete home communications systems. Covers all needs: shortwave radio, amateur radio, citizens band, scanners, federal, weather, alternate news, satellite radio, equipment sources. How to build and use alternate emergency power sources, solar, generators, backup batteries. 200 pages. $24 Fast delivery Priority Mail. MC or Visa. Call Universal Electronics 1-800-241-8171.

MILITARY COMPONENTS wanted. Capacitors, resistors, diodes, transistors, semiconductors, ICs. Electronic Material Industries, 818-769-1002, FAX: 818-769-1084.

ELECTRONIC EAVESDROPPING EQUIPMENT DESIGN by Winston Arrington. This revised edition contains 117 schematics and text of our production equipment. 29 crystal transmitters, 35 room, 32 telephone, 15 subcarrier, countermeasures and much more. Request a free detailed explanation sheet of contents. **PRICE:** $65 + S&H $6. **SHEFFIELD ELECTRONICS CO.**, PO Box 377940-E, Chicago, IL 60637-7940. Tel: 773-324-2196. http://www.adnetmk.com/sheffield

MONICA PROBABLY doesn't have a copy of "Tormet's Electronics Bench Reference" but you should. It has over 100 pages of circuits, design information, parts sources, large radio section, etc. See details at www.ohio.net/~rtormet /index.htm or send check or money order for $19.95+ $2.50 postage and handling to: RMT Engineering, 6863 Buffham Rd., Seville, OH 44273.

HOW TO PLACE A CLASSIFIED AD

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

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

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

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

PHOTOS, DRAWINGS, AND BOXES

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

FAXING IN AD COPY

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

DEADLINE

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

IMPORTANT INFORMATION

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

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

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

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KITS

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PUBLICATIONS *cont.*

START YOUR OWN TECHNICAL VENTURE! Don Lancaster's newly updated **INCREDIBLE SECRET MONEY MACHINE II** tells how. We now have autographed copies of the Guru's underground classic for $18.50. Synergetics Press, Box 809-K, Thatcher, AZ 85552. 520-428-4073. VISA/MC.

HACKERS GOLD CD-ROMs (2) 30,000 programs! The most complete underground collection of hacker's files ever assembled. 550+ megabytes on each! Published: February 1998. Either CD-ROM $34.95. Both $49.95. 520-726-2833. **TELECODE**, PO Box 6426-NV, Yuma, AZ 85366-6426. http://www.hackerscatalog.com/hackgold.htm

ROBOTICS

H-BRIDGE MOTOR controllers, 12VDC, 35A average, 50A peak PWM out. Forward, reverse, ramp-up and ramp-down on accelleration/decelleration. Current foldback when hot, reverse polarity protected, conformal coated, regenerative braking, compact, approx. 3.75"x5.5". $25 & S&H. 717-735-5053. http://members.tripod.com/~divelec

CNC SYSTEMS! Write: motivity, Attn. Pam, PO Box 428, Rocklin, CA 95677. Call: 916-349-8757. Info/pictures at **www.motivityusa.com** A great place to buy CNC.

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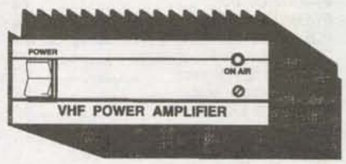

BROADCAST FARTHER! 75-110MHz amplifier connects to stereo transmitters. Produces 2-15 watts. Requires 50-150mW drive. Complete plans with part source and antenna information only $14 + $2 S&H. **Progressive Concepts,** PO Box 586, Streamwood, IL 60107. 630-736-9822.

BUILD THE MENDOCINO MOTOR. This fascinating device is a solar powered, magnetically levitated motor. It will delight and amaze you and your friends. The 27 page plans book includes a list of parts suppliers. The motor uses readily available parts. Plans are $15 plus $2.50 S&H. Write to: St. Elmo's Fire, PO Box 141, Stow, MA 01775. E-Mail: tcv@genrad.com

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HP 86603A RF PLUG IN 1MHZ-2.6GHZ	$1700.00	TEK TM506 POWER FRAME	$100.00
HP 86601A RF PLUG IN .01MHZ-110MHZ	$400.00	TEK 7104 1GHZ OSCILLOSCOPE FRAME	$1250.00
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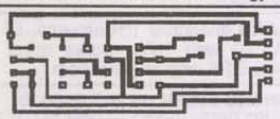

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UNLIMITED UNDERGROUND ELECTRONICS. Electronic weapons, EMP, rail guns, plans, kits, parts, alt energy, more. SASE for free catalog or http://www.access1.net/ninteach & Visit http://www.info-labs.com. UUE, 1839-D West Vistaway #515, Vista, CA 92083.

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MILITARY TRANSISTORS & DIODES & INTEGRATED CIRCUITS WANTED. ELECTRONIC MATERIAL INDUSTRIES 818-769-1002, FAX 818-769-1084.

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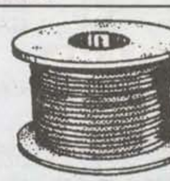

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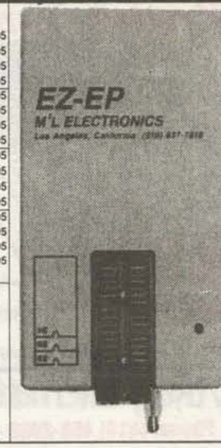

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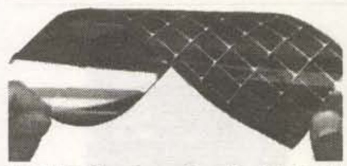

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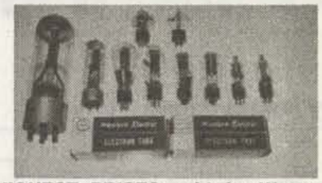

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AMATEUR ROBOTICS NOTEBOOK

by Robert Nansel

Sometimes, you just have to do really dumb, seemingly pointless things in order to make real progress in robotics. Anyway, that's what I kept telling myself this month when I set out to build a clone of the Parallax BS2-IC.

If you remember, last month, I swapped out the weeny BS1-IC in my original Breadbot for the more powerful BS2-IC. The brain surgery was a success, the patient survived, but it was only a couple days before I was itching to do more brain surgery.

This time I wanted to try out some of the spiffy SIMMStick boards I talked about a couple months ago in the August '98 edition of this column. Rather than dump everything I've built up to this point, I decided to try out the PIC.002, a single-height SIMMStick designed for the PIC16C55 and PIC16C57. The reason I chose this particular board is that the PIC16C57 is the chip used for the BS2-IC, and Parallax separately sells a PIC16C57 with the PBASIC2 firmware burned in. One version comes in a plastic DIP28 for $25.00. That was all I needed to know to get started.

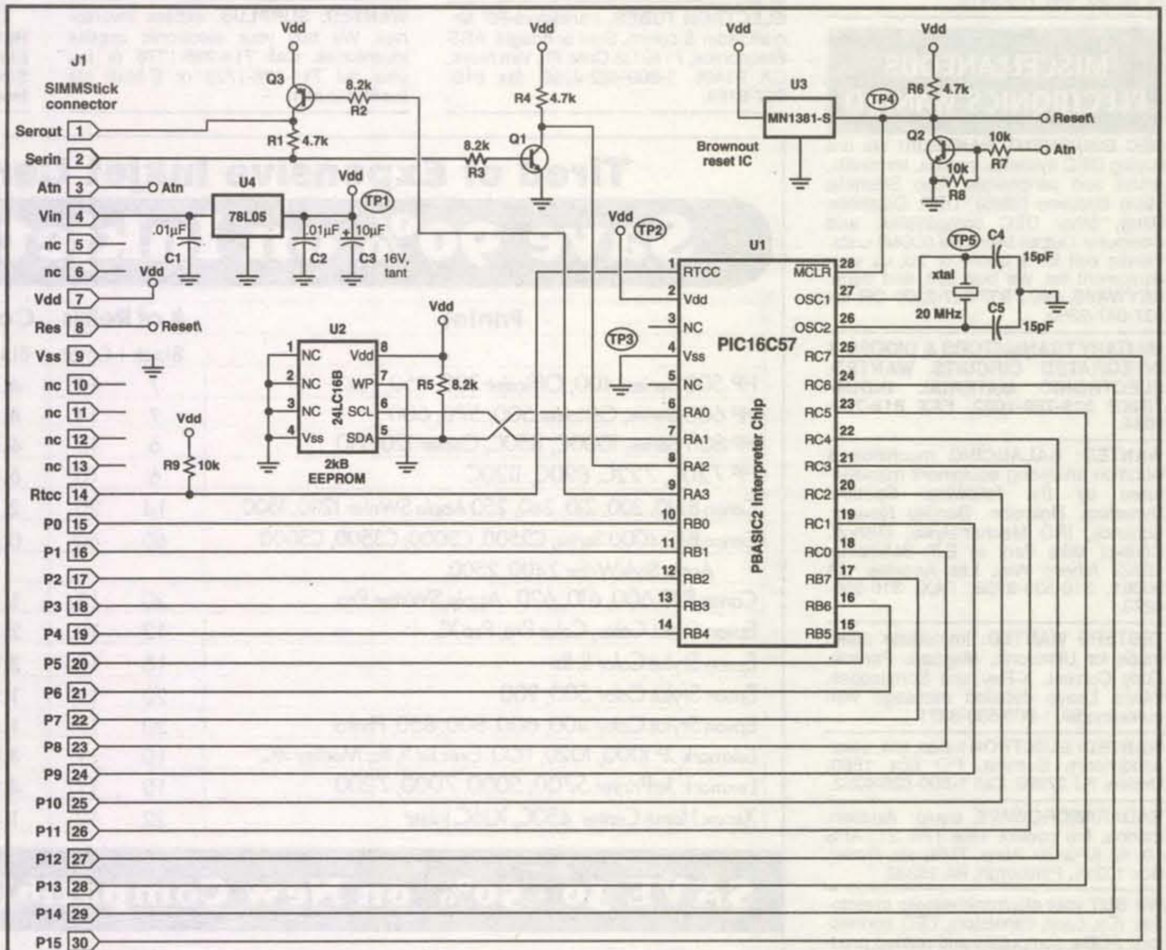


Figure 1. BS-2 SIMMStick Schematic

A BS2 Clone on a Stick

You may well ask why I would want to build a BS2 on a SIMMStick. After all, the Parallax version, with its surface mount construction, is smaller and lighter. And it comes preassembled. Cost? Here the SIMMStick has the advantage: even using the fancy machined-pin IC sockets that I prefer, it still cost less than $40.00, whereas a BS2-IC is $49.00. Plus I got to spend five hours building and debugging it. What a bargain.

Okay, okay, so maybe tearing my beard out for five hours getting the thing to work cancels out saving 10 bucks, but I learned plenty in the process, so I consider it a fair deal. If you follow my instructions it should take you beginners out there about an hour to build and test (and you grizzled veterans might learn – or relearn – a thing or two).

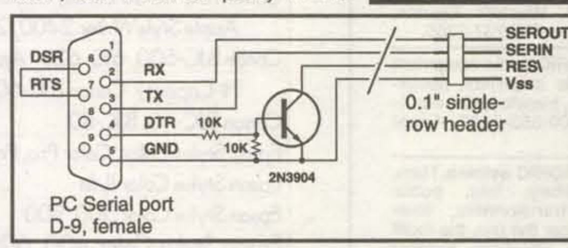


Figure 2. Alternative BS2 SIMMStick Programming Cable

Options, Options ...

Part of my trouble stemmed from the fact that all SIMMStick designs to date offer a plethora of options. This is a good thing, something that makes the whole SIMMStick line very hacker-friendly. However, the documentation for the first two SIMMStick designs – the (now obsolete) PIC.001 and the PIC.002 – leave a lot to the imagination (you can download the relevant document at: http://www.wirz.com/pic/docs/ds0002a.pdf). I hasten to add that from the PIC.003 on, the documentation has made great strides, and all of the DonTronics designed SIMMStick products are copiously documented.

But back to the PIC.002. First of all, the board has no silkscreened parts placement diagram. This isn't so bad because the docs do have a drawing to show where everything goes. A larger failing, though, is that there isn't a complete schematic for any of the PIC.002 board's options, including the

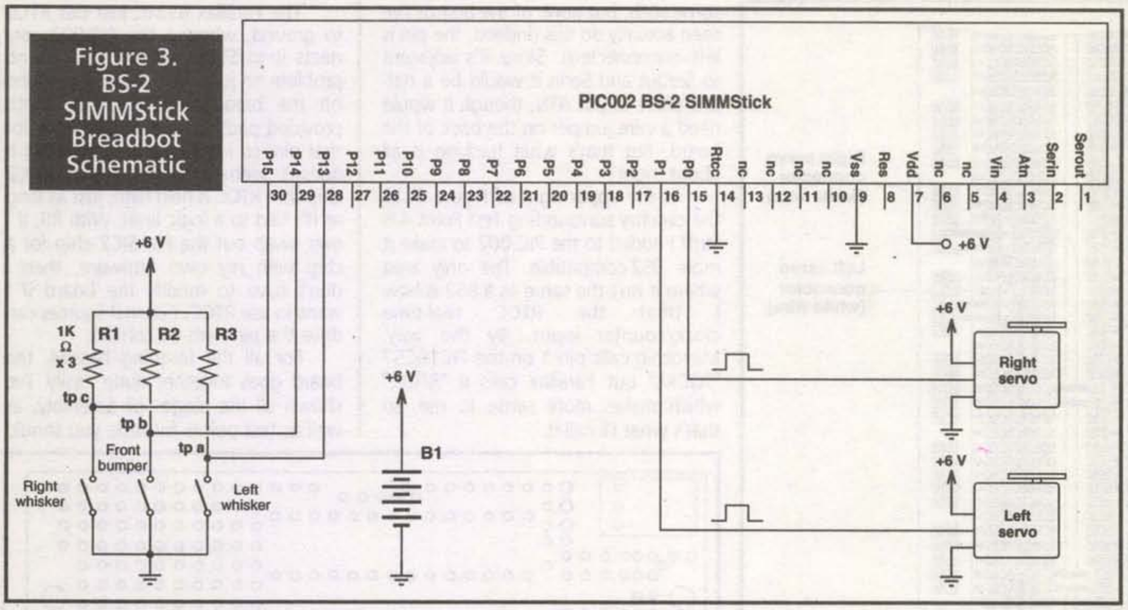


Figure 3. BS-2 SIMMStick Breadbot Schematic

BS2 option. There are fragments of schematics which show, for instance, how the quirky half-duplex RS-232 interface functions and what SIMMStick bus (SSBus) pins the serial EEPROM connects to, but little else.

Compounding the problem, the parts placement diagram shows some parts that aren't in any of the schematic fragments, and some parts I would expect to see (such as a brownout reset IC), are absent. When you first power-up a PIC, it can take several milliseconds for the power supply to come to full voltage, and a PIC can do peculiar things when it doesn't have enough voltage, but the MCLR\ (the PIC's reset line) is high. To prevent this, MCLR\ needs to be pulled low until power stabilizes, whether accomplished with a purpose-designed brownout reset IC or a transistor and some RC time delay.

I traced through the PCB and found a place where perhaps a simple reset transistor or a three-pin brownout reset IC could go, but the parts placement diagram showed a simple pullup resistor there instead.

And there was something weird about the programming cable schematic: it showed an outboard resistor, transistor switch combination connected between the PC serial connector's DTR pin and the PIC.002 RESET, but with the BS2-IC, DTR connects directly to the BS2-IC ATN pin, not RESET. Then I noticed that there was no pin dedicated to ATN in the SSBus pinout.

Hmmm. Time to check with a "higher authority."

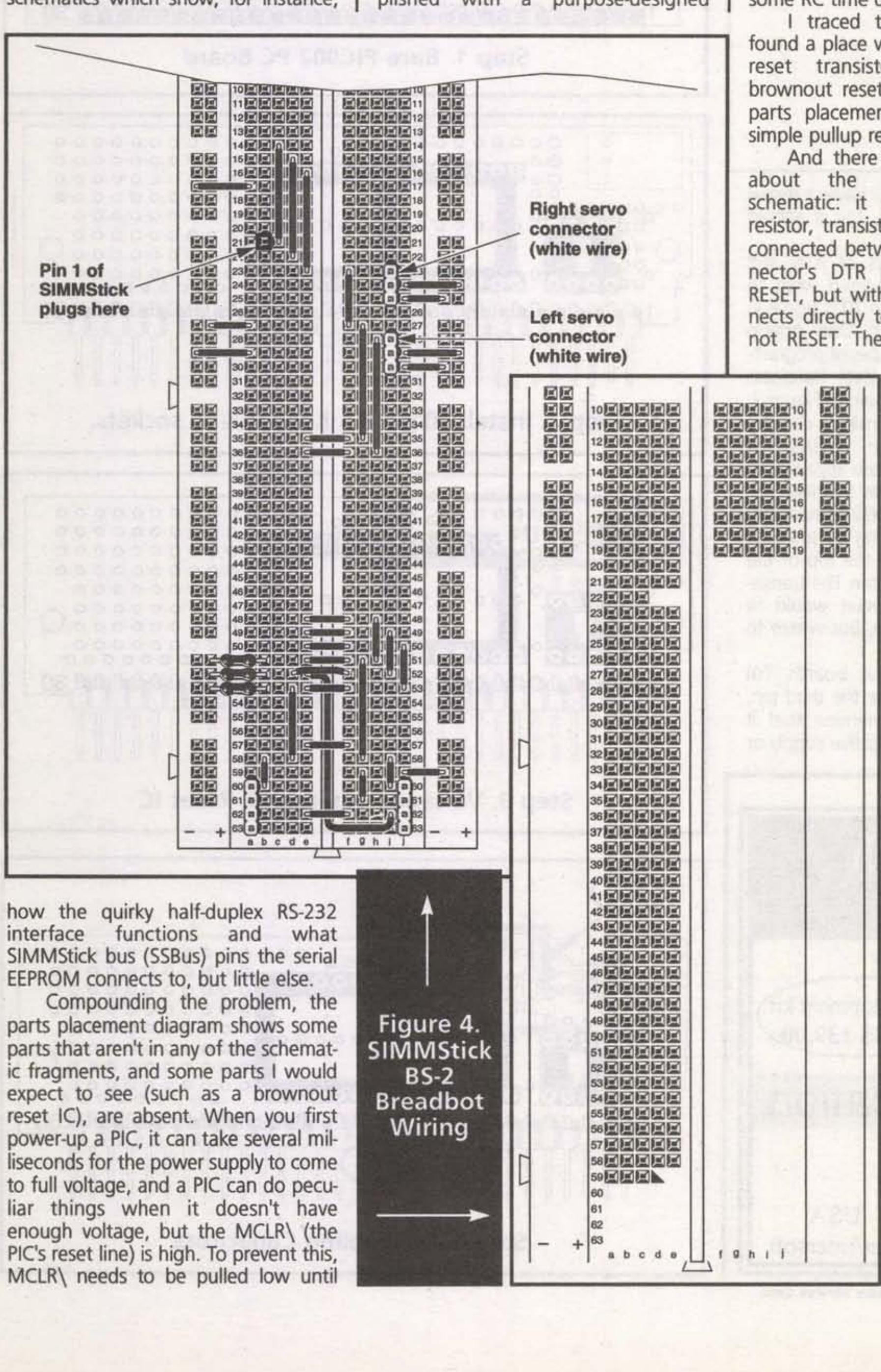


Figure 4. SIMMStick BS-2 Breadbot Wiring

Parallax to the Rescue

The higher authority I consulted was the bible of things BASIC Stampish, the *BASIC Stamp Programming Manual, Version 1.8.* This is available for free download from Parallax as a PDF file (ftp://ftp.parallaxinc.com/pub/acrobat/stamp_manual_v1.8.pdf).

There on page 207 in the BASIC Stamp II section were most of the answers I was looking for, namely a full schematic of a BS2 constructed from DIP package parts. That schematic, with modifications for the PIC.002, is shown here in Figure 1; all parts designations conform with the Parallax schematic, so read the PIC.002 documentation for the tidbits about other SIMMStick configurations, but ignore the BS-2 schematics and use this article instead, at least if you want to build the BS2 option.

Incidentally, there is another BS2 schematic in the Parallax manual on page 448, but that one is for the BS2-IC using surface mount parts and is much harder to read, too, because it's so tiny.

Anyway, the schematic on page 207 showed all the missing bits, and it cleared up the ATN vs. RESET conundrum: the ATN line is driven high by the PC serial cable's DTR line when the host PC software wants to reset the BS2. A +12V RS-232 level on ATN turns Q2 ON and forces Reset down to Vss (hereafter called "ground"), but, with a 0 to -12V level on ATN, Q2 remains OFF and Reset is pulled up to Vdd by R6.

This explains the odd programming cable (Figure 2) that the original PIC.002 docs showed. Since the SSBus doesn't have a dedicated ATN line as the BS2 does, it simply places the transistor switch circuit off the board; the transistor does double duty, translating the ±12 volt RS-232 line levels to logic

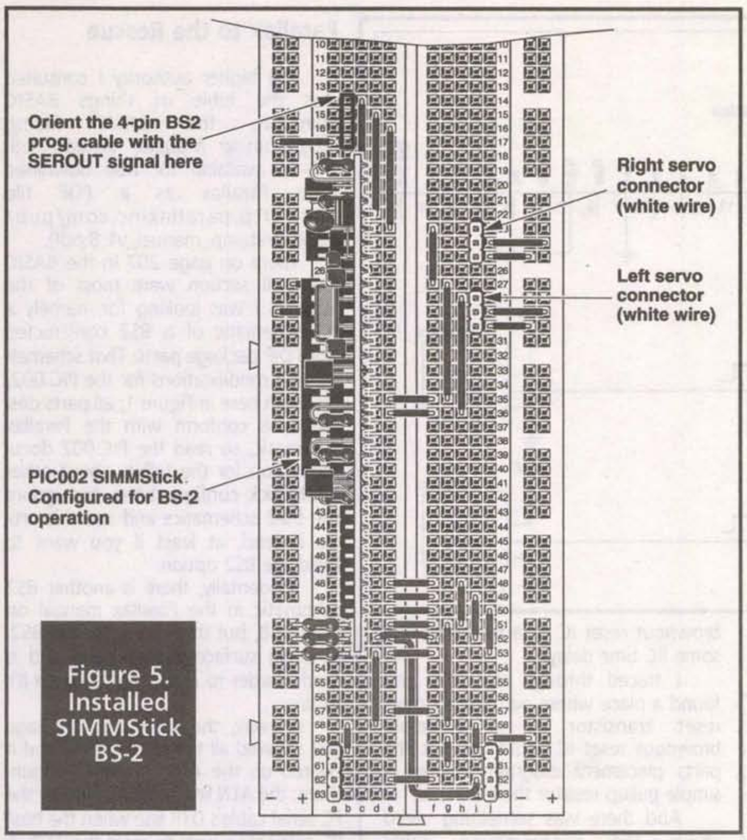


Figure 5. Installed SIMMStick BS-2

levels swinging between Vdd and Ground, and inverting the active high ATN so it works with the active low Reset. Indeed, that is the function Q1 and Q3 perform for the Serout and Serin lines.

A Little Brownout

The brownout reset IC, U3, also connects to Reset; whenever the supply voltage wanders down into the range of 4.2 to 4.5 volts (a "brownout"), U3 pulls Reset low to keep the PIC from running off into the weeds. Antti Lukats, who designed the first SIMMSticks, provided space on the PIC.002 board to put a three-pin brownout chip, though he didn't allocate specific pads for a pullup resistor.

If you use a CMOS output chip, such as the MN1381-S shown in Figure 1, then you might not need R6 as a pullup, but if you use an Open-Drain output device, such as the MN13811-S, then R6 is required. I haven't tested this latter combination, but it should work fine.

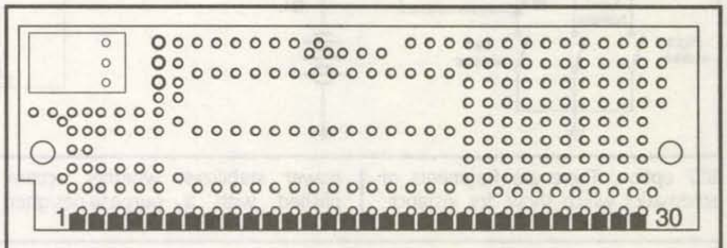
With the mysteries of ATN and Reset explained, I pondered what to do about the lack of an ATN signal in the SIMMStick pinout. One option would be to build the special programming cable with the level translator transistor built in as shown in Figure 2. Or, I could put the transistor circuitry on the breadboard chassis of Breadbot. Neither of these appealed to me. What I wanted was to make the PIC.002 board fully BS2-compatible, and that got me looking at some of those left over pads at the top of the board, just right of center. The transistor level translation circuit would fit quite comfortably there. But where to put the ATN line?

All the SIMMStick boards I'm familiar with do not use the third pin, called A3. The docs mention that it could be used for a negative supply or some such, but none of the boards I've seen actually do this (indeed, the pin is left unconnected). Since it's adjacent to Serout and Serin it would be a natural place to put ATN, though it would need a wire jumper on the back of the board. But that's what hacking is all about, right?

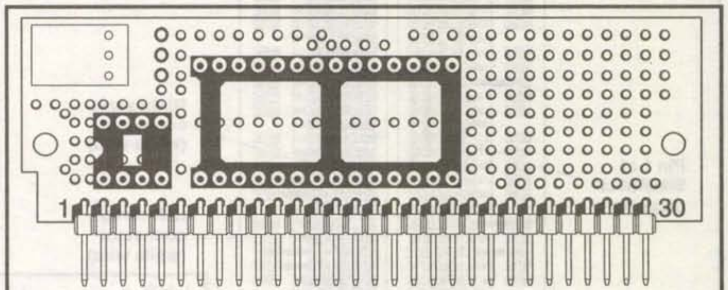
In the upper right of Figure 1, all the circuitry surrounding Test Point 4 is stuff I added to the PIC.002 to make it more BS2-compatible. The only area where it isn't the same as a BS2 is how I treat the RTCC real-time clock/counter input. By the way, Microchip calls pin 1 on the PIC16C57 "TOCKI," but Parallax calls it "RTCC," which makes more sense to me, so that's what I'll call it.

The Parallax BS2-IC just ties RTCC to ground, whereas the PIC.002 connects it to SSBus pin 14, and it's no problem to just tie the pin to ground on the breadboard. However, Antti provided pads for a pullup resistor for that pin, so I chose to install it (R9); it doesn't seem to bother the PBASIC2 chip that RTCC is held high, just as long as it's tied to a logic level. With R9, if I ever swap out the PBASIC2 chip for a chip with my own firmware, then I don't have to modify the board if I want to use RTCC; external sources can drive the pin with no conflict.

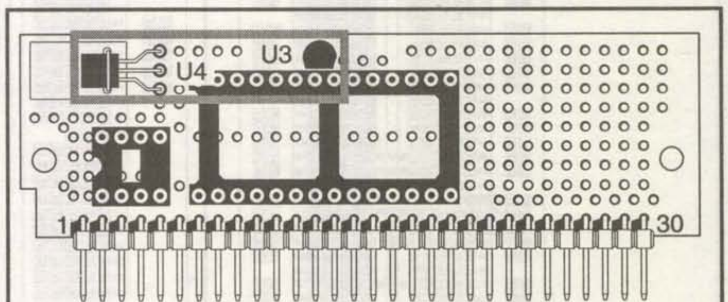
For all the forgoing hassles, the board goes together quite easily. I've shown all the stages of assembly, as well as test points for tests you should



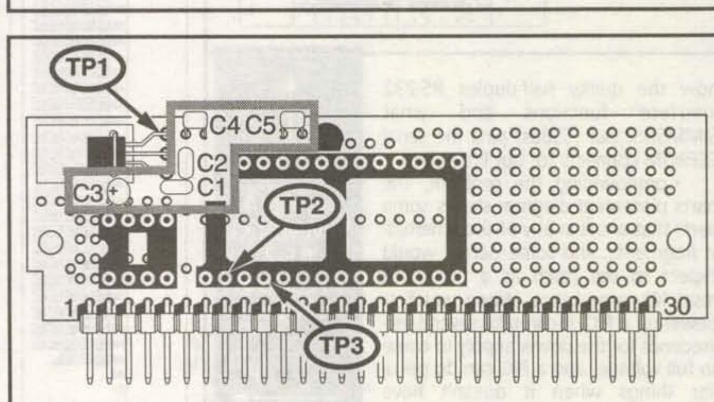
Step 1. Bare PIC002 PC Board



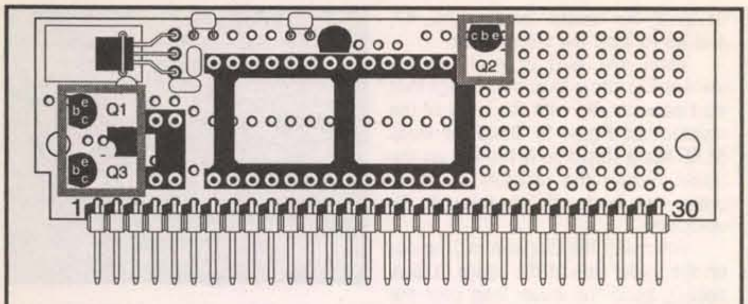
Step 2. Install 30-pin RA header & IC sockets.



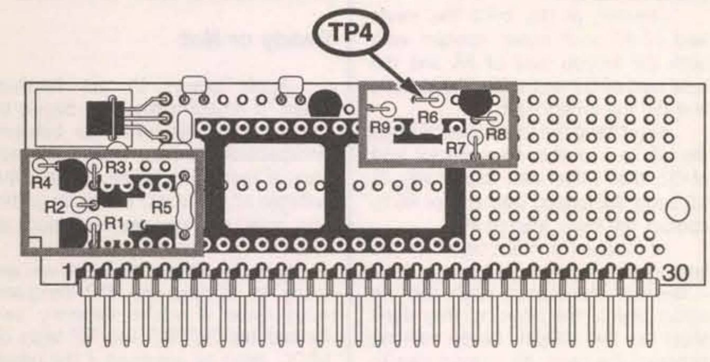
Step 3. Voltage Regulator & Reset IC



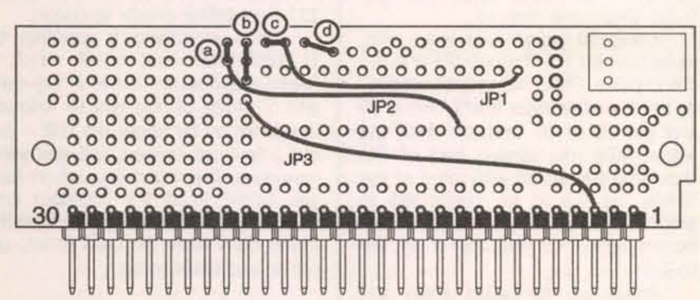
Step 4. Decoupling Capacitors



Step 5. Transistors



Step 6a. Install resistors



Step 6b. Wire jumpers and modifications.

do along the way to ensure everything works the first time. If you faithfully follow these steps, the blue smoke will stay inside your chips where it belongs, and you won't get the dreaded "Hardware not found" message from the STAMP2 software.

Do You VROC?

In bringing any microcontroller system to life, many, many hours of debugging and hair tearing can be saved if you remember this simple mnemonic:

VROC = Voltage + Reset + Oscillator + Communication

These four things (along with functioning software) are essential for every microcontroller system; if any one item in the mnemonic is wonky you are in for a frustrating experience if you can't diagnose the trouble and cure it. In order:

VOLTAGE

The chips have got to have a reasonably clean DC input in the +4.5 to +5.5 V range. With all the versions of Breadbot so far, I've been cheating a little in that I feed raw +6V directly from the battery pack to Vdd, bypassing the 5V regulator. For this reason, you can omit the regulator (U4 in Figure 1) if you like, though I recommend you put it in anyway on the theory that you never know when you will need it. Just be aware that U4 needs a minimum of 7.5 volts to provide its rated output voltage and current, so Breadbot's 6V battery pack won't cut it. That's why I use the raw 6V. But isn't that living dangerously?

It says here in the PIC microcontroller databook from Microchip that Vdd at 6V is beyond "Standard Operating Conditions," but it also says that the absolute maximum Vdd is 7.5V. There's also all sorts of legalese that essentially says, "Go ahead and use higher than 5.5V, but we won't guarantee it'll work." I may yet pay for my perfidy with a blown chip, but with 1.5 volts headroom, the odds are very good that 6V will not damage the PIC.

Feeding the MCU unregulated battery voltage can be problematic from another point of view, though, when you start building robots larger than what can be driven by hobby servos. Servos are pretty well-behaved creatures; because they are meant to operate in conjunction with sensitive superhet radio receivers, they are designed so they don't inject much noise into the power supply they share with the receiver.

For larger robots with larger motors and higher currents, you will definitely want to use regulated voltage for your controller. The hash large motors can put out can force you to provide completely separate batteries for the motors and controller, with opto-isolation for all logic signals passing between the controller and the motor drive electronics.

With little robots, we don't have those headaches – usually. If you are in doubt about how clean your battery power is, take a look at it on an oscilloscope some time when the motors are running. Even with regulators, it's a good idea to check the output with a scope. It's truly weird to see a lowly voltage regulator trying to oscillate in the megahertz range, but they will do just that if not properly bypassed with capacitors on the input and output. One clue a regulator is oscillating is that it's too hot to touch and nothing in your system is working.

In summary: Your supply voltage is guilty until proven innocent. That's why the first Test Point in Figure 1 is on the output of the regulator.

RESET

Microcontrollers, no matter who designs them, always have an unintentional extra instruction in their instruction sets, the so-called BTTG instruction ("Branch To Tall Grass"). It is invariably executed when you least expect or desire it, especially when your processor's oscillator starts clocking before the chip is fully powered up. Brownout reset ICs were invented to defeat the BTTG instruction. A simple pullup resistor will work 99% of the time, but it's that other 1% that you wind up spending 99% of your debug time on. They cost less than a buck. Use them.

OSCILLATOR

Another killer is an oscillator that doesn't. With digital microcontrollers, it's easy to forget how quintessentially analog a beastie the crystal oscillator is. For this discussion, I lump ceramic resonators with quartz crystals. I ran into oscillator problems when building my PIC.002 board. I discovered that the ceramic resonator I'd chosen wouldn't function with the PIC. I was trying to use a 20 MHz, three-pin ceramic resonator, the kind with built-in load capacitors, only I neglected to look at what the values of those load caps were. As it turned out, they were 30 pF, and when I powered up the system, the OSC1 and OSC2 lines stuck at some DC voltage partway between Gnd and Vdd, a dead giveaway (DC is, after all, not an oscillation).

When I checked the Microchip databook, it said that 15 pF is the maximum load capacitance for crystals and resonators. I didn't have any other resonators on hand, but I did have a 20 MHz crystal and a couple 15 pF caps. And that was all it took. Lesson: Make sure you see high-frequency wiggly lines on the scope when you probe

Test Point 5.

COMMUNICATION

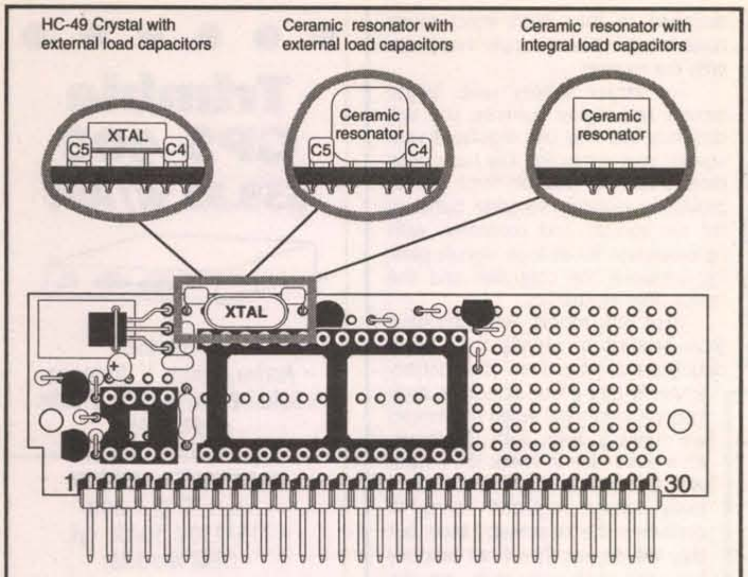
This one isn't as direly and directly related to the operation of a microcontroller but, for most systems, it's just no fun if they don't talk to the outside world in some reliable fashion, whether it be a blinky light or an RS-232 connection. When I built my board, I somehow managed to solder Q3 in backwards, and STAMP2 absolutely refused to acknowledge that I was even close to right. "Hardware Not Found," again and again. Arghh!

For RS-232 you should see signals in the range of +3V to +15V for one logic level, and -3V to -12V for the other. Measure the levels your PC actually puts on TxD (pin 3) and DTR (pin 4) of your serial cable; if the voltages are between +3V and -3V, then you have trouble with your serial card or the cable or both.

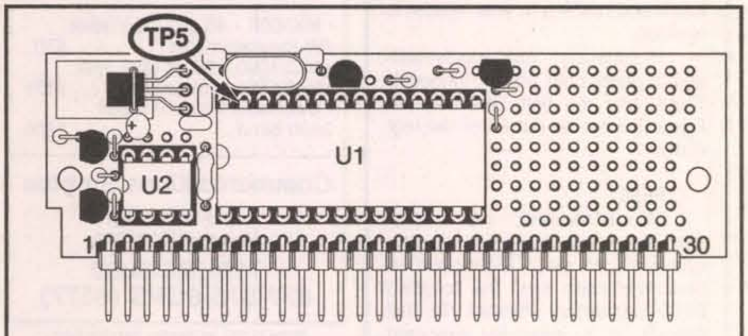
Now to Breathe Solder Smoke

Now that you know everything that can go wrong, it's time to build the board. The diagrams show in what order to solder the components and what test points to be probing at each step.

Steps 1 & 2: Install the 30-pin header so you can plug the SIMMStick into Breadbot. Orient the board in front of you so the notch is on the left and the lettering "PIC002" is visible on the right; the side of the board with



Step 7. Oscillator Options



Step 8. ICs

the lettering is the component side, and you'll be mounting all of the components from this side. Press the header pins in a bit at a time. The holes proved to be a very tight fit, so work the header pins in as best you can with needle-nose pliers.

Once you get all the pins in a little way you can flip the board over and press the board down on a flat surface until the header seats, then solder. If you are using IC sockets (a good idea), use bits of masking tape on the component side to hold them in place temporarily while you solder.

Steps 3 & 4: Install U3 and U4. The flat of U3 should face the header connector. Bend the leads of U4 so its flat lies against the copper area in the upper left corner of the board. I soldered a loop of 24 gauge bare wire as a strap to hold the plastic case in firm contact with the copper.

Next install the decoupling capacitors C1 through C3. Make sure the positive lead of the tantalum capacitor C3 is oriented to the left. Look ahead to Step 7 for a moment. Decide which of the oscillator options shown in Step 7 you are going to use. If it is one that requires load capacitors C4 and C5, then solder them in now, as well. Be sure to leave enough lead on the component side so you can bend C4 and C5 outward a bit so you have more room for the crystal or resonator, whichever you use.

Apply +7.5 volts to pin 7 and ground to pin 9 on the header and check the voltage between TP1 and TP3. It should be 5V. If it isn't, check that you haven't put U4 or C3 in backwards.

If it passes the 5V test, check the voltage between TP2 and TP3. If you still see +5V, then the "V" part of "VROC" is mostly taken care of. You'll want to check these test points for proper voltage again when you have the whole board assembled with U1 and U2 plugged in just to make sure it still works when there's a load on the regulator.

Steps 5 & 6: Solder in the transistors. Q1 and Q2 are NPN, and Q3 is PNP. The flats of the plastic cases of Q1 and Q3 should face left. Q2 should have its flat facing toward the upper edge of the board. Leave the pins of Q2 unclipped after solder until the resistors are soldered in because you'll be using the resistor leads of R6, R7, and R8 to form the reset circuit.

Form one lead of each resistor (except R5) into a loop that brings that lead back parallel with the body of the resistor (see Figure 5). Bend the leads of R5 like a staple so it fits flat on the board. Solder the resistors in place. Leave the leads of R6 through R9 unclipped.

Following the diagram in Step 6b, on the solder side of the board at location(a), bend the lower lead (not the looped lead) of R8 over so it touches the emitter lead of Q2 and flow some solder into the joint, then clip those two leads flush.

Likewise, at (b), bend the lower lead of R7 so it makes contact with both the looped lead of R8 and the base lead of Q2 and solder these joints and clip the excess leads.

At (c) bend the lower lead of R6 to the left so it touches the collector lead of Q2, then solder and snip. Finally, at (d) bend the looped lead end of R6 to contact the lower lead of R9.

At (a) and (b), make sure that you leave gaps – a paper thickness at least – between the resistor leads and the solder side of the board so they don't short to the copper traces running between the pads. It's a good idea to use a meter to check for shorts between the resistor leads and any traces they come close to.

Using 30 gauge wire wrap wire, make jumpers JP1 through JP3 and solder in place. Check for proper continuity between the lower lead of R6 at (c) and pin 28 of U1 and pin 8 of the SSBus; ATN (the looped lead of R7) should be connected with pin 3 of the SSBus; (a) should be connected to ground, pin 9 of the SSBus; (d) should be connected to Vdd, pin 7 of the SSBus.

Power up the board again and measure the voltage at TP4. With nothing connected to either pins 3 or 8 of the SSBus, you should see something near +5V. If you apply -12V to ATN, you should see no change. Apply +12V and TP4 should drop to ground. Likewise, when you temporarily connect Reset (pin 8) to ground, TP4 should also go to ground.

Steps 7 & 8: Solder in the crystal or resonator you've chosen. With the crystal it's important to make sure the metal case doesn't short against either of the adjacent load cap leads. Leave a gap of about 1/8 inch between the crystal case and the PC board as shown in Step 7 and in Figure 5.

Item	Description	Vender	P/N
C1, C2	0.01 µF 50WV, 5%, polyester	Digi-Key	P4582-ND
C3	10 µF, 16 V tantalum	"	P2038-ND
C4, C5	15 pF 5% monolith ceramic cap	"	P4839-ND
J1	30-pin single row, RA header	"	S1111-30-ND
J2*	8-pin DIP IC socket, .3" rows	"	ED333308-ND
J3*	28-pin DIP IC socket, .6" rows	"	ED3628-ND
PCB	PIC15C57 SIMMStick board	Wirz Elex	PIC.002
Q1, Q2	2N3904 NPN, 40V, 100mA, TO-92 case	Digi-Key	2N3904DICT-ND
Q3	2N3906 PNP, " " "	"	2N3906DICT-ND
R1, R4, R6*	4.7K ohm, 1/4 watt, 5% carbon film	"	4.7KQBK-ND
R2, R3, R5	8.2K ohm, " " " " "	"	8.2KQBK-ND
R7, R8, R9	10K ohm, " " " " "	"	10KQBK-ND
U1	PIC16C57 with PBASIC2 firmware	Parallax	PBASIC2/P
U2	2k byte serial EEPROM	Digi-Key	24LP16B/P-ND
U3*	Reset voltage detector, 4.5V, CMOS	"	MN1381-S-ND
U4*	+5V positive regulator, TO-92	"	NJM78L05A-ND
XTAL*	20 MHz crystal, HC49/US case	"	X438-ND

*see text

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, as usual you can reach me at:

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

Finally, using precautions against static discharge, install U1 and U2 with their orientation notches facing left as shown in Step 8.

Ready or Not

Apply power to the finished board. If anything gets hot, begins to smoke, sparks, or otherwise behaves unexpectedly, remove power immediately. If everything is fine, recheck the voltages at all the test points. In particular, make sure you see oscillations at TP5.

If all these tests check out, you are ready to connect the BS2 programming cable. If you've diligently performed the "V," "R," and "O" tests of VROC, don't be surprised if the board works the first time (though if it doesn't, you still have the Q1 and Q3 RS-232 level-shifter circuits to check).

Once everything is working, try TESTBB3.BAS. First you'll need to rewire Breadbot as shown in Figures 4 and 5. Those of you who've followed this series so far know the drill – pull out a few old jumpers and add some new ones. The rest of you, where have you been? Read the Breadbot construction articles starting with June '98. If you don't have the back issues, get online and order some.

Next Time

I'm getting eager to explore other boards that really show the performance potential of SIMMSticks. PBASIC is fine for first experiments, but I want something that really screams, and for that we'll be looking at other languages, including – gasp – some assembly language. Until then, keep on VROCing. **NV**

Suppliers Mentioned:

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http://dontronics.com

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http://www.parallaxinc.com

RadioShack
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http://www.radioshack.com

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

WANTED: AVIONICS test equipment, IFR, 600A, 401L, others, Collins, King, Sperry, North Atlantic, Litton INUs LTN series, rate and tilt tables, air data test sets, 941-625-3222 P, 941-625-0494 F, E-Mail: avionics@afcon.net

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GLOBE Gearhead Motor
with shaft encoder
$14.50

Perfect for many projects, this little DC motor operates on 3-24 volts. It features a 1/4" dia. shaft (machined flat) about 3/4" long. The body diameter is 1-3/16", and the gear box diameter is 1-3/8". The overall length (excluding the shaft) is 3-1/2". The no-load speed at 3v is 7rpm, at 6v 18rpm, and at 9v 29rpm. If you want more, try 12v for 41rpm, or at 24v you'll get 85rpm. Whether you are building a super robot, creating a laser display, or anything in between, this motor provides flexibility of design at a low cost. (Data sheet included)

PHOTON II MICROLIGHT

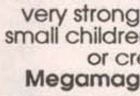
The popular photon microlight has been improved. These super-bright (better than 8 candellas!) LED lights are visible over a mile away. The LED is secured in a tough ABS case and offers a squeeze button for quick use, and a constant on slide switch for prolonged lighting needs. The lithium batteries last a very long time (10 year shelf life!) and are included. The light won't burn out because it is an LED! Specify your choice of five incredible bright colors. Great for home or office use, popular with fire and rescue professionals, pyrotechnicians, stage performers, and dimly lit restaurant patrons. PHOTON II microlights include a keyring and come in ruby red ($13.50), amber yellow ($13.50), sapphire blue ($17.50), diamond white ($17.50), and emerald green ($17.50). Includes two replaceable 2016 lithium batteries.

ANIMAL SOUNDS PIANO KIT
$29.95

This project kit has ten keys for playing notes of the scale and eight buttons to select the sounds associated with each note. Select the piano mode and the kit will synthesize piano sounds for each key. OR select one of seven different animal voices including cat, dog, pig, bird, chicken, duck, and sheep. Old MacDonald never had a choir like this! The circuit features an auto power-off function, a demo mode, and easy step-by-step instructions. Requires 2 AA batteries not included.

THE FINE PRINT : PRICES SUBJECT TO CHANGE WITHOUT NOTICE * GATEWAY IS NOT RESPONSIBLE FOR PRINTING ERRORS * MASTERCARD, VISA AND DISCOVER ACCEPTED * YES, WE'LL TAKE YOUR CHECK -- SORRY, NO C.O.D.s * $10 MERCHANDISE MINIMUM ON MAIL ORDERS * SUPPLY OF SOME ITEMS IS LIMITED * PRICES DO NOT INCLUDE SHIPPING * UPS GROUND SHIPPING/HANDLING WITHIN THE CONTINENTAL U.S. (ITEMS REQUIRING ADDITIONAL AMOUNTS ARE NOTED)...$4.25 FOR THE FIRST ITEM, $0.50 FOR EACH ADDITIONAL ITEM. RESTOCKING CHARGE MAY BE ASSESSED ON RETURNED ITEMS. WHERE ARE WE GOING? AND WHAT'S WITH THIS HANDBASKET?

for other neat stuff surf the internet www.gatewayelex.com



BE A FLY ON THE WALL!!!

Well, actually, those little wings would look pretty stupid on you, but you can build a miniature "bug". Surface mount technology is the latest techno-buzz word, and a challenging new frontier for kit builders. The manufacturer understood that the first try might be a bit rough, so they included enough components to assemble two units. (so it is o.k. to lose or damage a SMT component!) With the entire FM broadcast band (from 88 - 108 MHz) for your receiver, and a transmit range of 300 feet, even James Bond would like this kit! This unit is powered by a 1.5 volt watch battery (included) and features an electret type high gain microphone for superior audio quality and extended pick up range - hear a whisper at 10 feet.

A lot of fun in less than a square inch!!!

Micro Size FM Wireless Transmitter Kit $19.95

Lighted Screwdriver Supertool!
$9.95

At first glance, this appears to be an ordinary screwdriver, but press a button on the base and two lights illuminate the area you are working on. Nifty, huh? But wait, there's more! The seven interchangeable bits are stored right there at the base of the screwdriver (6 storage slots) for easy access. No handles to unscrew or tool boxes to dig through. Hey, you ain't seen nothin' yet...remove the bit and the magnetic retrieval tool telescopes from the screwdriver shaft! Incredible!!! Of course, the comfort grip handle and rugged construction are icing on the cake! Definitely a 'gotta have it' tool!

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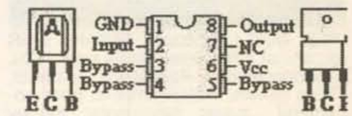

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Write In 69 on Reader Service Card.

Continued from page 13

software companies immediately abandoned floppy stacks in favor of using CD-ROMs to distribute software. It was cheaper by far, and cooler, too.

Consequently, no one has 2.88 floppy drives, no one needs them, and no one sells them or the disks. 1.44 floppy disks are not compatible with 2.88s.

Evan Weaver
Hockessin, DE

ANSWER TO #9983 - SEPT. 1998

Omega [www.omega.com, **1-800-826 6342**] makes salinity meters, but they are not cheap. CDH-287-KIT (which is not a construction kit) is $740.00 and their CDH-420 is $815.00.

These meters measure salinity indirectly by measuring the conductivity and the temperature of the sample. When salt dissolves in water, its constituent ions (e.g., Na+ and Cl-) separate. The ions will support a current flow, and more salt means more ions and higher conductivity.

Unfortunately, the conductivity is temperature dependent, so the meter must also measure the temperature and estimate the conductivity at standard temperature.

The standard conditions for measuring salinity are 15 degrees Celsius and one atmosphere, so the meter calculates what the conductivity would be if the sample were at 15 degrees.

The salinity in percent is calculated by dividing that conductivity by the conductivity of a solution of KCl (mass fraction = 32.4356e-3) at 15 degrees.

You could do the calculations yourself if you had a thermometer and a conductivity meter. The problem is salt water is very conductive and exceeds the range of Omega's inexpensive conductivity meters. An appropriate conductivity meter would cost about $400.00

Making your own conductivity meter is possible, but there are many subtle problems. You could buy a cheap conductivity meter less than $100.00 and dilute the sample to put it within the meter's range, but then you wouldn't want to make many measurements.

Gerald Roylance
Mountain View, CA

ANSWER TO #99810 - SEPT. 1998

The best answer to your steering problem would be to de-couple the motor from one of the two sets of wheels, providing another motor for the de-coupled wheels. This way you would have full control of a dual-motor vehicle. But this solution is easier said than done, so here is a more practical alternative.

Allow all wheels to remain driven by the single drive motor, but add a small device to the front of the vehicle that will be your steering module. This module will simply contain two elements: a servo motor (like the ones used in model R/C planes and cars), and a guide wheel approximately 3" or 4" in diameter (available at hobby stores).

The wheel will provide a direction of movement for the vehicle, like the rudder of a ship. The direction will be determined by the servo motor which simply places the wheel in the desired angle for turning.

Your vehicle will resist turning, tending to drive straight ahead, so you will have to mount the steering module in such a way that the front end of the vehicle is lifted off the ground slightly, say a couple of 1/16 of an inch or so. You'll have to experiment to determine the right amount of elevation.

The beauty of this approach is that you now have a couple of interesting alternatives for controlling your vehicle.

If you're into computers and programming, you could use a BASIC Stamp to control the vehicle and its steering module.

If you desire control via radio frequency, you could employ a multi-channel transmitter/receiver system (also available at hobby stores) which could easily control not only your steering module, but provides additional channels for controlling other items such as a wireless camera, remote arm, etc.

K. A. Delahoussaye
Melbourne, FL

ANSWER TO #9989 - SEPT. 1998

The idea to use the early IBM PC monochrome monitor is interesting, but not very feasible. The IBM monochrome units works so well because the coating (phosphor) that lights up to form the dots on the screen has a very slow decay characteristic.

After the electron beam strikes the phosphor, it takes a long time to stop emitting light. This is great for a static computer display, but with moving video images will give a terrible ghosting to the image. I do not reccomend trying this idea.

It may be possible to use this for a monitor with a notebook PC. You will need to see if you have a driver to get the display output to support the old monochrome standard. It is a long shot!

Bob Kelly
Poway, CA

ANSWER TO #9986 - SEPT. 1998

The best way to get all four drives working is to use a secondary IDE controller, assuming all four drives are IDE. The Promise EIDEMax is about $20.00 in stores and works with an existing IDE controller, plus large drive support.

If parallel/IDE support is still needed, H45 has an IDE/parallel adaptor kit for about $70.00. It can be ordered via http://www.necx.com.

Kuo-Sheng Chang
San Francisco, CA

ANSWER TO #9984 - SEPT. 1998

Rather than modifying the CCD camera, I suggest that you make a simple change to the viewing monitor. If you reverse the horizontal deflection coil wiring, you will conveniently convert the CRT to display a "mirror" image.

The deflection coil is found on the neck of the monitor's CRT (picture tube). You will see four taps: two for vertical and two for horizontal. If you unsolder the horizontal related connections and merely swap them, the image will be backwards (or upside down if you choose the wrong set).

If you want normal operation from the monitor, install a DPDT toggle switch that flips the wiring when desired.

T. Black
Folsom, CA

ANSWER TO #9985 - SEPT. 1998

The power output and frequency of your transmitter is regulated by the FCC and unless they okay that frequency which you are using to be used at a higher power, then you're stuck.

Stationary relay transmitters are commonly used in large cities, but mobile repeaters? Check with the FCC.

You will probably have to go with a more powerful legal radio or use a cell phone.

Chris
Bieber, CA

ANSWER TO #9987 - SEPT. 1998

I doubt very seriously that the device you mention works in the microwave range because microwaves don't stop at the wood, they bounce heavily, and are absorbed by any hydrogen atom including the water molecules in your body.

Ultra Sonics on the other hand do a similar trick with a more localized effect and are harmful only at very short distances.

Ultra Sonic welders are designed for welding plastics, melting plastics, curing glues, and are widely available to most industries.

To get the parts and information that you will need to build a unit you should inquire with a manufacturer or distributor of Ultra Sonic equipment, which you can find in the yellow pages under welding equipment, or Ultra Sonics depending on where you live.

Also the Dealer Direct, Business-to-Business, or several other larger city yellow page books will have the information you need.

With any luck and a good prying technique, they will tell you the operating frequency and power of their units.

Having seen inside a few machines, they range from primitive CW power units to transistorized switching units which allows the power to be more focused and adjustable.

Chris
Bieber, CA

ANSWER TO #9988 - SEPT. 1998

DTMF decoder/recorders can be purchased from several sources, including Mike Sandman Enterprises, www.sandman.com and Opto-electronics ww.optoelectronics.com.

If you want to build your own, then consider the BASIC Stamp microcontroller from Parallax, Inc. (www.parallaxinc.com).

You will need a BASIC Stamp, their 8K Serial EEPROM AppKit, and their DTMF transceiver Appkit.

You will also need to gather a few other low-cost components.

You will need to write a little S/W (the Stamp is quite fun to use).

T. Black
Folsom, CA

ANSWERS TO #99811 - SEPT. 1998

An outdoor thermal (IR) sensor is incorporated into those motion sensing lights that are readily available in the hardware stores. I have seen the assembly with two floodlight sockets for $10.00. An item in the Sept. '98 *Nuts & Volts* "Electronics Q & A" (page 48) shows a way to get a contact closure signal from the sensor.

There are computer boards that sense and create switch closures to tie that signal to your PC. It would also allow you to operate other equipment such as a bell or light when the PC program decides there is reason to sound the alert.

As far as an indoor sensor, All Electronics 1-800-826-5432, has a passive infrared detector (PIR) Cat# IR-145 that has a 40-foot detection range.

Denis Kuwahara
via Internet

ANSWERS TO #99811 - SEPT. 1998

If Nick wants to detect someone outside his house, my method will do the job and not tie up his PC.

Purchase a $12.00 floodlight motion detector (with four-second walk/test feature) and do this:

Run #14 three-wire cable to the unit. Discard the floodlight sockets, tie the hot lead from the detector to the red wire and bring it to a duplex outlet (the neutral will be there). Use a 12-volt AC wall transformer to a buzzer circuit. When the motion detector is activated the buzzer will sound (for four seconds).

This is an effective and inexpensive detection system.

Arlin Hatfield
via Internet

ANSWERS TO #99811 - SEPT. 1998

Nick, you can purchase ready-made IR motion detector circuits, and you can get controller modules that hook them up to the PC via the X-10 standard.

By setting up two detectors in a row on the path to the door, you can see whether the subject is approaching or moving away from your house. By setting up at least one detector per room and/or doorway, you can see who is where inside the house.

Some of the current X-10 modules even includes color cameras, universal remotes, and so on.

Here are some URLs to check out: **http://www.x-10.com, http://www.smarthome.com,** and **http://www.smarthomesystemsusa.com**

Kuo-Sheng Chang
San Francisco, CA

Continued from page 15

ly and easily; pinpointing unexpected and unwanted files and directories as well as important changes over time. Space Watch v3 is the first and only program to provide space ownership search and analyzes on both Netware and NT systems — at the same time.

For more information contact SharpeWare, 10 Gallow Hill, Peebles EH45 9BG, Scotland. E-Mail sales@sharpeware.com, Web http://sharpeware.com. A free full function 30-day shareware version is available for download from: http://www.sharpeware.com/pub/swatch3.zip.

ORGANIZE YOUR IMAGES — WITH PHOTO BASE DELUXE

AxisSoft has released Photo Base Deluxe 1.2 for Windows 95, a program for organizing your pictures into a neat database.

Photo Base Deluxe is a picture-database. The program is very useful in situations where you have a lot of pictures and want to organize these in a friendly system. You can put all the pictures into one database and organize them into 24 categories. The original file-format of the pictures is maintained in the database, so it's easy to get the original back again.

Photo Base Deluxe 1.2 for Windows 95 costs $49.95 for a single user license. Site licenses are available. For more information, contact AxisSoft, Rijnweg 17, 1628 PB, Hoorn, Netherlands. Voice: (31) 229-211626. Fax (31) 229-213379 or visit our URL: http://www.axissoft.com.

CREATE CLOUDS OF SOUND WITH ARP-X8

Metaphoric Software has released Arp-X8, the newest member of the Techno Toys family of electronic music production programs for Windows 95, 98, and NT.

Arp-X8 is an "octal arpeggiator," which uses the input from a standard MIDI keyboard to produce up to eight simultaneous, independent melodic lines.

Each of the eight arpeggiators has separate controls for MIDI channel, program, motion algorithm, rhythm, and more. Arp-X8 combines these settings with input from the keyboard to produce music that can range from simple arpeggios to rich, rhythmically complex clouds of sound.

Like all Techno Toys, Arp-X8 is fully interactive, with all output automatically recorded to a MIDI file for export to conventional sequencers. Multiple instances of Arp-X8 are automatically synchronized, and can sync to any other program or device that utilizes MIDI clock messages.

Arp-X8 sells for $24.95, and can be downloaded from the Techno Toys web site at http://www.technotoys.com. For more information, send E-Mail to info@technotoys.com.

LANGUAGE TUTOR GOES JAVA

Arro & Wartoft has released Selingua in Java — a Java version of the award-winning language tutor Selingua.

Selingua is an easy-to-use program that helps you learn 2,000 words in any of the languages English, French, German, Spanish, and Swedish. Seven varied exercises, including a crossword exercise, let you quickly build your vocabulary.

A pleasant way to make your five-minute breaks productive! You are welcome to try the demo version at http://www.aw.nu/java.

Don Lancaster's

RESOURCE BIN

number eighty one

New secrets of military surplus (Part 1).

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

Secrets of Mil Surplus

Something around $687.54 worth of US military surplus will get sold *each second.* Day in and day out. At prices which average well under one penny per dollar of initial acquisition costs. Everything from superb commercial electronic test equipment through aerobic exercise gear to live horses.

A few major changes have recently happened that can make bidding and participating in military surplus sales ridiculously simpler and much easier than it once was.

You can now handle nearly everything on the web and pay by VISA. Sometimes the goodies are even delivered right to your door.

On the other hand, at least one of their new bidding methods is not at all small scale or end-user friendly. And around half of the DRMO outlets are scheduled to close within a very few months or so.

I've been playing around with mil surplus. So I thought I'd share some of their secret insider stuff with you. Because your needed resource listings are unusually detailed, I will split this topic into two columns. Your first starting point on all this involves visiting ...

http://www.drms.com

This url is the federal surplus home page. Both this site and their overall operation is called DRMS. Or short for *Defense Reutilization Marketing Service.* Their individual base stores are called DRMOs. Brief for *Defense Reutilization Marketing Offices.*

Your first thing to do is to click on *Public Sales* and then go to *Catalogs*, followed by *Listed by DRMS/DRMO Location.* This should give you a quick picture of just what is being offered where. Next, you use the list and your own knowledge and the addresses in our resource sidebars to pin down the bases you can easily travel to; those bases that you can possibly get to; and those bases your cousin in Omaha or a business associate can reach.

Every DRMO site is not necessarily having a sale all the time.

NEXT MONTH: Part II of major new opportunities in mil surplus electronics.

So, it pays to verify their catalog list every few days or so to see what pops up.

In my own case, those "we deliver" RCP sites plus *Huachucha*, *Tucson*, and *Luke* are fairly close by. *Kirtland* and *Hollomon* are painful but useful. I will sometimes bid at harder-to-reach sites such as *Bliss*, *Cannon*, *Nellis*, *29 Palms*, *Barstow*, at *Fort Irwin*, or *Edwards.* But only if something exceptional is really worth making the lengthy trip will I purposely underbid by my travel and pickup expenses. Plus a tad more.

Finding Offered Items

There are three kinds of documents you'll find associated with each sale. The *Dynamic Listing* is a rather brief summary which more or less itemizes what is offered in each lot number. The dynamic listings supposedly will become stable 10 days before the bid close. But any item can be withdrawn at any time for internal reuse.

The *Official Catalog* has the brief but guaranteed description for each item or lot. Dynamic listings tend to go up earlier. The official catalogs may miss their web posting or go up late. In these cases, you have to use a polling fax or snail mail instead.

The third type is an *Inventory Value* document you'll have to generate all by yourself. You do this by using the fine DRMS search service to dump a list of the current inventory for your target site. These sheets show you the acquisition costs for each item, the bid dates, and the condition codes.

They also give you the FSC (Federal Supply Code) number. Your first four digits of this number can give you a clue as to exactly what type of item is being offered. Note that a "bowser" in class 2330 is literally a totally different animal than a class 8820 "bowser."

By searching for everything in a four-digit class, you can get a feel for the type of beast you are bidding on.

You may have to use smaller print and a landscape output to get all the columns to list properly.

Note that obvious misprints may or may not be. A "tirpod" could indeed be a useful thing to sit a video camera on. Or it could be part of the de-icing mechanism for some C-130 wing spar. While fiction and satire writers may be attracted to the "irony aluminum," I believe that this term really means aluminum scrap with hard-to-remove steel parts stuck to it.

Beware of listed "even value" costs such as $10.00 or $50.00. These are probably made up fictions that may or may not represent true prices.

There are several different types of sales. Each has its unique problems and opportunities. Let's list them here in the order I find most useful ...

Local Sealed Bid Sales

These are often your best bet. They typically consist of mixed lots of old and new stuff. Like salting a heap of Tektronix 565 doghouse scopes with a single newer 465. Rather often, there are very few bidders or no bidders at all on certain items. So you might be able to name your own price. Your usual ploy is to make reasonable bids on stuff you want and token bids on anything even remotely useful.

These sales usually start off with a 26-XXXX for Eastern US sales or else a 46-XXXX for Western US. Or at least in the "20s" or "40s."

The feds quite strongly suggest you *carefully inspect before you bid!* Which often prevents rude surprises such as ending up with poorly misdescribed trash. Or my finding out a load bank I won was ridiculously larger and far heavier than I thought it would be.

On one hand, inspection is plain old common sense. But on the other, there's no way to tell if an otherwise clean piece of test equipment has an internal problem. Even with a close look. And you can bid higher if you do not have the time and expense of a special inspection trip.

National Sales

A *National Sale* gathers together the *listed* offerings of a dozen bases into one combined catalog. Items tend to be of better quality and are much less assorted. Prices tend to end up higher because more bidders are attract-

MIL SURPLUS DRMO OFFICE LISTINGS (PART 1)

DRMO Alpha
Operation Joint Guard
Taszar, Hungary
APO AE 09793
Phone: 0036-82-426-740
Fax: 0036-82-426-739

DRMO Aberdeen (*)
Bldg 3620
Aberdeen PG MD 21005
Phone: 410-278-2235
Fax: 410-278-9220

DRMO Albany (*)
Bldg 1331 Dr 12 Topside
Marine Corps Logistics
Albany GA 31704
Phone: 912-439-5966
Fax: 912-439-5972

DRMO Anchorage
Bldg 34-600 Davis Highway
Elmedorf AFB AK 99506
Phone: 907-552-3733
Fax: 907-552-7548

DRMO Anniston
Bldg 282 AAD
7 Frankford Ave
Anniston AL 36201
Phone: 205-235-7837
Fax: 205-235-4468

DRMO Barstow
Marine Corps Logistics
Base Bldg 226 Boll Ave
Barstow CA 92311
Phone: 760-577-6568
Fax: 760-577-6526

DRMO Beaufort (*)
Box 55021
Bldg 1173
Beaufort, SC 29401
Phone: 803-522-7499
Fax: 803-522-7048

DRMO Belvoir (*)
8150 Beulah Street #101
Fort Belvoir VA 22060
Phone: 703-806-5632
Fax: 703-806-5567

DRMO Benning
Bldg 470
10th Mountain Div Rd
Benning GA 31905
Phone: 706-545-7214
Fax: 706-545-5125

DRMO Bitburg, Germany
Unit 4025
Bldg 1093
54634 Bitburg Germany
Phone: 011-49-6561-2484
Fax: 011-49-6561-2484

DRMO Bragg
Bldg J-1334 Knox St
Ft Bragg NC 28307
Phone: 910-396-5298
Fax: 910-396-7364

DRMO Bupyong
Unit #15395
APO AP 96283-0120
Phone: 011-82-32-524-4629
Fax: 011-82-32-520-6889

DRMO Campbell
Box 555 Bldg 5212
Fort Campbell KY 42223
Phone: 502-798-3525
Fax: 502-798-5183

DRMO Cannon
110 W Street
Cannon AFB NM 88103
Phone: 505-784-2436
Fax: 505-784-2012

DRMO Cherry Point
Bldg 154 D, Cleveland Dr
Marine Corps Air Station
Cherry Point NC 28533
Phone: 919-466-2743
Fax: 919-466-4075

DRMO Chievres, Belg
Unit #451 Bldg 66
Chievres Air Base
7950 Chievres Belgium
Phone: 011-32-68-27-5484
Fax: 011-49-06-31-4617

DRMO China Lake (*)
Naval Air Weapons Station
China Lake CA 93555
Phone: 760-939-2502
Fax: 760-939-0162

DRMO Colorado Springs
Bldg 318
Fort Carson CO 80913
Phone: 719-526-9678
Fax: 719-526-3656

DRMO Columbus
3990 E Broad St
Bldg 14
Columbus OH 43213
Phone: 614-692-3244
Fax: 614-692-3149

DRMO Corpus Christi
Bldg 22 Naval Air Station
Corpus Christi TX 78419
Phone: 512-961-2936
Fax: 512-961-3203

DRMO Crane
Naval Surface Warfare Ctr
Bldg 300 Highway 361
Crane IN 47522
Phone: 812-854-1554
Fax: 812-854-1998

DRMO Denver (*)
Bldg 621 Rocky Mtn Arsenal
Commerce City CO 80022
Phone: 303-289-0376
Fax: 303-289-0523

DRMO Drum Annex
10th Mountain Division
Bldg S-1350
Ft Drum NY 13602
Phone: 315-772-4592
Fax: 315-772-5809

DRMO Duluth
4997 Airport Rd
Duluth MN 55811-1517
Phone: 218-723-7441
Fax: 218-722-2611

DRMO Dyess
box 9545
358 Ammo Rd
Dyess AFB TX 79607
Phone: 915-696-2578
Fax: 915-696-3450

DRMO Edwards (*)
70 East Forbes Avenue
Edwards AFB CA 93524
Phone: 805-277-2209
Fax: 805-277-7039

DRMO Eglin
Bldg 525
Transportation Rd
Eglin AFB FL 32542
Phone: 850-882-2822
Fax: 850-882-4789

DRMO El Toro (*)
Bldg 319
Marine Corp Air Station ET
Santa Ana CA 92709
Phone: 714-726-4937
Fax: 714-726-3151

DRMO Ellsworth
650 Twining
Ellsworth AFB SD 57706
Phone: 605-385-1018
Fax: 605-385-1615

DRMO F E Warren (*)
7700 Booker Rd Bldg 930
Cheyenne WY 82005
Phone: 307-773-3970
Fax: 307-773-4160

DRMO Fairbanks
Bldg 5001
1/4 Mile Badger Rd
Fort Wainwright AK 99703
Phone: 907-353-7406
Fax: 907-353-7416

DRMO Fairchild
120 N Foulois Ave.
Fairchild AFB WA 99011
Phone: 509-247-4228
Fax: 206-967-8375

DRMO Forest Park (*)
Ft Gillem Bldg 310-B
Forest Park GA 30050
Phone: 404-363-5117/5118
Fax: 404-362-7424

DRMO Ft Bliss (*)
1733 Pleasonton Rd
Bldg 11126 Biggs Field
Ft Bliss TX 79916
Phone: 915-568-8503
Fax: 915-568-8161

DRMO Gordon (*)
Bldg 994
10th Street
Ft Gordon GA 30905
Phone: 706-791-3749
Fax: 706-791-8623

DRMO Grand Forks (*)
548 3rd Ave
GF AFB ND 58205
Phone: 701-747-3783
Fax: 701-747-4594

DRMO Great Falls
8035 Pole Yard Rd
Malmstrom AFB MT 59402
Phone: 406-731-6346
Fax: 406-731-6560

DRMO Great Lakes
Bldg 3212A
3012 Mississippi Street
Great Lakes, IL 60088
Phone: 708-847-3655
Fax: 708-847-2510

DRMO Groton
NSBase New London
Bldg 397 Box 12
Groton CT 06349
Phone: 860-449-3523
Fax: 860-694-2866

DRMO Guam
PSC 455 Box 151
FPO AP 96540-1900
Phone: 011-671-339-5227
Fax: 011-671-339-4228

DRMO Guantanamo
Bldg 696B PSC 1005
Box 33 Code 230
FPO AE 09593
Phone: 0-115-399-4184
Fax: 0-115-399-4184

DRMO Hawaii
Barbers Pt B140
Enterprise & Midway St
NAS Barbers Pt HI 96862
Phone: 808-684-5980
Fax: 808-684-6670

DRMO Hill
Bldg 890 7844 Arsenal Rd
Hill AFB UT 84056
Phone: 801-777-7422
Fax: 801-777-2695

DRMO Holloman
241 Arkansas
Holloman AFB NM 88330
Phone: 505-475-3748
Fax: 505-475-3235

DRMO Homestead Annex
29050 Coral Sea Blvd
Homestead ARS, FL 33039
Phone: 305-224-7300
Fax: 305-224-7451

DRMO Hood
80th Street Bldg 4289
Tank Destroyer & 80th Street
Ft Hood TX 76544-0210
Phone: 254-287-7763
Fax: 254-288-6794

DRMO Huachuca (*)
Bldg 90507
104 Brainard and Jim Ave
Sierra Vista AZ 85613
Phone: 520-533-2074
Fax: 520-533-7078

DRMO Huntsville
Bldg 7408 Warehouse Road
Redstone Arsenal AL 35898
Phone: 205-876-2453
Fax: 205-955-6687

DRMO Jackson
Bldg 1902 Ewell Road
Ft Jackson SC 29207
Phone: 803-751-7912
Fax: 803-751-3506

DRMO Jacksonville
Naval Air Station
8297 Roosevelt Blvd B174
Jacksonville FL 32212
Phone: 904-542-3411
Fax: 904-542-3418

DRMO Keesler
607 Parade Lane VHI Rm 1
Keesler AFB Bldg 4422
Biloxi MS 39534
Phone: 850-882-2822
Fax: 850-882-4789

DRMO Keflavik, Iceland
Bldg 866
PSC 1003 Box 29
235 Keflavik Airport Iceland
Phone: 011-354-425-7306
Fax: 011-354-425-7092

DRMO Key West
Bldg 931
Naval Air Station
Key West FL 33040
Phone: 305-293-5271
Fax: 305-293-5274

DRMO Kirtland
5050 Randolph Aveunue
Kirtland AFB NM 87117
Phone: 505-846-6959
Fax: 505-846-1825

DRMO Knox
2962 Frazier Road
Ft Knox KY 40121-5640
Phone: 502-624-3244
Fax: 502-624-7321

(*) Scheduled to close in the next few months.

ed to the sale. All the items *remain* on the supplying base. Inspection is *highly* encouraged. These sales often do start with 31-XXXX. Or other "30s."

Back in the old days of printed and snail mail catalogs, putting everything into one listing made sense. But with online listings and a polling faxback access, I don't see the point. You have to wade through all sorts of stuff that you couldn't possibly pick up to get at one or two reachable items.

Certain items in these sales may need a signed *End User Agreement.* In which you promise not to drop ship your winnings to Saddam or Fidel. These forms usually have to be faxed or remailed each time.

RCP Sales

These are the *Recycling Control Point* sales. They often have more detailed catalog descriptions and *they will ship to you.* Unlike regular sales, inspection is *not* permitted. These sales typically start with 01-XXXX. They are usually sorted into aircraft parts, instruments, test equipment, electronic parts, and miscellaneous hardware.

There seems to be a "one size fits all" shipping charge of $50.00 *added* for most items. This sort of has the effect of *raising* the minimimum bid to $60.00. Which is often much too high for a possibly broken single piece of older test equipment. The trick, of course, is to bid on lots that can share the $50.00 among several items. Or for heavier trophies on which such a charge can end up a real bargain.

RCP Group Sales

This one is raising quite a howl on my website and elsewhere. Because it seems so grossly unfair to individual bidders and most small scale startups. Group sales also start with 01-XXXX. Like the regular RCP sales, there are good descriptions, no inspection, and prepaid shipping.

Only this time, you have to bid on an *entire* one-bid-takes-all pile called a *group*. Which can be everything that a chosen base added to the sale. Often, there will be seven groups instead of several hundred lots.

From the feds standpoint, disposal costs are way lower, admin is a lot simpler, and there's no problems with unbid items. But the bidder now has to risk thousands or tens of thousands of dollars instead of pocket change. And you have to take all the junk to get at the goodies. Which leaves you with a "iffen yew cain't hunt with the big dogs, stay on the porch" situation.

On the other hand, the higher risks and minimums might drive down the individual item prices. Way down so far. But note that the shipping charges alone sometimes exceed $3,000.00.

The secret is to carefully add up the maximum you are willing to pay *only* for each item you *really* can use. Then, you internalize the shipping charges before you bid. If you end up with less value than your charges, then you obviously do not bid. Otherwise, you bid only the difference.

In a recent example, two mil worth of test equipment went for *three cents on the dollar* at $60,000.00. Plus the $3,700.00 worth of shipping charges.

Fully one third of the stash was HP spectrum analyzers described in "fair" condition. In other examples of much less obvious or less desirable stuff, the winning bids ended up way *under* the shipping charges.

While in the running, I have yet to hit on one of these group sales. But scoring places you in the surplus biz big time. And very conveniently.

Other Sales

There's several other types of less popular and less useful sales. A RCP LDV or *low dollar value* sales start with 02-XXXX and works just like a group sale. There is *one* winner-takes-all bid for a whole truck or two full of junk. Typically two-thirds aircraft parts and one-third electronic pieces. Maybe 1,500 items in mixed quantities. Mostly new. These would be more useful if they split the electrics out.

The *international* sales are normally held at places that you cannot get to. Driving to Guam or the Azores can be a real drowner. International sales may start with 50-XXXX.

Special sales are put on for larger boats (destroyers go for $200K), for general scrap (used cooking grease seems fairly popular) or for classified electronic scrap where you'll have to give proof of strict security controls before you are allowed to bid.

Some DRMO sites also offer a retail store where the stuff is sitting around with marked prices. Desks and filing cabinets are often popular here. Their hours tend to be short and unusual, so call before attending.

Live auctions are also rarely held.

Condition Codes

The feds try to indicate the quality of each item by using *condition codes.* One obvious set of codes runs *unused*, *good*, *fair*, *poor*, *residue*, and *scrap*.

Their fancier set consists of a letter followed by a number. A1 means new and perfect. A4 implies like new. F7 means probably easily repairable F8 means probably *not* easily repairable. H7 means pretty bad. HX means scrap plus hazardous materials that may be illegal to dispose of.

Most "F" test equipment does not include manuals, probes, and some plug-ins. We looked at finding older test equipment manuals last month back in RESBN80.PDF.

Additional details of these specific meanings are shown on their website. The bottom line: Use caution with any "F" item and extreme caution with any "H." Unless you token bid. Even then, the pickup and triage expenses may not be worth the hassle.

But a stack of identical bad items can often be rebuilt into a smaller pile of good ones. Provided they all failed in different ways.

Efficient Markets

An economist defines an *efficient market* in which there are lots of very smart buyers that force a "fair" price. With rather few exceptions, most mil surplus does not come even remotely close. As much as *one third* or so of the items will have no bidders at all. Or at most, only a single bidder. Whose bid price was obviously too high. Certain older specialized electronics may go for tenths of a cent on the dollar.

Older electronics do tend to be uselessly bulky and heavy. And may have zero market, except as scrap.

Some popular items do get bid up to respectable prices, though. Most of the "army-navy store" items go for 10 or 20 percent of cost. Modern Tek scopes "A4" and by themselves might hit 20 percent, while a like-new HP Spectrum analyzer might go for 35. A few high demand lathes and milling machines may actually go for 300% of mil cost. Owing to some recent dramatic price increases.

The vacuum tube nuts have been having a feeding frenzy lately. Seems your feds have of late been dumping mountains of tubes. Perhaps 80,000 of one number at a whack. Some of these are actually going for 130 percent of original cost! **NV**

(To be continued next month)

Don is the webmaster of his Guru's Lair found at ***http://www.tinaja.com***

AT&T 6300 Monitor Pinout

Q & A – Continued from page 33

Q. My wife bought a computer at a yard sale: an AT&T model 6300 made in Italy with a 1990 date on the back panel. It has a 20 MB hard disk and 640K of RAM. The machine seems to boot, but without an operating system. I tried installing DOS 3.3, but it wouldn't take. DOS 4.0 displays an illegal interrupt that causes the screen to roll out of control, like a TV with a bad vertical hold. If you can tell me how to get it working, I'd be grateful. More importantly, though, is whether or not I can use the color monitor on a VGA computer. There's a cord coming from the monitor with a DB25 connector at the end.

Stanley Kelember
skele@ccny.com

A. *This is an IBM PC AT clone made for export and assembled outside the country. As such, part of the operating system (DOS) is contained in the BIOS, which means you need a copy of the original DOS to get the system up and running. This was – and still is – done because certain types of software, like encryption software, can't be exported. Perhaps one of our readers has a copy. As for the monitor, it will work with your VGA computer. Here's the pinout with a VGA cross-reference.*

	AT&T 25-pin	*VGA 15-pin*
Pin	***Function***	***Pin***
1	*Horizontal sync*	*13*
2	*ID0*	*11*
3	*Vertical Sync*	*14*
4	*Red*	*1*
5	*Green*	*2*
6	*Blue*	*3*
7	*not used*	*—*
8	*not used*	*—*
9	*not used*	*—*
10	*ID1*	*12*
11	*Mode*	*0*
12	*not used*	*—*
13	*- Degauss*	*—*
14	*GND*	*6*
15	*GND*	*7*
16	*GND*	*8*
17	*GND*	*10*
18	*GND*	*—*
19	*GND*	*—*
20	*GND*	*—*
21	*GND*	*—*
22	*not used*	*—*
23	*not used*	*—*
24	*+15V*	*—*
25	*+15V*	*—*

For monochrome, ID0 and ID1 are open. For color, ID0 is 0, and ID1 is 1 (+5V).

MAILBAG

I downloaded TEST2000.ZIP and ran it. It says I'm not Year 2000 compliant, but could be if I used the program Y2KPCPro. How do I obtain this program?

Chaurlie Eakin
via Internet

Response:
At present Y2KPCPro is only sold in volume to organizations, with a minimum license for 10 PCs. However, individual users can find Y2KPCPro under the name CHECK 2000 PC, manufactured by Greenwich Mean Time. It's available from the following retailers for about $49.95.

CompUSA, Computer City, Micro Center, Office Depot, OfficeMax, J&R, Electronics Boutique, Chapters, London Drugs, @Computers Plus, Compucentre, Crazy Irving, Adventure Electronic, Future Shop, Costco, Bureau En Gros, RadioShack, Business Depot

Dear Mr. Byers:

In the July '98 issue, you answered a question about a clock that automatically receives a time signal through the airwaves. My Sony VCR (SLV-975-HF) does the same thing. Here's a quote from the owner's manual. "Some TV and cable channels transmit time signals with their broadcasts. Your VCR can pick up this time signal to automatically set the clock." Hope this helps.

Detroit
via Internet

Response:
My Samsung VCR does the same thing! The problem is that the time signal hitches a ride on your PBS channel, which isn't always strong enough to set the clock. Yes, it always works with cable, but I've found airwave signals to be sometimes questionable. Makes you wish our WWVB network were as reliable as Germany's.

TJ Byers
Q & A Editor

reader FeedBack

Continued from page 14

herein are represented up to 1/2 mile east of their actual location and occasional N-S errors of approximately the same magnitude.

In addition, the GPS III shows the head of lake navigation to be at N37° 47.6', W120° 23.6' whereas, with the lake at least 20 feet below the high water mark, the head of lake navigation is upriver at least seven to eight miles on three separate arms, none shown on the GPS III. This display also shows the lake as it would be if its level were 150-200 feet below the high water mark.

I found similar errors on other bodies of water as well. This is not only misleading, it could be dangerous to boaters. I realize that your warning disclaimer on the second screen to appear after power up is intended to deflect complaints and liability, but accurate shoreline representation is what I purchased the unit for. The level of detail shown is satisfactory, it just should be at the correct location.

The GPS location reported out of the NMEA port is usually accurate as evidenced by tracking along the highway with a DeLorme CD-ROM map on a notebook computer. (I do not use the computer in my boat.) Once on shore, the GPS position display on the notebook computer did correspond with the actual shoreline quite well at the few places that I observed it (usually at or near the launch ramp).

Although I did not purchase this unit for highway navigation (maps and signs are usually good enough), I find that the highway locations are likewise often misplaced — in some places perhaps at lease 1,000 feet off. At times, the railroads location is even shown on the wrong side of the highway.

Given a choice between highway maps and accurate representation of bodies of water, I will take accurate lake or ocean shores anytime. Location of small boat harbors (Newport Beach, Dana Point, Oceanside, CA, etc.) and breakwaters would likewise be extremely useful on your map display.

The altitude calculation and display on the GPS III is totally worthless. At my home location at about 600 feet elevation, the displayed altitude varies from -1,000 to +2,000 feet. You do not publish an altitude accuracy specification, but plus or minus 1,500 feet does nobody any good.

One further comment, the backlight is too dim (even at its brightest) for use inside a recreational vehicle in the daytime or anywhere at twilight.

My question is, does Gordon plan to offer a software and/or land data upgrade at a later date to correct these deficiencies?

John E. Lemmer

Response:

I agree with your findings, and again I say to all GPS users, don't rely on embedded land mapping information for coastal boating or navigating in tight spots on lakes and rivers. The land maps should be considered a "bonus" for those driving on major highways who want to take a look and see how many miles away the next town is, or the next big interstate turn-off. You might call this a "gee whiz" feature that might be useful out on the road.

But trying to safely navigate in harbors, oceans, lakes, and rivers with this type of information can be quite dangerous.

In fact, I would never go out on any body of water without a good local paper map or chart, and a GPS that would run off of specific C-Map or Navionics chart cartridges. Or I would tie the output of my GPS set into a professional CD-ROM land or marine charting program, and have the best of all worlds.

As Mr. Lemmer indicates in his letter, the GPS was indeed accurate, but the embedded no-local-cartridge cartography was not close enough for precise navigation.

This letter should serve as an important warning to anyone using GPS with pre-stored, embedded cartography.

Gordon West

Dear Nuts & Volts:

After reading yet one more article about the Y2K problem, the only thing that comes to mind about this bug is that its sole purpose in life is to sell articles and books for the purpose of fanning the hysteria flames.

Nowhere in any of these well-written articles is it mentioned that most computer controlled machinery other than financial institutions don't care what decade it is let alone what century.

A traffic light is quite happy living in the 18th century let alone the 21st, and will work just fine even if it prints out to its master the wrong information about its date status. Cat scanners, air conditioners, and water pumps work just fine with "00" instead of "99," and so will 99 percent of all other computers.

Financial institutions that haven't been upgraded before the change over "will be closed (and presumably forced to do manual calculations) according to the FED.

Even pre 90s Taiwan imitation PCs such as the one writing this letter don't have a problem with "00" and I doubt most other PCs will have a problem either.

Yes, there are a few systems in this country that will crash, but as far as the financial systems go, the latest figures are 98% and climbing referring to the fact that most computer programs have already been fixed. Panic and hysteria will cause more problems than the Y2K bug ever will.

Computer programs designed to seek and destroy (modify) the bug can, in effect, repair or rewrite a complete system within hours — not days or months — lowering the cost.

The idea that individual systems have to be reset manually by human hands and eyes is absurd. The purpose of computers is to speed up this process and programs such as Cobol and DOS were invented and designed to work universally on individual systems and work without the need of programmers at each station.

Once a language was written it was put to magnetic media and copied, transferred, and used at many different locations. A magnetic solution done at one location can also be copied, transferred, and distributed to other locations to fix, upgrade, or rewrite an entire system simply by inserting the new magnetic media or disk.

Individual company information doesn't reside within the realm of the date code, with the date being the only informational change needed. All other information such as shape, size, and direction will follow blindly the time code, once changed.

Even if a company opts to keep "00" representing the date "1900," all computations will follow blindly and happily thinking it is the year 1900, and will perform as intended without the slightest glitch. Only financial institutions with monetary interests in mind such as percentages, dollars, and interest rates need worry or change the date codes.

Traffic lights will regulate model "Ts" or "T-Birds" without even considering what century it is. If money isn't involved, then time and dates won't affect the running of switches, pumps, or even doors and elevators.

Reading an expired date code on my milk that says January 5, 1900 isn't going to lock up my arm and stop me from pouring it over my cereal unless hysteria and stupidity take control of my motor functions! I usually sniff the milk first and I suspect most americans also use this high-tech approach.

The fact that the date code will either read exactly correct or will be one century off doesn't take rocket science to figure out and I doubt a single citizen in this country will have a problem figuring out which is which?

The problems that reside within the Y2K bug are mostly in the financial district and the government has stated that any company that doesn't fix the problem before the year 2000 will be closed before that date and not allowed to trade until the upgrade has been installed.

The fact that the date code which is embedded in the chip or program allows for a date to exist that goes back to the year 1900, and is acceptable as a legitimate date code, means that aside from the financial institutions, there is nothing wrong with the year 1900 and most systems will run on that year code as if nothing was wrong.

I realize that I too have over-simplified the problem and that there will be some problems that will occur, but most articles over-play the problem and risk causing a panic that need not exist, and if unattended will likely cause a crash in the stock market and financial arenas simply because these institutions are run by ego, speculation, and blind trust to begin with.

Chris
Bieber, Ca

The Computer Controlled World: RS-232 Network Control Methods and Applications

GRAPHIC LCD DISPLAYS: PART 2

by Ryan Sheldon, National Control Devices (404) 244-2432 http://members.aol.com/ncdcat

Control up to Eight Graphic LCD Displays from Visual Basic 5 for Windows

Last month, I discussed graphic LCDs and how they can be controlled from Qbasic. And, once again, my Windows readers can learn how to add the power of graphic LCDs to their next custom Visual Basic application.

Graphic LCDs are not difficult to control, but they do require some time and patience. I have spent nearly 10 months packaging the LCD Animator 128 into a usable collection of information, both in the form of hardware and software. As a result, many users of the LCD Animator 128 are loading and displaying images and text within 15 minutes of taking it out of the box.

The most valuable part of this learning process — in my opinion— is that first-time users are able to skip the complexities of how the display controller works. As their curiosity is peaked, they can go back and read about their particular topic of interest. By allowing people to learn at their own pace, they are often less frustrated with the technicalities ... and I might add that graphic LCDs can be full of technicalities.

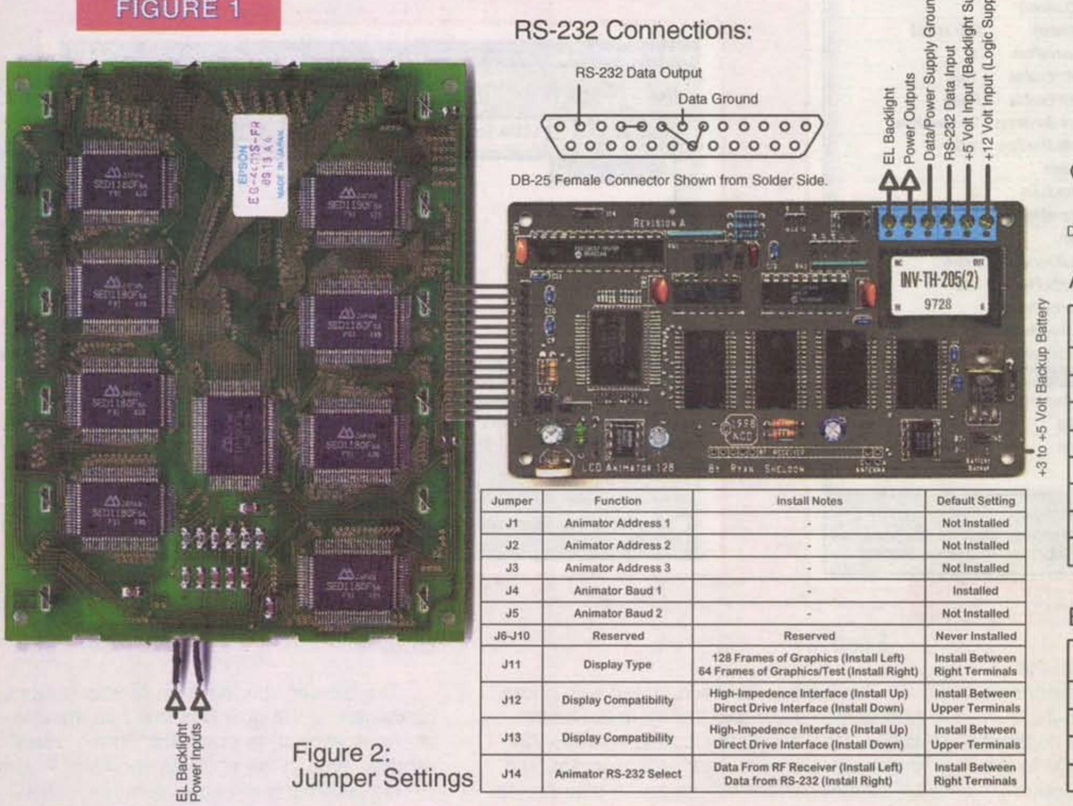
I guess it's easy for me to say that it is easy to control an LCD display but, in reality, I need to show users exactly what I am talking about before they think it's easy too. But to do this effectively, I am going to need some room for illustrations. So, I have broken this article into two parts. Next month will be a little more exciting, but for now, I want to get into the mechanics of controlling the LCD Animator 128 from Visual Basic.

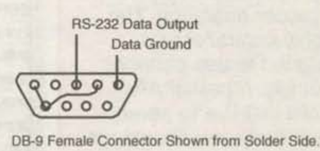
So this month, I want to show you how to use simple commands to control these LCDs by making simple use of subroutine calls. The subroutines have already been written for you, so all you need to do is use them appropriately to control the display.

Step 1

To get started, you will need to connect

FIGURE 1





Address Setup:

NCD Address	J1	J2	J3
0,8	Removed	Removed	Removed
1,9	Installed	Removed	Removed
2,10	Removed	Installed	Removed
3,11	Installed	Installed	Removed
4,12	Removed	Removed	Installed
5,13	Installed	Removed	Installed
6,14	Removed	Installed	Installed
7,15	Installed	Installed	Installed

Baud Rate Setup:

Baud Rate	J4	J5
9600	Removed	Removed
19,200	Installed	Removed
38,400	Removed	Installed
115,200	Installed	Installed

Jumper	Function	Install Notes	Default Setting
J1	Animator Address 1	-	Not Installed
J2	Animator Address 2	-	Not Installed
J3	Animator Address 3	-	Not Installed
J4	Animator Baud 1	-	Installed
J5	Animator Baud 2	-	Not Installed
J6-J10	Reserved	Reserved	Never Installed
J11	Display Type	128 Frames of Graphics (Install Left) 64 Frames of Graphics/Test (Install Right)	Install Between Right Terminals
J12	Display Compatibility	High-Impedence Interface (Install Up) Direct Drive Interface (Install Down)	Install Between Upper Terminals
J13	Display Compatibility	High-Impedence Interface (Install Up) Direct Drive Interface (Install Down)	Install Between Upper Terminals
J14	Animator RS-232 Select	Data From RF Receiver (Install Left) Data from RS-232 (Install Right)	Install Between Right Terminals

Figure 2: Jumper Settings

THE COMPUTER CONTROLLED WORLD

FIGURE 2

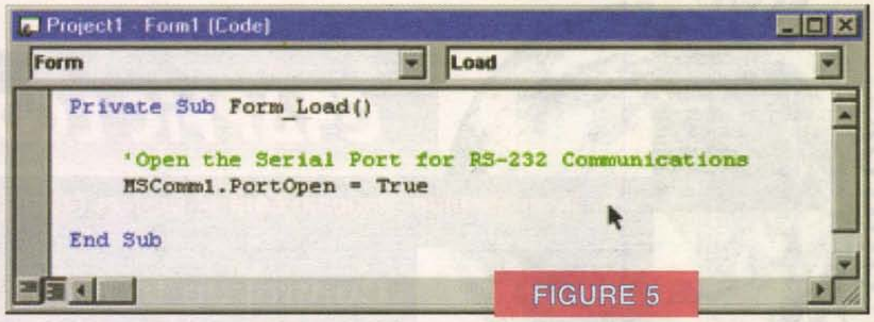


FIGURE 5

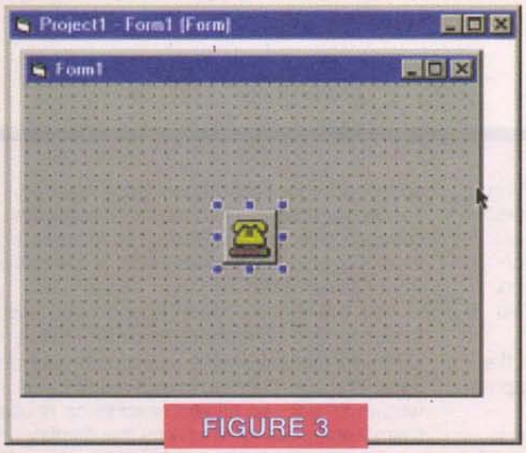


FIGURE 3

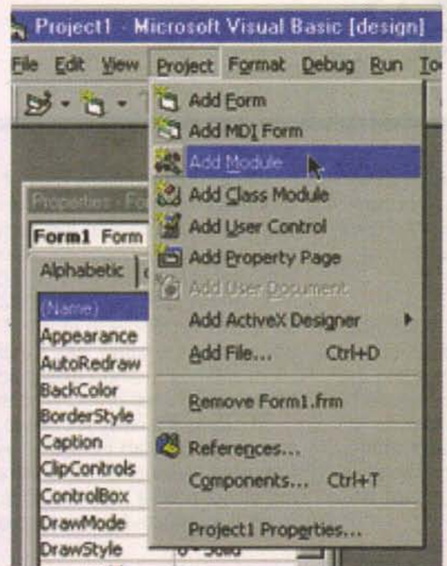


FIGURE 6

the LCD Animator 128 as shown in Figure 1. Set all jumpers to their default setting as shown. Make sure batteries are attached to the battery backup system. Batteries are not an option; they are a necessary component required for proper operation. The display controller was designed to use batteries sparingly. A pair of AAs should last five to seven years. Also, you should run the included Windows program, "LCD Animator Setup Utility" to initialize the display. Once initialized, the LCD Animator 128 will be waiting for commands.

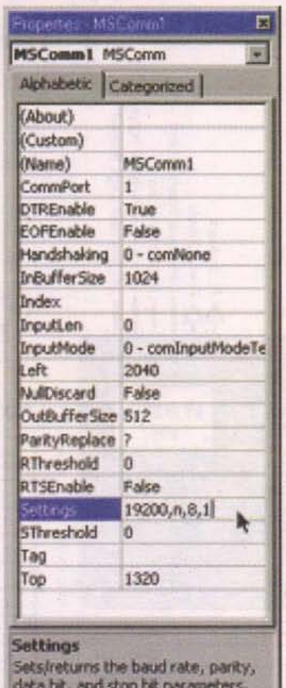


FIGURE 4

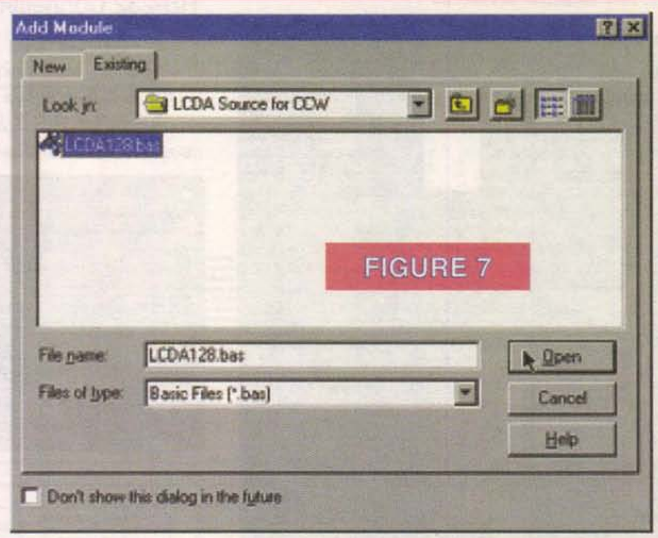


FIGURE 7

Step 2

Start Visual Basic 5 and select "Standard EXE" to begin a standard project.

Step 3

Next, select "Components" from the "Project" pull-down menu. The Components dialog box is used to add functionality to your VB applications. To add serial communications to your VB project, put an "X" in the box next to the "Microsoft Comm Control" label and select "OK."

Step 4

The toolbox will be updated with a telephone icon as shown in Figure 2. Double-click on the telephone icon to add RS-232 communications to your new program. The MSComm control will appear in your project as shown in Figure 3. The telephone icon will not be visible when the application is run. This icon is called an object in VB terminology. Your program will speak to this object each time you want to send data out the serial port.

Step 5

Select the MSComm icon on your application form. Use the "Properties" window to change the attributes of the MSComm control. Change the "Setting" attribute to 19.2K baud as shown in Figure 4. Note that the "CommPort" property should also be set to communicate with any available COM port on your computer. By default, the "CommPort" property is set to 1. An error may be generated if an unavailable COM port is chosen.

Step 6

Double-click on the form of your project (anywhere in the gray box that has the telephone icon on it) to open the "Form" "Load" window. Type in the code as shown in Figure 5. This command will open communications to the serial port when the project is first run.

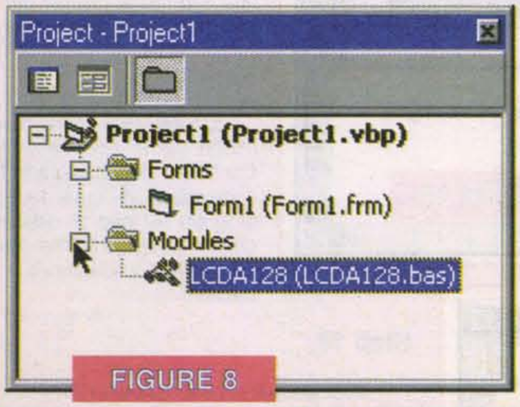


FIGURE 8

FIGURE 9

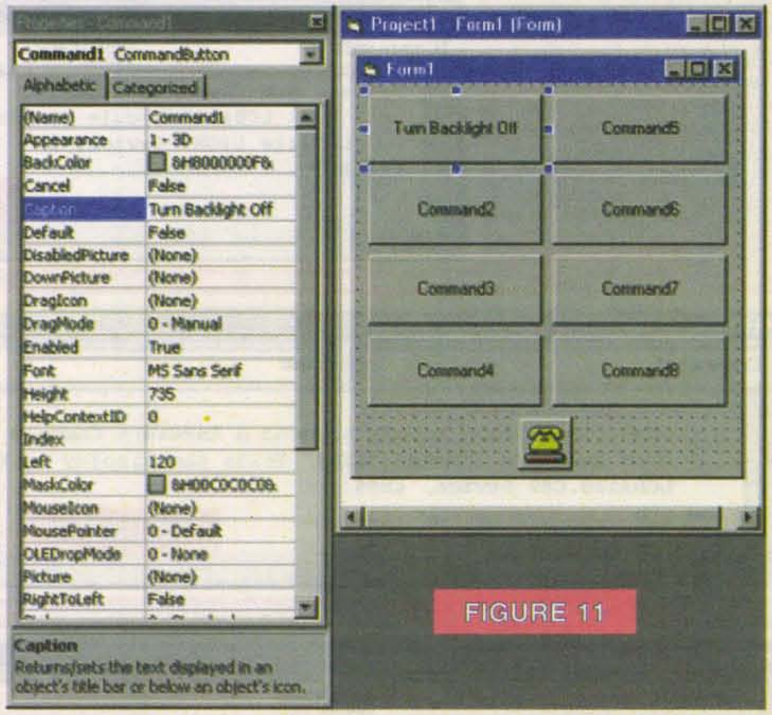


FIGURE 11

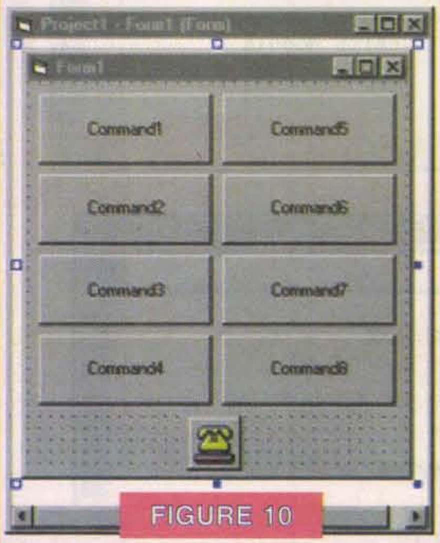


FIGURE 10

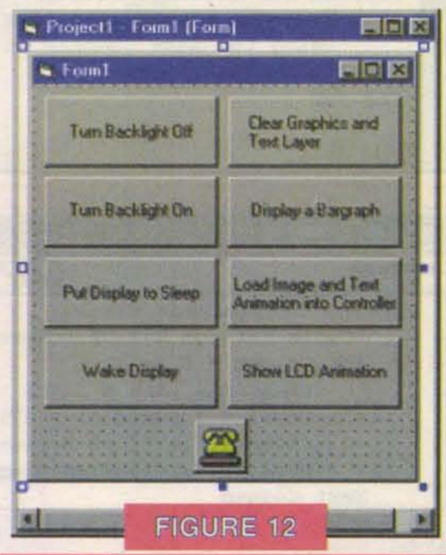


FIGURE 12

Step 7

Cheat. Instead of having you type in the core subroutines used to control the LCD Animator, I will have you download them from my web site at http://members.aol.com/ncdcat/. You can then load them into your project; effectively adding a complete command set to Visual Basic for communication to the LCD Animator 128 controller. While this does not save much programming, it does save magazine space. You can easily add this command set to your application by selecting "Add Module" from the "Project" menu as shown in Figure 6.

NOTE: Download the file "CCW0007.ZIP" to obtain all the source-code and images required for this article. Once you have downloaded this file, you should unzip the contents onto a floppy disk. All future references to files can be found on this disk.

Step 8

Select the "Existing" tab and the file "LCDA128.BAS" (and don't forget; this will be on your floppy disk, see note above). See Figure 7. This collection of subroutines will speak directly to the LCD Animator. You can view this small collection of subroutines by double-clicking on the "LCDA128.BAS" module shown in the project window (Figure 8).

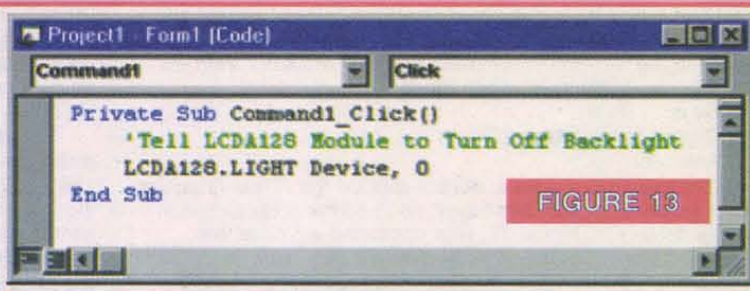


FIGURE 13

Step 9

Select the button tool as shown in Figure 9 and draw eight buttons as shown in Figure 10.

Step 10

Use the "Properties" window shown in Figure 11 to caption each of the buttons as shown in Figure 12.

Step 11

It's time to add functionality to these eight buttons. Double-click the "Turn Backlight Off" button to reveal an empty window. Enter the code shown in Figure 13. If you are not familiar with Visual Basic, then you will probably appreciate how subroutines are stored within modules. A module is simply a collection of subroutines. In this case, LCDA128 is the name of the collection. This collection is used specifically to control the LCD Animator 128. A different collection of subroutines would be used to control other devices.

Figure 13 simply tells the module (LCDA128) to execute a subroutine for controlling the backlight (LIGHT). Later, you will see how you can easily send other commands to the LCD Animator by calling other subroutines from within the LCDA128 module.

```
Private Sub Command2_Click()
    'Tell LCDA128 Module to Turn On Backlight
    LCDA128.LIGHT Device, 1
End Sub
```

FIGURE 14

```
Private Sub Command3_Click()
    'Use the LCDA128 Module to Send a Hardware Command
    'The Hardware Command "&H84" Tells the Display to Sleep
    LCDA128.CMD Device, &H84
End Sub
```

FIGURE 15

```
Private Sub Command4_Click()
    'Wake the LCD Display from Sleep Mode
    'Using the Wake Command in the LCDA128 Module
    LCDA128.Wake Device
End Sub
```

FIGURE 16

```
Private Sub Command6_Click()
    'Cycle through all 32 columns of text
    For Column = 0 To 31
        'Randomly pick a level
        Level = Int(Rnd(1) * 17)
        'Display Level on Screen
        LCDA128.VerticalTextGraph Device,
    Next Column
```

FIGURE 17

Step 12

Double-click the "Turn Backlight On" button and add the code shown in Figure 14. Note that two parameters are passed to the LIGHT subroutine stored within the LCDA128 module. The first parameter is "Device" and is a number from 0 to 7 used to send commands to a specific LCD Animator. Remember, up to eight LCD Animators can be attached to and controlled from a single serial port. The device number simply determines which of eight LCD Animator modules will receive the command to turn on the backlight.

Step 13

Double-click on the "Put Display to Sleep" button and add the code shown in Figure 15. This command will put the LCD Animator into low-power sleep mode.

Step 14

Double-click on the "Wake Display" and add the code shown in Figure 16. This command will wake the LCD Animator from low-power sleep mode.

Step 15

Next, double-click on the "Clear Graphics and Text Layer" and add the code shown in Figure 17. This command will clear the graphics layer, then the text layer. Since each layer is controlled independently, you will later be able to change the text displayed on top of a graphic image without affecting the graphics.

Step 16

Double-click on the "Display a Bargraph" button and add the code shown in Figure 18. This subroutine shows how you can easily display bargraphs on the LCD screen.

Step 17

Double-click on the "Load Image and Text Animation Into Controller" button and add the code shown in Figure 19. This program will load 16 different graphic images into the controller when the button is pressed.

Step 18

Double-click on the "Show LCD Animation" button and add the code shown in Figure 20. This short subroutine animates the images stored in the first 16 frames of the controller's memory. You must click the "Load Image and Text Animation Into Controller" button to load the images into the first 16 frames of memory. Otherwise, the screen will show garbage as you cycle through the animation frames.

Step 19

Now you can run your Visual Basic application. Try clicking on these eight buttons and watch the results on the screen of the LCD Animator.

Applications

Many readers have written to tell me about the projects they are working on and how they are using my devices to control the world from their PC. One reader wrote with a very creative control solution.

He is a big home-automation fan. He has a low-end Pentium computer stashed in his basement running Windows 95 and Visual Basic. He ran RS-232 wires throughout his house and yard. He uses our 8SC input scanner to read inputs connected to motion detectors. He uses a couple of AD8s to read temperature, light, and moisture levels in his yard. He also uses our ASEL connected to 12 cameras strategically placed throughout the premises. He uses our R85 to control various alarms, lights, and the sprinkler system in his yard. And finally, the LCD Animator is used to display messages of text and graphics based on data retrieved throughout his house, in his office.

When you walk through his house, motion is detected by the 8SC input scanner. The ASEL automatically switches to the video camera closest to that area. Data is sent to the LCD Animator informing him of the detected motion, a monitor shows him the area in which motion was detected. If he is not at home, alarms will sound and lights will flash.

Additionally, the AD8 monitors the temperature of his house and regulates the heating and cooling system using the R85. During the day, if the ground gets too dry and it is not raining, sprinklers will automatically activate. The cooling system in his house is kept off during weekdays, and activates 30 minutes before he comes home from work to conserve energy. These are the types of things our control network is used for. We have found many people who are using the LCD Animator in kiosks, movies, home, and industrial automation control applications.

By combining the power of these specific devices, you will be able to build a computer control system suited to your specific needs, with readily available off-the-shelf components.

Well, I hope you have been able to see a good working demo of how to send images and text to the LCD Animator 128 controller. Next month, I will continue the subject of LCD Animation by showing you some practical real-world control applications. Until then, feel free to call or write with your questions and comments.

Remember: the LCD Animator 128 is available to readers of this article for a special low price of $199.00. **NV**

Project1 - Form1 (Code) — Command6 / Click

```
Private Sub Command6_Click()
    'Cycle through all 32 columns of text
    For Column = 0 To 31
        'Randomly pick a level
        Level = Int(Rnd(1) * 17)
        'Display Level on Screen
        LCDA128.VerticalTextGraph Device, Column, Level
    Next Column
End Sub
```

FIGURE 18

Project1 - Form1 (Code) — Command7 / Click

```
Private Sub Command7_Click()
    'Count Frames from 1 to 16
    For FRAM = 1 To 16
        LCDA128.FRAME Device, FRAM: Rem Set the Current Frame
        LCDA128.CLRTXT Device: Rem Clear the Text Layer on the Current Frame
        File$ = "A:\FRAME" + Str$(FRAM) + ".BMP": Rem Create Filename of Image to Load
        LCDA128.SPEEDFILE Device, File$: Rem Load Image File into Display
    Next FRAM
End Sub
```

FIGURE 19

Project1 - Form1 (Code) — Command8 / Click

```
Private Sub Command8_Click()
    'Cycle Through 16 Frames of Animation
    For FRAME = 1 To 16
        LCDA128.FRAME Device, FRAME
    Next FRAME
End Sub
```

FIGURE 20

Boards and Chips Available

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National Control Devices
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Fax: **(417) 646-8302**
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The LCD Animator and EL Backlit LCD Display are available to readers of this article for just $199.00. You must mention this article when ordering.

THE COMPUTER CONTROLLED WORLD

New Product News

Continued from page 9

PALM PILOT

Whether traveling for business or pleasure 3-Com Connected Organizer – Palm Pilot – users can now turn their electronic organizer into a handheld navigation system, complete with maps and an electronic compass with The Palm Navigator by Precision Navigation, Inc.

the Palm Navigator, available for only $39.95, is a hardware sensor module that plugs into the bottom of the Palm Pilot (like a modem) turning it into a map navigation system and state-of-the-art electronic compass.

Included with the Palm Navigator is free MapSync software that allows for the easy downloading and storing multiple maps from the web onto the Palm Pilot.

The Palm Navigator provides direction information instantaneously and continuously whether moving or not. In addition, the Palm Navigator works even when under trees, near tall buildings or in a canyon, which GPS cannot do.

The Palm Navigator has no limit to how many maps can be stored or how small or large the maps can be displayed on the screen.

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DP-9 AND DP-9S MULTIBAND HF ANTENNAS

Dynamic Technologies, Inc. announces the release of DP-9 and DP-9S multiband HF antennas.

The DP-9 consists of nine full-size dipole antennas separated about two inches with PVC spacers for 160, 80-75, 40, 30, 20, 17, 15, 12, and 10 meters.

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The DP-9S is the same as the DP-9 except the 160 meter antenna has coils placed in the center of each side. The DP-9S is only 140' long and has a 2:1 SWR bandwidth of approximately 30 KHz on 160 meters and full bandwidth on the other bands.

DP-9 costs only $189.00 and the DP-9S costs $210.00 plus $10.00 shipping to USA locations.

For more information, contact:

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CODE TUTOR

MFJs new professional classroom Code Tutor was specially designed for VE Examiners, Vo-Tech/ham radio schools, ham clubs, and teachers.

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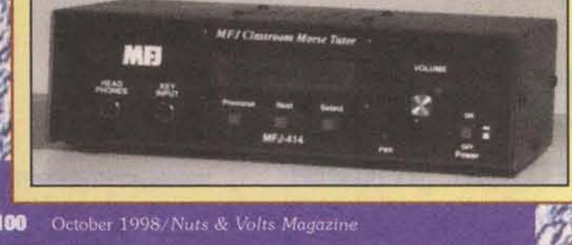
The Code Tutor is available for $199.95.



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Big sound from a stereo radio—without the big price!

Zenith Audio, a leading electronics manufacturer designs a "Small Footprint", "Big Sound" stereo system that's perfect for the home or office and priced below $100.

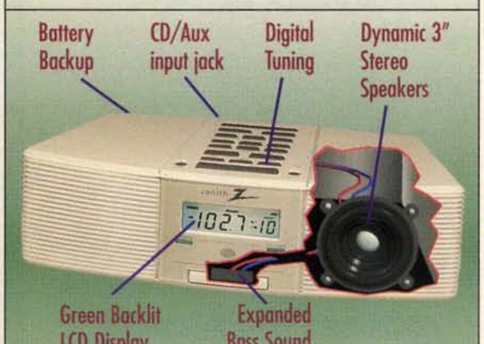
by John Jameson

I leaned back slowly in my chair with my eyes closed, listening to the haunting melody of a Mozart symphony. The acoustics were flawless, and the room was soon filled with full, rich stereo sound. From the crisp highs of the flutes to the tooth-rattling bass of the kettle drums, the music was crystal-clear and powerful. I could distinguish the distinct sounds from each individual musician, and as the orchestra reached the finale I almost fell out of my seat from the awesome force of the music. As the music faded, I leaned forward and hit a button on the stereo clock radio. I had a concert to go to that night—it was time to check the weather.

Ultimate sound machine. Zenith Audio has developed a Digital Stereo Clock Radio that boasts the acoustic quality and practical features of stereo radios four times as expensive. You'll be amazed at the sound quality and powerful bass you get from a radio this small and this affordable. This stereo radio features an 11-key handheld remote control and an input jack for CD players or other audio sources.

The best bass. Many small stereo radios can sound tiny and weak. This unit has an exclusive EXB button for expanded bass performance. It intensifies the lower tones for CD or FM stations, giving you rich, full and powerful stereo sound. If you want to listen to the stereo in private, there is a headphone jack on the side of the unit.

Compact Speakers with a Big Sound



The Zenith Audio Clock Radio has an exclusive EXB button for expanded bass performance. It intensifies the lower tones for CD or FM stations, giving you rich, full and powerful stereo sound.

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Loaded with features. You won't find a tabletop stereo with more added options. The AM/FM radio features digital tuning for pinpoint reception and crystal-clear sound. The STEREO indicator allows you to tune in to the stereo signal. It also picks up TV and WEATHER signals with 13 TV channels and 7 Weather channels, so your Zenith Audio Clock Radio is a great source of news, entertainment and information. You can program the unit's memory for 37 preset stations, and the tuning buttons can operate either manually or in a automatic search mode.

Practical functions. The backlit clock has several alarm functions, so you can wake to either radio, TV, weather or a buzzer. The sleep timer allows you to fall asleep to up to 90 minutes of music, TV or weather and then shuts off automatically. In the morning, if you need a few extra minutes of sleep, press the SNOOZE bar on the control panel or on the remote. The radio or alarm tone stops for 10 minutes and then sounds again. The process can be repeated several times as required. The unit's battery backup system will maintain the time, alarm and preset station memories in the event of a temporary power interruption. There is even a low battery indicator so you'll never oversleep in the event of a power failure.

Factory direct risk-free offer. You can spend hundreds of dollars more on a stereo radio, but why do it? We get the Stereo Clock Radio direct from Zenith Audio and pass the savings on to you. This product comes with a one-year manufacturer's limited warranty and Comtrad's exclusive risk-free home trial. If you are not satisfied for any reason, simply return it within 90 days for a full "No Questions Asked" refund.

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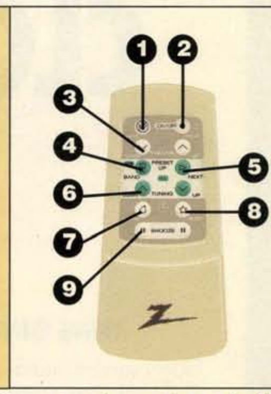
4. Band
5. Preset
6. Tuning
7. Alarm
8. Sleep
9. Snooze



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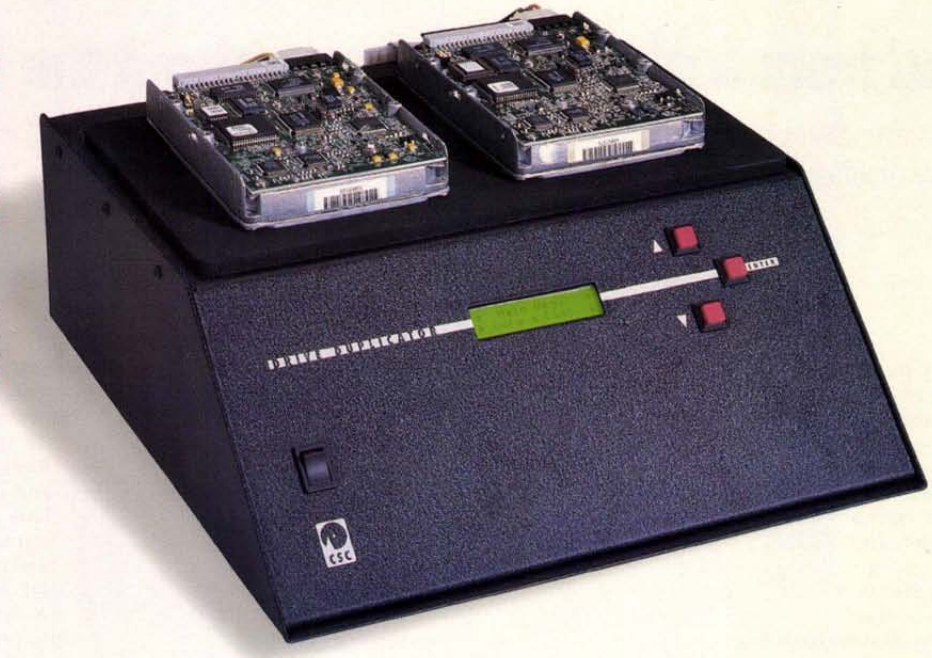

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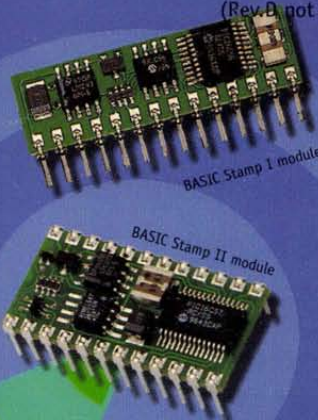

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