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October 2001
Vol. 22 No.10

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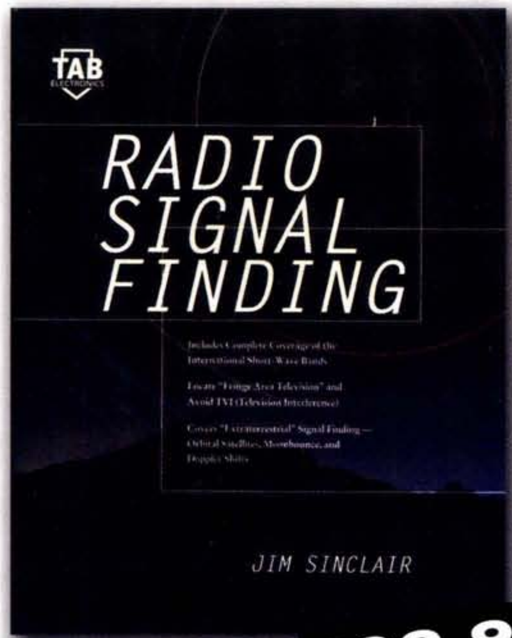

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by Jim Sinclair (published by McGraw Hill)

From getting smoothly launched to bringing in difficult signals, Jim Sinclair's *Radio Signal Finding* is packed with tips that make every minute of ham radio more satisfying, entertaining, and diverse. With its straightforward presentation, tested advice, and strategies, this guide is like having a trusted, experienced, and knowledgeable operator at your side. Whether you want to learn the locations of the most intriguing signals or eliminate interference, you'll find your answer in this unique guide as you're shown how to:

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Tune in orbiting satellites
Catch moon-bounce and Doppler-shift signals
Overcome TV interference
Couple to the environment for low frequencies

CONTENTS: Chapter 1: The Scope of This Book. Chapter 2: Long Range on the Broadcast Band. Chapter 3: Coupling to the Environment for Frequencies Below 30 MHz. Chapter 4: Fringe-Area Television in the Computer Age. Chapter 5: Television Interference. Chapter 6: The International Short-Wave Bands. Chapter 7: FM Stereo and Television Sound. Chapter 8: Receiving the Extraterrestials. Chapter 9: Radio Communications. Chapter 10: Going Mobile. Chapter 11: Cellular Mobile Telephones. Chapter 12: Data, Codes, and Selcalls.

Analog Interfacing To Embedded Microprocessors Real World Design

by Stuart R. Ball (published by Newnes Press)

Provides hard-to-find information on interfacing analog devices and technologies to the purely digital world of embedded microprocessors. Gives the reader the insight and perspective of a real embedded systems design engineer, including tips that only a hands-on professional would know.

Covers important considerations for both hardware and software systems when linking analog and digital devices.

At a time when modern electronic systems are increasingly digital, a comprehensive source on interfacing the real world to microprocessors should prove invaluable to embedded systems engineers, students, technicians, and hobbyists. Anyone involved in connecting the analog environment to their digital machines, or troubleshooting such connections will find this book especially useful. Stuart Ball is also the author of *Debugging Embedded Microprocessor Systems*, also published by Newnes. Additionally, Stuart has written articles for periodicals such as *Circuit Cellar INK*, *Byte*, and *Modern Electronics*.

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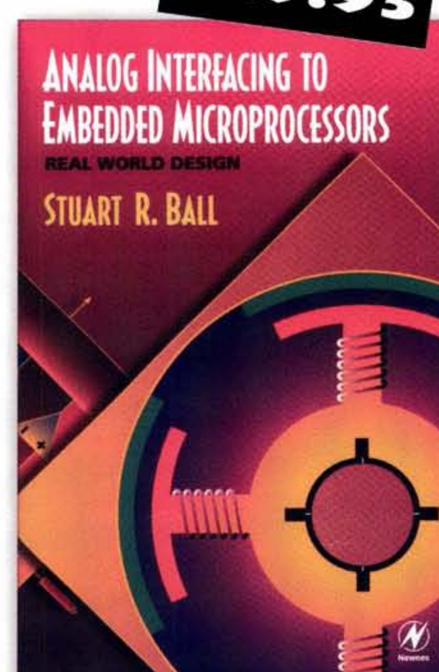

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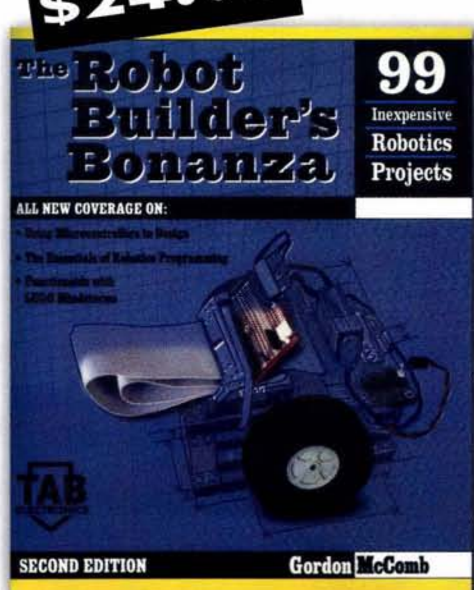

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(2nd Edition) by Gordon McComb (published by McGraw Hill)

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by Jeff Mazur

AIBO TURNS TWO

Part 1

This summer marked the second anniversary of Sony's AIBO Entertainment Robot. The event was celebrated on both coasts (in San Francisco and New York) with the introduction of three new colors for AIBO and some new software. AIBO Internet sites have not been on vacation either, producing several exciting new enhancements for the AIBO system.

Since my original article on AIBO — Sony's robotic pet (*Nuts & Volts* March/April 2001) — there have been several new additions to the litter. Most importantly, the wireless LAN card began shipping, as well as the AIBO Master Studio performance editing software. Since the LAN card is central to most of the new software being written for AIBO, I'll describe it first.

AIBO Wireless LAN Card

Installing the LAN card into AIBO is quite simple. After removing the two left legs, you simply slide the card into the PC slot (see Figure 1), snap the legs back on and you're done. Unfortunately, configuring the wireless LAN card to communicate with your PC can be quite tricky, especially if you want to add it to an existing wireless LAN.

The AIBO Wireless LAN card communicates using the 802.11b WiFi standard. *[Although the term WiFi (Wireless Fidelity) strictly refers to products that have been tested and certified by WECA (Wireless Ethernet Compatibility Alliance), most 802.11b products are compatible.]* This is currently the most popular wireless technology, operating in the 2.4GHz RF band using direct-sequence spread-spectrum (DSSS) modulation, and provides a range of approximately 300 feet. WiFi can operate at up to 11 Mbps (although 7 Mbps is probably the real upper limit), but this speed dramatically drops as the distance between units increases. Anything over 50 feet will usually result in slower connections, all the way down to 1 Mbps at the fringe zone.

Basically, there are two different topologies for setting up a WiFi LAN. You can use the peer-to-peer mode (aka ad-hoc mode) to connect one or more computers (either a laptop with its own wireless PC card or a desktop PC with internal or USB wireless card). Alternatively, you can use a wireless access point (AP) which bridges between a wired ethernet LAN and the wireless devices. This is referred to as the infrastructure mode.

While the former is much easier to set up, it assumes that you have no other network connection. Since I already had a wireless network set up, I needed to configure the AIBO wireless LAN card to use my wireless AP.

When setting up an WiFi network, there are four parameters that must be set before two wireless devices can communicate. They must agree on a mode (e.g., peer-to-peer), channel number (frequency), network ID (SSID), and optionally, a Wired Equivalent Privacy encryption (WEP key). This is in addition to the IP address, subnet mask, and optional gateway address.

Wireless Woes

According to the instructions supplied with the AIBO LAN card, Sony provides a default setting for the network name and encryption that must be used when first attempting connection to AIBO. This seems to make sense since AIBO does not have a keyboard or any simple means to set up the card once it is inside the robot. The instructions therefore indicate that you must reconfigure your existing access point to match the default AIBO settings.

Then, once connected, you can use a settings web page delivered by AIBO to change its internal configuration to match your desired settings. At this point, you reconfigure the access point back to its original set-up, reboot AIBO, and all should be okay. That is, until you boot up AIBO without the LAN card, at which point, it will revert back to the default settings.

This might all make sense ... if it actually worked. First, however, this requires that you have an access point whose SSID can, in fact, be changed. Several products — including Sony's own PCWA-A100 WAP — do not supply software capable of making this change. They suggest you first connect to AIBO in the peer-to-peer mode with a wireless PC to change AIBO's settings. However, this was not an option for me at this time.

Then there is a whole other nightmare of setting the WEP key. Although higher security standards exist, most current WiFi products use a 40-bit encryption key (some products refer to this as a 64-bit key, but only 40 bits can actually be set). There are three ways to specify the 40-bit encryption key: as 10 hexadecimal digits, as five ASCII characters, or via a pass-phrase. Every wireless product allows at least one of these methods.

The default AIBO WEP key is "AIBO2," so this requires setting the key in ASCII mode (or alternatively using the hex digits: 4149424F32). To make matters even more confusing, my existing access point allowed either hex or text entry of the WEP key. However (as I was to discover only much, much later), text entry was considered a pass phrase and was not directly converted to the corresponding ASCII codes. Therefore, my initial attempt using

Figure 1. The AIBO Wireless LAN card slides neatly into the PC Card slot at the rear of AIBO.

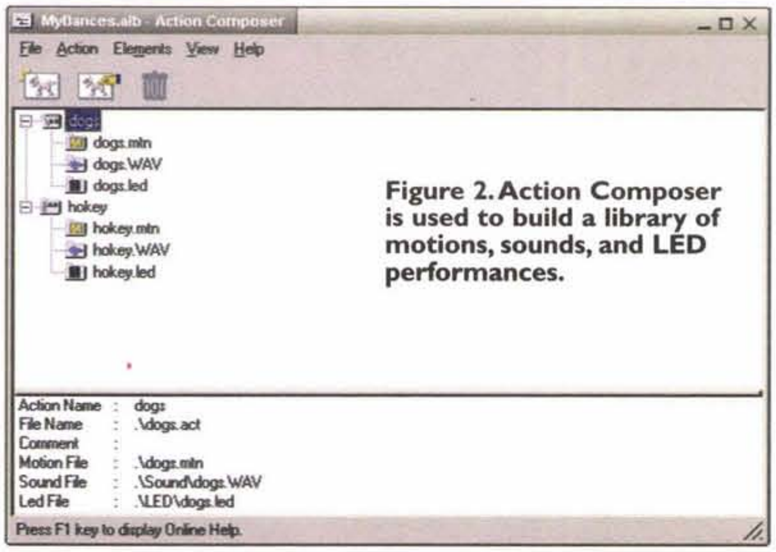

Figure 2. Action Composer is used to build a library of motions, sounds, and LED performances.

the WEP key of AIBO2 failed to connect. Calls to technical support for the makers of this wireless AP only muddied the water as I was told there could be problems connecting to wireless cards based on the Lucent chipset, which is what ABIOS's LAN card uses.

Sony would only confirm that AIBO had been tested with their own wireless AP or the generic Orinoco product (AP-1000 or Residential Gateway) on which it is based. So I went out and bought the Sony AP. This is when I found out that you could not change its SSID.

Fortunately, during my numerous trials to get the wireless LAN card to work, I had started looking at the files on AIBO's memory stick. Inside a system WLAN directory, I found — lo and behold — a file named Wlandflt.txt. This was a plaintext file containing all of the default configuration parameters, as shown below:

```
HOSTNAME=AIBO
ETHER_IP=10.0.1.100
ETHER_NETMASK=255.255.255.0
IP_GATEWAY=10.0.1.1
ESSID=AIBONET
WEPENABLE=1
WEPKEY=AIBO2
APMODE=2
CHANNEL=3
```

So it seemed that I had found a much easier way to configure the AIBO LAN card without having to change the rest of the network to match. While this method does require having a memory stick reader attached to your PC, I would bet that almost everyone who purchases the AIBO LAN card already has such a reader. Therefore, my advice is to IGNORE THE SONY INSTRUCTIONS! Just edit the Wlandflt.txt file to match your desired settings. If you still have trouble connecting, you can also set WEPENABLE=0 and try connecting without encryption.

With the Sony access point, the SSID is fixed to a six-digit hex string and the default WEP key is the last five of these digits. Be careful, however, these five digits are really ASCII characters, so they must be entered precisely using lower case characters. I also used another access point (from Asante) where the WEP key had to be entered as a 10-digit hex number; this required converting the

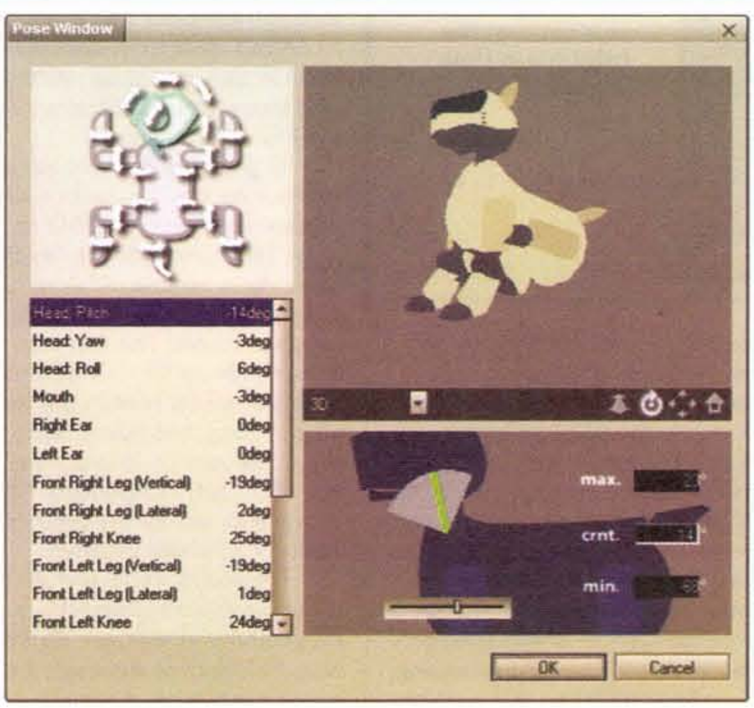

Figure 3. In the Pose Window, you can set each of AIBO's joints as desired.

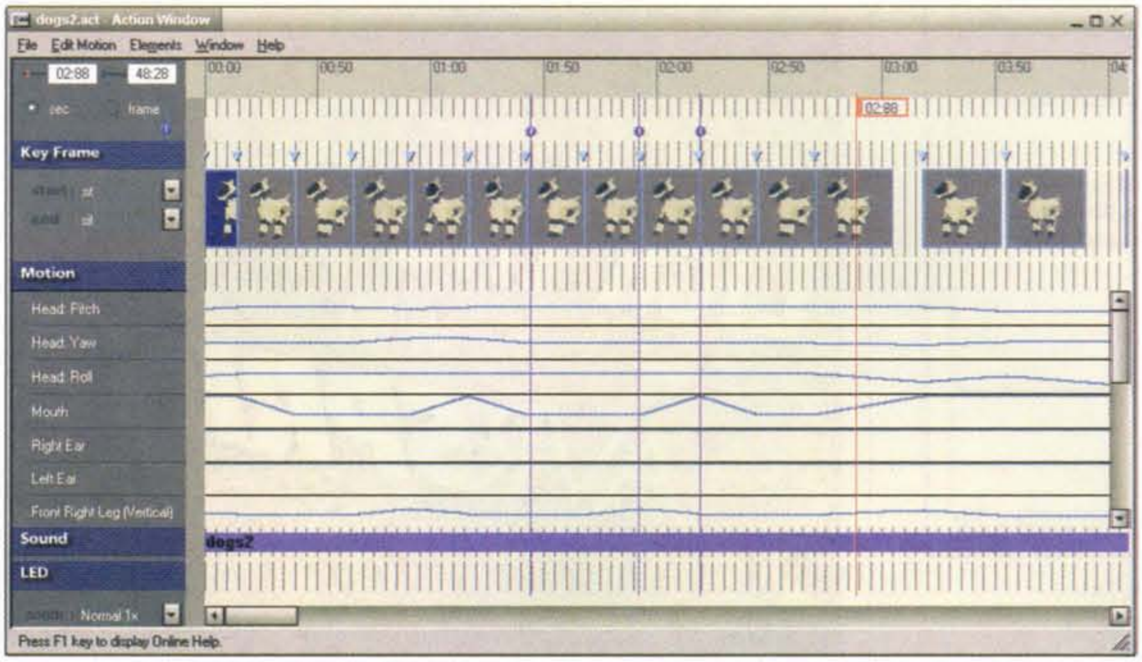

Figure 4. The Action Window, showing a portion of the "dog's" routine.

RESOURCES

AiboPet
Lots of great AIBO info, tools, and software
http://www.aibopet.com/

ClubAIBO
Sony's user site. Has newsboard and a special AMS Trading Post to share your creations.
http://www.clubaibo.com/new/frames.php

dogsbody
AMS Motion file tools
http://www.dogsbodynet.com/

Practically Networked
Great website dealing with wireless network info
http://www.practicallynetworked.com/

WECA
http://www.wi-fi.org/

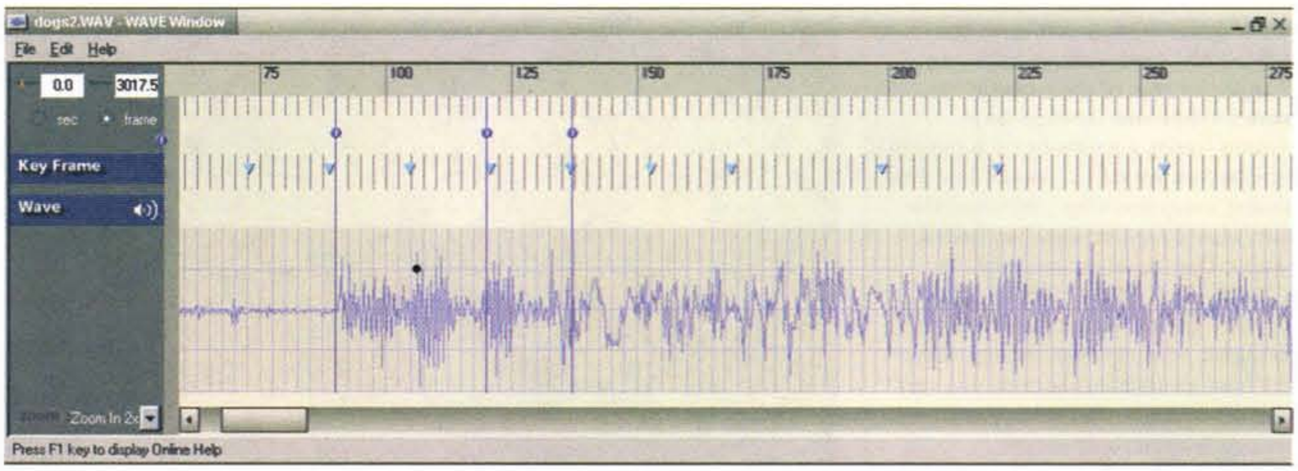

Figure 5. A waveform view of the music (wave) file. Note the purple marker lines showing synchronization points which carry through to the motion and LED editors.

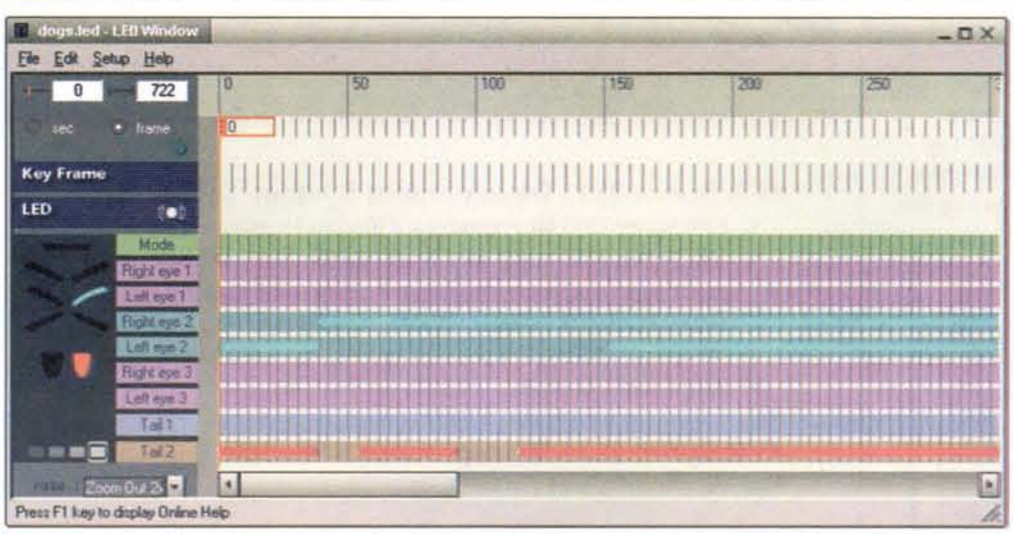

Figure 6. The LED Window lets you control the brightness (four levels) of each LED.

Figure 7. In the Preview Window, a Virtual AIBO will perform your action. You can drag AIBO to any position and view the action from any angle.

five hex digits from ASCII characters to their hex equivalents (e.g., 4a2ac became 3461326163). So much for uniformity in the 802.11b "standard."

Once I had the wireless LAN card working, I could ping AIBO from my PC and was now prepared to try the wireless connectivity provided within AIBO Master Studio (AMS). Although you can run AMS without the wireless LAN — saving your performances directly to a Programming Memory Stick (PMS) — this involves shuttling the stick between AIBO and your PC. The wireless LAN lets you download, test, and run your behaviors right from the PC without removing the PMS. You do have to reboot AIBO, however, after making any changes to the library of routines stored on the PMS.

AIBO Master Studio

AMS lets you create custom behaviors for your AIBO. There are two major components to this process. First you create and/or modify existing "actions," which can contain motion, sound, and LED "tracks." This is done using the Action Composer program which, in turn, calls upon motion, sound (wave or MIDI), and LED editing programs. These actions are then saved into a library file for use by the next component, Behavior Arranger.

Behavior Arranger is somewhat like a primitive programming language. Using a graphical interface, you build sequences of actions into a performance. By using branch steps, with the ability to read the status of AIBO's sensors and other parameters, you can build a program that lets AIBO react to its environment. You can also save programming snippets into a group (akin to a subroutine) for later re-use.

To get a feel for how this all works, I decided to create a couple of dance routines for AIBO to perform. Each dance (the Hokey Pokey, and a disco version of "Who Let the Dogs Out?") would be created as separate actions. The first step was to create a library file — MyDances.alb — which would contain the two actions (dogs and hokey), each with their own motion (.mtn), wave (.wav), and LED (.led) components. Figure 2 shows how this library appears in the Action Composer program.

The sound tracks contain music which I converted into AIBO's required mono, eight-bit, 8K sample rate, PCM format. Although the hokey music started out as a MIDI composition, AIBO can only play back single channel, single track, single note, SMF0 (Standard MIDI File Type

0) files. This may be okay for AIBO's emotional outbursts and cell phone ringers, but it really doesn't cut it for musical accompaniment. Therefore, I converted the MIDI file into a wave file for a better sound (although at a price of over 1 MB for the .wav vs. 12K for the .mid)! At this point, the motion and LED tracks were essentially blank, so I next began editing the motion file.

Action Composer

When starting a new motion, you must select the starting and ending positions as either standing, sitting, or sleeping. Between these fixed poses, you can insert as many other positions as desired. This is done by creating keyframes, where the position of each joint is specified. You do this in a Pose window as shown in Figure 3. In between the keyframes, AIBO will smoothly transition each joint as needed. Keyframes can also be copied and pasted at will, either individually or as a group. Timing of the keyframes is accomplished by inserting or deleting timeslices — called subframes — between the keyframes.

After adding a sound track and several keyframes, the action starts to come together as shown in Figure 4. Note the graphs, which indicate the motion of each joint. If you attempt to move one of AIBO's joints faster than it can actually go, a portion of the graph will turn red and you cannot save the motion until it is corrected.

Clicking on the sound track automatically brings up the sound editor where you can see a waveform representation of the audio and make simple adjustments (see Figure 5). You can also set markers at various points in the sound track that will show up in the motion and LED editors, simplifying synchronization. Similarly, you edit the LED track which sets the timing for each of AIBO's seven face LEDs, as well as the two tail LEDs (see Figure 6).

To see how the entire action will look when performed by AIBO, there is a Preview Window (Figure 7) in which a virtual AIBO can be viewed performing the motion along with the sound and LED indicators. This virtual AIBO can be repositioned in 3D space to see the motion from any angle (including a top or bottom view). This will give a good indication of how AIBO will actually look when playing back this action. Note, however, that the virtual AIBO uses a stationery body, so the legs move up and down without respect to being on a flat surface. In other words, if you make AIBO sit, you will see the back legs move up instead of having the back of the body section move down. This does make it harder to predict certain motions but you still get a fairly good idea.

Once the actions have been created, they can be tested from Action Composer via the wireless LAN interface, if available. However, I did find that certain timing issues arose when testing actions containing synchronized motion and sound and, at other times, the sound file would get corrupted.

Behavior Arranger

At this point, it's time to run the Behavior Arranger program to instruct AIBO how and when to perform these actions. After loading your library from Action Composer, these actions can be accessed. Behavior Arranger also has a library of built-in actions that can be programmed. For example, you can command AIBO to stand, sit, or lie down. Other commands take various parameters — when you tell AIBO to Walk, you supply an angle and a distance. There are even a few commands to help in debugging your behaviors, using AIBO's LEDs as indicators.

Like any good programming language, you can also create and manipulate variables (all are 16-bit integer values). Simple arithmetic and boolean operations can be performed, as well as a random function. Variables can also be saved to, and restored from, the PMS.

AIBO's sensors can all be interrogated along with the position of each joint (except the ears). You can also tell how long a sensor has been pressed and even the pressure on the head sensor (e.g., how AIBO knows the difference between a "good" pat, vs. a "bad" rap, on the head).

Other miscellaneous variables give you access to AIBO's internal clock/calendar, battery, and body temperatures, and IR distance sensor. You can also read the remaining battery charge. And a STATUS variable will tell you if AIBO's fallen down.

In my case, I built a simple program that checks both the head and back sensors. When the back sensor is pressed, AIBO performs the hokey action; when the head is pressed, it does the dog's dance. This is easily apparent from the behavior file (MyDances.be) shown in Figure 8. Double clicking the "check_touch" branch box reveals the internal

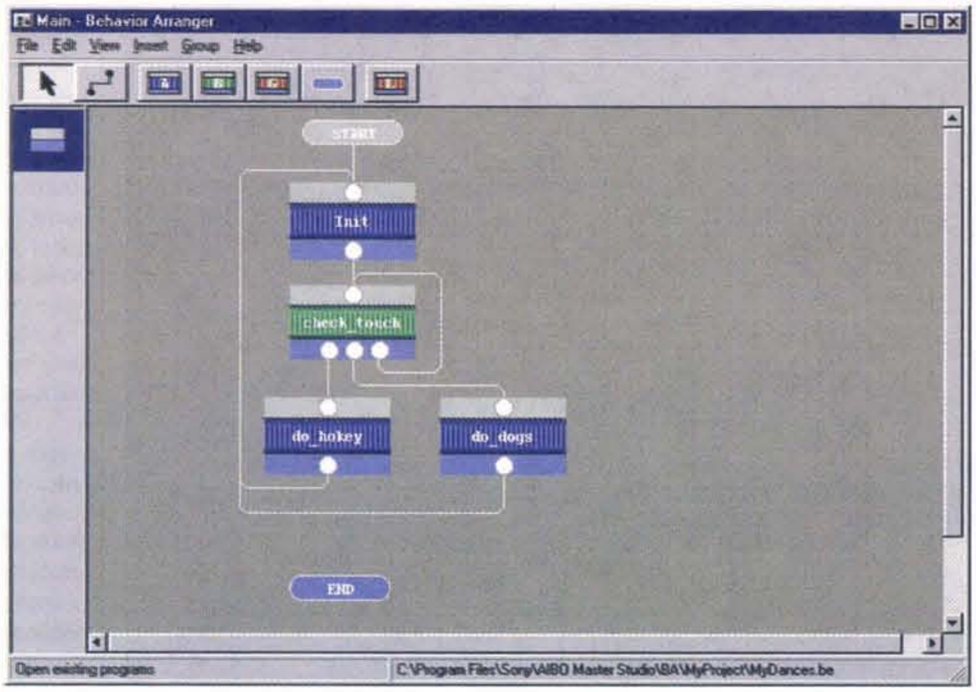

Figure 8. In Behavior Arranger, you program AIBO using a graphical interface. Action and Branch boxes are connected by drawing lines between their terminals.

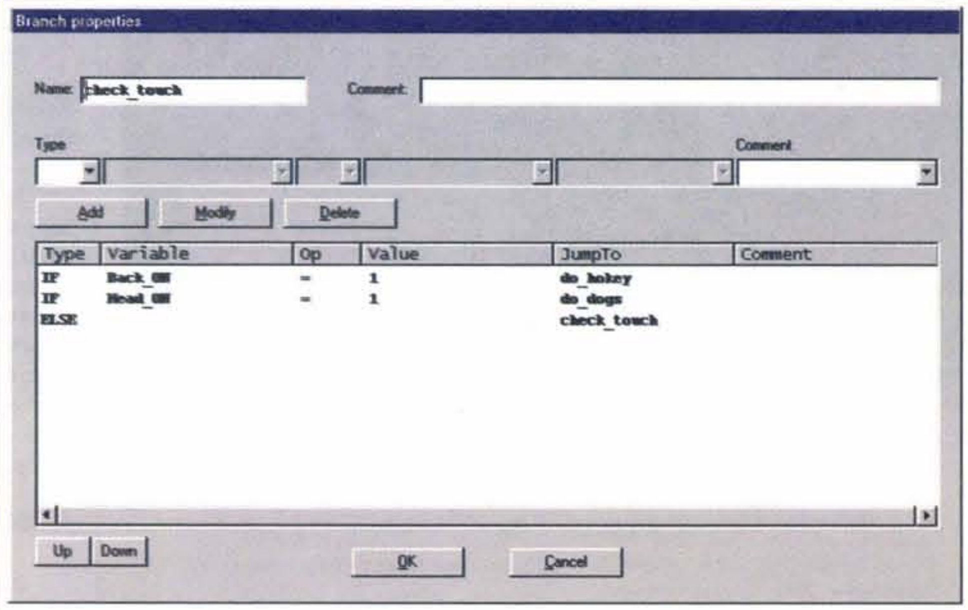

Figure 9. Inside the "check_touch" branch box. Here is the actual code to perform the branch.

Figure 10. AIBO Navigator puts the video feed and all controls on one screen. Note the Recovery button in case AIBO falls.

Underscoring its vision to bring a new form of entertainment into every US household, the Entertainment Robot America (ERA) unit of Sony Electronics will release a new line of Entertainment Robots·, affectionately to be known as the AIBO™ LM series [ERS-311/312]. Pre-sale orders will be accepted starting on Oct. 1, with the lovable new models appearing on store shelves and made available through the Internet (www.aibo.com) on Oct. 27.

programming used to accomplish this behavior (see Figure 9).

Once again, with the LAN card installed, this behavior can be tested from within the Behavior Arranger program. Otherwise, the behavior file must be added to the memory stick and then re-inserted into AIBO.

All in all, the AMS program worked quite well, especially for the first release of the software. I did run into trouble as the actions grew quite long (over two minutes each); even with half a gig of RAM, Action Composer began to choke on the large files (although interestingly, the actual .mtn file was only 19 Kbytes).

Probably the largest shortcoming is that you cannot edit individual joints separately. Every keyframe applies to all joints. This makes it hard to build upon an existing sequence. For example, after getting the legs to perform as desired, I wanted to go back and add mouth movement. This meant re-editing all of the existing keyframes to include the mouth motion.

Where additional keyframes were needed to synchronize the mouth to the music, it was easy to create a new keyframe from the interpolated values. But all of the existing keyframes had to be tweaked making this much more difficult than it should be. Fortunately, the motion file format is known and several freeware programs have surfaced to deal with many of these issues.

Next month, we'll take a look at some DOS tools that let you copy individual joint movements, change the motion's speed, and much more.

Sony Holds a Birthday Party

At the bi-coastal birthday events, Sony introduced three new AIBO colors: Mazeran Green, Everest White, and Sapphire Violet. These Second Anniversary Special Edition colors were available for a limited time. No other changes were made to the ERS-210. Two new programs were also announced: AIBO Navigator and AIBO Messenger.

AIBO Navigator

It certainly seemed inevitable that we would see a program that used the wireless LAN card to let you "drive" AIBO from your PC and also see a real-time image back from AIBO's camera. The AIBO Navigator program, as shown in Figure 10, does just that. You get a cockpit view showing an almost real-time camera view (somewhere around 10-15 frames per second), a virtual AIBO representation, and a radar screen that can be used to track AIBO's pink ball.

There are also controls to make AIBO lie down, sit, or stand, and to make it walk forward/back or left/right at any of three speeds. You can also adjust the camera angle (i.e., AIBO's head) to control where it is looking. A simple button press will cause AIBO to take a snapshot and store it on your PC. And you can record up to five seconds of audio and have it come out of AIBO's speaker.

The Play button in the lower right directs AIBO to perform one of 27 pre-loaded actions. Unfortunately, there is no easy way to add your own actions to this menu. Activating the search button in the upper right causes AIBO to begin looking for its pink ball. When located, AIBO will move itself to just in front of the ball, just as it does with the AIBO Life and Hello AIBO! programs.

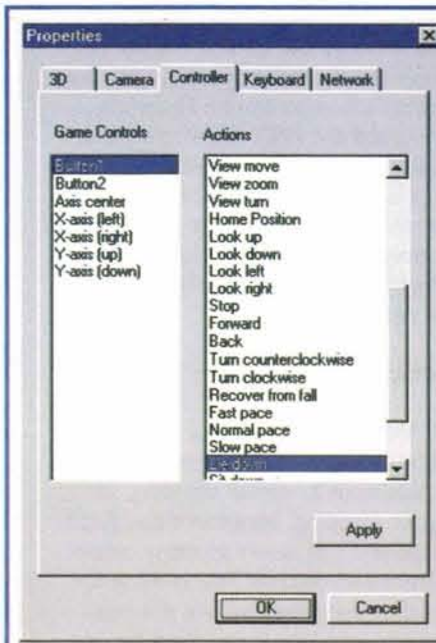

Figure 11. You can assign any of Navigator's functions to the Game Controller.

At this point, you can use one of the Header or Kick buttons to have AIBO smack the ball. For some reason, my AIBO would almost always stop too far from the ball to actually hit it. It would be nice if there was some way to calibrate AIBO so that its performance could be better.

Most of Navigator's functions can be assigned to individual keystrokes so you can control everything from the keyboard. If you have a joystick connected to your PC, you can also steer AIBO and assign each button to a particular function as shown in Figure 11. However, even with a joystick, you can only make AIBO walk in one of the four directions at a given time. So, for example, you can only walk forward, stop, turn right, stop, walk forward again. There is no way to walk at an angle, which is strange since that is exactly how the internal R-Code commands are sent.

It is easy to come up with a wish list for future versions of this program. Real time, two-way audio should be high on the list, as well as ways to add custom actions. In addition, the pinging noise AIBO makes continuously while Navigator is running can be annoying and there should be a preference setting to disable it (although it is probably there to prevent spying on someone, much like the head movement is intentionally restricted to prevent looking straight up, presumably that is, up a woman's dress).

Next month, we'll continue with a look at AIBO Messenger. This program lets AIBO read aloud your email and other information from the web. We'll also examine a wealth of freeware programs, some of which are truly remarkable. If you can't wait, check out the AiboPet and dogsbody websites listed in the resource section. **NV**

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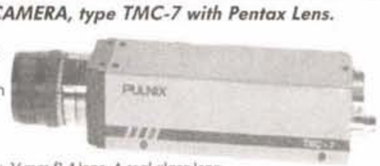

Specs: 1/2" CCD, 460 Lines resolution, 768H x 494V Pixels, 2 Lux sensitivity @f1.4, Auto/Manual AGC, Auto/Manual Shutter from 1/60 to 1/10,000 remotely controllable via 6 pin connector (not included), Auto/Manual white balance, Manual gain and hue control from outside the camera. Complimentary color filter. Operates on 12VDC @320mA, Power supply included. Also includes a high quality Pentax, 16mm f1.4 lens, A real glass lens. Standard NTSC video out on BNC connector. Y/C (S-Video) output also available on 12 pin connector supplied. Superior construction. Compact size only: 1.6"W x 1.25"H x 5.5" long. Perfect for use in process monitoring, surveillance, medical and microscopy. Excellent condition, removed from inspection systems. Regular price $600
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AAEON, 486-DX-4-100MHz, HALF SIZE CPU CARD.

SBC-455, HALF SIZE CPU CARD. Perfect for EMBEDDED APPLICATIONS

Brand new and in their original manufacturers boxes. Each package includes five 3.5" floppies with VGA and LCD drivers. A set of interface cables for the keyboard, mouse, serial and parallel ports. A comprehensive 88 page manual.The SBC-455 is an industry standard half size PC/AT compatible ISA-Bus card. Our configuration includes an Intel 486-DX4-100 CPU and 2MB of DRAM. The on-board PCI-bus, flat panel/CRT SVGA controller uses the CHIPS 65548 chipset. High speed local bus IDE controller for mode 3 or 4 hard disks. Compatible with CD-ROM, tape and other IDE devices. (Up to four) On-board features include two high speed RS-232 ports with 16C550 UARTs, one bidirectional SPP/EPP/ECP parallel port and a floppy controller. (up to two) In addition to the 486's 16KB of on-chip cache, the SBC-455 includes an extra 128KB of on board cache. Two 72 pin simm sockets for up to 64MB of DRAM. AMI flash bios. Daughter board available from the manufacturer for various flat panel displays. Watchdog timer on board. Connectors for PC/104 modules. "Green " power management support. Clear CMOS function.
OCTOBER SPECIAL, SBC455.....$99ea.

NEW! 6.8" LCD COLOR, TFT, ACTIVE MATRIX DISPLAY, A huge 23sq. inch VIEWABLE AREA, Super Deal. 2.8X the VIEWING AREA of a 4" panel and 1.5X a 5.6" WOW! We wish you could see the color saturation and resolution of this superior LCD display, it is fantastic. Excellent contrast ratio, high quality, full color images are comparable to a CRT. Perfect as a portable, general purpose color monitor for standard NTSC color or B&W video systems. Fully compatible with all our cameras as well as Camcorders, VCR's, DVD's etc. OEM "component" style unit has no outer cabinet. Designed to be installed in YOUR housing via four mounting tabs as shown. Specs: Resolution, 1152H x 234V, 270K Pixels! Viewing angle, Top 10°, Down 30°, Left 45°, Right 45°. Brightness, 300 nit, Size: W x H x D (mm/in), 157.2 x 122.6 x 8.0, 6.2" x 4.83" x 1.1", Weight (gm./oz.) 280 gm, 10oz. Supplied with 30" input cable. Video input via BNC jack , 12VDC input via a standard barrel connector. Regulated 12VDC @700mA power adapter included. **BRAND NEW, FIRST QUALITY. GMTFT68.......$169ea.**

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PINHOLE STYLE, LIPSTICK CAMERA is so small you can use it almost anywhere you can imagine. Sleek black anodized, alum. housing, O-Ring sealed & RAINPROOF. Adj. tilting mount. 1/3" CCD, 380 Lines, 0.3 Lux, AGC, Auto Shutter. 9-12VDC @100mA, 4mm, f2, 90° FOV real glass lens, NTSC video. <1/2 ounce! IR SENSITIVE. 36" cable with BNC video & DC barrel jack. So tiny you can install it directly into a door. Only a 0.9" diameter hole! Size only 23mm d.x35mm long. Think of the places you could put this little jewel. **GM-200K-PH....$69ea.**

10V @ 2.5 AH SEALED, LEAD ACID, PACK.

Each pack has 5, 2 Volt cells. 'D'size cells are arrainged as 1X5 cells. Enclosed in an ABS outer shell. (removed for photo) Perfect for high drain applications. Make custom packs of any rating. Size: 7.5"L x 2.8"H x 1.5"D **SALE! 6-five packs for $20, 40 for $99**

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New, model S03601-82-02C series. The module includes the VFD, microcomputer and driver. Connects directly to the system bus via 8 bit, TTL compatible input. Display up to 20 dot matrix, 5 x 7 characters (96 character U.S. ASCII-7), 5mm H x 3.5mm W with cursor. Display color is green at 505nm. Brightness is 170fL, Weight: 4 oz. Size: 6.63"L x 2.2"H x 0.6" thick. Power required is 5VDC@ 386mA. Perfect for any high visibility display requirement. With data. **IEE-VFD20..$12ea. 4 for $39**

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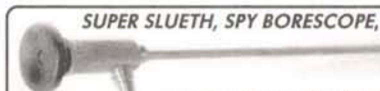
SUPER SLUETH, SPY BORESCOPE,



Actually a doctor would call it an anrithroscopic borescope. Super high quality medical grade, stainless, construction. Direct view eyepiece with a 6.5" long, 5mm diam. tube. Objective end optic is at a 30 degree angle for easy viewing of surrounding area. 7.5mm diam. external light port. Very limited quantity. **Hospital Price...$800ea.**
SPECIAL.......$229ea. addt'l models on web.

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A fantastic lens with a current replacement cost of $20K. Extremely flat field and extemely high quality. Removed from wafer-lithography system, excellent condition.
ZEISS-PLANAR................$495

NEW, lower cost, High quality, MINI BOARD CAM, w/audio 1/3" CCD, 420 Lines Res., 0.3 Lux sens., AGC, Auto Shutter. Pwr. from 9 to 12VDC @100mA, 266k PIXELS, Std. model, 3.7mm, 92° FOV lens, A real glass lens. Auto shutter from 1/60 to 1/100,000 sec. Focus from 10mm to infinity. Std. NTSC video out. 1/2 ounce! SENSITIVE to IR. Size Std: 1.25"sq. x 1"d. Connections via a 6" pigtail with PC board connector.
SPECIAL, GM-1000B-STD......$45ea.

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For covert, military & scientific applications that must be color, this is it. Unbelievable 0.005Lux @ f1.2 performance is enhanced through low speed electronic shuttering, digital frame integration and advanced DSP. Auto sensitivity mode starts as it becomes dark. 24 hour surveillance is possible with the optional f1.2 auto iris lens shown below. Seven Gain/Shutter modes are user selectable. Normal, X4, X8, X16, X24, X32, X64. These provide frame rates of 60, 15, 8, 4, 3, 2 and 1 per second. Auto/Man. white balance 3200° to 10000°K, auto/man BLC, S/N >52dB, Mirror on/off, Gain on/off, auto electronic shutter 1/60 to 1/120,000 sec., Alum. housing, dual 1/4x20 mtg. Specs: 1/2" CCD, 768(H) X 494(V), with 380K pixels, 470 Lines, 12VDC ±1V@200mA, Std. video out on BNC. Size: 51mm x 51mm x115mm long. Regulated power adapter included. All functions can be externally controlled. Use standard c-mount lens not included. **GMV-3K..........$449ea.**
High performance auto iris lens, 12mm, f1.2...$199ea.

ULTRA RESOLUTION & HIGH SENSITIVITY, SCIENTIFIC QUALITY for demanding applications. Type GM-6000, offers 410K pixels, 570 Lines resolution, < 0.1 LUX sensitivity. >45db s/N with AGC off. Access all operating parameters, outside the camera! C or CS mount. Adjustable shutter speed from 1/60 to 1/100,000sec, BLC on/off, AGC on/off, gain auto/off., Auto iris selectable, DC/Video with level control, external/internal sync. 24VAC powered, adapter included. Video out on BNC. Industrial quality metal housing.Just the thing for scientific or low light. **SPECIAL, GM6000......$199ea.**

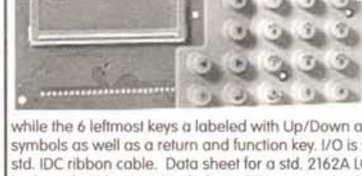
DAYLIGHT/LOW LIGHT MINI CAM & A/I LENS, For dawn 'till dusk applications. Rugged alum. housing, dual mtg. sockets. 1/3" CCD, 420 lines res., 0.1 Lux sens., AGC, 12VDC @120mA. Take full advantage of camera sensitivity with super, 4mm, f1.4, 78° FOV Auto Iris lens included. BNC video out. 50mm sq. X 65mmL. With pwr. adapt. **GM-510A/I...$179 or 2/$349**

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

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

GM412, less lens..$99, GM410, less lens..$149

16 x 2, LCD DISPLAY and KEYBOARD COMBO,NICE!



A Densitron, 2162A-CT LCD module. (no backlight) with 18 key elastomeric keypad arranged in a 4 x5 matrix. The rightmost 12 keys are labeled like a telephone pad while the 6 leftmost keys a labeled with Up/Down and Left /right cursor symbols as well as a return and function key. I/O is via a 3" long, 24 pin, std. IDC ribbon cable. Data sheet for a std. 2162A LCD module and keyboard cable pinout included. LCD is a standard 16 x 2 arrangement of 5 x 7 dot matrix characters 2.96mmW x 5.56mmH with cursor. TN type with top viewing. On board industry standard Hitachi 44780 driver with 8 bit parallel interface. Overall board size: 6.4"L x 2.5"H x 0.6"D, Viewing area: 62mmW x 16.2mmH. Will really make your project look pro!
Brand New, with data. LCDKBD-2162........$5.00ea.
or 10 for $4.50ea. or 100 for $3.50ea.

FABULOUS MOTION SYSTEM, Asymtek 102 series. The Automove® 102G is a highly configurable, automatic XYZ system capable of handling a full range of applications. Wherever hand-held dispensers are currently used, automating with the 102G system will increase both accuracy and throughput. Of course the system can be configured for many other motion automation applications as well. Your imagination is the key. The system can be programmed to dispense dots or continuous lines precisely and consistently using a wide variety of fluids. This flexibility makes it ideal for applications ranging from surface mount electronics to form-in-place gasketing. The system offers several standard features: At speeds of up to 508 mm/sec (20 in./s), it provides 0.025 mm (0.001 in.) resolution with a teach accuracy of 0.025 mm (0.001 in.). It is a gantry configuration with a 457 x 457 mm (18 x 18 in.) work area. Overall size: 36"W x 28"D x 20"H. Once programmed with a personal computer, the 403G stores up to 10 separate programs in onboard memory. Features: • Programmable speeds up to 508 mm/s (20 in./s) perfect for fast, short, repetitive moves required in automated applications. • Semiautomatic part skew alignment corrects for workpiece misalignment. • Easy-to use, flexible, Fluidmove® software for quick program creation is availble from the manufacturer. (Not supplied). • Multiple programs can be stored in onboard memory allowing computer-free operation in a production environment. Unit is used and in excellent condition. Ships via truck. See www.asymtek.com for info.
Reg. Price >$10K, Special Asymtek 102G...$2495

SPECIAL PRICE, 350MHz, TEKTRONIX 2467, MICRO CHANNEL PLATE CRT! with 4 Channels, 500ps per div. in normal room light. Displays intermittent variations as they happen. Captures the slowest one shot events with 4ns per division a 100 fold increase in the visual writing rate over conventional CRT. Features: 1 ns rise time, 500ps/Div time base, 2mV/Div. vertical sensitivity at 350MHz, 20ps time interval resolution, 1Mohm / 50-ohm input, 500Mhz trigger bandwidth, four channels. On-screen waveform cursors provide vertical & horizontal scale factors, trigger level, voltage, time, freq., phase, ratio values and mode indication. With 2 probes, pouch and manual. EX. cond. 90 day warranty. **New..$12K**

Now SPECIAL, TEK 2467........$2495.

Circle #42 on the Reader Service Card.

reader FeedBack

Dear Nuts & Volts:

The latest issue was really great, but I have a question regarding the code for the Keyboard Emulator on page 69 of the July 2001 issue.

I can't find what the periods do in the lines of code listed below. The manual for MPASM does not show this usage. Any information will be appreciated.

```
movlw .13 (in the delay routine)
movlw .8 (in the KB_tx routine)
```

Royce Simmons
Zone 5

Response:

I, too, was a bit stumped at first as to what the periods meant, but then realized they're my best friends! Simply put, they tell the assembler that the number following the period is to be treated as a decimal number. If you don't use the period, and the radix is set to hex, the numbers will be treated as hex.

Tim Hamel

Dear Nuts & Volts:

As a former Journalist in the PC industry for more than 14 years, I have a healthy cynicism.

In reference to your article on "Ultimate TV," the use of the term, "ultimate" by Microsoft, in my humble opinion can only mean "to Microsoft's ultimate advantage."

The need for web access puzzled me until I thought more about the Microsoft staffer's mentality where they believe that first MSDOS was created, then Bill created the rest of the world.

So, let me put this as I suspect it is. The web access is a necessary part of the package not so much for the purchaser to access the web, but for Microsoft to gather statistics on the viewer's activities surfing/watching the TV channels.

This is free ratings material gathering, in fact, it is better than free as the user is paying for the privilege of providing the link for passing this information back to Microsoft.

If this is the case, I doubt sincerely that Microsoft would disseminate these stats to anyone for free. Had the box been available and the web connection an option and not a mandatory part of the package, I would be less cynical. Reading your article, I get the impression it is mandatory.

So, let my cynicism reign and I will be pleased to be proven incorrect. I would love to have a quote from Microsoft that no data gathering of viewer's TV program viewing habits is being collected, but if it is, then none of it is being passed back via the Internet connection.

I have a bridge in Brooklyn and land in Florida with ocean views, both for sale at a good price.

Donald Johnson
Prescott Valley, AZ

Dear Nuts & Volts:

When I opened the September issue of *Nuts & Volts* and turned to the Tech Forum — one of my favorite sections — I was really taken aback. In the "answer" to 8015, the writer said that he didn't want to get into Physics 101. That's lucky for physics students.

Water solutions of anything, and I do mean anything, DO NOT carry an electrical charge!

When Chris worked in the plant that deionized the water before utilizing it for the plating operation, they were removing the ions that interfered with the plating process, not an electrical charge. Most city water contains dissolved salts such as Calcium Carbonate, Calcium Bicarbonate, Sodium Carbonate or Bicarbonate or Chloride, or Aluminum, Copper, Iron, Magnesium, and/or Manganese salts. Additional chemicals can also

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Natalie Sigafus

DISPLAY ADS
Mary Gamar

News Bytes

MATCO OPENS CANADIAN SUBSIDIARY

Matco is pleased to announce the opening of a new subsidiary in St Laurent, Quebec. The Canadian location marks the first remote office for Matco outside of its headquarters in Schaumburg, IL.

By adding this new location near Montreal, company officials expect to broaden their Canadian base and make it easier for customers to do business with the company.

Matco — which markets its products under the EverSecure name — was already serving some customers in Canada, but company officials saw an opportunity to expand their Canadian market. "Having an office here would serve our Canadian customers better. They don't have to deal with customs and with the currency exchange, and besides promoting Matco's products, the Canadian location also provides technical support." said Roy Dewey, general manager of Matco Canada.

As a result of adding Matco Canada, company officials expect sales to increase by at least 18 percent from its current sales levels of $3.4 million. "We found that a lot of the customers coming to the Canadian location are customers that have traditionally been buying from other competitors" said Rich Bogdan, the director of marketing for Matco, Inc.

Matco's opening of Matco Canada is part of its strategy to strengthen its presence in the security industry through new locations. Matco is also looking into new office locations in Puerto Rico and Europe.

Contact www.matco.com for Canada and US accounts. Web site: www.matco.com, email: Info@matco.com.

Matco, Inc., 2246 N. Palmer Dr., #103, Schaumburg, IL 60173; Sales: (800) 719-9605, Fax: (847) 303-0660.

Matco Canada Sales: (877) 720-9222 Canada/USA, Tech Support: (514) 340-9222, Fax: (775) 659-6544.

Matco Canada Address: 4028 Cote Vertu, St. Laurent, Quebec, H4R 1V4.

READER FEEDBACK CONTINUED ...

be in the water, in the form of Nitrates, Fluorides, Phosphates, and/or Sulfides. All of these salts dissociate into both negatively charged particles (anions), as well as the positively charged cations — BUT, the charges balance each other so that there is no net charge in the water.

All of the salts are electrolytes, meaning that they are electrically conducting when in a water solution. The ion exchangers remove those ions, exchanging Hydrogen (H) ions for the metals and the hydroxyl (OH) ion for the anions. The resultant material is WATER with no charge — except maybe for the cost of the operation.

Leonard E. Herzmark, P. E.
Tucson, AZ

CALL CORDER — 'PHONE CALL RECORDING MADE EASY!'

Pingram Marketing has announced the release of new Call Corder 2.0, the award winning call recording software. Call Corder is a program that allows recording of telephone conversations directly to hard drive.

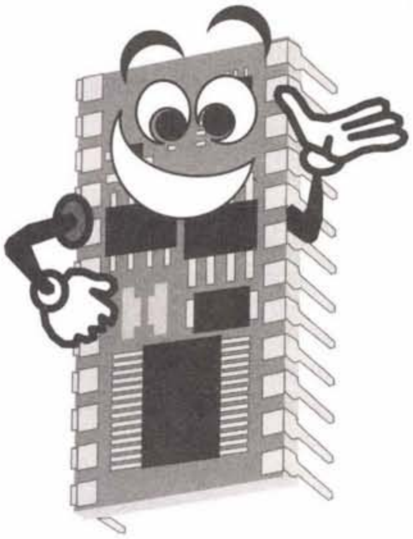
Call Corder is designed with a business user in mind. It can be configured to play a custom pre-recorded legal message every time the recording starts. Recorded calls are saved as standard Windows (.WAV) sound files, and can be later edited, annotated, and forwarded via email.

Hold On-Hold™, a unique service designed by Pingram Marketing, has now been included in the new version of Call Corder. Whenever you are put on hold, start Hold On-Hold and get away from a telephone.

You will be notified as soon as a live person answers the phone on the other end. More information about Hold On-Hold service can be found at http://www.holdonhold.com/.

Call Corder is a perfect companion for your existing answering

Continued on Page 78



by Jon Williams

Stamp Applications

SOUNDS LIKE TIME FOR TRICKS AND TREATS

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

For me, there is no better night of the year than October 31st. Halloween. Better than my birthday (July 25th in case you'd like to send a belated gift ...) and Christmas and any other day that is fun. Perhaps I'm a freak. That's okay — Halloween is still my favorite.

Don't get me wrong ... I like black clothing, but other than October 31st, I don't dress any differently than any other 39-year-old "normal" guy, and I certainly don't wear make-up unless I'm working on a film or television project. In that case, it's to hide the dark circles, not to accentuate them. And still, I love Halloween.

When I was living in Southern California, my friend Paul and I used to create these elaborate, crawl-through haunted houses out of commercial cardboard shipping boxes. These boxes were very strong. The last time I was involved, we actually made a two-story model. Inside, we would paint it black to make it even darker, we would have dangling threads, sound effects, pressure switches that set off flashbulbs, and even a couple of holes where we could reach our hands through for an extra fright. Again, these things were designed for kids — and kids seem to come in all ages. We didn't have to worry about dissembling that haunted house; the adults crawling through it did a good job.

Since there's not a lot of time between now and Halloween, we're going to do an incredibly easy project; no tricks, just a treat. One that is Halloween-cool and can be assembled on a solder-less-breadboard (like a BOE) in about two minutes. And it gives me the opportunity to introduce a couple of new, Stamp-friendly products: the key fob transmitter/receiver pair from RF Digital and the new QV306M1 sound module from Quadravox.

When I moved to Texas, I really missed that. Then my friend Kelley moved into the city and asked me to decorate her lawn for Halloween. What I discovered is that there are a lot of dedicated Halloween prop and decoration builders that are doing some really amazing things (and more than a few are using BASIC Stamps). We created a cool display with headstones and a decapitated witch and spiders and snakes and all the usual Halloween stuff. Her lawn was the hit of the neighborhood.

Our success just got me going and I ended up buying several books on prop building. As you read this, I'm in full-swing production on several new props that will decorate the yard of my acting coach. She throws a big party each Halloween, figuring actors will really get into it. Of course, we do.

A lot of the stuff I'm building is mechanical in nature and certainly not appropriate here. You can be sure though, many of my decorations are being controlled by BASIC Stamps. In the end, there will be five or six Stamps running everything that moves, has lights, or makes sounds.

Since there's not a lot of time between now and Halloween, we're going to do an incredibly easy project; no tricks, just a treat. One that is Halloween-cool and can be assembled on a solderless-breadboard (like a BOE) in about two minutes. And it gives me the opportunity to introduce a couple of new, Stamp-friendly products: the key fob transmitter/receiver pair from RF Digital and the new QV306M1 sound module from Quadravox.

Sounds From Beyond The Grave

This little project is what I needed for our graveyard section. I wanted sounds to come from it, but not at preprogrammed intervals or in any particular order. What I needed was some sort of remote control. That way, if someone gets too close, I can play a "Get out!" sound file and make them think twice before proceeding.

I could use a remote switch, but that would mean stringing wires and would limit my mobility. I could use IR like we did a couple months ago ("Control From The Couch" — August '01 issue), but that would mean that I would have to be in sight of the IR receiver. Then a solution came: RF Digital came out with the key fob transmitter/receiver pair.

The key fob transmitter looks just like the transmitter that you probably have to unlock your car or set/disable its alarm. It has five buttons: one in the center with four, slightly larger buttons that surround it. The buttons are comfortably spaced so there's no problem with holding the transmitter in one hand and operating any of the buttons with your thumb.

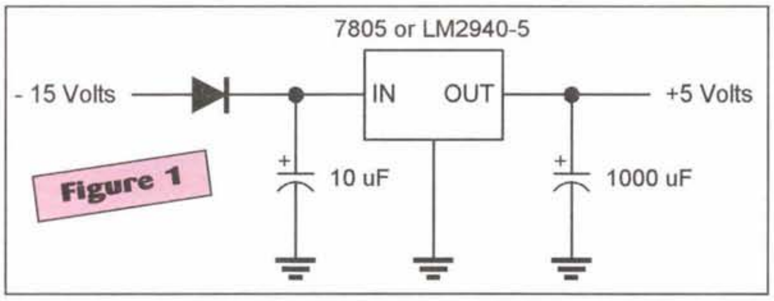


Figure 1

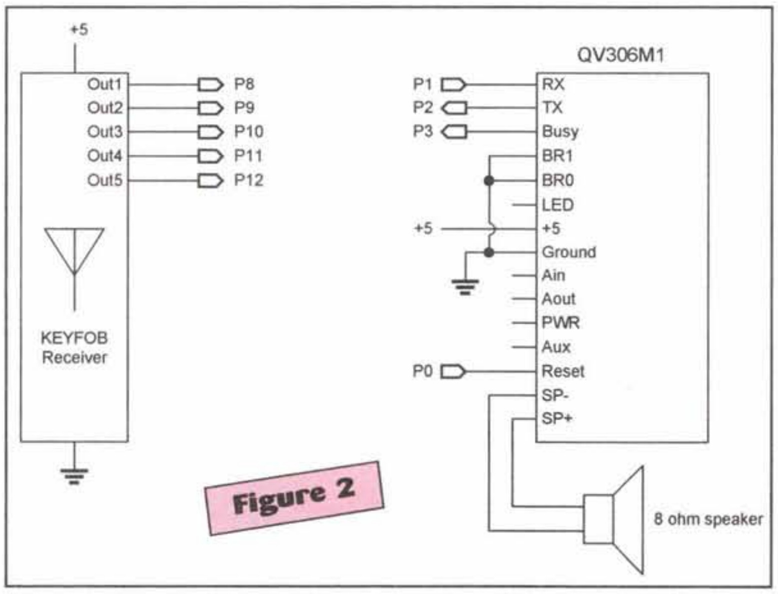


Figure 2

SOUNDS LIKE TIME FOR TRICKS AND TREATS

The key fob transmitter/receiver pair is available in two frequencies: 418 MHz and 433 MHz. The range is about 75 feet – outdoors without obstructions. This is perfect for me since I won't be more than 20 or 30 feet from the yard at any time.

The key fob receiver is a small (0.75" x 2.5"), single-sided PCB with a simple wire antenna and a seven-pin SIP header. The pins make it perfect to plug into a solderless breadboard. All we have to do is provide regulated five volts and ground, then press a button on the key fob transmitter. When we do, the associated output pin will go high. It's that easy.

Bigger Sound From A Smaller Package

Back in June and July, I showed you how to use the Quadravox QV306M4 to add sound to your BASIC Stamp projects. Well, my friends at Quadravox have been working hard and listening to customer feedback about the product. They've recently introduced a new module, the QV306M1.

The M1 module is mechanically, electrically, and software compatible with the M4. The only change you would have to make is in the volume setting. M4 volume level is from 0 to 31, while the M1 volume level is from 0 to 63.

The M1 is considerably smaller than the M4. It's just over one-and-a-half inches wide and about three-quarters of an inch tall. This was accomplished by using surface-mount components. This being the case, there's not much filtering on the power supply input so you really need to do that externally.

There are two more important features that make the M1 very attractive: it has a better amplifier capable of delivering a full watt of sound (the M4 is 300 mW), and it has a serial buffer that lets us assemble a "string" of files and then play that string with no discernable gaps in between. This last feature is really great and has been the biggest annoyance among M4 users.

Let's be clear though, it's not a flaw with the M4. The ISD chip that is used on the module makes extra noises (clicks and pops) when accessed in sequential mode. The guys at Quadravox know this (they spend most of their time developing ISD development tools and they definitely have a handle on this), so they have incorporated logic into the M4 controller that mutes the amplifier between sound files. This takes a bit of time. By design, the M1 does the same thing, it's just that a better amplifier is available so the process is significantly less noticeable.

Another reason for delays between speech/sound files is the external processing (from the Stamp, for example). This problem is solved with three new commands in the M1:

$F9 Open string buffer
$FA Close string buffer
$FB Play string buffer

When the $F9 command is sent, sounds will not immediately play (like in direct mode, $F0). Instead, they'll be queued in a buffer that can be up to 48 bytes long. When we've finished putting sound file numbers into the buffer, we send $FA. This tells the M1 that we're done building the buffer. Sending $FB plays it; cleanly, without gaps – it's a beautiful thing. And, just as a bonus, if we want to replay the buffer we can without rebuilding it.

Playing Spooky Sounds

Okay, let's build the project. The schematic in Figure 1 shows just how simple this project is. I kid you not: I assembled the hardware in about two minutes on a Parallax BOE (Board of Education). Of course, you can use any solderless breadboard – just be sure that you provide a clean, five-volt source to the key fob receiver and to the QV306 (see Figure 2 for an example).

The connections between the key fob receiver and the Stamp are direct connections. The receiver provides a digital high output when the corresponding button is pressed (yes, we can press more than one button at the same time), otherwise the outputs are low. We'll configure pins 8 through 12 as inputs and watch them for a button press.

The connections between the Stamp and the QV306M1 are "maxed out" – so to speak. In many applications, we can get away with fewer. Please note that by using these connections, the QV306M4 can be used with this project, as well. A difference between the M1 and M4 is that the M4 requires the Reset line to bring it out of sleep mode. Any serial input to the M1 when it is asleep will cause it to wake (the command will be ignored). And with the ability to build and play strings, we really don't need the Busy line when using the M1.

Let's chat a bit about the program's design before we get into code details. What I did is collect a bunch a Halloween-oriented WAV files from the Internet, process them to meet the requirements of the QV306, and downloaded them to the QV306 using the QV430 programming cradle. Remember, you can "roll your own" programmer using a BASIC Stamp. Download the July column from the Parallax web site for details on the DIY programmer and on processing WAV files for the QV306.

The software is really just as simple as the circuit. About the trickiest thing we'll do here is make it compatible with the QV306M4 and the QV306M1 by using the device-type request function. Keep in mind that the M1 variant has the string play function and we'll take advantage of it.

Notice that in the connections definitions we're renaming (aliasing) the InH register (inputs for pins 8 through 15) as KeyFob. This will let us grab all five receiver bits at once. This leads us to an important consideration: Since we're only using five bits, it's a good idea to mask out the unused bits. That way, the unpredictable results returned by the floating inputs will not interfere with proper operation of the program. We could use pull-down resistors on the unused inputs, but this just adds extra parts.

After defining our variables, we'll store the file numbers for sound strings in **DATA** statements. You'll notice that each string is terminated by $FF. The terminating byte allows us to keep the string length variable. $FF is used for convenience. Technically, any value greater than $EF (239; the highest possible QV306 sound file) will work with the program.

The QV306 is initialized by taking its Reset line low for 100 milliseconds, then bringing it back high. After the device is reset, we pause for two seconds to allow the QV306 to take care of internal housekeeping.

Since this code is designed to work with either the QV306M4 or the newer QV306M1, the get device-type command ($FF) is sent to the sound module. The return should be 54 for the M4 module or 55 for the M1 module. **LOOKDOWN** is used to set the variable devType to 0 or 1 based on the detected device.

You might wonder why we used **LOOKDOWN** instead of a simple subtraction to set the devType variable. The reason is this: If the module doesn't respond (perhaps the QV306 TX line is not connected), we will assume it's an M4 module and treat it accordingly. Since the M1 uses a superset of the M4 commands, this will allow either module to work fine. If it is, indeed, an M1 module, the sound may be a little low.

Once we know the device type, we'll set its volume. Refer to the July article for using a potentiometer (read with **RCTIME**) to set the volume if you need it to be variable. I selected default volume levels for each module type base on the speaker I'm driving. This is the one area you'll definitely need to adjust for your set-up.

Finally, we'll initialize the value of lastKey. It's important to initialize lastKey to something different than theKey so that the string will be built in the QV306M1 if Button1 is pressed first.

In the main loop of code, the first thing that happens is that the inputs from the key fob receiver are scanned. The **NCD** function is used to return the button number pressed. This means we'll only look at one button at a time. If you want to allow multiple button presses, you should add a bit of debounce routine (and drop **NCD**). Debouncing isn't necessary for this program because that is handled by the key fob transmitter and receiver. Note that the constant called KeyMask is used to mask out the unused bits.

The result of **NCD** will be between zero (no press) and five. If zero, we simply loop back and look again. For non-zero values, we'll subtract one and use **LOOKUP** to load the first byte of our stored sound file string.

Next, we look at the device type. If it's an M4, we can start sending (playing) chunks from our sounds string. If the device is an M1, we look to see if the requested string is the same as the last one. If yes, we'll play it. If not, we'll send the Open String command to the M1.

The next section (at Get_Sound_File) loops through the EEPROM reading the sound file numbers and sending them to the QV306. We need to monitor the busy line during this process, especially if the module is an M4 and the sound will be playing. When $FF (end of string) is encountered, the string is complete. If the module is an M1, we'll close the string then send the Play String command.

At the end, we'll make sure that there's a button pressed before moving on. This will prevent unintentional repeat plays of the same string.

Go To It

You see, this is an easy project so get to it. There are any number of modifications you could make to add your own input devices. Feel free to download the Halloween WAV files I used from *Nuts & Volts* or from the Parallax web site — or go get your own; there's a bunch of them available on the Internet. And for those of you who might be new to the QV306 sound module, be sure to review the June and July issues for additional details.

Happy Stamping. **NV**

Resources:

Jon Williams
3718 Valley View Lane, #3040
Irving, TX 75062
(972) 659-9090
jonwms@aol.com

Parallax
599 Menlo Drive, Suite 100
Rocklin, CA 95756
(888) 512-1024
www.parallaxinc.com

RF Digital
www.rfdigital.com

Quadravox
www.quadravox.com

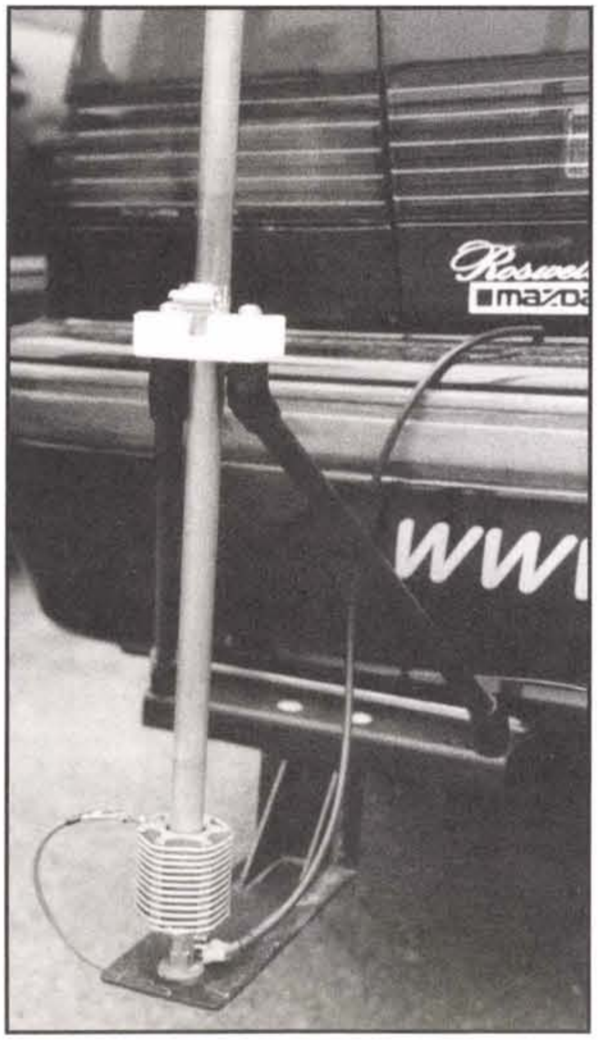
```
' -----[ Title ]-----------------------------------------------------------
'
' File...... HALLOWEEN.BS2
' Purpose... Wireless Halloween Sound FX Controller
' Author.... Jon Williams
' E-mail.... jonwms@aol.com
' Started... 09 SEP 2001
' Updated... 11 SEP 2001

' {$STAMP BS2}


' -----[ Program Description ]---------------------------------------------
'
' This program monitors pins 8 - 12 for input from a Parallax keyfob receiver.
' Based on the inputs, it plays sounds stored in a QV306M4 or QV306M1 sound
' module.

' QV306M4 / QV306M1 Connections:
'
'  1 (RxD)              Stamp.P1
'  2 (TxD)              Stamp.P2
'  3 (Busy)             Stamp.P3
'  4 (BR1)              Ground
'  5 (BR0)              Ground
'  7 (+5)               +5 volts
'  8 (Gnd)              Ground
' 14 (Reset)            Stamp.P0
' 15 (Sp-)              8 ohm speaker -
' 16 (Sp+)              8 ohm speaker +
'
' Keyfob Receiever Connections:
'
'  1 (Gnd)              Ground
'  2 (+5)               +5 volts
'  3 (Out1)             Stamp.P8
'  4 (Out2)             Stamp.P9
'  5 (Out3)             Stamp.P10
'  6 (Out4)             Stamp.P11
'  7 (Out5)             Stamp.P12


' -----[ Revision History ]------------------------------------------------
'


' -----[ I/O Definitions ]-------------------------------------------------
'
KeyFob          VAR     InH                     ' from keyfob receiver

QV_RST          CON     0                       ' to QV306M4 or QV306M1
QV_RX           CON     1
QV_TX           CON     2
QV_BUSY         VAR     In3


' -----[ Constants ]-------------------------------------------------------
'
T2400           CON     396             ' 2400 baud, true
IsBusy          CON     0

' Quadravox Commands

QV_Play         CON     $F0             ' play direct file
QV_Stop         CON     $F6
QV_Sleep CON    $F8
QV_OpenStr      CON     $F9             ' open string buffer (QV306M1)
QV_CloseStr     CON     $FA             ' close string buffer (QV306M1)
QV_PlayStr      CON     $FB             ' play string buffer (QV306M1)
QV_Volume       CON     $FC
QV_Reset CON    $FD                     ' software reset
QV_Rev          CON     $FE             ' module revision
QV_Type         CON     $FF             ' module type

QV306M4         CON     0
QV306M1         CON     1

KeyMask         CON     %00011111       ' mask for pin inputs


' -----[ Sound Files ]-----------------------------------------------------
'
_attack         CON     0               ' animal attack.wav
_belch          CON     1               ' belch.wav
_boing          CON     2               ' boing.wav
_bonk           CON     3               ' bonk.wav
_door           CON     4               ' creaking door.wav
_dingdong       CON     5               ' ding-dong.wav
_zap            CON     6               ' electric current.wav
_laugh1         CON     7               ' evil laugh 1.wav
_laugh2         CON     8               ' evil laugh 2.wav
_explode CON    9                       ' explode.wav
_barf           CON     10              ' funny barf.wav
_getout         CON     11              ' get out.wav
_glass          CON     12              ' glas.wav
_gunshot CON    13                      ' gunshot.wav
_hh             CON     14              ' happy halloween.wav
_moan1          CON     15              ' moan 1
_moan2          CON     16              ' moan 2
_phone          CON     17              ' phone ring.wav
_scream         CON     18              ' scream.wav
_shotgun CON    19                      ' shotgun.wav
_thunder CON    20                      ' thunder.wav
_werewolf       CON     21              ' werewolf.wav


' -----[ Variables ]-------------------------------------------------------
'
qvData          VAR     Byte            ' data to/from QV306
devType         VAR     Bit             ' device type
theKey          VAR     Nib             ' current key press
lastKey         VAR     Nib             ' last key press
addr            VAR     Word            ' ee address of sound file


' -----[ EEPROM Data ]-----------------------------------------------------
'
Btn1            DATA    _hh, _laugh1, $FF
Btn2            DATA    _scream, _gunshot, _bonk, _glass, $FF
Btn3            DATA    _dingdong, _door, _attack, $FF
Btn4            DATA    _belch, _laugh2, _barf, $FF
Btn5            DATA    _getout, _moan1, _werewolf, _thunder, $FF


' -----[ Initialization ]--------------------------------------------------
'
Initialize:
  LOW QV_RST                                    ' Reset the QV306
  PAUSE 100
  HIGH QV_RST
  PAUSE 2000

  GOSUB QV_GetType                              ' get device type from module
  LOOKDOWN qvData, [54, 55], devType            ' 0 = QV306M4, 1 = QV306M1

  DEBUG CLS, "Device is QV306M", "4" - (devType * 3)

  qvData = 25                                   ' default volume for QV306M4
  IF (devType = QV306M4) THEN Set_Volume
  qvData = 50                                   ' defualt volume for QV306M1

Set_Volume:
  GOSUB QV_SetVolume

  lastKey = ~theKey                             ' force string build first time


' -----[ Main Code ]-------------------------------------------------------
'
Main:
  theKey = NCD (KeyFob & KeyMask)               ' get receiver inputs
  IF (theKey = 0) THEN Main                     ' button pressed?
  LOOKUP theKey-1, [Btn1, Btn2, Btn3, Btn4, Btn5], addr

  IF (devType = QV306M4) THEN Get_Sound_File    ' skip this if 306M4
  IF (theKey = lastKey) THEN Play_M1_String
  SEROUT QV_RX,T2400,[QV_OpenStr]               ' open buffer on 306M1

Get_Sound_File:
  READ addr, qvData                             ' get sound file
  IF (qvData > 239) THEN Done

QV306_Busy:
  IF (QV_Busy = IsBusy) THEN QV306_Busy         ' wait for Busy to release
  SEROUT QV_RX,T2400,[qvData]                   ' send the phrase
  addr = addr + 1                               ' point to next phrase
  GOTO Get_Sound_File                           ' send it

Done:
  IF (devType = QV306M4) THEN Do_Again          ' if 306M4 - we're done
  SEROUT QV_RX,T2400,[QV_CloseStr]              ' ..otherwise, close buffer

Play_M1_String:
  SEROUT QV_RX,T2400,[QV_PlayStr]               ' play it
  lastKey = theKey

Do_Again:
  qvData = KeyFob & KeyMask                     ' check inputs
  IF (qvData > 0) THEN Do_Again                 ' make sure they're clear
  GOTO Main                                     ' get next button
  END


' -----[ Subroutines ]-----------------------------------------------------
'
QV_GetType:
  qvData = 0
  SEROUT QV_RX,T2400,[QV_Type]                  ' send request
  SERIN  QV_TX,T2400,2000,NoType,[qvData]       ' get type
NoType:
  RETURN


QV_SetVolume:
  IF (QV_Busy = IsBusy) THEN QV_SetVolume       ' wait for Busy to release
  SEROUT QV_RX,T2400,[QV_Volume]                ' send volume command
  SEROUT QV_RX,T2400,[qvData]                   ' send volume level
  RETURN
```

3/8 x 24 HF MOBILE ANTENNAS

by Gordon West

The amateur radio General class license — allowing worldwide high-frequency privileges — has become the fastest growing ham class in the long history of the service. Last year, the Federal Communications Commission (FCC) restructured the amateur service, decreasing the worldwide General class Morse Code requirements from 13 wpm down to a simple 5 wpm Morse Code exam.

This has attracted ham radio "terminal no-code Technicians" to rethink the merits of learning the Morse Code, and most no-coders are doing just that — ordering up the Gordo learning code six-tape cassette course, spending about three weeks with the tapes, and easily passing the Morse Code upgrade exam and the simple General written class exam on the first try (materials from 1-800-669-9594).



Antenna impedance matching coil.

MOBILE HF ANTENNAS

So what does it take to get onto the worldwide bands from your favorite car, truck, or van? Any way to get on the air with a great worldwide signal without having to bore holes in the fender or bumper? And really, is it absolutely necessary to have that huge loading coil halfway up the mobile antenna mast to get signals into Europe?

I am happy to report that the following tests I will describe on small mobile antennas lead to great stateside and worldwide voice contacts running under 100 watts of power, and no, you won't need to bore holes or attach a garbage can size loading coil to get a worldwide signal out there on the General class ham radio airwaves. Read on ...

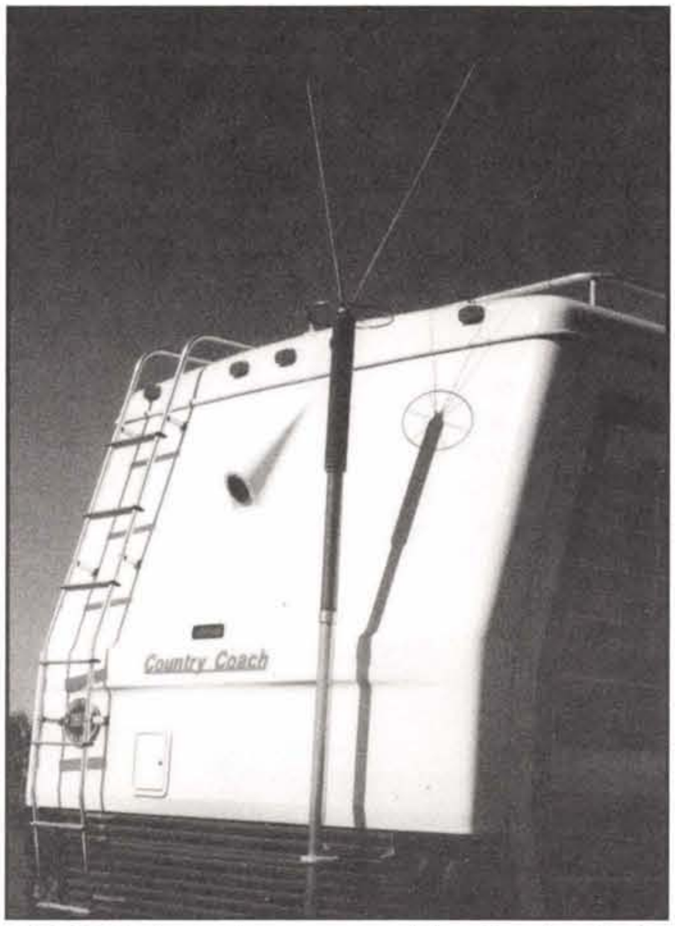
The big monster mobile coils attached to a mobile antenna shaft the size of your exhaust pipe are absolutely not necessary to get started with a great signal on the higher high-frequency bands. Those monster mobile antenna systems may also require custom mounts at the base to hang them onto the framework of your vehicle — and they also require an additional small coil at the base that must be adjusted each time you change bands.

These major mobile antennas with their massive coil are indeed better performers on the lower nighttime bands like 75/80 meters and 160 meters. On the day and night 40-meter band, the massive mobile antennas with their huge mount to the frame may increase your signal strength *slightly* over a conventional skinny whip. And on the higher ham bands like 10 meters, 12 meters, 15 meters, 17 meters, and 20 meters, you can work worldwide DX (long range) with little differences in signal strength to a station in Italy ready to go to bed as you cruise the freeway for your morning commute.

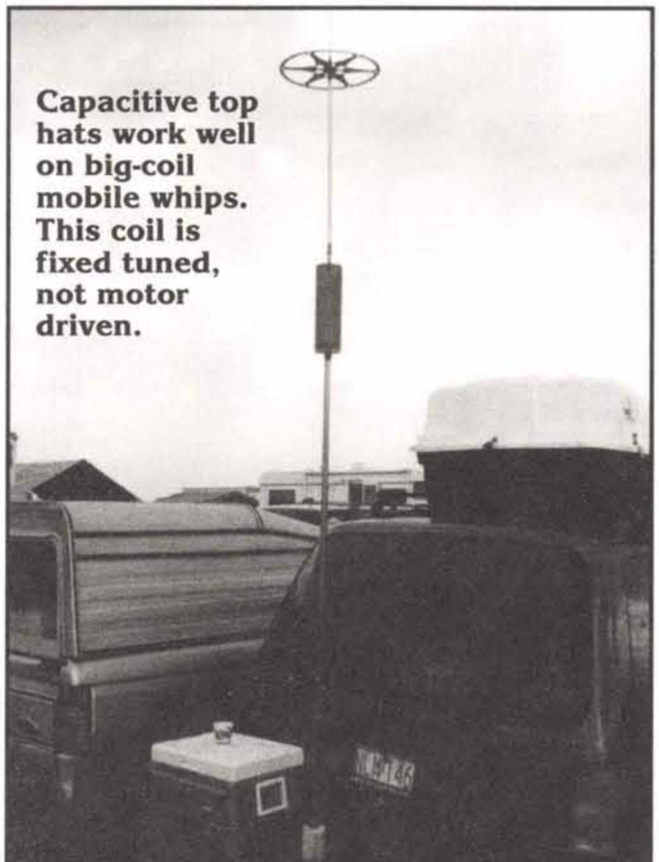
3/8" x 24

These are the numbers for the thread size and pitch for the common mobile antenna that will screw into the common receiver threads. The "receiver threads" is that assembly that might be part of a lip mount, hatch mount, spring mount, or bracket mount fed with coax that leads to your high-frequency mobile transceiver. Many of these mounts do not require any holes to be drilled in the side of your vehicle — one of the most sturdy mounts is the lip mount from Diamond Antenna, K400-3/8C (available at all ham radio dealers). MFJ has a similar trunk lip mount, Model 345 (www.mfjenterprises.com). Both the Diamond and the MFJ mounts need to be ordered with the coaxial cable kit that goes between the mount and your high-frequency radio.

And these 3/8 x 24 mounts don't necessarily need to slip over a trunk lip — variations include a mirror/luggage pipe clamp mount (MFJ-340), hatch mount (Diamond K412), Comet mounts (all ham dealers); and if you really insist on wanting to drill some holes in your



W7AEG homebrew capacitive top-loaded power HF antenna. Whatta signal on 40 and 75 meters!


Capacitive top hats work well on big-coil mobile whips. This coil is fixed tuned, not motor driven.

fender, go for the classic ball mount from Hustler (C-32 all ham dealers). If you have a trailer hitch jutting out from the back of your vehicle, Ham Radio Outlet www.hamradio.com) offers the "Tenna Hitch" with a 3/8 x 24 receiver.

And before we leave the subject of mounts and start talking about our tests of 3/8 x 24 threaded mobile whips, we proved conclusively that lightweight mobile whips mounted way up high on the vehicle, just under the 13'6" maximum limit, were much better performers than bigger and more exotic coil mobile whips mounted just inches above the pavement. Test after test revealed that getting your mobile whip as high up on your vehicle ground (chassis of the vehicle) is exceptionally important for increased signal strength at the other end of the circuit.

Our test of mobile lightweight and medium-weight whips with 3/8" x 24 threads covered almost every antenna available in the marketplace. If I missed anyone, call me and I will review your antenna this fall!

MFJ HF whips $20.00 each.
Valor whips $20.00 each.
Anttron ham whips $20.00 each.
Anixter helical top-loaded whips $30.00 each.
Lakeview ham stick $21.00 each.
Hustler center coil whips $25.00 each.
Wintenna whips $20.00 each.
Comet multi-band HF whips $160.00.
Alphadelta Outbacker multi-band $300-$400.
Iron Horse HF sticks $20.00 each.
Old Swantenna Used market.
Hi-Q motorized/or manual all-band antenna. Pricing at www.hiqantennas.com.
Old Webster Bandspanner Used market.
Ten Tec single-band whips Used market.
Antenna World "short shaft" suitcase HF whips $22.00 each.
SGC QMS 37 auto-tuner system around $400.00.
Telescopic military fiberglass mast, 35' military surplus.
Yaesu ATAS-100, lightweight, motorized HF whip under $400.00.

NO BEATING THE BASICS

What we are attempting to achieve on high frequency — using a metal vehicle as our ground plane — is as much signal with as little coil-winding loss as possible, compared to a one-quarter wavelength whip.

10 meters = 8 feet
15 meters = 11 feet
20 meters = 16 feet
40 meters = 32 feet
75/80 meters = 64 feet
160 meters = 128 feet

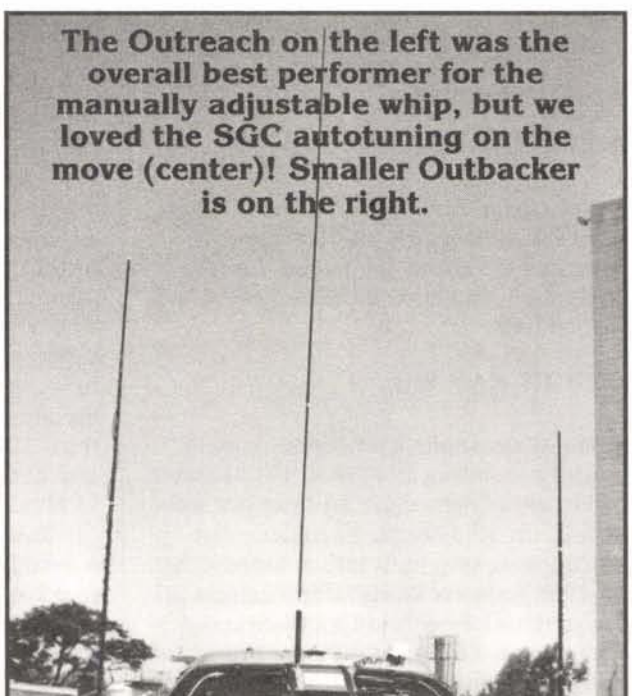
Certainly you're not going to drive around with all of these different whip lengths extending into the sky, ready to snag drive-through overhangs and fry you instantly when you tangle with power lines on that 75-meter, 64-foot whip. In order to make a one-quarter wavelength vertical physically short, compared to wavelength, these antenna manufacturers have worked out their own loading coil schemes, each with benefits to the radiated signal, but obstacles for us to get it to screw onto a relatively lightweight mount and remain in place at 60 mph.

Yet others are quite aerodynamic and hold on fine to a lightweight trunk-lip mount, but may lead to slightly less performance than their bulkier counterpart. Some manufacturers electronically tune with coils, capacitors, and relays at the base, where others may use an open-air or compact sealed coil in the center. Other manufacturers may use linear loading with a stainless steel tip whip (most aerodynamic), yet others may top load with the coil windings at the very tip of the fiberglass shaft.

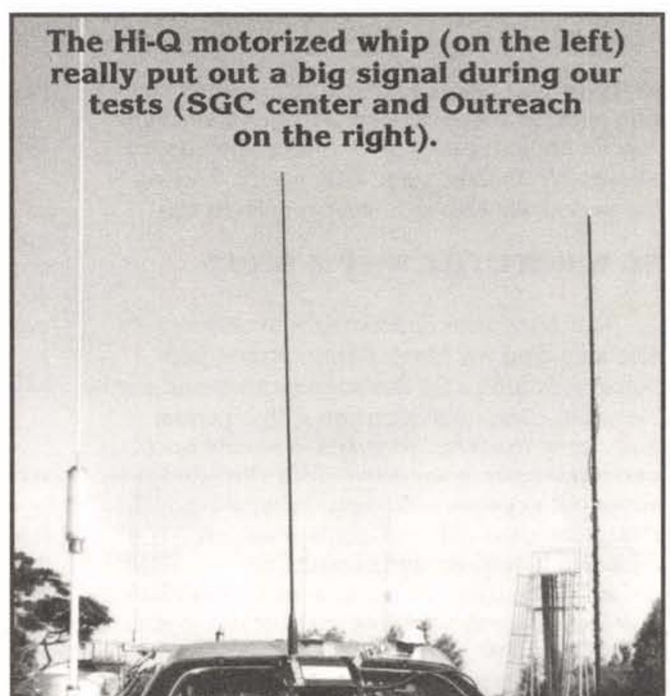
But the technique of making a short antenna perform "better than others" doesn't stop here — base impedance matching coils are sometimes necessary, capacity hats can help the radiation characteristics up at the top of the whip, and precisely how the coil is wound may dramatically reduce the wire ohmic losses.

Worldradio Magazine antenna expert, "Kurt Sterba" (Peter Onnigan, W6QEU), has two antenna books called *Aerials* that will give you all the techniques behind a better signal (order at 916-457-3655).

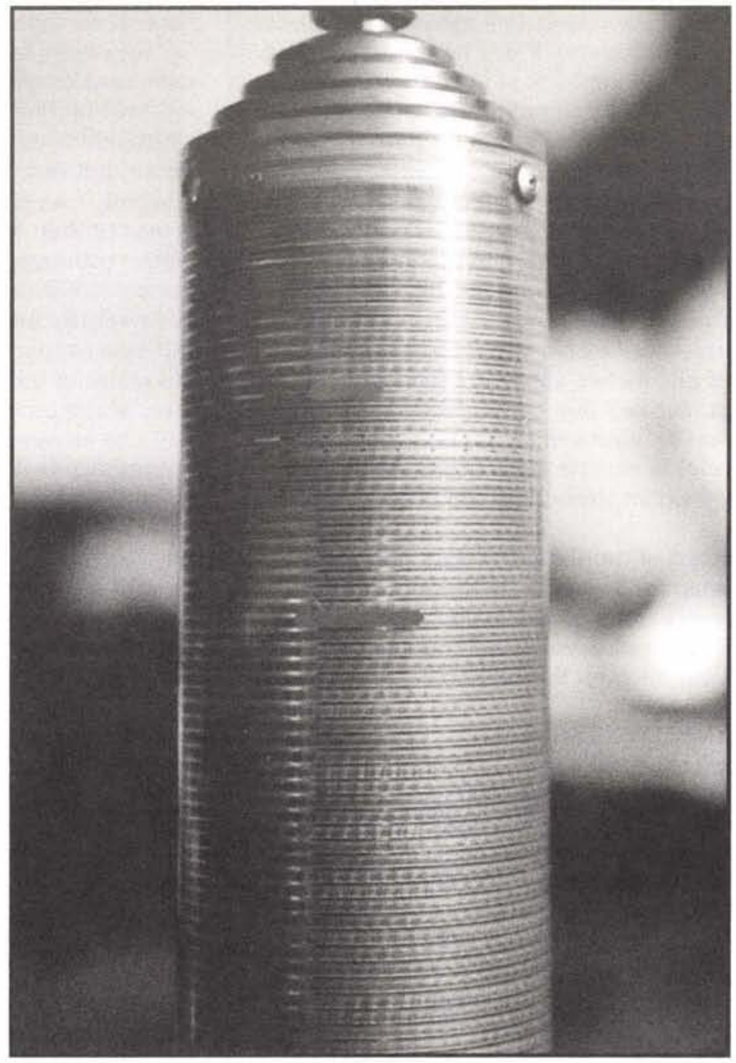
All of the mobile antennas I have described should not be compared to the massive bug catcher, motorized DK, and other monster antennas not intended and not capable of hanging onto a relatively lightweight trunk lip mount



The Outreach on the left was the overall best performer for the manually adjustable whip, but we loved the SGC autotuning on the move (center)! Smaller Outbacker is on the right.



The Hi-Q motorized whip (on the left) really put out a big signal during our tests (SGC center and Outreach on the right).



Close-up of the Hi-Q coil.

with 3/8 x 24 threads. You would graduate into one of these more massive and more efficient mobile antennas only after you've been on the air with HF mobile for at least a year. This waiting period will also save your marriage, too.

SO WHICH LITTLE WHIP IS BEST?

Our tests were conducted with several vehicles including my black station wagon peppered with 3/8" x 24 threaded mounts and our big white communication van with an equal number of mounts. We tested in a wide open parking lot where we could easily turn circles to verify our skywave readings. We would quickly switch between different whips using an Alphadelta multi-antenna switch. Several different rigs were used for our test, including ICOM IC-746, Kenwood TS-2000, and Yaesu FT-100, and SGC 2020.

The stations we would test with would be attracted to our on-the-air goings on at random. Almost all were skywave — some 1,000 miles away — and some 3,000 miles away. Our ability to quickly switch from whip to whip gave us every opportunity to confirm relative signal reports without the concern of typical up and down band conditions. We would operate on 10 meters through 75 meters phone. The tests lasted for several weeks, and the results were generally accepted by real antenna experts who reviewed some of my notes after our on-the-air comparisons. Here is a capsule account of what we learned over several weeks of testing over 20 individual 3/8" x 24 high-frequency ham antennas:

THE TALLER, THE BETTER

The Alphadelta Outbacker Outreach measures 11 feet tall, and on the station wagon it outdid everyone else from 10 meters down to 40. But below 40, the big coil Hi-Q antenna had everyone else beat.

LIGHTWEIGHT HAM WHIPS

Slim fiberglass shafts with center loading windings and a stainless steel whip were easiest to work with, ultra lightweight, and put out walloping signals on 10 through 40 meters. But their shaft was too long to fit into a suitcase, so the short shaft Antenna World whips compared ultra-close to their longer four-foot fiberglass shaft counterparts. Of all the different brands of fiberglass lightweight ham whips, their on-the-air performance was almost identical.

We found that different brands of these ham lightweight whips would offer better matching at specific locations on the vehicle. While a built-in automatic antenna tuner could help improve the base impedance match, I would prefer to run them direct and hope for a perfect base match. We noticed that a very slight mismatch would cause all of our radios to begin to pull back power, and we immediately received bad signal reports when we saw any elevated SWR on the face of the radio.

Since solid-state transceivers pull back output power with almost any amount of reflected power, you want to see a full-scale output and almost no indication of SWR to be assured you will have the loudest HF signal on the air.

The skinny ham sticks performed just as well to an equal length multi-band Outbacker. But the Outbacker has the capability of breaking down into three sections (special order), making it more advantageous for rent-a-car mobile.

The SGC automatically tuned antenna system performed well, and gave us the unique capability to change bands and operate without having to stop the vehicle for center loading or base impedance matching adjustments. We would first transmit with voice to set the SGC tuner, and then activate the transceiver's built-in tuner to squeeze the last drop of power out of the equipment. Once we did this, performance from 10 meters down to 40 meters was equal to any of the other pre-tuned whips that came up to about the same height over the roadway.

Placement of any of the whips higher up on a vehicle (such as on our communications van roof line) dramatically improved signal reports. Unfortunately, many of the whips up high exceeded the 13'6" limit, so you would operate in this mode only when mobile at rest.

CAUTION: WATCH OUT FOR OVERHEAD POWER LINES WITH ANY WHIP TALLER THAN 15 FEET ABOVE GROUND!

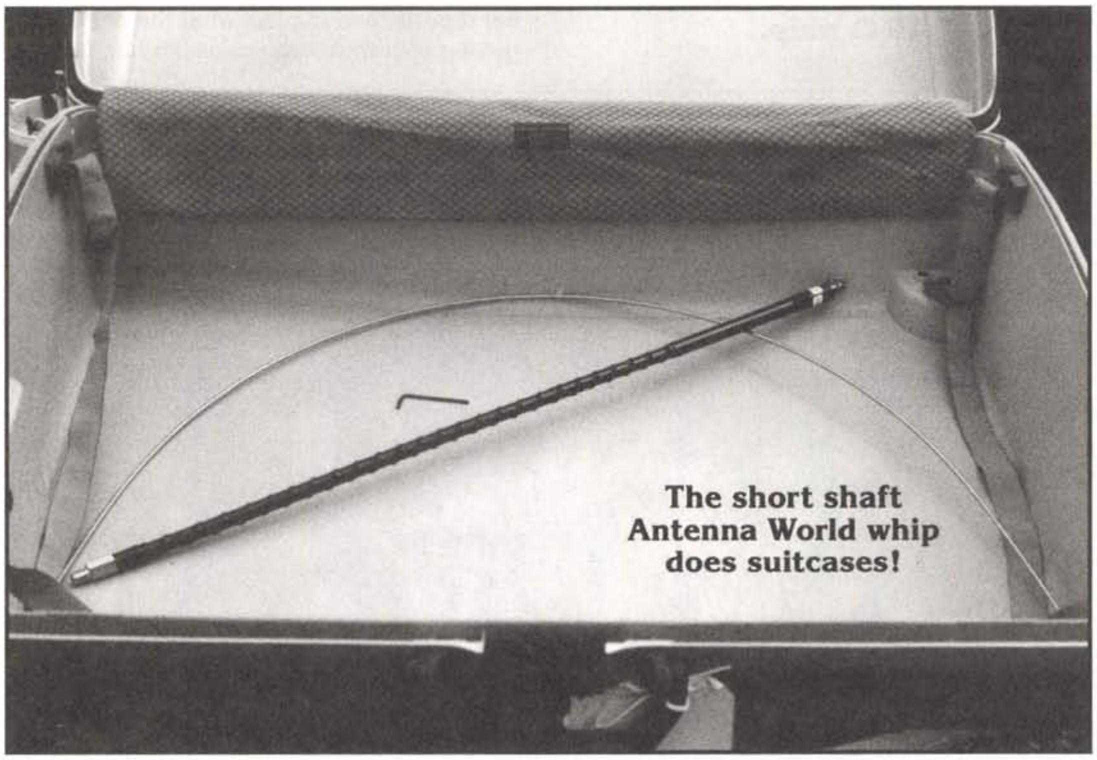
Repeated tests of similar lengths and similarly constructed lightweight whips revealed little signal strength changes between them, providing the base impedance match was optimum. One set of whips came with little tiny disk capacitors that were illustrated to be added at the feedpoint in order to improve the base match. Now tell me, when you change bands, you're going to get on the back side of your fender and change capacitors? I doubt it! A better way to go would be to get the MFJ Model 910 selectible base impedance matching box. One click and you are back to a perfect match.

During one of our tests, a fellow ham came by with one of the largest bug catching, capacity hat, open-air, coil antenna systems I have ever seen on a vehicle, just under the 13'6" limit. On 10 meters, 15 meters, and 20 meters, signals were almost identical to other stations throughout the country and Europe. The big mama antenna usually lead to reports of "slightly better audio qualities," a term we have heard a lot on the air where the signal simply sounds stronger, but on the S-meter seems to be almost the same.

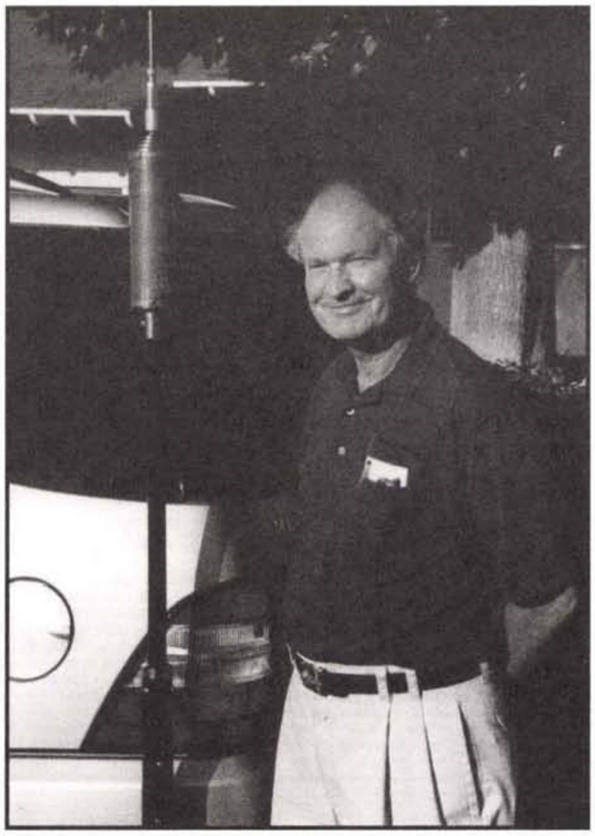
On 40 meters, the big major open-air bug catching antenna with the giant capacity hat beat out everything else we had by at least two S-units. The only close to it was our Outbacker Outreach and, better yet, the Hi-Q motorized antenna with the extra long fiberglass CB whip and a small top hat over the precision-wound coil.

Down on 75 meters, only the most massive of vehicle chassis mounted antennas gave us any real signal to skywave stations several hundred miles away. All of the other smaller antennas — even though they matched up well — were down in the mud. If you're serious about operating nighttime 75 meters, or way down at 160 meters, you really need to get a major amount of aluminum and open air coils and capacity hats up there in the air. No little whip can do any trick below 40 meters — and even the small whips on 40 meters were well down in signal strength when compared to the Hi-Q antenna and the big Outbacker Outreach.

Another discovery we made was how robust or how cheap some of these antennas were from the manufacturer. The Alphadelta Outbackers defy fracturing when repeatedly slammed against a brick wall. Yet some of the fiberglass shaft, inexpensive, single-band, ham whips would crack, lose their tip whip if connected with just a single Allen screw, or the tip whip was of a non-tempered stainless steel that would immediately take a set if you tried to coil it up in a suitcase. The Antenna World and


The short shaft Antenna World whip does suitcases!


Outbacker triple breakdown HF whip, also suitcase rated!



Charlie shows off his motorized Hi-Q whip.

it up in a suitcase. The Antenna World and Valor tip whips seemed to be bend-free after the suitcase test, including the Outbacker Perth with its high-quality, yard-long, stainless steel whip tip.

For those of you who travel, you can appreciate a suitcase antenna system, including the Diamond mount, for quick antenna attachment to almost any kind of rental vehicle at the distant location. My favorite is the Outbacker Outreach that breaks down into three sections, held onto the side rear door of a rent-a-car, keeping the tip whip just under the legal limit. I use a small gel 12-volt battery to buffer the rent-a-car cigarette lighter battery socket, and I am on the air in minutes when I get to the next hamfest.

CONCLUSIONS

You will have an excellent signal on 10 meters through 20 meters with almost any type of lightweight, skinny ham antenna you get up nice and high on your vehicle. To optimize for 40 meters, you're going to need to go with something that is taller and has a larger coil. If you're thinking of 75 meters, you will be extremely disappointed that the little tiny lightweight whips only give you marginal mobile signal reports, nothing like what the big boys are getting with their huge capacity hat, bug catching mobiles.

If you have a Yaesu 847 or AT-100, the little Yaesu ATAS antenna works nicely from 10 meters through 40 meters. If you regularly change from band to band, consider the many different types of SGC QMS strap-on, automatically tuned, military-quality mobile antenna systems — they look goofy, but they put out an admirable signal as we tested with a QMS-37.

Finally, check for any slight mismatch of base impedance. While a slight mismatch of 2:1 to 1 doesn't seem like much, you may find that your transceiver is cutting down to half-power output. If your mobile transceiver normally shows 20 little bar segments for maximum power output into a 50-ohm load, 15 or 16 little LCD bars of output might really impact your signal on the airwaves. That little MFJ impedance matching black box gave us instant reports of increased signal strength when our equipment without an internal tuner automatically went to full power out.

So have fun this fall on high-frequency mobile. Ten meters through 20 meters, almost anything works well that is resonant and up high on the vehicle. For 40 meters, start thinking open-air coil or big kilowatt coil like Hustler, and the Hi-Q. For 75 meters, read the *World Radio* books and see what it takes to get a monster signal into the air from a monster mobile antenna. Have fun! **NV**

ELECTRONICS Q&A

With TJ Byers

In this column, I answer questions about all aspects of electronics, including computer hardware, software, circuits, electronic theory, troubleshooting, and anything else of interest to the hobbyist. Feel free to participate with your questions, as well as comments and suggestions. You can reach me at:

TJBYERS@aol.com

or by snail mail at Nuts & Volts Magazine, 430 Princeland Ct., Corona, CA 92879.

What's Up:

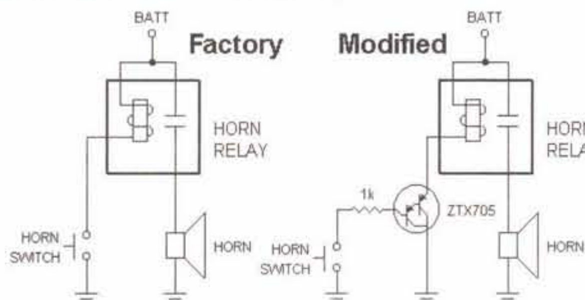
This month, I do a clean-up of past projects and answers. How do you clean dirt from an old printed circuit board (PCB)? Is PCB fiberglass dust unhealthy? How about drilling holes in a PCB? Read on. My favorite is an answer about vinyl nostalgia, which applies to motor control again (robotics?).

Horn Fix Update

Q. Concerning the "Horn Quick Fix" in the July 2001 issue, I don't know a thing about Toyota cars, but every "American" car or truck that I've owned had a horn relay between the button and the twin horns. Could the Toyota have the same? Might it be the reason for the odd resistance readings?

Bob Jay
via Internet

A. No. The Toyota drives the horn directly from the steering wheel switch, which carries a lot of current. There is no relay involved. In fact, I wasn't aware of this until I submitted the circuit below to the reader, after which he politely informed me of the discrepancy. But you are quite right, the "Big Three" car makers in the US use horn relays.



To bypass a high-resistance horn wire in these vehicles, I'd use a PNP Darlington transistor wired as shown to the left of the factory wiring. With a gain of 3,000 minimum, this lets the horn wire resistance to go as high as 120k or higher before it becomes unusable. As before, this isn't a fix, just a band-aid.

Testing Switching Power Supplies

Q. I heard, or read, somewhere that a PC switching power supply will be seriously damaged if powered on without a load on the outputs. My questions are: Is it necessary to load all the outputs (+12V, -12V, +5V, and -5V) or only certain ones? If so, which ones? How much load is needed to have the power supply operate safely?

My goal is to make a plug-in AT power supply tester with the necessary loads and indicators to show the health of the unit. Then I'd like to use the +12V output to operate an amateur radio or audio amplifier if only the 12-volt output needs to be loaded.

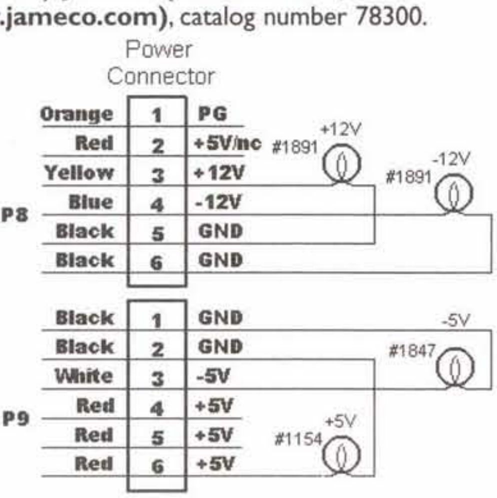
Curt Powell WB4WAA
via Internet

A. You heard right, the power supply does need a load to work properly. There are no hard numbers, it depends on your particular power supply, but the minimum load normally runs between 10% and 25% of the rated full load. Here's an example of a typical 250W AT switching power supply.

PS Voltage	PS Current	Typical Load
+5V	25A	6A
+12V	12A	2A
-5V	0.5A	0.0A
-12V	0.5A	0.3A
Total	277.5W	57.6W

Typically, the power supply regulates the voltage of all the outputs according to the voltage on the +5V output. If you don't put enough load on the +5V output, you don't get a stable +12V output. For your amateur radio application, I suggest placing a 25-watt load on the +5V output to stabilize the regulator, then use the +12V output to power your ham shack. This is easily done using a six-volt auto headlight. Not only does it properly load the power supply, it also provides spot lighting for your shack.

As for a power supply plug-in tester, it too, can use lamps for both the load and indicator. For the +5V load, a six-volt automotive tail/stop light bulb (like the 1154) is perfect. The stop lamp consumes 18 watts and the tail light consumes five watts. Depending on your particular switching power supply, combinations of the two filaments should satisfy the minimum current requirement. Once the +5V line is properly loaded, you can use any suitable lamp to indicate the condition of the remaining outputs. Granted LEDs are the most versatile — because one size fits all outputs — but they won't show if the voltage is at its proper level, whereas an incandescent lamp can be used to judge output voltage by its brightness. I suggest the following PC AT switching power supply tester. The AT power connector is stocked by **Jameco (800-831-4242; www.jameco.com)**, catalog number 78300.



PCB Scrub-a-Dub

Q. I've recently become the beneficiary of a cache of old personal computers — with adapter cards — that I'm presently getting up and running for charity use. Most of the boards are coated with a thick layer of dust, but they still work. I seem to recall from my high-school electronics that this could eventually cause resistance and heat problems. Is there an effective way to remove this build-up without damaging the components? I have compressed air available, but I'm wondering if there are any brushes with bristles that would be safer to use.

Dean, Flora, Jeremy, and Emma
via Internet

A. The professionals use DI water (de-ionized water) to remove crud and dirt from circuit boards. Here is their recommended procedure.

1 — Remove any loose items from circuit boards and place circuit boards in suitable cleaning rack. Circuit boards should be placed within the rack at a minimum 45° angle to ensure proper rinse run-off.

2 — Place the rack within the batch cleaning system and run through the cleaning cycle. Cycle temperature and cycle times follow:

Wash Cycle Temperature: 120 °F to 140 °F
Wash Cycle Time: 75 to 85 seconds
Rinse Cycle Temperature: 120 °F to 140 °F
Rinse Cycle Time: 10 to 30 seconds

3 — Remove the rack and visually examine circuit boards for cleanliness.

4 — Dry the circuit boards in oven, if desired.

While this procedure is designed to be used with a commercial "dishwasher," it can be easily adapted for less critical applications — such as cleaning the dust off your PC boards.

Start with a sink that has a hand sprayer, the kind used to preclean plates before they go into the dishwasher. Adjust the water temperature according to the guidelines above and follow the procedure, adjusting the times according to your dirt level. After the board has been washed to your satisfaction, follow the rinse cycle with a heavy dose of tepid distilled water — the kind you can find on any grocer's shelf — to remove any minerals that may be in your tap water. Finally, thoroughly air or oven dry before placing into service.

Is PCB Dust Dangerous?

Q. I have a question that has been bothering me for some time now. Is it hazardous to breathe in small quantities of dust generated when sawing clad circuit boards? The proverbial "well-ventilated area" is very hard to find in the basement, where my jig-saw resides (sigh). These boards are supposedly epoxy, but I suspect the epoxy may well be impregnated with fiberglass, or whatever, for additional strength. What exactly are the materials in these boards, anyway? Am I slowly killing myself by saving a few bucks by sawing these boards in half?

E. Nicholas Cupery
Senior Consultant Farba Research (www.FarbaResearch.com)

A. According to the American Lung Association, you could be exposing yourself to a potentially early death. As you suspect, fiberglass is a component of epoxy PC boards. Here's an excerpt from their brochure "Facts about Fiberglass" **(abrannen.home.mindspring.com/alag/fbrglass.htm)**.

"Direct contact with fiberglass materials or exposure to airborne fiberglass dust may irritate the skin, eyes, nose and throat. There is a possibility that these fibers cause permanent damage to the lungs or airways, or increase the likelihood of developing lung cancer. Inhaling the fibers may irritate the airways, resulting in cough and production of excess mucus, a condition known as bronchitis."

"Epoxy Resins are chemicals used in lacquers, varnishes and plastics, or in combination with other components to form plastics. They are also used to strengthen, harden, or give flexibility to fiberglass. Breathing epoxy resins may cause chest tightness, shortness of breath, or wheezing."

"Smoking cigarettes and/or marijuana may increase the risk of developing lung disease when combined with exposure to fiberglass and to chemicals used with it."

American Lung Association of Georgia® — East Central Region

The American Lung Association goes on to list protection and protection risks of exposure from fiberglass dust, including painter's masks and frequent washing down of the dust. However, all these precautions are unnecessary if you cut your circuit boards the way the big boys do it — with a guillotine-like bench or foot shear, the same kind found in any sheet metal shop.

These shears come in various sizes and price ranges, with some under $250.00. So where do you buy one? Check out local sheet metal and HVAC shops around town, there might be a used one hiding in a corner that's for sale, and check out the following web sites for leads.

www.grizzlyindustrial.com/fcgi-bin/lookup.fcgi/products/lookup.cfg?q=sub_category&kw=Sheet%20Metal

www.dalesway.co.uk/shears.htm

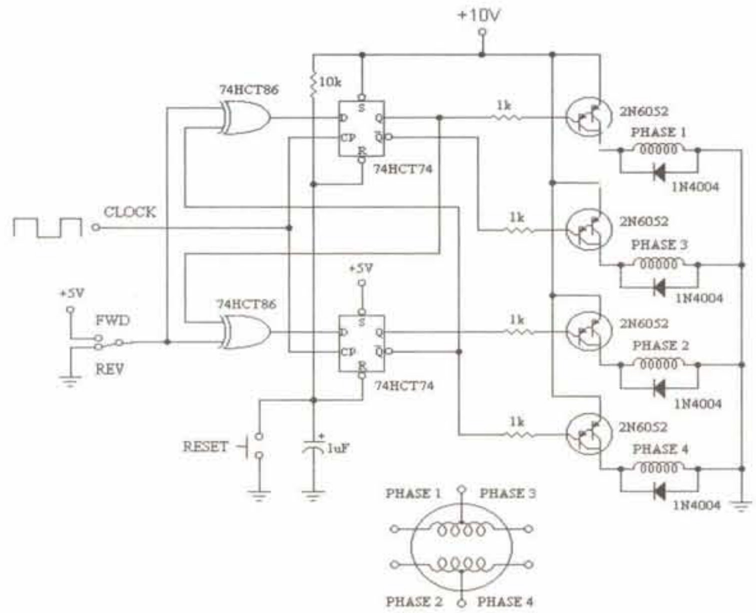
www.accutter.com/ac2001info01.htm

DIY PCB Drill Press

Q. I am making my own PCB drill, and want to be able to control the speed of a brush/less AC motor from my computer, or from a PIC microcontroller. I can program the PIC myself, and have modest knowledge of PC I/O. Can you help me with a circuit that can do this?

Imad Knio
via Internet

A. For this application, I'd use a stepper motor, like the unipolar Lin Engineering #5618X-11S-16 from **All Electronics (800-826-5432; www.allelectronics.com)**. That's because most of the holes you will be drilling use a drill size of #61 or smaller, which doesn't require a lot to torque but precise speed control. Here is a controller circuit than can be connected to a PC port or PIC to control the speed and direction of the stepper motor. Of course, you'll need a belt/pulley arrangement to drive the drill spindle, but I'm sure you already knew that.



The Old-Time Record-Cutting Edge

Q. What type of direct drive DC motor and controller could be used to obtain a smooth, non-clogging slow rotation down to 3 RPM? I'm trying to reproduce a simple overhead record mastering lathe.

Kim
via Internet

A. When I was about 10 years old, I stumbled across an old recorder that my dad had stored in the basement. It used seven-inch aluminum-based "vinyls" that were often used during the war years to send recorded letters home. It used the same mechanical set-up you're seeking. Unfortunately, I haven't seen one of these machines in a while, so starting from scratch is probably your best bet. I'd start with a six RPM gearhead motor from **All Electronics** (cat #CHM-1205-5) and a worm gear that you can make yourself using a lathe (or job it out to a machine shop). Here are a few web sites that can step you through this lost art.

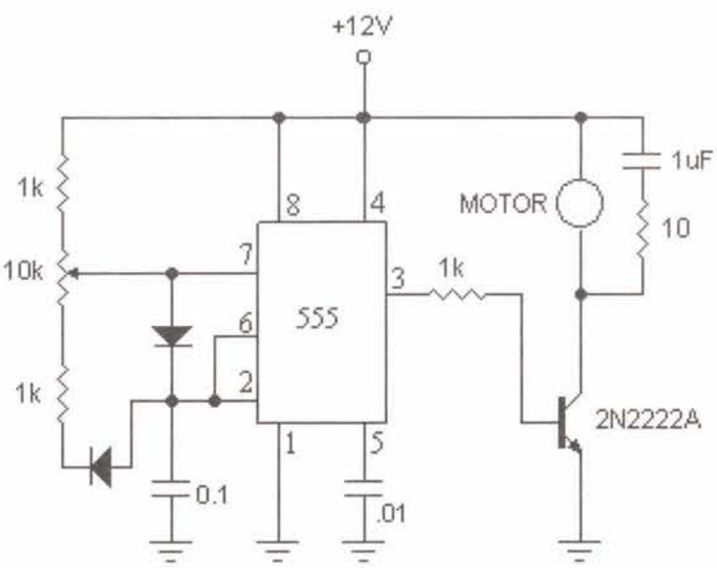
The Record-Cutting Page
www.kasumirecords.com/cutting/index.htm

Portable Recorders as a profitable sideline. Re-printed from *National Radio News*, Aug/Sept 1938
www.shellac.org/nri/index.html

Cutting the Record
www.shellac.org/wams/wrecord3.html

Notes on Machining Techniques for Worm Drives
easyweb.easynet.co.uk/~chrish/worms.htm

You'll also want to precisely control the speed of your cutting-needle motor. I suggest a PWM (pulse-width modulation) DC voltage source, like the circuit below.



USB By The Book

Q. I have a problem with the USB ports on my Win 98 box. Simply put, even though these ports are on the motherboard, I can't seem to access them, or find them on the hardware profiles tree. A search of the 'net suggests that I should refresh my BIOS. If ever there was a case of "a little knowledge is a dangerous thing," this has to be it. Is there something I should check before trying something so drastic?

Mike Neary
via Internet

A. Most new motherboards have USB connectors, but I can't say the same for all "new" software. Without going into a lot of history, USB was but a gleam in the eye of WIN 95, and only a recent addition to WIN 98. So what your problem is that you don't have a USB driver installed. Now here comes the thorny part. Installing this very simple driver is not so simple. Depending on which version of Windows you have, adding this driver to your current platform will vary, something I definitely don't have room for here. I suggest you go to **www.aesystems.com/usb_install.html**, which has the best hands-on USB install procedure I've ever seen. A good friend of mine, Jan Axelson, has written a very definitive book on the *USB Complete* that you can buy from our On-Line Store
www.nutsvolts.com/Store_Pages/Books/Book_Index.htm.

Blame It On Windows? No, The Programmer!

Q. I recently upgraded from a Windows 95 computer to a Windows 98SE computer. I have some old DOS programs which I rely on. They run fine on my older WIN 95 machine, but not on my new WIN 98 machine. For example, when I try to run Procomm Plus from WIN 98 in a DOS window, I get an error message "Run-time error R6003 - Integer divide by zero ..." and the whole system hangs. Doing a "Restart in MS-DOS mode" doesn't help. Neither does setting BootGUI=0 and LOGO=0 in MSDOS.SYS (whereby the system boots to the C:> prompt and doesn't start windows). Do you have any suggestions on how to make WIN 98 friendlier to DOS programs?

Steve Roberts
via Internet

A. No I don't. This is a problem with older legacy programs, particularly in DOS. But your question piqued my curiosity, so I ran a small DOS application test on my Windows 98 Pentium III system, and came up with these results. A filter program from Intusoft produced a run-time error and would not run. Referee semiconductor cross-reference from Netcom ran, but wouldn't shell back to Windows; hence, it was locked in the DOS mode permanently. A cold reboot was required. VT, a vacuum tube catalog/cross-reference guide, worked flawlessly. Go figure.

MAILBAG

Dear TJ,

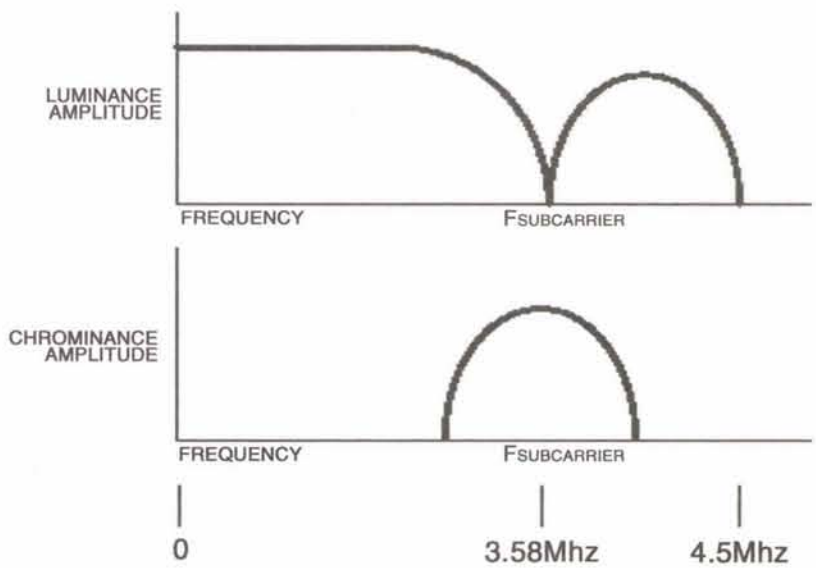
There's a possibly dangerous point in your discussion of wire colors at the end of "Blame it on Ben" (Aug. 2001). In AC power ("house") wiring, the neutral lead is always white, but is — never — referred to as "ground." Properly, the neutral is the "groundED" conductor, while the green lead is the "groundING" conductor, or the protective ground. The difference is that the neutral conductor normally carries the return current, at zero potential referenced to the real ground, while the grounding conductor only carries fault currents.

To further confuse things, the International code uses green with yellow stripe for "earth" (North American "ground"), black or brown for the neutral, and blue for the first hot lead. You'll often see these colors if you cut open an IEC-type power cable. I realize that you were talking in terms of source/sink, but improper use of the neutral and ground leads could produce a dangerous situation.

Carl Zwanzig
via Internet

Dear TJ,

You're slipping again! Just thought you might like to correct your answer to Phil Combs regarding S-Video (Sep. 2001). The chroma signals modulate a 3.58 MHz carrier, not 3.68 MHz as shown.



Jeff Mazur
via Internet

Cool Web Sites

Have questions? These web sites have answers.

Will this Halloween have a witching moon? Check for yourself.
www.googol.com/moon/

Internal combustion engines in a cell phone or notebook PC?
www.chipcenter.com/TestandMeasurement/ed015.html

Silence is golden: Audio noise suppression techniques are discussed in detail in this tech note. Capacitor, transformer, and circuit packaging noise issues are some of the topics covered.
http://tm0.com/sbct.cgi?s=118417869&i=369607&d=1583261

Low-to-moderate cost hardware and software from overstocks, surplus, and liquidations — including freebies from time to time.
www.ComputerSurplusOutlet.com

Response:

Ooops. Am I red faced. Here's the correct chart.

TJ Byers
Q & A Editor

Dear TJ,

Thanks for the answer. After I sent my question to you, I found an adapter at RadioShack (# 15-1242) that not only converts composite video to S-video, but will convert a stereo audio pair to coaxial or fiber-optic digital. This wonderbox sells for $50.00. I bought one and tried it, and it does a very good job with the video conversion. (I haven't tried the audio.) You might want to point other readers to this option, as well.

Phil Combs
via Internet

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HP 8756A Scalar Network Analyzer, HPIB $1,375.00
HP R85026A WR28 Detector, 26.5-40 GHz, for HP 8757 series $1,200.00

SIGNAL GENERATORS

FLUKE 6060B/AK Signal Generator, 0.1-1050 MHz, 10 Hz res. $1,250.00
FLUKE 6060B-130,830 Signal Generator, 0.1-1050 MHz, 10 Hz res., GPIB $1,600.00
GIGATRONICS 1018 Signal/Sweep Gen., 0.05-18 GHz, 1 kHz res., +8 dBm $5,000.00
GIGATRONICS 600/ 6-12 Synthesized Source, 6-12 GHz, 1 MHz res., GPIB $1,500.00
GIGATRONICS 6000/ 8-16 Synthesized Source, 8-16 GHz, 1MHz res., GPIB $2,250.00
GIGATRONICS 875/50 Levelled Freq. Quadrupler, 50-75 GHz output, -3 dBm $2,500.00
GIGATRONICS 900/2-8 Signal/ Sweep Generator, 2-8 GHz, 1 MHz res., GPIB $1,750.00
HP 11707A Test Plug-in, for HP 8660 series $400.00
HP 11720A Pulse Modulator, 2-18 GHz, 80 dB on/off ratio $450.00
HP 8656B-001 Signal Generator, 0.1-990 MHz, 10 Hz res., HPIB, OCXO $2,750.00
HP 8660C/603A/633B Signal Generator, 1-2600 MHz, 1 or 2 Hz res., AM, FM $3,250.00
HP 8660D/86603A-00 Signal Generator, 1-2600 MHz, 1 or 2 Hz res., phase $6,000.00
HP 8672A Signal Generator, 2-18 GHz, 1-3 kHz res., AM, FM, +3 dBm $4,500.00
HP 8672A-008 Signal Generator, 2-18 GHz, 1-3 kHz res., AM, FM, +8 dBm $5,000.00
HP 8673H-212 Signal Generator, 2.0-12.4 GHz, 1 kHz res., AM, FM, +8 dBm $8,500.00
HP 8673M Signal Generator, 2-18 GHz, 1 kHz res., AM, FM, +8 dBm $9,500.00
HP 8683B Signal Generator, 2.3-6.5 GHz, cavity tuned, AM/ WBFM/ $2,250.00
HP 8683D Signal Generator, 2.3-13.0 GHz, cavity tuned, AM/ WBFM/ $3,750.00
HP 8684B Signal Generator, 5.4-12.5 GHz, cavity tuned, AM/ WBFM/ $2,250.00
HP 8684D Signal Generator, 5.4-18.0 GHz, cavity tuned, AM/ WBFM/ $3,750.00
MARCONI 2019 Signal Generator, 80 kHz-1040 MHz, 10 or 20 Hz res $850.00
WAVETEK 952 Signal Generator, 1-4 GHz, +10 dBm, AM, FM $750.00
WAVETEK 957 Signal Generator, 12-18 GHz, +7 dBm, AM, FM $750.00

SWEEP GENERATORS

HP 8350B/ 83522A Sweep Oscillator, 10-2400 MHz, +13 dBm levelled $3,750.00
HP 8350B/ 83525A Sweep Oscillator, 10 MHz-8.4 GHz, +13 dBm levelled $5,000.00
HP 8350B/ Sweep Oscillator, 2.0-8.4 GHz, 70 dB step atten. $3,250.00
HP 8350B/ Sweep Oscillator, 5.9-12.4 GHz, 70 dB step atten. $3,750.00
HP 8350B/ 83570A Sweep Oscillator, 18.0-26.5 GHz, +10 dBm levelled $7,500.00
HP 8350B/83570A-H2 Sweep Oscillator, 17-24 GHz, +10 dBm levelled $5,000.00
HP 8601A Generator/ Sweeper, 0.1-110 MHz, +20 dBm levelled $400.00
HP 8620C Sweep Oscillator Frame $500.00
HP 86222B-002 RF Plug-in, 10-2400 MHz, +13 dBm, 70 dB step atten. $1,250.00
HP 86222B-E69/8620 Sweep Osc. & frame, 0.01-2 GHz & 2-4 GHz bands $1,200.00
HP 86241A RF Plug-in, 3.2-6.5 GHz, +8 dBm levelled $300.00
HP 86251A RF Plug-in, 7.5-18.6 GHz, +10 dBm levelled $500.00
HP 86260A RF Plug-in, 12-18 GHz, +10 dBm unleveled $400.00
HP 86260A-H04 RF Plug-in, 10-15 GHz, +10 dBm unlevelled $400.00
HP 86290A RF Plug-in, 2-18 GHz, +7 dBm levelled $1,200.00
HP 86290B RF Plug-in, 2.0-18.6 GHz, +10 dBm levelled $1,650.00
HP 86290C RF Plug-in, 2.0-18.6 GHz, +13 dBm levelled $1,850.00
WAVETEK 2001 Sweep Generator, 1-1400 MHz, +10 dBm, 70 dB atten. $900.00
WAVETEK 2002B Sweep Generator, 1-2500 MHz, +13 dBm, GPIB $1,750.00
WILTRON 6647M Sweep Generator, 10 MHz-20 GHz, +10 dBm, GPIB $4,500.00
WILTRON 6717B-20 Synthesizer/ Sweeper, 10 MHz-8.4 GHz, +13 dBm,GPIB $6,000.00

POWER METERS

BOONTON 42B/ 41-4E Analog Power Meter, with 1 MHz-18 GHz sensor $400.00
HP 435B/8481A Power Meter, -30 to +20 dBm, 10 MHz-18 GHz $900.00
HP 436A-022/ 8481A Power Meter, -30 to +20 dBm, 10 MHz-18 GHz, HPIB $1,200.00
HP 436A-022/ 8482A Power Meter, -30 to +20 dBm, 100 kHz-4.2 GHz, HPIB $1,200.00
HP 436A-022/ 8484A Power Meter, -70 to -20 dBm, 10 MHz-18 GHz, HPIB $1,200.00
HP 436A-022/ 8485A Power Meter, -30 to +20 dBm, 50 MHz-26.5 GHz, HPIB $1,500.00
HP 436A-022/ 8485D Power Meter, -70 to -20 dBm, 50 MHz-26.5 GHz, HPIB $1,700.00
HP 8477A Power Meter Calibtator, for HP 432 series $400.00
HP Q8486A Power Sensor, 33-50 GHz, -30 to +20 dBm, for 435/6/7/8 ..... $1,500.00
HP R8486A Power Sensor, 26.5-40 GHz, -30 to +20 dBm, for 435/6/7/8 ..... $1,500.00

RF MILLIVOLTMETERS

BOONTON 92C RF Millivoltmeter, 3 mV-3 V f.s., 10 kHz-1.2 GHz $500.00
RACAL-DANA 9303 RF Millivoltmeter, -70 to +20 dBm, 10 kHz-2 GHz, GPIB $750.00

AMPLIFIERS, MISCELLANEOUS

AMPLIFIER 4W1000 Amplifier, 40 dB gain, 4 Watts, 1-1000 MHz $950.00
BOONTON 82AD Modulation Meter, AM/ FM, 10-1200 MHz $500.00
C.P.I. VZC6961K1 TWT Amplifier, 35 dB gain, 4-8 GHz, 20 Watts $3,500.00
ENI 525LA Amplifier, 50 dB gain, 1-500 MHz, 25 Watts $3,250.00
HP 11713A Switch / Attenuator Driver, HPIB $800.00
HP 11729B-003 Carrier Noise Test Set, 5 MHz-3.2 GHz $1,900.00
HP 415E SWR Meter $200.00
HP 8406A Comb Generator, 1/ 10/ 100 MHz increments, to 5GHz $500.00
HP 8447E Amplifier, 22 dB, 0.1-1300 MHz, +13 dBm output $650.00

HP 8447F-H64 Dual Amp., 0.01-50 MHz 28 dB & 0.1-1300 MHz 25 dB $900.00
HP 8901A Modulation Analyzer, 150 kHz-1300 MHz, HPIB $1,500.00
HP 8901B-1,2,3 Modulation Analyzer; rear input, OCXO, external LO, HPIB $2,000.00
HP 8970A Noise Figure Meter, 10-1600 MHz, HPIB $3,750.00
HUGHES 8010H13F000 TWT Amplifier, >30 dB gain, 3-8 GHz, 10 Watts $2,500.00
RACAL 9009 Modulation Meter, 30-1500 MHz, AM, 1.5-100 kHz pk FM $350.00
RF POWER LABS ML50 Amplifier, 2-30 MHz, 47 dB gain, 50 Watts, metered, 28 V $200.00
ROHDE&SCHWA ESH2 Test Receiver, 9 kHz-30 MHz $3,250.00

COAXIAL & WAVEGUIDE

AEROWAVE 28-3000/10 WR28 Directional Coupler, 10 dB, 26.5-40 GHz $300.00
AMERICAN NUC. AM-432 Cavity Backed Spiral Antenna, LHC, 2-18 GHz, TNC(f) $95.00
AVANTEK AMT-400X2 WR28 Active Doubler, +10 dBm in & out $450.00
BIRD 8201 500 Watt Oil Dielectric Load, DC-2.5 GHz $350.00
FXR/MICROLAB SL-03N Stub Stretcher, 0.3-6.0 GHz, 1 00 Watts max., N(m/f) $75.00
GENERAL RADIO 874-LTL Constant Impedance Trombone Line, 0-44 cm, DC-2 GHz $400.00
HP 11590A-001 Bias Network, 1.0-18.0 GHz, APC7 ..... $450.00
HP 11691D Directional Coupler, 22 dB, 2-18 GHz, N connectors $450.00
HP 11692D Dual Directional Coupler, 22 dB, 2-18 GHz $800.00
HP 33327L-006 Prog. Step Attenuator, 0-70 dB, DC-40 GHz, 2.9mm $1,000.00
HP 778D-011 Dual Dir. Coupler, 20 dB, 0.1-2.0 GHz, APC7 ..... $450.00
HP 87300C-020 Directional Coupler, 20 dB, 1.0-26.5 GHz, 3.5mm $475.00
HP K422A WR42 Flat Broadband Detector, 18.0-26.5 GHz $350.00
HP K532A WR42 Frequency Meter, 18.0-26.5 GHz $450.00
HP K752A WR42 Directional Coupler, 3 dB, 18.0-26.5 GHz $450.00
HP K752C WR42 Directional Coupler, 10 dB, 18.0-26.5 GHz $450.00
HP K752D WR42 Directional Coupler, 20 dB, 18.0-26.5 GHz $450.00
HP K870A WR42 Slide Screw Tuner, 18.0-26.5 GHz $275.00
HP K914B WR42 Moving Load, 18.0-26.5 GHz $250.00
HP Q752D WR22 Directional Coupler, 20 dB, 33-50 GHz $650.00
HP R422A WR28 Crystal Detector, 26.5-40 GHz $400.00
HP R752A WR28 Directional Coupler, 3 dB, 26.5-40 GHz $450.00
HP R752D WR28 Directional Coupler, 20 dB, 26.5-40 GHz $450.00
HP R914B WR28 Moving Load, 26.5-40 GHz $250.00
HP V365A WR15 Isolator, 25 dB, 50-75 GHz $750.00
HP V752D WR15 Directional Coupler, 20 dB, 50-75 GHz $650.00
HP X870A WR90 Slide Screw Tuner $150.00
HUGHES 45322H-1110/112 WR22 Directional Couplers, 10 or 20 dB, 33-50 GHz $350.00
HUGHES 45712H-1000 WR22 Frequency Meter, 33-50 GHz $750.00
HUGHES 45714H-1000 WR15 Frequency Meter, 50-75 GHz $900.00
HUGHES 45721H-2000 WR28 Direct Reading Attenuator, 0-50 dB, 26.5-40 G $1,000.00
HUGHES 45722H-1000 WR22 Direct Reading Attenuator, 0-50 dB, 33-50 GHz $1,000.00
HUGHES 45724H-1000 WR15 Direct Reading Attenuator, 0-50 dB, 50-75 GHz $1,000.00
HUGHES 45732H-1200 WR22 Level Set Attenuator, 0-25 dB, 33-50 GHz $250.00
HUGHES 45752H-1000 WR22 Direct Reading Phase Shifter, 0-360, 33-50 GHz $1,400.00
HUGHES 45772H-1100 WR22 Thermistor Mount, -20 to +10 dBm, 33-50 GHz $400.00
HUGHES 47316H-1111 WR10 Tunable Detector, 75-110 GHz, pos. polarity $600.00
HUGHES 47741H-2310 WR28 Phase Locked Gunn Osc., 32 GHz, +18 dBm $2,000.00
HUGHES 47742H-1210 WR22 Phase Locked Gunn Osc., 42 GHz, +18 dBm $2,750.00
KRYTAR 201020010 Directional Detector, 1-20 GHz, SMA(f/f)/SMC $200.00
KRYTAR 2616S Directional Detector, 1.7-26.5 GHz, K(f/m)/SMC $200.00
M/A-COM 3-19-300/10 WR19 Directional Coupler, 10 dB, 40-60 GHz $450.00
NARDA 3000-series Octave Band Directional Couplers, N connectors $150.00
NARDA 3020A Bi-Directional Coupler, 50-1000 MHz $500.00
NARDA 3022 Bi-Directional Coupler, 20 dB, 1-4 GHz $450.00
NARDA 3024 Bi-Directional Coupler, 20 dB, 4-8 GHz $375.00
NARDA 3090 Precision High Directivity Couplers $225.00
NARDA 368BNM Coaxial Hih Power Load, 500 Watts, 2-18 GHz, N(m) $500.00
NARDA 3752 Coaxial Phase Shifter, 0-180 deg./GHz, 1-5 GHz $900.00
NARDA 3753B Coaxial Phase Shifter, 0-55 deg./GHz, 3.5-12.4 GHz $950.00
NARDA 4000-series Octave Band Directional Couplers, SMA connectors $75.00
NARDA 4247-20 Directional Coupler, 20 dB, 6.0-26.5 GHz, 3.5mm(f) $200.00
NARDA 5070-series Precision Reflectometer Couplers $300.00
NARDA 562 DC Block, 10 MHz-12.4 GHz, 100 V max., N(m/f) $65.00
NARDA 765-10 10 dB Attenuator, 50 Watts, DC-5 GHz, N(m/f) $165.00
NARDA 791FM Variable Attenuator, 0-37 dB, 2.0-12.4 GHz $500.00
NARDA 792FF Variable Attenuator, 0-20 dB, 2.0-12.4 GHz $375.00
NARDA 793FM Direct Reading Variable Attenuator, 0-20 dB,4-8GHz $225.00
NARDA 794FM Direct Reading Variable Attenuator, 0-40 dB,4-8GHz $375.00
OMNI-SPECTRA 2085-6010-00 Crystal Detector, 1-18 GHz, neg. polarity, SMA m/f $50.00
PAMTECH KYG1014 WR42 Junction Circulator, 18.0-26.5 GHz $250.00
SONOMA SCI. 21A3 WR42 Circulator, 20 dB, 20.6-24.8 GHz $75.00
TEKTRONIX 2701 Step Attenuator, 0-79 dB, DC-1 GHz $150.00
TRG B510 WR22 Direct Reading Attenuator, 0-50 dB, 33-50 GHz $900.00
TRG V551 WR15 Frequency Meter, 50-75 GHz $600.00
TRG W510 WR10 Direct Reading Attenuator, 0-50 dB, 75-110 GHz $1,000.00
TRG W551 WR10 Frequency Meter, 75-110 GHz $750.00
WAVELINE 100080 WR28 Terminated Crossguide Coupler, 30 dB $200.00
WEINSCHEL 150-110 Programmable Step Atten., DC-18 GHz, SMA **$450.00**
WEINSCHEL DS109 Double Stub Tuner, 1-13 GHz, N(m/f) $150.00
WEINSCHEL DS109LL Double Stub Tuner, 0.2-2.0 GHz, N(m/f) $150.00

COMMUNICATIONS

HP 37204A-003 HPIB Extender, fiber-optic connection "unused" $250.00
HP 59401A HPIB Bus Analyzer $375.00
TAMPA MW. BUC1W-02W-CST Ku band Upconverter, 1 Watt 14.0-14.5 GHz WR75 "NEW" $150.00
TEKTRONIX 1411R-opt.04 PAL Test Gen.,w/ SPG12,TSG11.TSP11,TSG13,15,16 ..... $1,400.00
TEKTRONIX 147A NTSC Test Signal Generator, with noise test signal $800.00

MISCELLANEOUS

EG&G/ P.A.R. 5302 / 5316 Lock-in Amplifier, 100 mHz-1 MHz, GPIB / RS232C $2250.00
FLUKE 2180A RTD Digital Thermometer $500.00
HP 59307A HPIB VHF Switch $200.00
P.A.R. 5206-95.98 Two-Phase Lock-in Amp., 2 Hz-100 kHz, GPIB $1,250.00
TEKTRONIX TM5003 TM5000-series 3-slot Programmable Power Module $450.00
TEKTRONIX TM5006 TM5000-series 6-slot Programmable Power Module $500.00
TEKTRONIX TM503 TM500-series 3-slot Power Module $150.00
TEKTRONIX TM504 TM500-series 4-slot Power Module $175.00
TEKTRONIX TM506 TM500-series 6-slot Power Module $250.00
TEKTRONIX TM515 TM500-series 5-slot Portable Power Module $250.00

Circle #40 on the Reader Service Card.

Lamp Control With Your Stamp

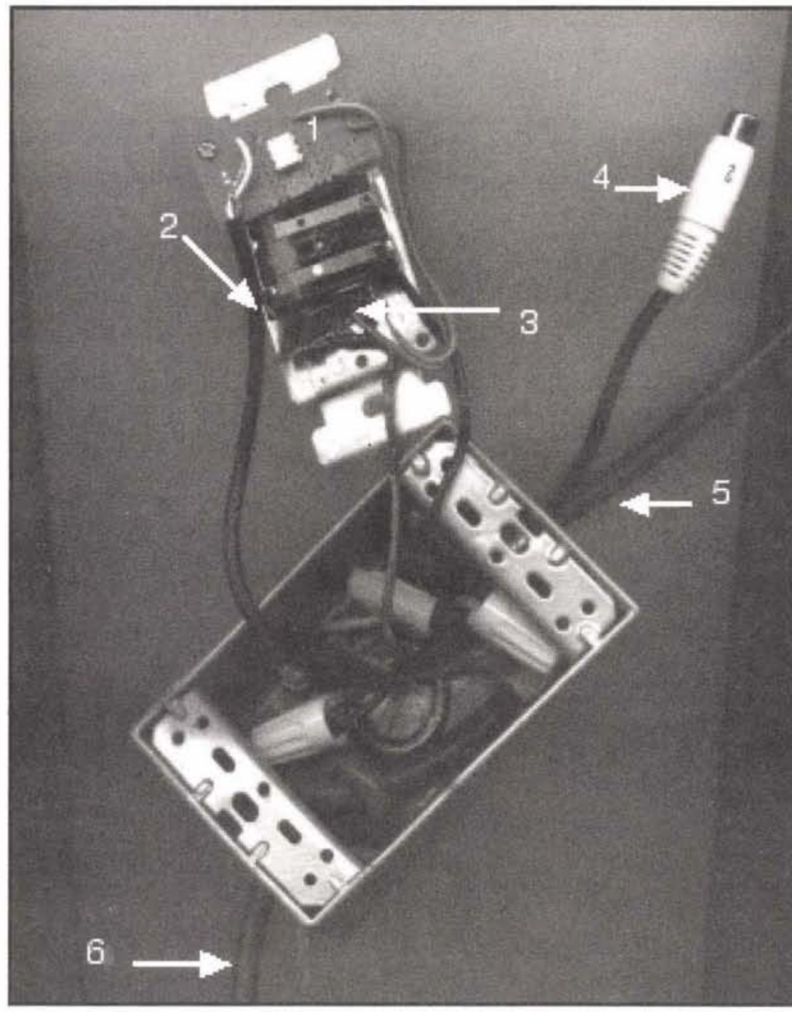


FIGURE 1: The modified unit, just before closing the electrical box. At the top is the back of the dimmer, with its housing removed. Below that is the electrical junction box housing the connections among the dimmer, and the extension cables to the load and the wall outlet. The MOC 3010 optocoupler is mounted on a small piece of perf board, shown at (1). At (2), the incoming shielded cable from the digital output of the Stamp leads to the optocoupler input. Reference (3) indicates where the wires from the optocoupler output are connected to the dimmer's potentiometer. Number (4) denotes the connector for attachment to the Stamp's output. Reference (5) is the extension cable to the lamp socket, and number (6) is the extension cable portion leading to the wall plug.

by Jerry Reed

Here's a simple, inexpensive hardware set-up for controlling 120 VAC loads from a BASIC Stamp. While the design is not exactly elegant, the implementation is quick and easy, involving only off-the-shelf components and a bit of hardware hacking. Since it connects a handful of RadioShack chips with ready-made lamp dimmers, extension cords, and common electrical fittings, I call the construction technique "contractor's delight."

Originally put together for controlling lights with a BS2 OEM board, the interface will work with a PC parallel port or other digital outputs, as well. It controls any non-reactive AC load up to about 500 watts per channel.

With a suitable BASIC program, I was able to get four channels of lamp control running for about $20.00 each, exclusive of the Stamp itself.

Goals

I wanted to flash several strings of decorative lights in independent patterns under program control. The BASIC Stamp seemed ideal as the core of the controller, since it was directly programmable in a high-level language, and I wouldn't need an assembler, an EEPROM programmer, or compiler software. But how should I control hundreds of watts of lights from each 2 mA Stamp output? Thinking back on making "color organ" light shows in the 70s, I realized I could make inexpensive AC-control peripherals for the BS2 by modifying the triac-based light dimmers available for about $5.00 at local chain stores.

Now it's perfectly possible to build your own AC control hardware. Several recent articles in *Nuts & Volts* do a great job of explaining what's involved. In fact, custom hardware and software may be exactly what you need, if you want fine-grained control of illumination, quick response, or to start and stop that two horsepower washing machine motor in your Battle-Bot. However, for control of modest capacity, non-reactive loads, it's hard to beat a $4.95 triac lamp dimmer from the

Low-Tech Variable Output Control

While the scheme described in the article is simple to build and program, it only allows for full-on or full-off control of the AC load. Yet, it is possible to squeeze some proportional control out of this inexpensive hardware, if you're willing to mix up some epoxy, and if you're willing to program a bit of BASIC Stamp trickery. Using the Stamp's Pulse Width Modulation (PWM) command and a homemade optocoupler yields variable output at the expense of greater processing load on the Stamp.

The MOC 3010 is a digital optocoupler. Its embedded triac can only turn on or off in response to the LED. But combining an LED with a cadmium sulfide (CDS) photoresistor gives us an analog optocoupler. The resistance of the CDS cell varies continuously with the illumination of the associated LED, allowing intermediate output values from the dimmer. The effect is hardly linear, but it does work.

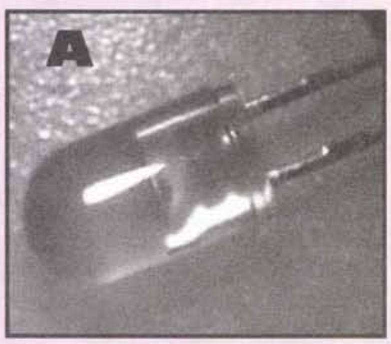
Varying the brightness of an LED with the Stamp is straightforward, but the programming requires a bit of explanation. The Stamp's PWM command sends a string of pseudo-random bits to the selected output pin, approximating the effect of a simple pulse train with a software-controlled duty cycle. (The Stamp manual states filtering the PWM output with an RC low-pass circuit yields a very crude digital-to-analog converter. The duty cycle argument you supply to the Stamp's BASIC PWM command controls a proportional train of 1s and 0s at the output pin. The output pulse train is filtered to an analog voltage, and the voltage determines the brightness of the LED. The LED brightness, in turn, controls the CDS cell resistance, which has exactly the same effect on the modified dimmer circuit as turning the potentiometer.

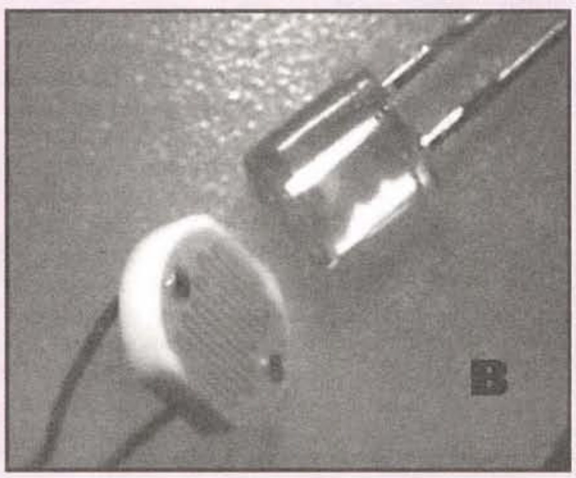
Schematic 2 shows an RC filter circuit driving the optocoupler from a Stamp output. Figure 2 shows how to construct the LED/CDS cell optocoupler.

Wire this optocoupler in place of the MOC 3010 using the contractor's delight construction described in the article. Be sure to follow the same precautions in construction, wiring, and operation described there.

Listing 1 shows a fragment of Stamp BASIC to generate PWM output. Driving the dimmer output with PWM is time critical. Take too long between PWM commands and the lamp will start to dim from the desired level as the voltage across the RC filter dips. You'll need to experiment to see just how much time is available for whatever other Stamp operations you require in between "pumping" the dimmer output pin with a PWM command.

Small changes in PWM values can make a large difference in lamp brightness, due to the multiple non-linearities in the system. Try different values for the resistor and capacitor in the filter. Larger capacitor values will reduce the need to pump the circuit with PWM commands so frequently, but will result in slower output changes in response to program commands.





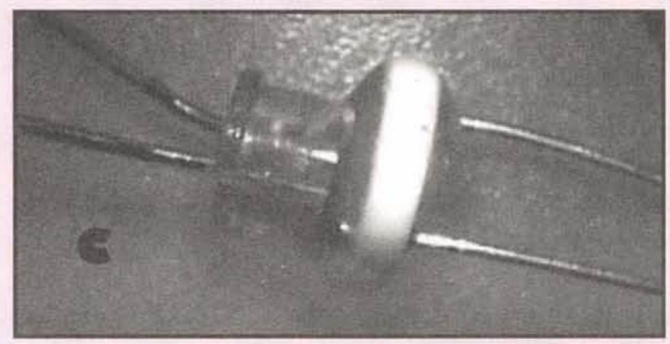


FIGURE 2: Prepare the LED by clipping the rounded end off with a sharp pair of wire nippers or a utility knife. Sand the end smooth. Be careful not to cut too much off the LED, as you don't want to expose the encapsulated semiconductor junction. Coat the front surfaces of the LED and the CDS cell with quick-set epoxy and clamp the two together, face-to-face. After the epoxy hardens, solder color-coded, insulated leads onto each element, and enclose the whole assembly in heat shrink tubing to keep out ambient light.

home improvement store. Add an optocoupler from RadioShack, or a roll-your-own optocoupler from LEDs and CDS cells, and you get cheap on-off control, all easily driven by a Stamp.

The trade-off is always simplicity in programming and hardware versus performance and flexibility. This design goes for quick, limited, cheap, and easy.

A little theory

Schematic 1 shows a typical light dimmer. It also indicates how an optocoupler can be bridged into the circuit to yield remote digital control.

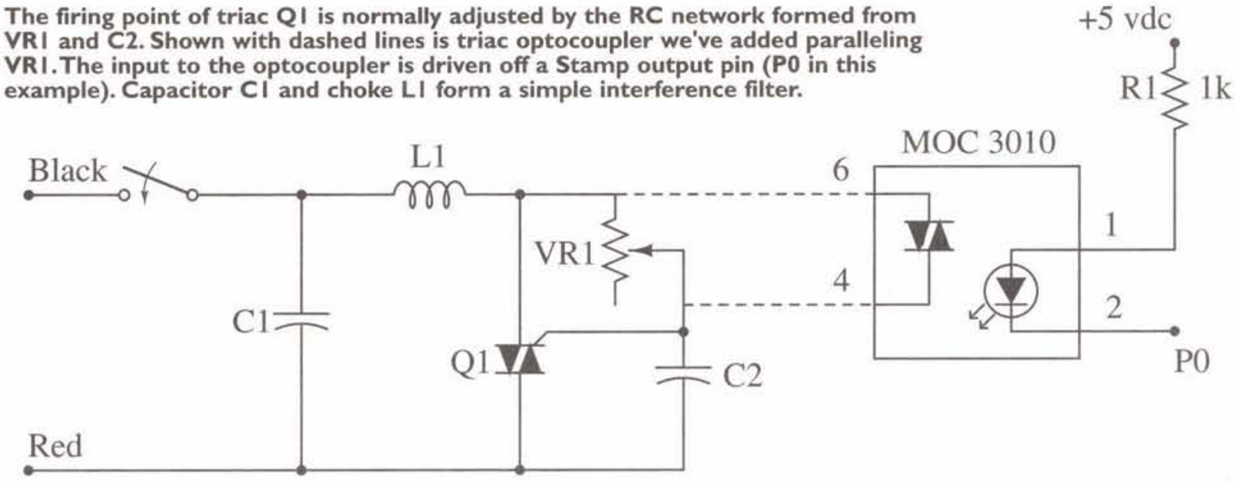
Inexpensive commercial lamp dimmers vary the proportion of each AC half-cycle applied to the load. The sole active element is a triac that turns on when its gate voltage exceeds the threshold, and then latches on until the voltage across its terminals drops to zero. As the potentiometer in the dimmer varies the gate voltage, the triac turns on later and later in each half cycle relative to the zero crossing. The later the triac turns on, the less the average voltage output, and the less the resulting lamp brightness. (An excellent tutorial on lamp dimmer circuits and the physics of incandescent lighting is located at http://www.epanorama.net/documents/lights/lightdimmer.html.)

Although the dimmers are capable of continuous control of AC loads, here they are used for full-on and full-off operation only. BASIC interpreted by one MIP Stamp is not blindingly fast. Achieving continuously variable output levels requires synchronization with the phase of the AC line and timing accuracy that just aren't achievable with the BS2. (But see the sidebar for an experimental option.)

We can take advantage of the triac and trigger circuitry already built into the dimmer by bridging a suitable optocoupler across the potentiometer contacts. When the Stamp turns on the LED in the optocoupler's input, the associated, but electrically-isolated triac in the optocoupler's output effectively turns the

SCHEMATIC 1: Circuit for a typical dimmer.

The firing point of triac Q1 is normally adjusted by the RC network formed from VR1 and C2. Shown with dashed lines is triac optocoupler we've added paralleling VR1. The input to the optocoupler is driven off a Stamp output pin (P0 in this example). Capacitor C1 and choke L1 form a simple interference filter.



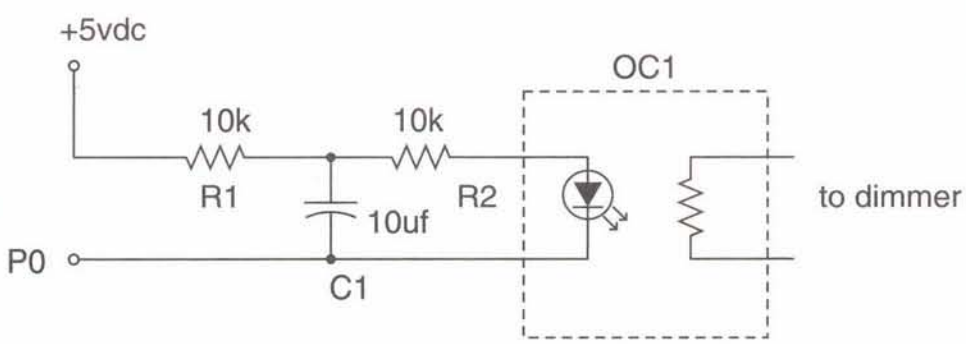
Listing 1

```
high 0
i var byte
i = 5
again:
      i = i + 1
      debug dec ? i
      pwm 0,i,200
goto again
```

Example PWM command. This program fragment varies the duty cycle of the Stamp PWM output and writes the current value on the screen using the debug command. Note values that result in appropriate dimming values for your loads and reuse them in your own programs.

SCHEMATIC 2: Simple passive circuit to smooth the Stamp's PWM output and allow a degree of proportional control.

R1 and C1 form a low-pass filter, converting the pseudo-random pulse train from the PWM output into a smoothly varying DC voltage. R2 limits the current flow through the LED section of the optocoupler OC1.



potentiometer fully on by shorting out. When the Stamp program turns the LED in the optocoupler off, the internal triac opens, and the dimmer's triac thinks the potentiometer is at maximum resistance.

Assuming you have a BASIC Stamp board like the BS2 OEM, all you really need are common electrical supplies and a couple of chips from your local RadioShack.

Here's how to hack it together

1. Remove the plastic back of the dimmer. For greatest convenience, look for dimmers that have their plastic back attached to the aluminum front via screws. Some other dimmers I have used have the insulating back attached via rivets, and if you get one of these, you'll have to spend a few minutes drilling out the rivets — not a big job, really. I didn't worry about re-attaching the plastic back since, if you mount the modified dimmer in a grounded metal box, or an insulating plastic electrical box, you don't really need the original back cover anyway. (That was mainly to keep our prying fingers out, anyway, and it's too late for that.)

2. Solder the optocoupler in place on a small scrap of PC board and attach two short (approximately 3") wires to the output section of the optocoupler (pins 4 and 6). Half of a RadioShack perf board works great for mounting. These wires will be soldered to the potentiometer contacts in the dimmer.

3. I used RCA patch cables for the digital inputs from the Stamp. Cut the patch cables in half. I used the female ends. Strip and tin the wires leading to one connector, and solder each to the LED portion of the optocoupler. The center conductor should go to pin 1, while the braid attaches to pin 2.

4. Drill a small hole in the aluminum faceplate of the dimmer, being careful not to hit any internal parts. The area above the potentiometer works well. Mount a metal standoff post in this hole using the supplied hardware. Now mount the PC board with the optocoupler to the top of the standoff.

5. Locate the potentiometer contacts. Although potentiometers normally have three contacts, those in the dimmers I examined have one contact clipped off, leaving only the two needed. Solder the ends of the wires attached in Step 2 to the potentiometer pins. Take care to make a good connection. Be sure that all wires currently leading to the potentiometer pins remain in place. Polarity is unimportant. Good insulation and careful mounting and soldering are important. (This is 120 VAC, remember?)

6. Cut an extension cord in two and strip the ends of all conductors. Since my lights were displayed outside, I used 50' and 100' three-wire cords, and I cut them about 10' from the plug (male) end. Fish the cord ends and the RCA cable from Step 3 through the openings in a metal or plastic electrical box. Provide strain relief by tying a knot in each wire large enough that it cannot easily be pulled through the hole in the box. If you're using metal outlet boxes as housings, a neater strain relief solution is to use the cable clamps sold for this purpose at your friendly building supply store.

7. Wire the modified dimmer into the extension cord circuit by connecting it in series with the black conductor using the wire nuts originally supplied. If you are using a metal box, screw the green conductor of each cord end to the metal box. If you are using a plastic box, attach the green conductors to one another with wire nuts.

8. Check all your wiring with an ohmmeter.

9. Screw the modified dimmer into the electrical box and attach a faceplate. Now re-check the wiring as above.

Safety First!

Always remember that you're dealing with potentially lethal voltages. If you connect things incorrectly, the least you will likely do is fry your Stamp. A really unfortunate connection could be very dangerous to you or others.

Dimmers have a built-in on-off switch. Please use it in addition to any control you program via the Stamp or other computer interface. Always switch the dimmer off or unplug it before making any adjustments or connections. Never rely on the software alone to turn off the load if there is any possibility that you or anyone else could make contact with the 120 VAC circuitry.

Be cautious, test before powering up, double-check all connections, and you'll safely avoid any shock hazards.

Testing

Before attaching the modified dimmer to the Stamp, test the operation as follows. Connect a lamp to the socket end of the cord, and plug in the line cord of the dimmer. You should be able to turn the light on and off, and vary its brightness using the dimmer's control, just as if the dimmer were unmodified.

Problems at this stage are almost certainly AC wiring in the outlet box. Check all connections against the instructions that came with the dimmer until everything works correctly.

Turn the dimmer off and connect the digital input to one of the Stamp's output pins. See Schematic 1 for details. Turn the dimmer back on, but set the control so that the lamp is not illuminated.

Load the program from Listing 1. When you run this program, the lamp should blink slowly on and off. If this doesn't work, check the program carefully.

One way to isolate hardware problems from software problems at this point is to use an external flashlight battery and current limiting resistor instead of the Stamp's output to test the digital input.

If you are successful in turning the lamp on and off with the battery and resistor test fixture, then the problem is in the Stamp, the software, or the interconnection.

If the battery test fails, the problem is in the optocoupler or its connection to the dimmer (assuming that the dimmer itself works correctly as described in the stand-alone tests above).

Using the controller

Above all, experiment. Different wattage lamps have very different turn on and turn off characteristics, and will respond differently to pulses from the Stamp program.

Remember that the manual control on the dimmer interacts with the control via the digital input. You can set the manual control so that the lamp remains on (or nearly on) at all times and then use the digital control to make it full brightness instantaneously, for instance.

With some lamps, this allows noticeably faster flashing. **NV**

Events CALENDAR

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

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

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

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430 Princeland Court
Corona, CA 92879
Phone 909-371-8497
Fax 909-371-3052
E-mail events@nutsvolts.com

OCTOBER 2001

October 5-6

NH - HOPKINTON - Hamfest. HOSSTRADERS, Joe Demaso K1RQG, 207-469-3492. Email: k1rqg@aol.com Web: http://www.qsl.net/k1rqg

October 6

FL - JACKSONVILLE - Hamfest. FL Community College, North Campus, 4501 Capper Rd. 6:30-2pm. Crown Amateur Radio Convention Committee, Billy Williams N4UF, 904-765-3230. Email: n4uf@nofars.org or Willis Layfield KD4UJK, 904-765-1104, email: willis@kd4ujk.com Web: http://www.nofars.org/hamfest.htm
KS - HOLTON - Hamfest. Atchison County ARC, Joel Breakstone K1CQ, 785-945-3763. Email: joel@ksdot.org
NJ - HACKENSACK - Hamfest. Bergen ARA, James Joyce K2ZO, 201-664-6725. Email: jjjoyce@cybernex.net Web: http://www. bara.org
NY - POMPEY HILLS - Hamfest. Radio Amateurs of Greater Syracuse, 315-698-4558. Email: ragsonline@hotmail.com Web: http://www.pagesz.net/~rags
PA - LANCASTER COUNTY - Tailgate Fest. Red Rose Repeater Assn., Dave Phillips W3CWE, 717-872-6578. Email: jjcd@prodigy.net Web: http://www.qsl.net/rrra/
SC - ROCK HILL - Hamfest. York County ARS, Sheila Parrish KG4CDF, 803-328-5983. Email: coy@cetlink.net
TX - BELTON - Hamfest. Bell County Expo Center. VE testing. Talkin: 146.820- PL 123. Temple ARC, Mike LeFan WA5EQQ, 254-773-3590. Email: hamexpo@tarc.org Web:

October 7

CT - WALLINGFORD - Hamfest. Mountainside Special Event Facility, High Hill Rd., Exit 15, Rt. 91. 9am-3pm. Talkin: 147.36. Meriden ARC, Inc., email: nutmeghamfest@qsl.net Web: www.qsl.net/nutmeghamfest
IL - BEARDSTOWN - Swapmeet. UFCW Union Hall, Arenzville Rd. 8am-5pm. Talkin: 146.715. IL Valley ARC, Tim Childers, 217-245-2061, email: kb9fbi@arrl.net or Butch Tritsch KB9LZP, 217-322-2803, email: bruce@jacil.org
IL - DECATUR - Decatur Old Fashioned Hamfest, Jerry Sebok N9RBQ, 217-423-2095
IN - BEDFORD - Hamfest. Lawrence County 4H Fairgrounds. FCC testing. Talkin: 145.310. Hoosier Hills Ham Club, Jerome Kutche N9LYA, 812-849-0095. Email: n9lya@blueriver.net Web: http://www.hoosierhillshamfest.org
OH - MEDINA - Hamfest. National Guard Armory, 920 W. Lafayette Rd. 8am-2pm. VE testing. Talkin: 147.030+. Medina Two Meter Group, Mike Rubaszewski N8TZY, 330-273-1519. Email: n8tzy@m3net.net Web: http://www.qsl.net/m2m

October 10

FL - ORLANDO - Hamfest. The Bahia Shrine, 2300 Pembrook Dr. 6am-2pm. Talkin: 147.390. Larry KG4CON 407-648-8489, email: king4con@netzero.net. Alan 407-740-7817, email: albie1820@earth link.net. Ed KY4E 904-736-7770, ky4e@excite.com

October 12-13

FL - WALDO - Hamfest. The Trading Post Restaurant. Fri: 2-6pm, Sat: 8am-2pm. Talkin: 145.150. Tony 904-964-9328, email: wb2fgl@arrl.net. John, email: hamfest@ku4ay.net. Web: www.angelfire.com/fl/arcba/hamfest.html ?fyr

October 13

FL - PLANTATION - Cy Harris W4MAQ Memorial Free Flea. Motorola, 8000 W. Sunrise Blvd., Northeast parking lot. Talkin: 146.79 (-600). Robin Terrill N4HHP, 954-583-3625. Email: kg4chw@arrl.net Web: www.geocities.com/bcepn/freeflea.html
FL - STARKE - Hamfest. ARC Bradford Area, John Bradley KU4AY, 904-782-1185. Email: hamfest@ku4ay.net Web: http://ku4ay.net/starkehamfest.html
FL - TAMPA - Hamfest. Egypt Shrine Temple, Keith Dean KA4JLW, 813-879-2449. Email: kwdean@gte.net
GA - AUGUSTA - Hamfest. Evans Middle School. 9am-3pm. VE testing. Talkin: 145.490-. ARC of Augusta, Henry Arostegui KN4AV, 706-793-1625, email: kn4av@bellsouth.net or Jay KG4LEY, 706-651-9504, email: kg4ley@bellsouth.net
HI - HONOLULU - State Convention. Koolau ARC, Walt Niemczura AH6OZ, 808-263-3872. Email: ah6oz@arrl.net Web: http://www.chem.hawaii.edu/karc/
IL - SALEM - Hamfest. Centralia Wireless Assn., Daisy King AA9EK, 618-532-6606. Email: bking@accessus.net
NY - LAKE PLACID - Hamfest. Northern New York ARA, Chuck Orem KD2AJ, 518-563-6851. Email: kd2aj@arrl.net Web: http://www.geocities.com/nnyara
PA - TREVOSE - VHF Conference. Mt. Airy VHF Radio Club, John Sorter KB3XG, 610-505-6940. Email: JohnKB3XG@aol.com http://www.ij.net/packrats/Hamrama%20 2001/Hama_01.html#Anchor-35593
TN - OAK RIDGE - Hamfest. Fraternal Order of Eagles Bldg., 1650 Oak Ridge Turnpike. 9am-3pm. VE exams. Talkin: 146.88. Oak Ridge ARC, David Bower K4PZT, Email: d.bower@ieee.org
VA - STAFFORD - Hamfest. Stafford ARA, Rich Diddams KF6UTH, 540-657-8322. Email: rldiddams@earthlink.net Web: http://www.n4nw.org/Hamfest.htm
WA - BREMERTON - Hamfest. North Kitsap ARC, Susan Johnson AB7MD, 360-697-9379. Email: nkarc@yahoo.com Web: www.silverlink.net/nkarc/hamfest.html

October 14

IL - OAKBROOK TERRACE - Hamfest. Entrance at Park View Dr., north from Cermak Rd. 8am-1pm. CARC, Melissa Meneely KB9QWZ, 773-384-7514 or Dean NB9Z, 708-331-7764. Email: carc_inc@hotmail.com Web: http://www.chicagoarc.com
IN - GREENFIELD - Swapmeet. Riley Park. 7:30am-2pm. IN Historical Radio Society, Glenn Fitch, 765-565-6911, email: glenn.fitch@cnz.com
MI - DIMONDALE - Hamfest. The Summit, 9410 Davis Hwy. 8am-2pm. VE testing. Talkin: 145.390- or 146.520 simplex. Central MI ARC & Lansing Civil Defense Repeater Assn., J. Ervin Bates W8ERV, 517-676-2710. Email: w8erv@arrl.net Web: http://www.qsl.net/lcdra/hamfair.org.html
OH - ASHLAND - Hamfest. Ashland Area ARC, John McMurray KC8AAR, 419-281-3117. Email: johnamcmurray@myexcel.com
PA - LINGLESTOWN - Hamfest. Linglestown Firehall & Grounds, 5901 Linglestown Rd. VE session. Talkin: 145.47. Central PA Repeater Assn., Harold Baer KE3TM, 717-566-8895.
PA - WRIGHTSTOWN - Hamarama 2001. Mt. Airy VHF Radio Club (Packrats), Joe Keer W3KJ, 215-256-1464. Email: packrats_w3ccs@yahoo.com Web: http://www.ij.net/packrats

COMPUTER SHOWS

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

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

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

Computer Central Shows
630-782-4625 Fax 630-834-2594
E-Mail: cc@gats.com
www.computercentralshows.com

Computer Country Expo
847-662-0811 Web: www.ccxpo.com

Five Star Productions
810-379-3333 E-Mail: jeff@fivestar
www.fivestarshows.com

Gibraltar Trade Center, Inc.
734-287-2000 Taylor, MI.
E-Mail: taylor@gibraltartrade.com
www.gibraltartrade.com

Gibraltar Trade Center, Inc.
810-465-6440 Mt. Clemens, MI.
E-Mail: mtclemens@gibraltartrade.com
www.gibraltartrade.com

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

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

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

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

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

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

October 19-20-21

CA - CONCORD - Convention. Sheraton Hotel. Mt. Diablo ARC, Terry Matzkin KE6WRE, 925-820-5848. Email: tickets@pacificon.org Web: www.pacificon.org

October 20

CO - GOLDEN - Hamfest. Jefferson County Fairgrounds, 15200 W. 6th Ave. 8am-2pm. VE testing. Talkin: 144.62/145.22. Rocky Mountain Radio League, Inc., Ron Rose N0MQJ, 303-985-8692. Email: n0mqj@arrl.net Web: http://rmrl.hamradios.com
IL - GODFREY - Hamfest. Lewis & Clark RC, Dennis Hutchins WA9RD, 618-377-5033. Email: dhutchins@mtsinet.com Web: http://www.ezl.com/~lmiller/lcrc.html
LA - LAKE CHARLES - Hamfest. Southwest LA ARC, Charlie Blankenship WB5NXD, 337-478-7566. Email: wb5nxd@yahoo.com
OR - RICKREALL - Hamfest. Mid-Valley ARES, Bud Smith N7BUD, 503-838-0266. Email: n7bud@arrl.net Web: www.teleport.com/~binder/swap.html
TX - DENTON - Hamfest. Denton County ARA, Clint Miller KD5BYY, 940-390-5338. Email: cmiller@dentonhamfest.org Web: http://dentonhamfest.org
TX - HOUSTON - Hamfest. Clear Lake ARC, John Taylor KD5IHO, 713-504-1403. Email: kd5iho@swbell.net Web: www.clarc.org

October 20-21

GA - ROME - Hamfest. Northwest GA ARC, Ed Byars WB5FGM, 706-235-2048. Email: biged5341@aol.com Web: www.wavegate.com/~chall/home.html

October 21

MA - CAMBRIDGE - Hamfest. MIT Radio Society/Harvard Wireless Club/MIT UHF Repeater Assn., Steve Finberg W1GSL, email: w1gsl@mit.edu (Nick Altenbernd KA1MQX, 617-253-3776 9am-5pm.) Web: http://web.mit.edu/w1mx/www/swapfest .html
MI - KALAMAZOO - Hamfest. Kalamazoo County Fairgrounds. Talkin: 147.040. Kalamazoo ARC & SW MI Amateur Radio Team, Charlie Burgstahler KB8BLO, email: charlieb@net-link.net. Web: http://www.qsl.net/k8blo/hamfest.htm
MI - WARREN - Hamfest. Utica Shelby Emergency Communication Assn., Delphine Wrona KC8JSH, 810-791-4669. Email: delwrow@att.net Web: http://www.useca.org
NY - QUEENS - Hamfest. Hall of Science parking lot, Flushing Meadow Corona Park, 47-01 111th St. VE exams. Talkin: 444.200 repeat, PL 136.5, 146.52 simplex. Hall of Science ARC, Inc., Steve Greenbaum WB2KDG, 718-898-5599 eves only. Email: WB2KDG@Bigfoot.com
PA - SELLERSVILLE - Hamfest. Sellersville Fire House, Rt. 152. VE testing. Talkin: 145.31. RF Hill ARC, Linda Erdman KA3TJZ,

Events CALENDAR

215-679-5764. Email: rfhillarc@yahoo.com Web: http://www.rfhill.ampr.org

October 26-27

OK - KINGSTON - Texoma Hamarama Assn., Len Carlson K4IWL, 972-519-0521. Email: k4iwl@arrl.net Web: http://www.angelfire.com/tx5/TexomaHamarama/

October 27

CANADA - QUEBEC - LONGUEUIL - Hamfest. Montreal South ARC, Micheline Simard VE2XW, 450-446-0477. Email: ve2xw@amsat.org
CT - WATERFORD - Auction. Senior Citizens Center, Waterford Municipal Complex, Rt. 85. Talkin: 146.97 PL 156.7. Tri-City ARC, Darryl DelGrosso, 860-443-7799. Email: DDelgrosso@aol.com
FL - JACKSONVILLE - Hamfest. Morocco Shrine Auditorium, 3800 S. St. Johns Bluff Rd. Sat. 8am-4pm. VE exams & upgrades. Talkin: 146.76, backup 146.88. Greater Jacksonville Hamfest Assn., Richard Smythe KF4PBL, 904-739-9713. Email: rsmythe2@bellsouth.net Web: www.jacksonville.net/~lrich/JAXHAMFEST.html
MN - ST. PAUL - Hamfest. RiverCentre. 8am-4pm. VE exams. Twin Cities FM Club, Amanda Roberts KG0AY, 612-535-0637 or 651-460-6050. Email: kg0ay@pclink.com Web: http://www.hamfestmn.org
MO - ST. LOUIS - Hamfest. Kirkwood Community Center, 111 N. Geyer Rd. 7:30am-1pm. VE exams. Talkin: 146.31-.91. St. Louis ARC & Gateway to Ham Radio Club, Steve Welton W0SLW, 314-638-4959. Email: slw@partyline.net Web: http://www.halloweenhamfest.org
NM - SOCORRO - Hamfest. Socorro ARA, NM Tech ARA, & City of Socorro, Al Braun AC5BX, 505-835-3370. Email: ac5bx@juno.com Web: www.ees.nmt.edu/sara/homepage.html
SC - SUMTER - Hamfest. Sumter ARA, Carl Ecabert AA1MD, 803-469-7183. Email: aa1md@sumter.net Web: http://www.geocities.com/CapeCanaveral/2695/sara.htm
TN - EAST RIDGE (CHATTANOOGA) - Hamfest. Chattanooga ARC, Louise Carter KE4DGW, 423-821-4043. Email: ke4dgw@msn.com Web: http://www.hamfestchattanooga.com

October 28

IA - DES MOINES - Hamfest. Tikva Tracers ARC & Iowa Assn. of AR Clubs, Rod Ivers KI0BW, 515-278-9945 or 515-276-0500. Email: ki0bw@arrl.net
MD - WESTMINSTER - Hamfest. Carroll County Agricultural Center. VE session. Talkin: 145.41-. Carroll County ARC, Inc., email: k3pzn@arrl.net, web: http://www.qis.net/~k3pzn
NY - LINDENHURST - Hamfest. GSBARC & SCRC, Phil Lewis N2MUN, 631-226-0698. Email: info@gsbarc.org Web: http://www.gsbarc.org
OH - CANTON - Hamfest and Auction. Stark County Fairgrounds, 305 Wertz Ave. NW. 8am-3pm. Talkin: 147.18+. Massillon ARC, Terry Russ N8ATZ, 330-837-3091. Email: marc.hamclub@juno.com Web: http://www.qsl.net/w8np

NOVEMBER 2001

November 2-3

TX - ODESSA - Hamfest. West Texas ARC, Craig Martindale W5BU, 915-366-4521. Email: w5bu@arrl.net

November 3

FL - UMATILLA - Hamfest. Umatilla High School Annex, 60 Smith St. VE exams. Talkin: 147.255+. Lake ARA, John Gabele W8KCE, 352-394-2723. Email: w8kce@aol.com Web: http://www.qsl.net/k4fc
OK - ENID - Hamfest. Garfield County Fairgrounds, Hoover Bldg. 8am-5pm. VE testing. Talkin: 145.29 -600, 444.400+ 5.0. Enid Hamfest Group, Tom Worth N5LWT, 580-233-8473 or Fred Selfridge WA5OU, 580-242-3551. Email: enidhamfest@yahoo.com

November 3-4

GA - LAWRENCEVILLE - State Convention. Gwinnett County Fairgrounds. Alford Memorial RC, Randy Bassett KR4NQ, 770-663-4244 xt 3989. Email: KR4NQ@bigfoot.com Web: www.totr.radio.org

November 4

IA - DAVENPORT - Hamfest. Davenport RAC, Dave Mayfield W9WRL, 309-762-6010. Email: hamfest@gwltd.com Web: http://www.w9wrl.com/hamfest
MI - ST. JOSEPH/BENTON HARBOR - Hamfest. Blossomland ARA, Duane Durflinger KX8D, 616-982-0404. Email: comdac@comdac.com Web: www.comdac.com/bara

November 10

AL - MONTGOMERY - Hamfest. AL State Fairgrounds, Garrett Coliseum, Federal Dr. 9am-3pm. CAVEC testing. Talkin: 146.84 W4AP. Montgomery ARC, Dennis Rumbley KS4UO, 334-409-9971. Email: ks4uo@arrl.net Web: http://jschool.troyst.edu/~w4ap/
FL - PORT ST. LUCIE - Hamfest. Port St. Lucie ARA, John Cruz KT4VI, 561-465-9533. Email: brothercruz@cs.com
OH - GARFIELD HEIGHTS - Hamfest. Laura Lonczak, 216-663-3258. Email: 1n4js@visn.net
OH - GEORGETOWN - Hamfest. Grant ARC, Dot Silman KB8TQU, 937-446-2234. Email: Huggee@Bright.net
SC - MYRTLE BEACH - Hamfest. Grand Strand ARC, Gordon Mooneyhan KE4HXL, 843-448-9379. Email: beachfest2001@hotmail.com Web: http://www.w4gs.org
TX - AZLE - Hamfest. Tri-County ARC, Jim Aiello N5QU, 817-444-9465. Email: drjaiello@aol.com Web: http://www.qsl.net/tcarc-ntx

November 11

IL - CHICAGO - Auction. DeVry Institute of Technology, 3300 N. Campbell. Chicago ARC, Inc., Melissa Meneely KB9QWZ, 773-384-7514 or Dean NB9Z, 708-331-7764. Email: carc_inc@hotmail.com Web: http://www.chicagoarc.com

November 16-17

MS - OCEAN SPRINGS - Hamfest. West Jackson County ARC, Ernie Orman W5OXA, 228-392-2816. Email: w5oxa@arrl.net Web: http://www.datasync.com/~w5oxa

November 17

LA - MONROE - Hamfest. Twin City Hams ARC, Scott Dickson W5WZ, 318-644-2215. Email: w5wz@arrl.net Web: http://www.tchams.org/users/hamfest/

MA - NEWTONVILLE - Auction. Waltham ARA, Eliot Mayer W1MJ, 617-484-1089. Email: w1mj@arrl.net Web: http://www.wara64.org/auction

NH - LONDONDERRY - Hamfest. The Lions Club Hall, Mammoth Rd. VE session. Talkin: 146.850- PL 85.4. Interstate Repeater Society, Paul Gifford K1NL, 603-883-3308. Email: k1nl@juno.com

November 17-18

IN - FORT WAYNE - State Convention. Allen County War Memorial Coliseum Expo Center, 4000 Parnell Ave. Sat: 9am-4pm, Sun: 9am-3pm. Talkin: 146.88-. ACARTS, James Boyer KB9IH, 219-489-6700. Email: jboyer@ail.com Web: http://www.acarts.com

November 24

FL - OCALA - Hamfest. Booster Stadium, NE 36th Ave. 8am-2pm. Marion County, 352-236-0744 voice. Email: jtcomm@atlantic.net

FL - OKEECHOBEE - Hamfest. Okeechobee ARC, Josh Osterman KF4JHI, 863-634-9862. Email: kf4jhi@flweather.com Web: http://www.flweather.com/oarc/

IN - EVANSVILLE - Hamfest. Vanderburgh Co. 4-H Center Fairgrounds Auditorium. 8am-2pm. EARS, Neil Rapp WB9VPG, 812-479-5741. Email: ears@w9ear.org Web: http://w9ear.org.hamfest.htm

November 25

IL - WHEATON - Radio Fest & Flea Market. DuPage County Fairgrounds. Fire & Radio Traders Society of Northern IL., 630-826-7981. Email: alf3148@megsinet.net

DECEMBER 2001

December 1

AZ - MESA - Hamfest. Superstition ARC, Ed Cole KB7RMO, 520-468-9015. Email: colej@cybertrails.com

December 1-2

FL - PALMETTO (TAMPA) - Hamfest. Manatee County Convention and Civic Center, One Haben Blvd. at US 301. Sat: 8am-5pm, Sun: 9am-2pm. VEC exams. Talkin: 145.430- and 442.950+. The Florida Gulf Coast ARC, Fred Hendershot N3BUL, 813-671-9556. Email: fgcarc@fgcarc.org Web: http://www.fgcarc.org

December 2

MI - HARRISON TOWNSHIP - Hamfest. L'Anse Creuse ARC, Gregg Crump KC8PXJ, 810-463-0729. Email: grcrump@home.com Web: www.ameritech.net/users/lc_arc/index.html

December 9

IN - GREENFIELD - Hamfest. Greenfield Central High School Pavilion, 810 N. Broadway St. 8am-2pm. VE testing. Talkin: 145.330-. Hancock ARC, email: kb9vzl@excite.com Web: www.w9atg.org

JANUARY 2002

January 5

WI - WAUKESHA - Hamfest. West Allis RAC, Phil Gural W9NAW, 414-425-3649. Email: janphil@execpc.com

January 11-12

FL - FT. MYERS - Hamfest. Shady Oaks Community Center, 3280 Marion St. Fri: 1pm-9pm, Sat: 9am-3pm. Ft. Myers ARC, Earl Spencer K4FQU, 941-332-1503. Email: k4fqu@juno.com

January 13

IN - SOUTH BEND - Hamfest. Michiana Valley Hamfest Assn., Bob Denniston KA9WNR, 219-291-0252 (7-11pm EST).

January 19

MO - ST. JOSEPH - Hamfest. MO Valley ARC & Ray-Clay ARC, Carlene Makawski KA0IKS, 816-279-3406. Email: nem3238@ultra.ccp.com

January 20

NY - NORTH BABYLON - Convention. Great South Bay ARC, Diane Ortiz K2DO, 631-286-7562. Email: k2do@aol.com Web: http://www.arrlhudson.org/nli

January 27

OH - DOVER - Hamfest. OH National Guard Armory, 2800 N. Wooster Ave. 8am-1pm. Talkin: 146.730-. Tusco ARC, Gary Green KB8WFN, 740-922-4454. Email: kb8wfn@tusco.net

FEBRUARY 2002

February 1-2

MS - JACKSON - State Convention. Jackson ARC, Ron Brown AB5WF, 601-956-1448. Email: ab5wf@arrl.net Web: http://www.jxnarc.org

February 2

SC - NORTH CHARLESTON - Hamfest. Charleston ARS, Jenny Myers WA4NGV, 843-747-2324. Email: brycemyers@aol.com Web: www.qsl.net/wa4usn/index.html

February 2-3

FL - MIAMI - Tropical Hamboree. Dade Radio Club of Miami, Evelyn Gauzens W4WYR, 305-642-4139. Email: w4wyr@arrl.org

February 8-9-10

FL - ORLANDO - Convention. Orlando ARC, Harold Prosser KK1B, 321-235-7513 (days) or 407-365-2444 (eves). Email: hal@mpinet.net Web: http://www.oarc.org/hamcat.html

February 10

OH - MANSFIELD - Hamfest. InterCity ARC & MASER, Scott Yonally N8SY, 419-522-

Events CALENDAR

9893. Email: n8sy@arrl.net Web: http://www.maser.org

February 23

NY - HORSEHEADS - Hamfest. The National Guard Armory. 8am-3pm. Talkin: 146.700-, 444.20. ARAST, Randy 607-738-6857. Email: n2syt@arast.org Web: http://www.arast.org

February 24

FL - ZEPHRYHILLS - Hamfest. Zephyrhills Area ARC, Ron Russell N8VFE, 813-782-1602. Email: ron301@aol.com
NC - ELKIN - Hamfest. Briarpatch & Foothills ARCs, Pat Hill AE4HK, 540-236-6747. Email: Craig Patton @ kg4fla@hotmail.com
NY - HICKSVILLE - Hamfest. Long Island Mobile ARC, Ed Muro K2EPM, 516-520-9311. Email: hamfest@limarc.org Web: http://www.limarc.org
NY - WILLIAMSVILLE - Hamfest. Lancaster ARC, Luke Calianno N2GDU, 716-634-4667. Email: luke@towncountryflorist.com Web: http://gbhamfest.hamgate.net

MARCH 2002

March 2

FL - NEW PORT RICHEY - Hamfest. Gulf Coast ARC, Rick Brown AG4JN, 727-934-8741. Email: ag4jn@arrl.net Web: http://www.gulfcoastarc.org/

March 3

NY - LINDENHURST - Hamfest. GSBARC & SCRC, Walter Wenzel KA2RGI, 631-957-0218. Email: info@gsbarc.org Web: http://www.gsbarc.org

March 9

AR - HARRISON - Hamfest. North AR ARS, Bill Rose N5VKF, 870-741-7074. Email: billrose@cswnet.com Web: http://www.qsl.net/naars/hamfest/index.html

March 16

NJ - CLINTON - Hamfest. North Hunterdon Regional High School, Rt. 31. VE testing. Talkin: 147.375. Cherryville Repeater Assocation II, 908-788-4080. Web: www.qsl.net/w2cra

March 17

OH - MAUMEE - Hamfest. Toledo Mobile Radio Assn., Paul Hanslik N8XDB, 419-385-5056. Email: kb8iup@arrl.net Web: http://tmrahamradio.org

March 23

FL - PLANTATION - Cy Harris W4MAQ Memorial Free Flea. Robin Terrill N4HHP, 954-583-3625. Email: kg4chw@arrl.net http://www.geocities.com/bcepn/freeflea.html

March 30

TX - BRENHAM - Hamfest. Brenham ARC, Dan Lakenmacher N5UNU, 979-836-8739. Email: briang@comwerx.net Web: http://www.alpha1.net/~barc

APRIL 2002

April 6

MN - ST. PAUL - Hamfest. Robbinsdale ARC, Jerry Dorf N0FWG, 763-537-1722. Email: k0ltc@visi.com Web: http://www.visi.com/~k0ltc

April 6-7

MD - TIMONIUM - Greater Baltimore Hamboree. Timonium Fairgrounds. Sat: 6am-5pm, Sun: 6am-3pm. Baltimore ARC, James Green WB3DJU, 410-426-3378. Email: w3ft@juno.com Web: http://gbhc.org

April 14

NC - RALEIGH - State Convention. Raleigh ARS, Chuck Littlewood K4HF, 919-872-6555. Email: k4hf@arrl.net Web: http://www.rars.org/hamfest
WI - STOUGHTON - Hamfest. Madison Area Repeater Assn., Paul Toussaint N9VWH, 608-245-8890. Email: n9vwh@arrl.net Web: http://www.qsl.net/mara

April 20-21

CA - PALO CEDRO - EMCOMM Convention. Sacramento Valley Section ARES, Jerry Boyd K6BZ, 530-396-2256. Email: k6bz@arrl.org Web: http://www.qsl.net/k6soj/

MAY 2002

May 3-4

MO - LEBANON - State Convention. Lebanon ARC, Bill Wheeler K0DEW, 417-532-4642. Email: bwheeler@advertisnet.com

Gravity, Inertia, and the Electromagnetic Spectrum – Part 2

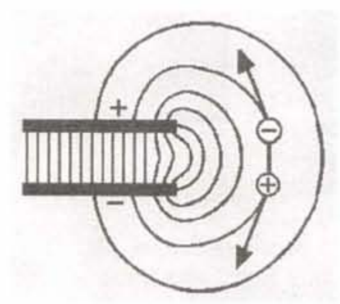
by Richard Panosh

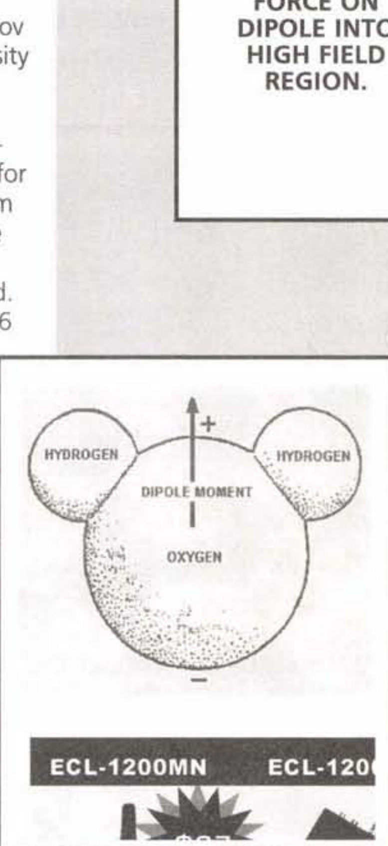
Research on the world's first anti-gravity device made the news in the 1996 *London Sunday Telegraph* about an upcoming article by Eugene Podkletnov – a researcher at Finland's University of Tampere. Weight losses from 0.05% to as high as 2% were reported, but the article was withdrawn from publication. Reasons for the delay in publication range from errors in the measurements to the premature release of information before patent issues were resolved.

According to the Oct. 11,1996 issue of *Science*, NASA has invested several thousand dollars into anti-gravity research. Ning Li of the University of Alabama approached NASA with a similar theory based upon the connection between gravity and superconducting materials proposed by Podkletnov. The theory proposed that a superconducting disc spun at high speeds exhibited partial gravitational shielding of various substances suspended from a balance above the disc.

Obviously, NASA would be interested in any new techniques to advance interstellar space travel and even sponsors a "Breakthrough Propulsion Physics Workshop" to achieve this goal.

FIGURE 1: FORCE ON DIPOLE INTO HIGH FIELD REGION.





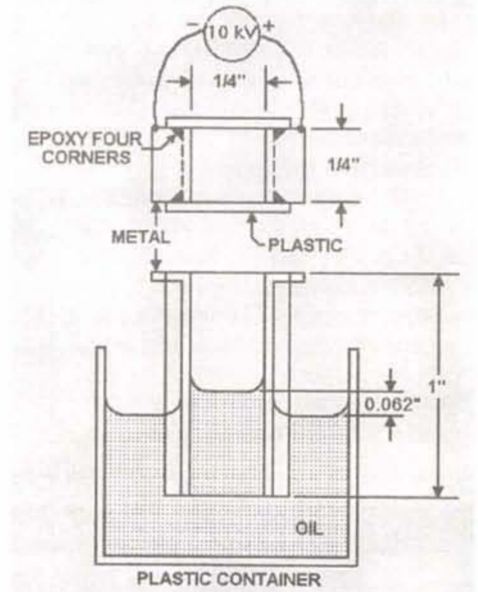


FIGURE 2: DIELECTRIC FORCE IN A CAPACITOR.

The physics of shielding gravity using a superconductor disc is unknown. Some believe the effect is due to Einstein's theory that a spinning object will distort space or Li's theory that superconducting electrons produce an unknown compounding effect that results in anti-gravity.

In view of the ZPF electromagnetic theory of gravity and inertia, a superconducting disc spun at high speeds might provide partial shielding of the electromagnetic field. Rapid spinning of the disc would allow the perfect diamagnetic screening of the superconducting Cooper pairs to be spread out into a blur that might affect the ultra short Planck wavelengths involved. However, the rotational speeds described would appear to be insufficient. (Both papers, by Podkletnov and Li, are currently available on the web, as well as some later work.)

In 1999, NASA awarded $600,000 to various research organizations in an attempt to replicate and verify these experiments.

In 1997, H. Puthoff received some funding from NASA to experimentally prove that inertia is the drag produced by motion through the ZPF. They have built a sensitive pendulum in an attempt to detect the wake produced by the pendulum as it moves through the ZPF.

CAUTION!

The following experiment employs high voltages that are lethal! This experiment should not be attempted by inexperienced personnel.

Puthoff's paper describes the force of gravity that is developed by the interaction of the parton electric dipoles in all matter with the high-frequency electric field of the ZPF.

The equations that describe this force are identical to the force experienced by an electric dipole in a gradient static electric field as illustrated in Figure 1.

The dipoles within the dielectric experiences a force to the left and are drawn into the larger electric field between the capacitor plates. No force is developed in a uniform electric field.

This is the classical problem described in most college electromagnetic's texts. It provides an attractive force that can only be reduced by shielding or by the application of another local bias field that orients the dipoles perpendicular to the distant field. If the dipoles are oriented antiparallel to the electric field, they experience a repulsive force.

Figure 2 illustrates an experimental set-up to demonstrate the effect. Two 1/4" wide metal foils (copper, brass or aluminum) are epoxied between two 1/2" wide clear acrylic windows to form a rectangular tube (thin window Plexiglas is available from hardware stores). The plastic may be sanded to obtain a rougher surface for better adhesion, but a clear window is essential to observe the effect.

The gap can be made uniform by gluing the pieces together around a 1/4" piece of stock as a spacer. In order to remove the spacer, be careful not to get glue on it. The spacing is somewhat important since the applied high voltage will be limited to the breakdown voltage of the air gap.

The length of the tube is about 1" and is immersed halfway into a liquid dielectric such as mineral oil or corn oil in a small plastic cup. The tube can be supported by a plastic cross member suitably glued in place or merely from stiff wire leads clipped to the two metal ears on either side.

When high voltage is applied to the capacitor plates, the liquid will be drawn upward. The effect for typical materials is not large and will only amount to about 1/16" for 10 kV with the 1/4" gap. The rise in height inside the capacitor is proportional to the square of the electric intensity (volts/distance) and the dielectric constant of the liquid (typical oils are about 2.2).

Now that you have a good picture of the static case, picture the electric field replaced with an AC field. If the dipoles can flip as fast as the AC field, they will rotate with the field and the same type of force will be developed. The resulting force is produced by the interaction of the dipoles and the gradient electric field. The effect is independent of frequency as long as the dipoles can rotate with the electric field and will occur with all electromagnetic waves.

You can demonstrate this effect by replacing the high voltage DC supply in the previous experiment with a 60-Hertz AC supply.

CAUTION!

The following experiment employs microwaves and high voltages. The effects can be extremely dangerous and even lethal! Never look into the open end of the waveguide or point it towards anyone. The waveguide should not be operated without proper shielding. This experiment should not be attempted by inexperienced personnel.

A better simulation of gravity can be produced using a 2.45x10E9 MHz (2,450 MHz) magnetron from a microwave oven as a single frequency source of electromagnetic waves. The electric field of the microwaves will interact with suitable dipoles in a wireless version of the previous experiments. Unlike the force of gravity that occurs due to the shortest wavelength, the microwaves are about 5" long and can be easily shielded with a metal screen.

The partons are simulated by the much larger dipoles in water. The water molecule (H_2O) consists of two atoms of hydrogen and one atom of oxygen. The electrons (negative charge) associated with the hydrogen are shared closely with the oxygen atom because of the strong attraction that occurs to the eight protons in the core of the oxygen atom. The shift leaves the oxygen atom slightly unshielded with a net negative charge and the hydrogen side has a slight positive charge as illustrated in Figure 3.

It is this dipole that allows the water molecule to rotate in the electric field of your microwave oven to cook your food. Fortunately, the dielectric constant of water at this frequency is high and considerable energy can be coupled into it from the microwave radiation. The dielectric constant is still about the same as the low frequency value of 80, and has a temperature coefficient of about -0.4%/°C. The heating is due to the breaking of hydrogen bonds between clusters of water molecules, not the rotation of the molecules. The microwave oven cavity also reflects and stirs the microwave energy to prevent hot spots within the food.

The magnetron is mounted in a short length of straight waveguide and coupled into the horn as illustrated in Figure 4. The field is plane polarized in the TE10 mode so that measurements can be made in various orientations of the E & M field. While the three-dimensional field gradient has not been measured,

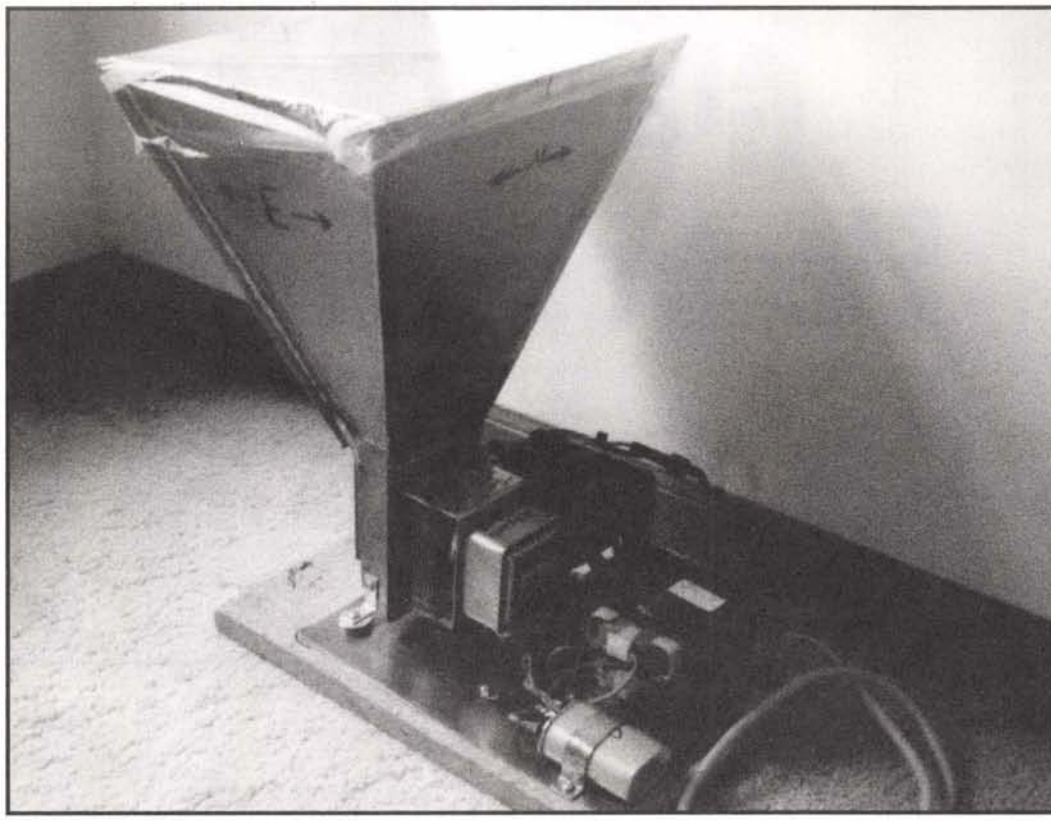


FIGURE 4: MAGNETRON, POWER SUPPLY AND HORN.

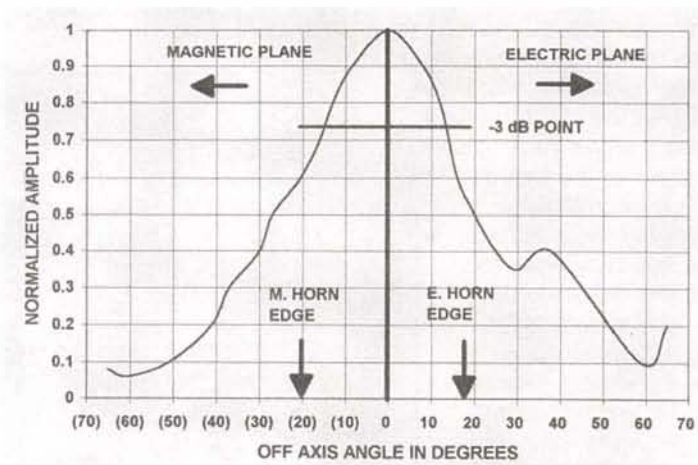


FIGURE 5: RADIATION PATTERN OF HORN.

Websites:

http://imagine.gsfc.nasa.gov/docs/ask_astro/ask_an_astonomer.html (questions and answers to physics and astronomy problems)

http://sciastro.astronomy.net/sci.astro.4.FAQ (frequently asked questions)

www.calphysics.org/research.html (good source of current zero-point field publications)

www.gravity.org (Podkletnov, Li papers, and other related information)

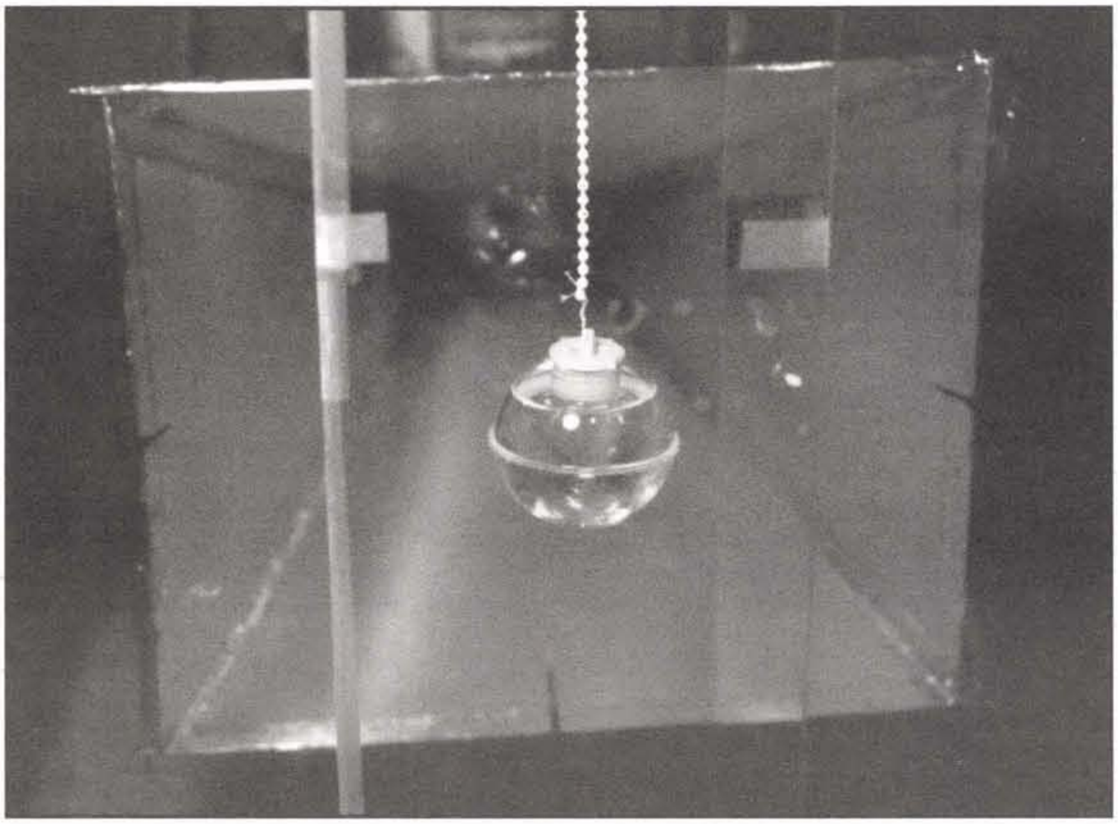


FIGURE 6: BALL OF WATER IN FRONT OF HORN.

the microwave horn design yields an approximate beam shape as illustrated in Figure 5 with a forward gain of about 15 dB. The field pattern provides the electric gradient that interacts with the dipole moment to produce the force.

In free space, the energy density of the magnetic field and the electric field are equal. This allows us to infer the electric field intensity in the plane of M from Figure 5. The edges of the horn are also marked in Figure 5 and correspond closely with the -3 dB point (point at which the power drops to half the initial value).

The electric intensity can be viewed as the solid surface generated by rotating the upper 3dB curve around the zero degree axis. To a good approximation, the field over the horn is shaped like a round nose bullet with the greatest intensity at the horn center.

The horn was located in a large room shielded with a microwave absorber. The absorber is an electrically-conductive foam that converts the microwave energy into radiant heat energy to prevent reflections.

The power supply for the magnetron is a half wave doubler that produces microwave pulses of 8.3 milliseconds with a 50% duty cycle and provides an average power of 600 watts. The actual output power is estimated at 300 watts.

The water was contained in a 2" diameter plastic ball made from a lighted fishing float. The light, socket, and battery were removed. A water tight seal is provided by an "O"-ring at the top. The ball contained 61 grams of water and was suspended from a sensitive electronic balance by means of a plastic beaded pull chain used for light fixtures. The beaded chain allowed the height of the water ball to be varied reproducible in front of the microwave beam. The ball was positioned 4" in front of the horn opening and surrounded by a 4" square Plexiglas tube to prevent air currents from affecting the readings. The assembly is illustrated in Figure 6.

The electronic balance was a Mettler HK160 with a sensitivity of 0.1 milligram. Some additional shielding was added around the electronics to prevent erroneous readings from microwave leakage or reflections from the ball of water. The zero stability was on the order of 0.5 milligrams. The balance provides an automatic tare function that allows the weight changes in the ball of water to be easily recorded.

The procedure was to release the balance and to obtain an auto zero condition. Turn the magnetron on for 10 seconds and record the weight change in the ball of water and then switch the magnetron off and confirm that the balance returned to a zero reading.

After every set of eight readings, the water was allowed to cool for 30 minutes. The vertical position of the ball of water was positioned with respect to the horn, or alternately, the horn was positioned horizontally in 1/2" increments until the weight changes along the central lines of the horn had been mapped.

Figures 7 and 8 illustrate the resulting data measured along the E & M field direction with the E-field perpendicular to the gravitational field. The calculated weight change due to the electric field gradient and amount of water in the ball is on the order of ±20 milligrams, and is in reasonable agreement with this experimental data. The sign of the weight change depends upon the direction of increasing electric field gradient. Figure 8 is somewhat similar as would be expected, but it exhibits some asymmetry on the left side of the horn that may be caused by an asymmetric field distribution.

Figures 9 and 10 illustrate the data measured in the same fashion with the horn rotated 90°, so that the E-field is now parallel to the gravitational field.

Since the electric field gradient is similar in the E and M plane, Figures 9 and 10 should be similar to Figures 7 and 8. Instead, they present an entirely different picture. The weight change is predominately negative and about 25 times larger than expected. The weight loss corresponds to about -0.37%. This result is unexplained at this time.

Further work is obviously

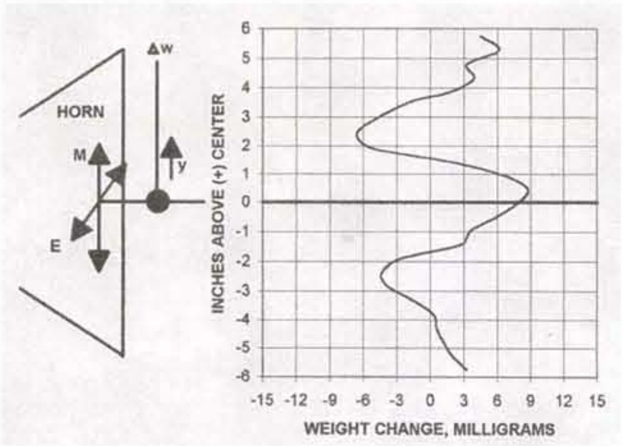


FIGURE 7: WEIGHT CHANGE, E PERPENDICULAR TO g.

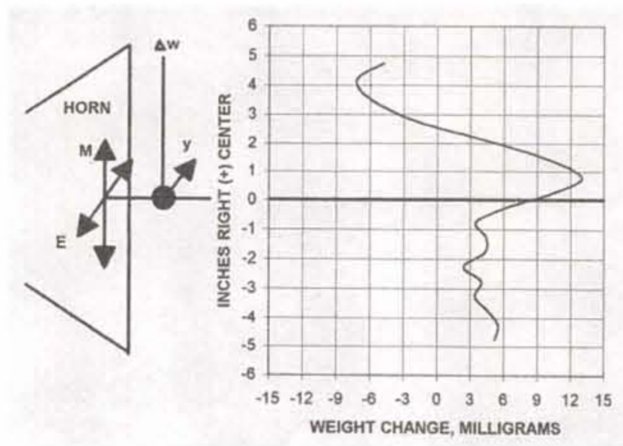


FIGURE 8: WEIGHT CHANGE, E PERPENDICULAR TO g.

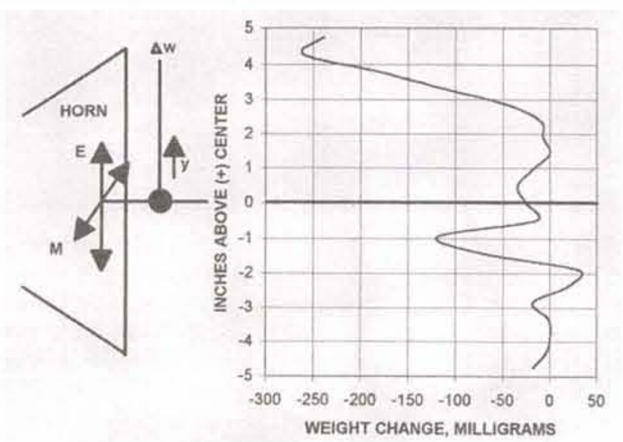


FIGURE 9: WEIGHT CHANGE, E PARALLEL TO g.

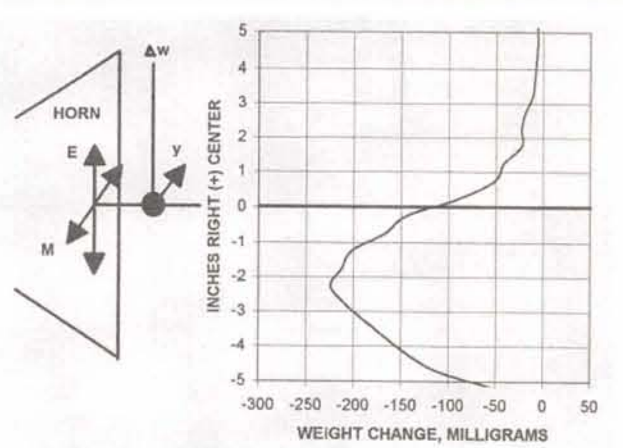


FIGURE 10: WEIGHT CHANGE, E PARALLEL TO g.

required to verify this experiment. A computer controlled data system with the microwave horn indexed in three dimensions so that the data could also be presented on a 3-D plot is highly desirable.

Since this force is exhibited by all electromagnetic waves, it would also be possible to make measurements at either optical wavelengths or with X-rays and a suitable liquid or solid that exhibits a resonance. Measurements could also be made between the longer and shorter wavelengths to experimentally study the interaction. For example, can a short wavelength gain energy surfing in the wake of a long wavelength beam?

This procedure yields a good method to experimentally verify an electromagnetic theory of gravity. It provides a static measurement of the forces involved. Prior to this technique, the ball of water had been connected to a long string to form a pendulum. Optically, the period of the pendulum was measured with a Hewlett Packard counter. However, this simple measurement is difficult to interpret since the free pendulum swing damps out with time. As it damps out, the frequency increases and the period decreases.

One prominent aspect of this data was evident. When the magnetron was energized, the period increased by 0.01%. This can be interpreted as a weight reduction or increased drag. Since the swinging pendulum is dynamic, the effect could be attributed to an induced drag component similar to the theory for inertia and might provide experimental proof for this concept.

Even with a theory of gravity and inertia in hand, it is unlikely that we will be able to control either very soon. To generate such short Planck wavelengths would require control of the individual partons. If we could control the partons such that they emitted a coherent Planck wavelength much like a laser, the effect would be a controlled force beam of gravity similar to the Star Trek tractor beam.

To neutralize the force of gravity due to the wide bandwidth (spread spectrum nature) and random phase associated with the ZPF would require a material that inherently operates to negate these short wavelengths. Such a material is negative matter, not to be confused with anti-matter. If anti-matter comes in contact with normal matter, it will be annihilated and release a large amount of energy. Whereas negative matter consists of negative energy and, if it comes in contact with normal matter, it will cancel out energy and disappear.

The partons of negative matter inherently jiggle opposite to those in normal matter. Whereas the partons of normal matter are attracted towards an increasing electric gradient, the partons of negative matter are repelled by the same field. Thus, while normal matter re-radiates the ZPF field without attenuation (no overall change or transfer of energy), negative matter will actively attenuate the ZPF field.

The difference between normal matter and negative matter is due to the chirality or handedness of our universe. In our universe, normal matter and anti-matter are both right handed and both emit electromagnetic fields that follow the "right hand rule." The "right hand rule" states that if the right index finger points in the direction of the electric field and the other fingers point outward in the direction of the magnetic field, then your thumb will point in the direction of motion or energy flow (the poynting vector). It is the right-handed nature of the ZPF that favors the creation of normal matter and anti-matter in this universe. Some theorists believe this handedness also produces the high homochirality signature in life forms. Most biomolecules exist in a single handedness unlike non-living systems that contain equal numbers of left and right handed molecules.

Negative matter is left handed and follows the "left hand rule" to produce an opposite motion or mirror image as compared to that of ordinary matter. Negative matter would have the effect of inherently damping out and attenuating the effects of the normal right handed ZPF at all wavelengths. For example, negative matter would produce left handed electromagnetic radiation that would cancel out normal radio waves.

If we could produce and control the partons in negative matter to produce a coherent beam at Planck wavelengths, it would produce an anti-gravity beam or repulser field. Perhaps the best way to use negative matter would be to generate a cloud of it beneath the space ship to screen the effects of gravity and inertia. Such a spacecraft could then be propelled by an intense beam of light to achieve the future magic of technology. **NV**

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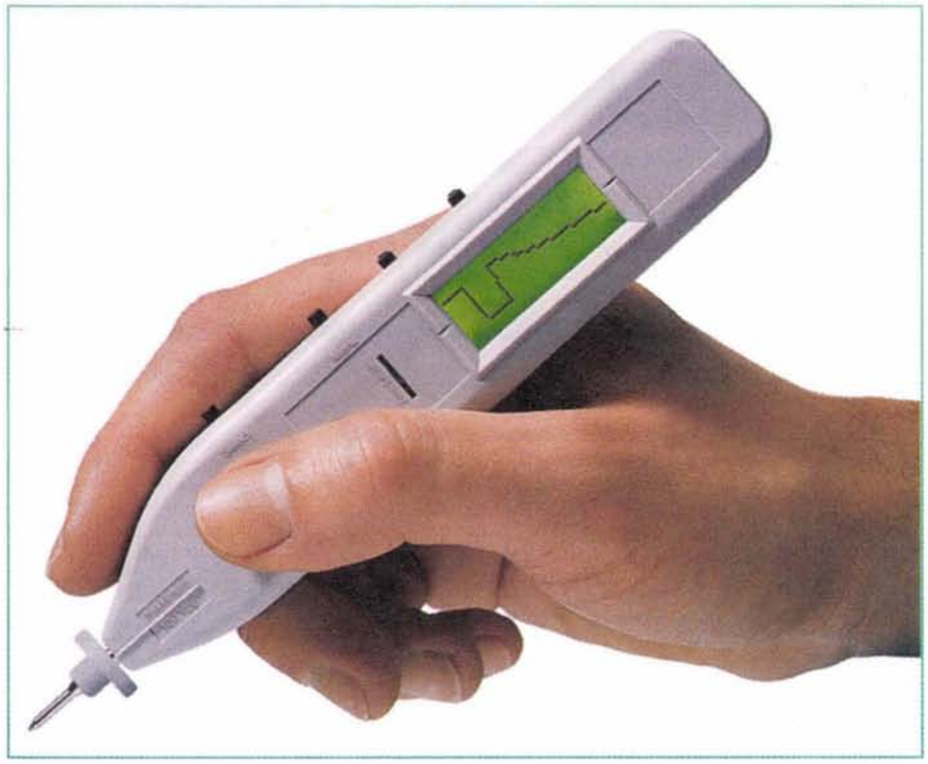
Pen-Type Oscilloscope

by TJ Byers



If you're among the many hobbyists who wish they had a bench oscilloscope, but can't afford one — listen up. If you have a PC and $99.99, you can buy a quality oscilloscope with features found only on test instruments costing many times more. I'm talking about the osziFOX — popularly known as the Pen-Type Oscilloscope — from Wittig Technologies (1-800-247-1241; www.wittigtechnologies.com).*

**Right now, Wittig is offering the Pen-Type Oscilloscope at a special price of $69.99 — see their ad on page 10 for details.*

The Pen-Type Oscilloscope is actually two test instruments in one: a portable, stand-alone oscilloscope and a fully-featured PC-based bench scope. That's what they say, anyway. This sounded too good to be true — something I just had to see for myself.

Stand-Alone

First and foremost, the Pen-Type Oscilloscope is a pen-style oscilloscope that finds widespread applications. Need to troubleshoot in the field? Simply slip this magic marker-sized probe into your pocket and be on your way.

Built into the handheld probe is a backlighted, 16-by-64 resolution LCD display, which serves as the scope's screen. Two push buttons along the upper edge select the operating mode and scan rate (horizontal sweep speed). Input coupling, AC or DC, and input sensitivity (vertical voltage range) are selected via two slide switches, also along the upper edge.

The Pen-Type Oscilloscope is styled so that you can take signal measurements with one hand without ever having to turn your head, like you need to do when using a DMM. Not only does it prevent accidental shorting of adjacent pins, it leaves the other hand free to make adjustments.

Speaking of voltmeters, a DVM is also built into the Pen-Type Oscilloscope. In the DVM mode, a six-bit A/D converter displays a voltage in full-scale ranges of 1, 10, and 100 volts. Ironically, the maximum input is limited to 42 volts DC — less than half the full range.

While the DVM displays an accurate DC voltage, the Scope mode only shows the waveform — without an overlay reference grid. You can only estimate waveform values by judging the relative height and width in relationship to the sweep and voltage settings.

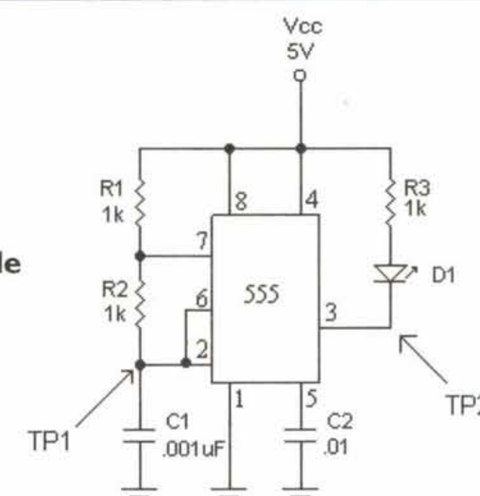
PC-Based

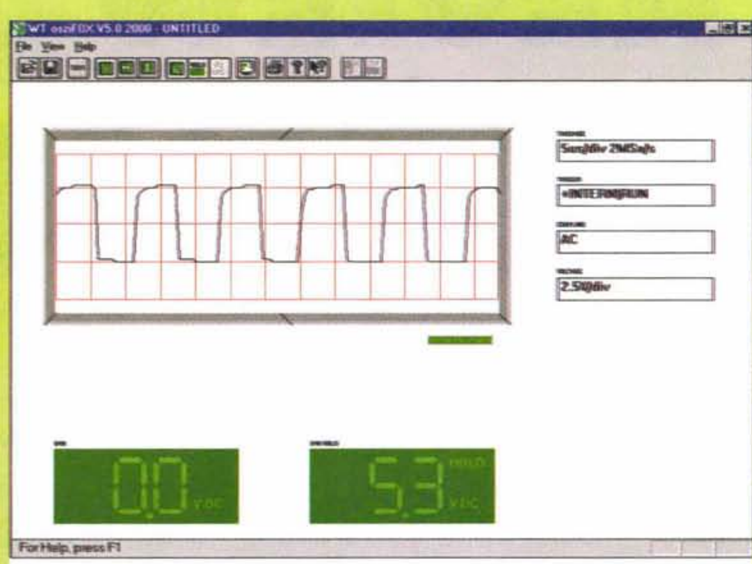
Although the stand-alone personal oscilloscope is the Pen-Type Oscilloscope's selling point, it barely scratches the surface of this amazing device. Plug the Pen-Type Oscilloscope into the serial port of your PC, and it becomes a large-screen DSO (digital storage oscilloscope) with some very sophisticated features — including automatic measurements for period, frequency, and voltage.

Installing the Pen-Type Oscilloscope software is straightforward. It consumes a mere 440k of hard disk space, and even works with older 386 desktop or notebook PCs.

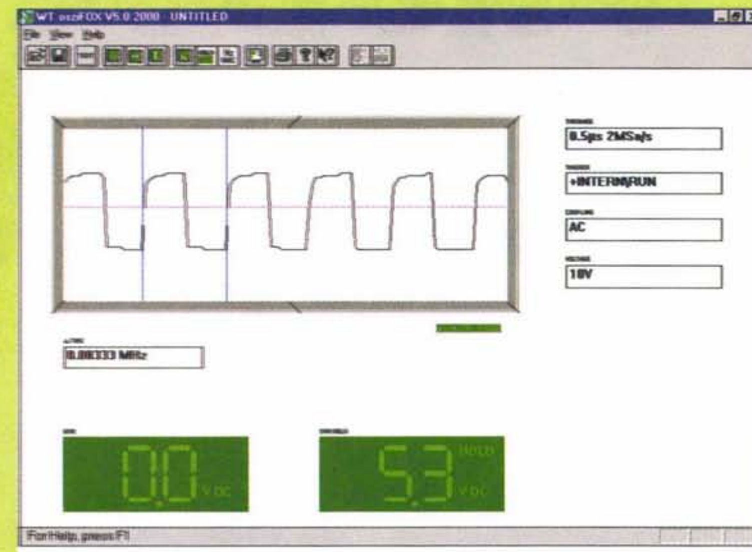
The oscilloscope display parameters are set using a combination of probe switch settings and software functions. You can find these functions as icons in a toolbar at the top

Figure 1 — A typical 555 astable multivibrator.

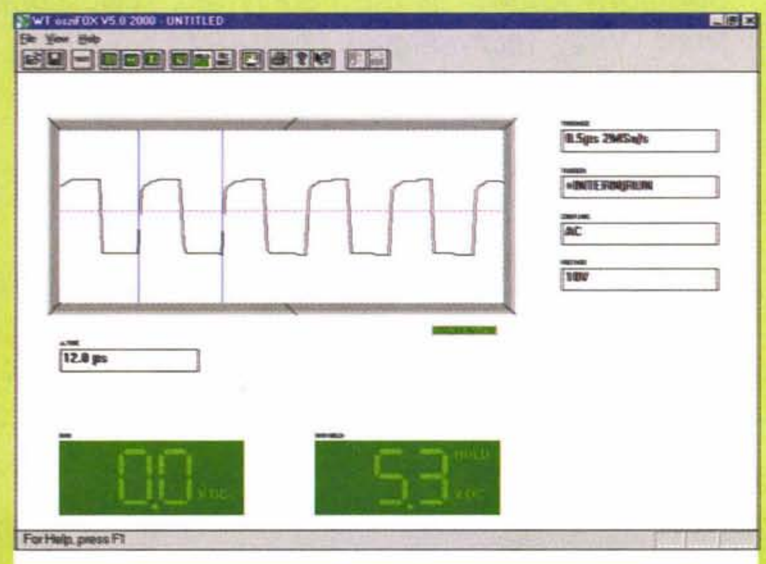




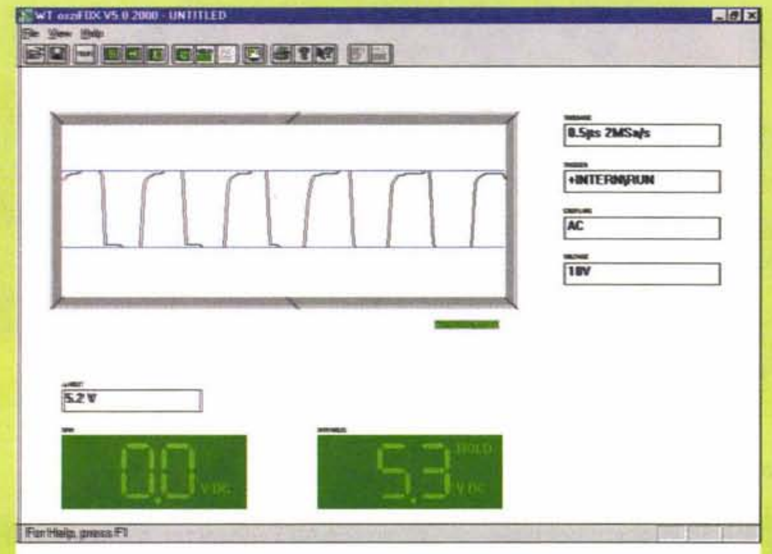
Screen 1 — A feature of the Pen-Type Oscilloscope is its DSO screen, which permits post-processing after the signal is removed.



Screen 2 — The Pen-Type Oscilloscope will automatically calculate and display the frequency of the signal ...



Screen 3 — ... the time period of the waveform ...



Screen 4 — ... and the peak-to-peak voltage.

Figure 2 — In addition to its compact size, when the Pen-Type Oscilloscope is connected to a PC, it offers features found in oscilloscopes costing many times more, including automatic time, frequency, and voltage measurements.

of the screen, in the View pull-down menu, or using keyboard shortcuts.

An annoyance that I found when working with the toolbar icons is that their function doesn't appear as a tooltip (where a hint of its function appears when holding the cursor over the icon) like most Windows applications do. This forces you to memorize their function or use the View menu until you get used to them — which shouldn't take long with frequent use.

Like all quality scopes, the Pen-Type Oscilloscope provides several triggering methods, which include ± external triggering. An external hook clip is provided for this purpose — a clip that, unfortunately, often slips off its contact (ditto for the ground hook clip).

The triggering method is selected using the Mode and Select buttons on the hand probe. For most benchtop applications, the ± internal trigger is preferred, and will be the method used for the following discussion.

TABLE I

Timebase	Frequency
50 nS	20 MHz
100 nS	10 MHz
0.5 uS	2 MHz
1 uS	1 MHz
5 uS	200 kHz
10 uS	100 kHz
50 uS	20 kHz
0.1 mS	10 kHz
0.5 mS	2 kHz
1 mS	1 kHz
2 mS	500 Hz

Frequency And Time Measurements

An outstanding feature of the Pen-Type Oscilloscope software is DSO screen displays, where the waveform remains frozen on the screen even after the signal is long gone. This allows you to do post-processing of the signal. Heading the list of post-processing are frequency, time period, and voltage measurements.

To understand these features, let's analyze the circuit in Figure 1, a simple astable multivibrator built with a 555 timer. The circuit works as follows. Capacitor C1 charges through R1 and R2. When the voltage across C1 equals 3.33 volts (2/3 of Vcc), C1 discharges through R2 and resets the 555, which causes C1 to charge through R1 and R2, and so on. The points of interest for this design are TP1 and TP2.

Your first step is to set the scope's parameters, beginning with the Timebase. If you don't know the frequency or pulse width, then it's done by trial and error. Table 1 show the correlation between the available sweep rates and their corresponding frequency.

For this circuit, the correct setting is 0.5uS. Next, set the trigger to +Internal and you're ready to rock 'n' roll. First up: TP2, the output signal. (Follow the screens shown in Figure 2.)

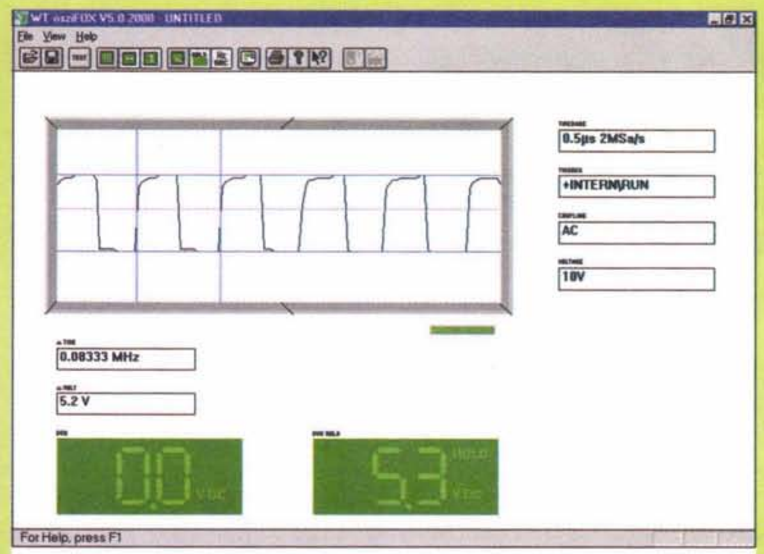
With the Grid on, center the waveform vertically on the PC screen using the thumbwheel adjustment on the hand probe (Screen 1). Remove the probe and click on the Hold icon to freeze the waveform.

The waveform is now ready for post-processing. Frequency and time are measured by positioning the vertical cursor lines on the left and right hand sides of the waveform (Screen 2). You can change between frequency and time by successive clicks of the Hz/sec icon (Screen 3). Voltage is measured using the horizontal cursor lines, as shown in Screen 4. Put together, the screens looks like Screens 5 and 6 of Figure 2

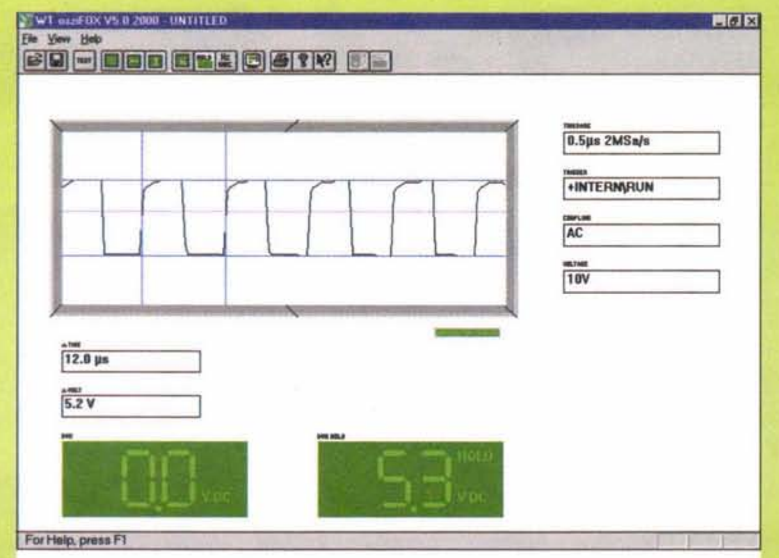
The same can be done with TP1, the charge voltage across C1 (Figure 3). An interesting feature of the Pen-Type Oscilloscope is the ability to display two traces, as shown in Figure 4 — not simultaneously, but consecutively one then the other using the Hold function. These two traces can be used for phase measurements — as outlined in the Owner's Manual in PDF format on the floppy disk — or just to compare happenings in the circuit at different points.

Beyond The Basics

But the good news doesn't stop there. The DVM display can be trans-



Screen 5 — The final frequency analysis.



Screen 6 — The final time period analysis.

ferred to the PC's screen — and the voltage can be frozen (Hold) on the screen just like the scope traces. Furthermore, the scope can accurately display AC signals with a DC offset (bias) — both values of which can be automatically calculated using the method outlined above.

Want more? Single sweep mode and instantaneous incident capture, both of which are frozen in time.

How about the ability to save a scenario to a file for future analysis? The saved file can be manipulated just as if it were running the post-processing in real-time. Using the above features with a battery of saved files, the Pen-Type Oscilloscope can solve problems that would normally require a multi-channel data recorder.

The Report Card

I must admit that when I first heard about the osziFOX "Pen-Type Oscilloscope," I was more than skeptical. But after a couple of days of playing with this gem, I became a believer.

In fact, for low-frequency work, 5MHz and under, I'd plug the Pen-Type Oscilloscope into my PC before firing up my bench-hog 20MHz dual-trace scope. Two thumbs up. **NV**

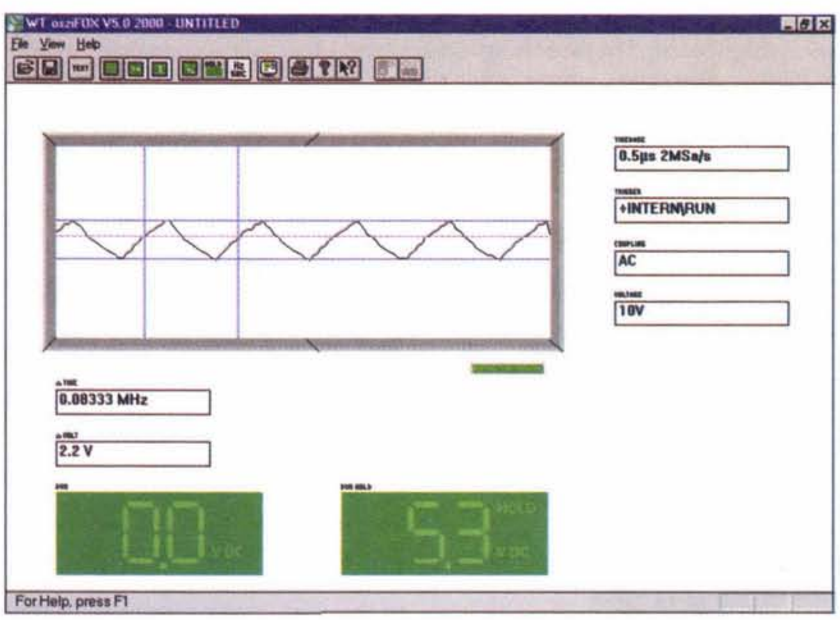


Figure 3 — An analysis of TP1 shows the presence of a triangular wave across C1.

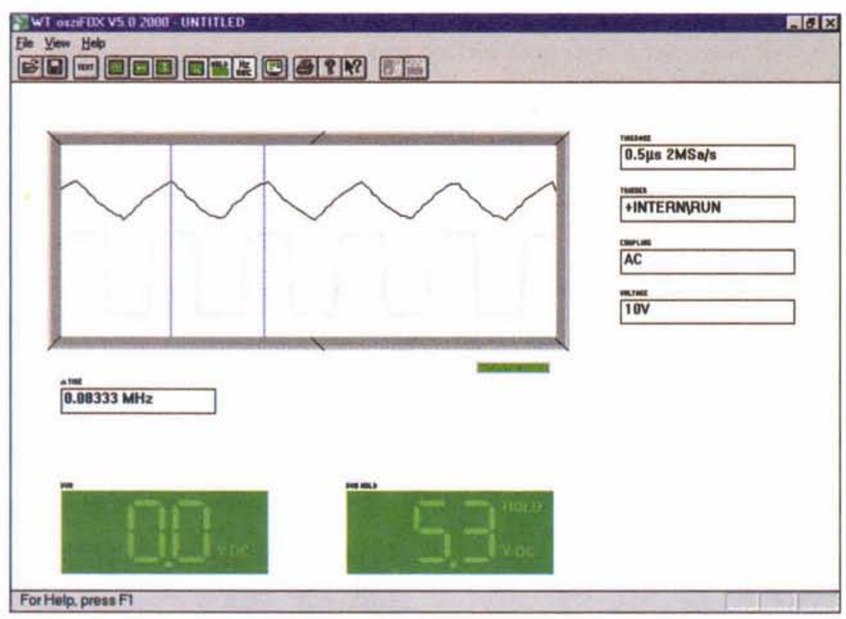


Figure 4 — Two signals can be placed on the screen for phase comparison measurements.

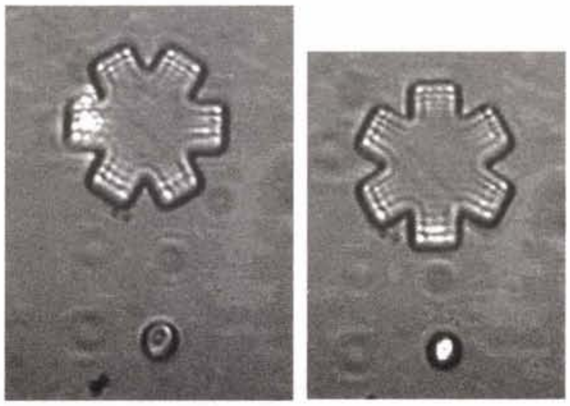
TechKnowledgey 2001

Events, Advances, and News From the Electronics World

by Jeff Eckert

Advanced Technologies

Laser Tweezers



A 15 x 3 µm epoxy star can be trapped in the specimen plane and precisely oriented with a dual-beam optical tweezer. Courtesy of Harvard University, Prentiss Group.

Many precision laser tools are moving into mainstream applications in medicine and microfabrication, and one of the more interesting of them is laser tweezers, also known as optical tweezers. The device is based on the principle that small particles can become trapped within a highly focused laser beam. The beam creates an "optical trap" in which the particles encounter a resistive force if they try to escape. The force exerted is on the order of a nanonewton, which is relatively weak but sufficient for manipulating cellular-level objects. Because the force is distributed over most of a target's surface area, it is suitable for manipulating extremely fragile particles.

Several research-level examples have been built by the Prentiss Group of Harvard University's Department of Physics (with support from the National Science Foundation and the Ford Foundation). The devices are useful for experiments in physics, biophysics, biology, and chemistry. A simple one is the "red tweezers" version, based on low-power helium-neon (HeNe) laser sources.

The visible beam makes it highly effective for testing new specimens, and the low power output makes for safer operation. Best of all, you can build one yourself if you have $6,000.00 to spare. This compares favorably with commercial devices, which can cost $50,000.00 or more.

For information, go to **atomsun.harvard.edu/** and follow these links: Research —> Optical Tweezers —> Tweezers Main Page.

Computers and Networking

Putting the Squeeze on AMD ...

Pentium 4 processor, unpackaged die. Courtesy of Intel Corp.

Several reports indicate that chipmaker Advanced Micro Devices, Inc. **(AMD, www.amd.com)**, is being squeezed on several fronts. In August, IBM announced that it will no longer offer AMD chips as a build-to-order option on its NetVista consumer PCs, which now will use Intel processors exclusively. Dell Computer also does not offer AMD processors as an option, but those who prefer the products can still choose from among several Hewlett-Packard, Compaq, and Gateway machines.

In addition, Intel Corp. **(www.intel.com)** recently launched a 2-GHz Pentium 4 processor (see photo) and cut prices on the rest of the Pentium 4 line. The 2-GHz version replaces the 1.8-GHz processor and will be sold for the same wholesale price ($562.00 in quantities of 1,000). Intel will also sell a 1.9-GHz version for $375.00. Slower chips have dropped in price: 1.7-GHz and 1.6-GHz Pentium 4 processors are now priced at $193.00 and $163.00, and the 1.5-GHz unit is down to $133.00. Similar price reductions were announced for Pentium III, Celeron, and other microprocessor products.

... But AMD Responds

In response, AMD has reduced prices on the entire line of Athlon desktop processor chips. Reportedly, manufacturers can now get a 1.4-GHz Athlon for $130.00 (previously $253.00), a 1.3-GHz chip for $125.00 (down from $230.00), and a 1.2-GHz processor for $120.00 (formerly $199.00), all based on quantities of 1,000 units. AMD has also cut prices on other processors, including the low-cost Duron product family. In addition, AMD has introduced a 1.1-GHz mobile Athlon 4, which brings the company's product line up to par with Intel's 1.13-GHz Pentium III mobile device.

Microsoft Case Supported by Dead People

The Utah State Attorney General's Office, which has joined the US Department of Justice and 17 other states in the antitrust case against Microsoft, reportedly has received more than 400 letters supporting Microsoft and urging prosecutors to go easy on the company. But when it became apparent that many of the letters had exactly the same wording, state officials became suspicious. It turns out that many of the letters contained false information and only appeared to be handwritten, and at least two of them were signed by people who have been dead for some time. The letters have been traced back to an organization called Citizens Against Government Waste (CAGW) and, in fact, the CAGW web site includes a page **(www.cagw.org/policy/hightech/pf.hightech.agletters.htm)** that will automatically generate a letter expressing, among other things, that you are "deeply alarmed by the continuing legal assault by your office and the US Department of Justice against Microsoft." This comes in handy if you are deeply alarmed, but not quite deeply enough to write your own letter.

Circuits and Devices

Is it a PC or a Cell Phone?

Motorola's Accompli™ Personal Communicator delivers voice and data to most major cities across a large portion of the Earth. Photo courtesy of Motorola, Inc.

You have probably noticed that PCs are getting smaller while cell phones are incorporating an ever-increasing range of functions and displays. In another step toward a merging of the two, Motorola, Inc. **(www.motorola.com)**, will be marketing the Accompli Personal Communicator Model 009 by the end of this year. Looking more like a tiny PC than a phone, the Accompli 009 delivers convergent voice and data with its support of tri-band (900, 1800, and 1900) global system for mobile communications (GSM) and general packet radio service (GPRS).

The Accompli 009 is said to be the first wireless communications device to incorporate both tri-band GSM and GPRS protocols, phone functionality, Internet access, email, and short message service (SMS) with a full QWERTY keyboard and 256-color screen.

The device — which measures only 3.8 x 2.8 x 1 inches (9.7 x 7.1 x 2.5 cm) — is designed to capitalize on the rollout of GSM/GPRS networks in North America this year.

The Accompli 009's tri-band GSM protocol allows users to stay connected in most major cities across Europe, the Middle East, Asia, Africa, and the Americas. Simply changing the band setting automatically triggers a search of available networks in the immediate area. The Accompli 009 also provides a variety of games to entertain the world traveler during long layovers or breaks between meetings.

GPRS technology offers "always on, always connected" Internet access, which eliminates the need for dialing up, provides high-speed data retrieval, and results in lower costs, since business users are charged for the packets of information transferred, not the time spent connected.

The Accompli comes with 8 MB of flash memory to manage a variety of remote office functions. For example, the POP3 email toolkit allows users to configure their device to manage up to 10 personal email accounts. The Accompli 009 provides a mobile extension of existing email accounts, allowing users to originate, read, forward, file, and reply to email, while keeping a copy of all messages on their desktop email. The list price is expected to be less than $600.00.

Embedded Controller Aims for Faster, Cheaper Notebook PCs

The PC87591 embedded controller. Courtesy of National Semiconductor.

National Semiconductor Corporation **(www.national.com)** has introduced an embedded, low pin count controller designed to provide power and cost savings for PC notebook manufacturers, plus a built-in security function. The PC87591 is predicted to save manufacturers more than $5.00 per system by integrating traditional keyboard components into a complete system design.

Designed specifically for notebook PCs, the PC87591 features the typical keyboard controller functions, such as internal keyboard matrix scan and decode, plus it acts as an interface between the external keyboard and mouse. In addition, the PC87591 can secure the PC using an on-chip random number generator to implement password protection, BIOS integrity checking, and memory protection.

The PC87591 offers the low power consumption via aggressive power down modes with fast wake-up. Idle current is less than 15 µA, and active current consumption is 20 mA @ 4 MHz and 30 mA @ 20 MHz. The device can quickly switch between idle and active modes and between operating frequencies, enabling further reduction of power consumption based on real-time processing needs. The PC87591 is upgradable due to its on-chip flash memory. Innovative programming of the flash allows for a complete in-system firmware (and BIOS) update by the host.

The device is available in 128-pin and 176-pin LQFP packages. In 1,000-unit quantities, the PC87591S with 128k flash, 4k RAM, and RNG costs $15.00, while the PC87591E with 64k flash, 2k RAM, and no security function costs $13.80. A chip scale package option will be available by year end.

Industry and the Profession

More Dot-Coms Wilt on the Vine

In January 1988, Egghead, Inc. decided to close its "brick-and-mortar" stores and focus exclusively on Internet sales. In March 2001, suffering from a lack of such sales, Egghead laid off 180 employees and borrowed $20 million from IBM to remain in operation. In August 2001, the company filed for bankruptcy, laid off two-thirds of its remaining employees, and announced the sale of its assets to Fry's Electronics (a chain of stores based in San Jose, CA). Sales of Egghead stock were halted by the Nasdaq exchange on August 15 after the price dropped to $.30 per share. Reportedly, Fry's Electronics will continue to operate the egghead.com web site.

Meanwhile, online retailer Buy.com laid off 50 employees in August as it too faced declining sales. This follows a layoff of 125 workers in February and constitutes a total loss of 68 percent of its workforce. The company booked $788 million in sales last year, second only to Amazon.com in total Internet sales volume. But second-quarter revenues this year were down 51 percent from the same period in 2000, and Buy.com registered a $5.7 million loss.

Nasdaq has now dropped it from the list of companies that can be traded on the exchange. In a somewhat odd development, it has been reported that company founder Scott Blum will re-acquire Buy.com for $23 million in cash, which is probably about as shrewd as sending a big check to the Gary Condit Re-election Campaign.

MIT Plans to Give Away the Store

Massachusetts Institute of Technology (MIT) President Charles M. Vest has announced that MIT will make the materials for nearly all its courses freely available on the Internet over the next 10 years (see **http://web.mit.edu/newsoffice/nr/2001/ocw.html for details**). He made the announcement about the new program, known as MIT OpenCourseWare (MITOCW), at a press conference earlier this year. The OpenCourseWare project will begin as a large-scale pilot program over the next two years. By the end of the two-year period, it is expected that materials for more than 500 courses will be available on the MIT OpenCourseWare site.

According to Vest, "OpenCourseWare looks counter-intuitive in a market-driven world. It goes against the grain of current material values. But it really is consistent with what I believe is the best about MIT. It is innovative. It expresses our belief in the way education can be advanced — by constantly widening access to information and by inspiring others to participate." Commenting on the motivation behind OpenCourseWare, he said, "MIT faculty have a deeply ingrained sense of service and mission — they like to work on big problems and, frankly, they like to influence the world." In his remarks to the press, Vest expressed confidence that giving away courses will not compromise enrollment numbers, downplayed the importance of revenue-generating activities, and invited other institutions to follow MIT's lead.

The plan for uncompensated distribution of MIT's technical knowledge base has been very favorably received by potential beneficiaries the world over (presumably including those who will no longer have to obtain a passport, travel abroad, and pay tuition to receive a world-class education in nuclear physics, electrical or biochemical engineering, electronic warfare, etc.).

Rumor has it that, inspired by MIT's bold move, the US government will gradually extend Social Security benefits to everyone in the world, McDonalds will phase out its market-driven requirement that customers pay for their food, and everyone on Earth will be issued two Yanni CDs and a string of love beads. Ommmmmm. **NV**

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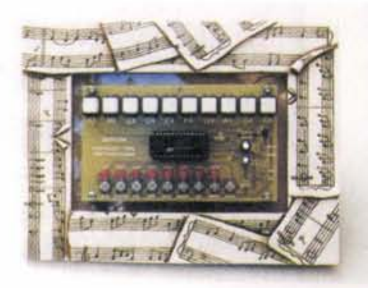
OBJECTS d'ART ELECTRONIQUE



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Are you a kit builder? If so, here's what you can do with all of those completed kits!

Some electronic hobbyists are just that — 'hobbyists.' The projects undertaken by these individuals (and I include myself in this group) are from articles published in *Nuts & Volts* or from kits.

As a representative of this group I know enough to read schematic diagrams, assemble components and, in some cases, slightly modify the circuit. I do not know how to design my own circuits nor do I feel the need to develop this aspect of project building.

I consider my approach as 'embroidery' for the technical-minded with electronic kits providing the basis for the majority of the activity. Kit building is an interesting, educational, and satisfying form of relaxation for me — but what do you do with all of those completed kits?

This short article isn't about kit building, but about displaying the finished projects on the wall, a shelf, or on a desktop. The simplest way to achieve this is to mount the project PC board in a picture frame.

The "mini-atlas" which follows indicates the kit manufacturer and describes the type of frame used to display the finished projects shown in the accompanying photographs. I broke the kits into 12 categories (signs, clocks, activated lights, decision makers, sounds, running lights, games, Christmas, hearts, radios, blinkers, and music) and for each category produced two examples of how to configure the kits as a standard display and as an unusual display for a total of 24 mounted kits. Several projects involved mounting the kit PC board on objects that can be placed on a desk, but are not picture frames.

The standard displays mostly involved mounting the project PC board in an appropriately themed frame. Half of the frames I used were wall mounting (W) frames and the other half used were desktop (D) standing frames.

Everything from 'put-it-together-yourself' metal frames to frames found in specialty shops and mail-order catalogs were used. The glass was removed from the frame and the cardboard backing was used to size and cut a replacement hardboard backing. The hardboard back was either painted (usually white) or covered with a piece of adhesive-backed colored felt (easier and quicker than painting) before mounting the PC board using 1/4" or 1/2" standoffs.

An SPST switch and battery holder were added to the front and/or back of the frame. The creative activity for these projects involved finding and matching an appropriate frame to the kit project.

Some projects such as the OBJECTS d'ART ELECTRONIQUE sign, the large LED clock, and the sound-effects generator were effectively mounted in conventional black aluminum frames surrounding a white painted hardboard or plain hardboard. And by the way, for those who believe that soldering 'soothes the soul,' try one of the Velleman sign kits!

For the PC board that spells out 'ELECTRONIQUE' there are 85 transistors to solder, 103 resistors to solder, 182 LEDs to solder, and 235 jumper wires to solder, plus a few miscellaneous parts including seven capacitors, 25 diodes, and two IC sockets.

Other projects such as the animal sounds piano (music notes frame), executive decision maker (Chinese symbols easel-frame), and the Santa sled and Christmas tree (wood frame with a green felt back) were chosen a little more creatively.

The unusual display frames or stands for certain kit projects 'made' the display. Unusually shaped frames comprised one group and included a beating-heart kit in a heart-shaped frame, an AM radio kit in an oval wood frame with burlap backing (looks like old grille cloth), a Christmas star kit in a star-shaped wire basket, and scrolling clock kit mounted on an inexpensive analog wall clock with the hands removed.

Another group of unusual displays simply involved using very decorative frames such as the electronic die kit mounted in a dice frame, a light-chaser kit mounted in marble-beaded frame, a Y2K blinker attached to a globe frame, and a coin tosser decision maker kit constructed as a table-top display using two quarters to indicate heads or tails.

Several other unusual displays were created by attaching the kits to some sort of stand that could be placed on a desk or shelf. An electronic parrot circuit board attached to a ceramic parrot, an LED blinker placed in a bottle shaped like a light bulb, a melodies circuit built as a music tower, and a sound-activated LED starburst kit mounted on a homemade stand are all examples from this last group.

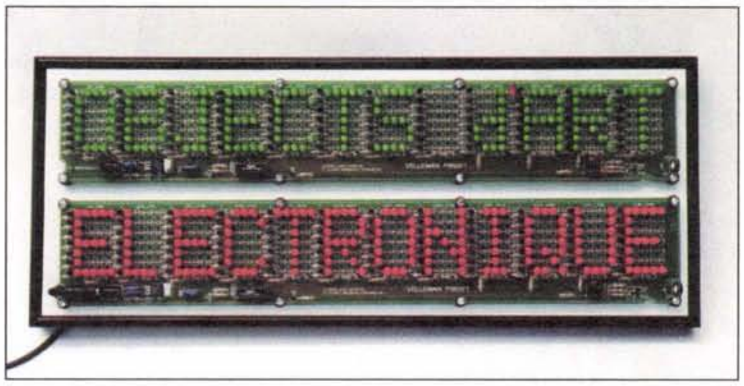
One easy way to track down kit sources is to access Bob Bamont's Electronic Kit Catalogs website at www.bobbamont.com/elkits.html which provides a list of 20 companies that sell kits, with addresses and some direct web links.

The electronic mini-atlas presented here of the 24 kit displays shows a picture for the completed project along with a brief description, including the kit manufacturer. Most of these kit display projects I use as gifts at Christmas, Valentines Day, birthdays, etc. I am forever finding new frames or stands that will accommodate kits currently under construction.

For example, a recently acquired large metal world-globe picture frame will be used to house a Ramsey Electronics Shortwave Receiver (Kit SR2) and a set of salt and pepper shakers in the shape of light bulbs will be placed on a stand that will flash a mini-strobelight (Chaney Electronics Smallest Variable Strobelight Kit, stock# C6844) when the shakers are removed for use.

OBJECTS d'ART ELECTRONIQUE

SIGN — STANDARD DISPLAY



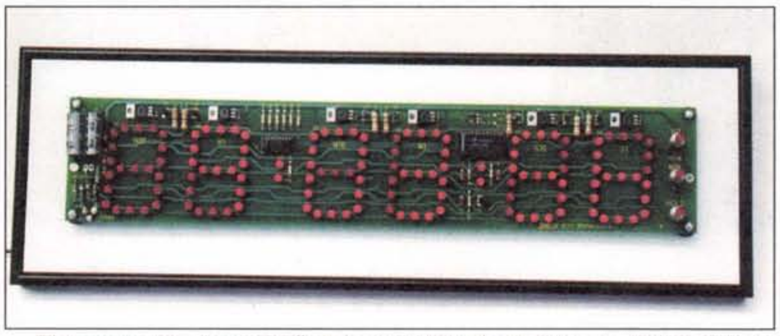
The title of this article is embodied (forever) in two Velleman sign kits — K5600R (red) and K5600G (green) — that took a considerable amount of time to fabricate. Both PC boards were mounted in a black frame with a white painted hardboard back.

The two signs were slaved together in order to synchronize the special lighting effects (scrolling, blinking, rolling, and panning). (W)

SIGN — UNUSUAL DISPLAY

The PC board of a Chaney Electronics Y2K Alert Kit — "RED" was mounted in a world-globe picture frame to stress the international nature of the Y2K problem (or lack thereof) that was anticipated in the year 2000. It simply blinks! (D)

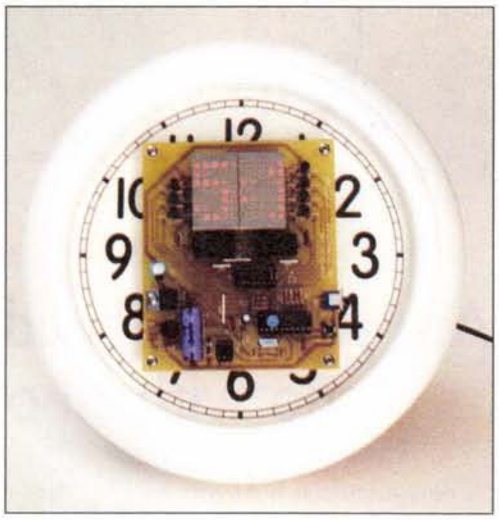
CLOCK — STANDARD DISPLAY



This attractive, large 2.5" digit, red LED clock (Jameco JE725KIT) was mounted in a 7" x 21" aluminum black frame on a white, painted hardboard back. (W)

CLOCK — UNUSUAL DISPLAY

LNS Technologies offers this unique, attention-getting, scrolling LED clock kit (SCROLL-CLOCK-KIT) which was mounted on the face of an inexpensive plastic analog wall clock (about 9" in diameter) minus the hands. (W)



ACTIVATED LIGHTS — STANDARD DISPLAY

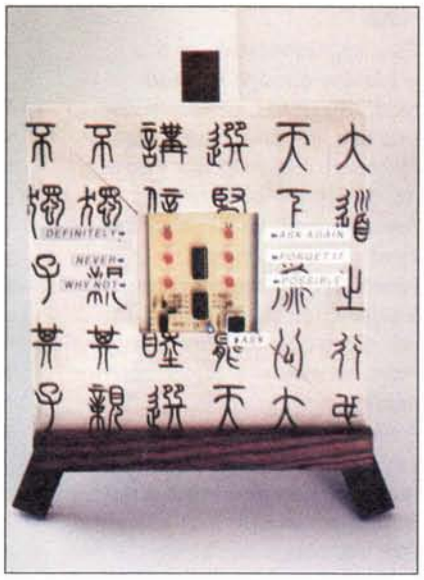
This Magic Eye Robot Flasher Kit from Chaney Electronics (#C6755) uses an IR LED and IR sensor to detect the presence of any obstacle within two feet of the circuit board. The result is a four-LED multicolor 'flashing greeting' from the robot. When mounted in a simple black frame with a blue felt background, it produces a very effective wall display. (W)

ACTIVATED LIGHTS — UNUSUAL DISPLAY

Rainbow Kits produces this Starburst Sound to Light Display Kit (SB-1) which was mounted on two pieces of pine board glued together to form a stand. When standing on a shelf or desk, any nearby sound picked up by the onboard electret microphone produces an 'explosion' of color involving 64 red LEDs. (D)

DECISION MAKER — STANDARD DISPLAY

The Executive Decision Maker (Kit K-32 from Elenco) was mounted in a Chinese symbols easel-frame with added labels produced from an electronic handheld label-making machine. Although simple to put together, this display is a big hit when I leave it on my desk. (D)



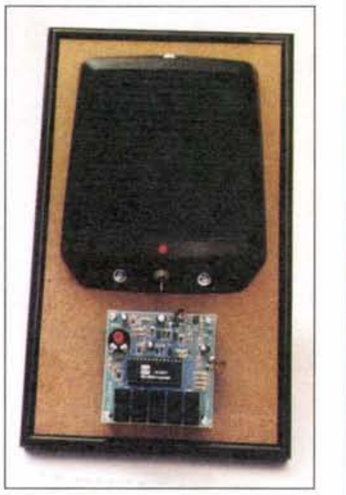
DECISION MAKER — UNUSUAL DISPLAY

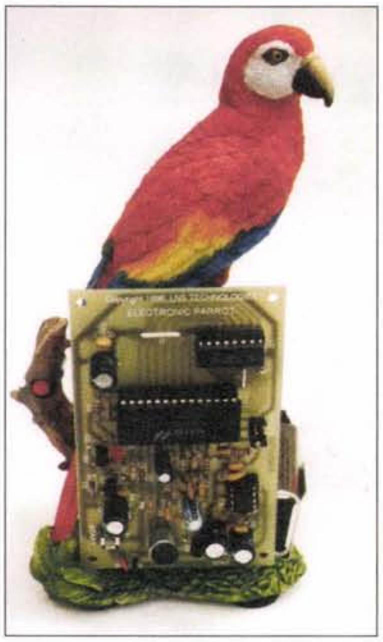
Chaney Electronics produces a simple Touch Sensitive Coin Tosser/Decision Maker kit (C6354) that I housed in a 6" x 2" x 1" project box (RadioShack 270-1804). Two quarters, soldered to 1/4" bolts, were anchored to the project box lid and wired to the two touch-pads on the PC board. When two fingers are placed on the quarters the LEDs will flash back and forth on each side of the quarters, until the fingers are removed. One LED will remain lit indicating heads (red) or tails (green). (D)

OBJECTS d'ART ELECTRONIQUE

SOUNDS — STANDARD DISPLAY

A Velleman Sound Generator Kit (K4401) was mounted on a black framed piece of unpainted hardboard along with a plastic speaker enclosure. The battery, LED indicator, and SPST switch were all attached to the speaker enclosure. Passer-bys pressing one or more of the 10 push buttons create a variety of sounds including guns, sirens, engines, explosions, tunes, phasors, etc. (W)





SOUNDS — UNUSUAL DISPLAY

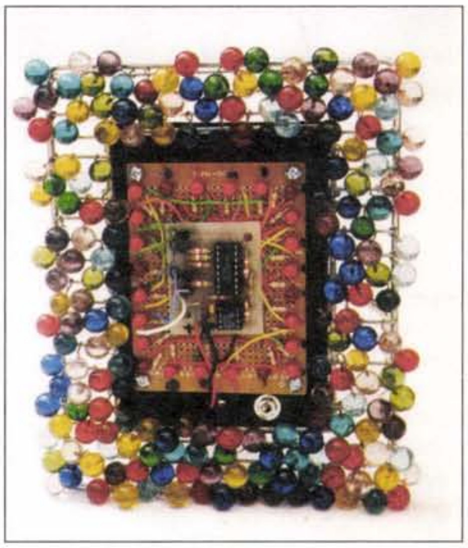
An LNS Technologies Electronic Parrot Kit was bolted to a resin-cast painted parrot and used as a desktop display. This kit is the favorite of those who have seen and played with my bizarre collection. Once the start button is pushed, the parrot will record and instantly playback about eight seconds of speech, laughter, and other assorted noises, and then reset itself to start the process all over again. I am amazed at how delighted people are to hear their voice 'parroted' instantly back to them. (D)

RUNNING LIGHTS — STANDARD DISPLAY

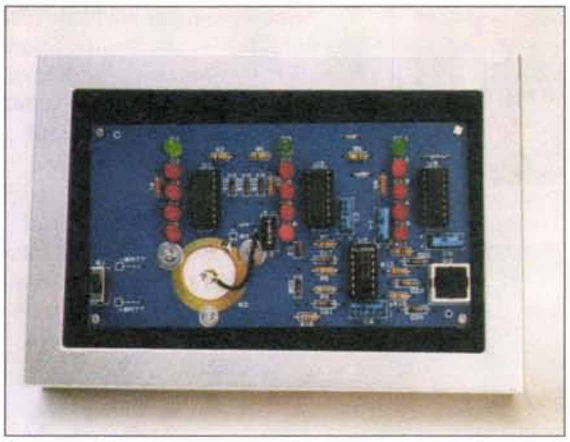
The Atomium (Kemo Germany #04-194) was epoxy-welded to a small aluminum frame that exactly fit the PC board. The bolt shown at the bottom was attached so the frame could be set on a desktop. (D)

RUNNING LIGHTS — UNUSUAL DISPLAY

The Chaser Light (Rainbow Kits CL-1) PC board was glued to a copper-plated 4.5" x 6" perfboard that provided the base for wiring the 24 LEDs around the perimeter. The entire assembly was mounted to a frame consisting of colored transparent beads against a black felt-covered hardboard backing. The resulting display is quite striking. (D or W)



GAME — STANDARD DISPLAY



The One Button Bandit Kit (K-34) from Elenco Electronics, Inc., was mounted in a brushed aluminum frame with a blue felt-covered hardboard backing. This is an attention-getting kit with people stopping to play much longer than only the minute or two they 'claimed' to have had originally. (D)

GAME — UNUSUAL DISPLAY

The Holtek Digital Dice Kit from LNS Technologies was mounted in an unusually suitable and attractive frame on a black felt-covered hardboard backing. (D)

CHRISTMAS — STANDARD DISPLAY

Two Velleman kits — Electronic Xmas Tree (MK100) and Riding Santa (MK116) — were mounted together in a oak wood frame with a green felt-covered hardboard backing. Two astable flashing LED circuits are used to light the Christmas tree and the Riding Santa shows motion on the sled runner and reins by using chaser light sequences. The running reindeer is created by alternately blinking two different sets of hind and fore legs. (W)

CHRISTMAS — UNUSUAL DISPLAY

The Flashing Christmas Star Kit 46 (Grantronics Pty., Ltd.) available from kitsrus.com is a spectacular special effects kit using a programmed micro-controller to produce a large number of different geometric patterns using the 30 LEDs that outline the five-pointed star. The PC board was mounted in a five-pointed metal mesh star basket picked up (actually purchased) at a local gift shop. (W)

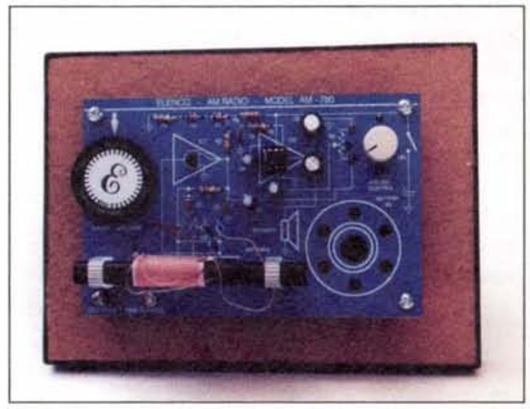
OBJECTS d'ART ELECTRONIQUE

HEART — STANDARD DISPLAY

Chaney Electronics Heart Throb Kit (#C6410) mounted on red felt-covered hardboard in an 'I Love You Frame.' Two fingers placed on the copper pads will cause the heart to blink at a rate depending on your capability to 'stimulate.' (D)

HEART — UNUSUAL DISPLAY

Flashing LED Sweetheart Mini-Kit (MK 101) from Velleman 'beats' at roughly 60 times a second when switched on. Mounted in a heart-shaped frame, it makes a great Valentines Day gift. (D)



RADIO — STANDARD DISPLAY

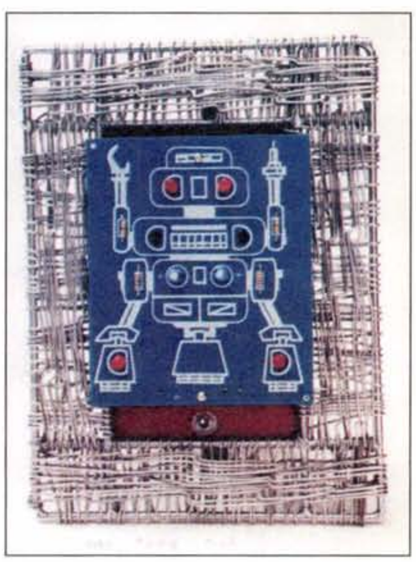
An Elenco Electronics, Inc., AM Radio Kit (Model AM-780) mounted in an inexpensive black plastic frame with brown felt-covered hardboard backing. This radio performs well with good selectivity. (W)

RADIO — UNUSUAL DISPLAY

DIY KIT63-One Chip AM Radio, mounted in oval wood frame with burlap covered hardboard backing to simulate old fashioned grille cloth. The selectivity of this radio is directionally dependent. (W)

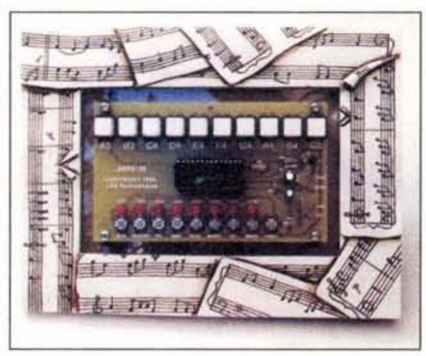
BLINKER — STANDARD DISPLAY

This simple LED Robot Blinker Kit from Elenco Electronics, Inc., looks pretty good mounted in a wire frame against a red felt-covered hardboard backing. (D or W)



BLINKER — UNUSUAL DISPLAY

A bottle shaped like a light bulb (originally for sale filled with popping corn) became the basis for this desktop standing display. Two kits — a Chaney Electronics Bright Yellow Beacon Kit (#C6731) and a DIY KIT35 (1.5V to 9V step up DC-to-DC Converter) — were wired together along with an AA battery. Heavy gauge wire was used to keep everything stiff and in place. The entire assembly was connected to a push-on, push-off SPST switch mounted to the screw-on cap of the 'light bulb.' A lot of work to make a simulated blinking light bulb, but very satisfying when it lit up! (D)

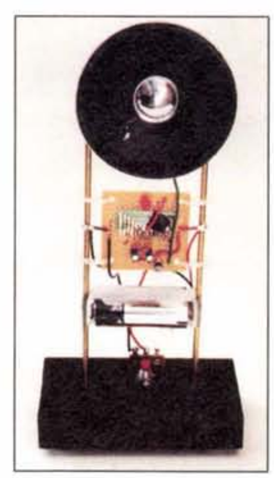


MUSIC — STANDARD DISPLAY

Another unique kit from LNS Technologies — the Animal Sounds Piano Kit — contains a keyboard that can be touched to play tunes with a choice of seven different animal sounds or a synthesized piano.

A demo mode plays stored tunes using a mixture of all of the different sound types. The entire PC board was mounted in a music-note frame that catches a lot of attention. (D)

MUSIC — UNUSUAL DISPLAY



This music melodies tower was my first foray, some time ago, into objects d'art electronique and was made from a kit that I cannot find in current catalogs. Other melody generator kits are available from several suppliers and could easily be used to construct a tower similar to the one pictured here. The kit I used consisted of only a very small PC board containing the music chip, a speaker, and a two-cell AA battery holder. The speaker was soldered to two brass rods that also acted as supports for the epoxy-welded battery holder, and for the PC board (with music chip)/perforated board combination that was attached to the rods using plastic wire ties. A momentary push-button switch was inserted into the wood base and connected by a couple of wires to the circuit board. Sitting on my desk, the 'tower' is irresistible to passer-bys who are rewarded with one of 12 melodies after pushing the red button. (D) **NV**

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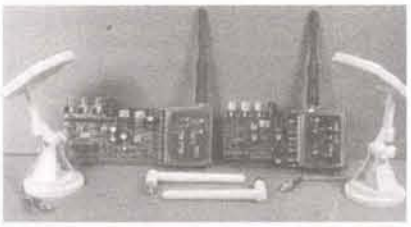

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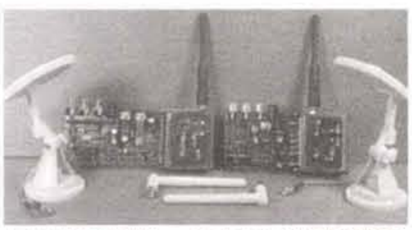

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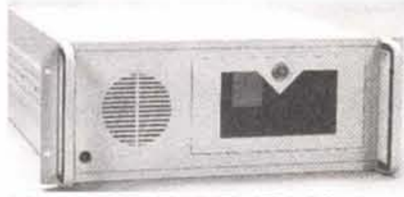

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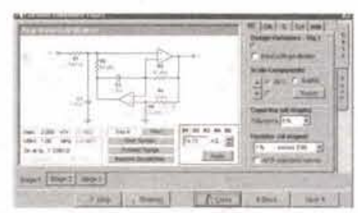

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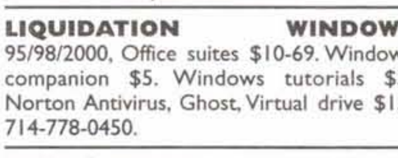

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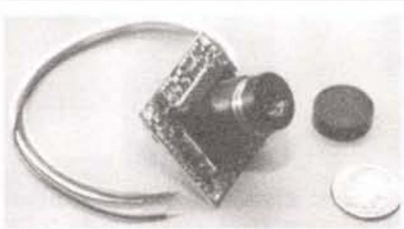

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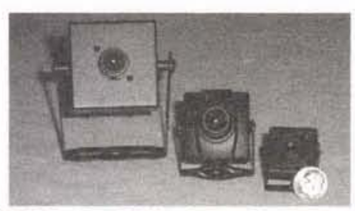

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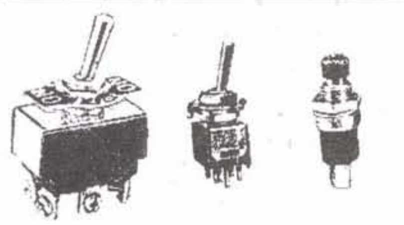

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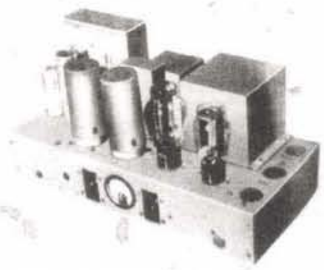

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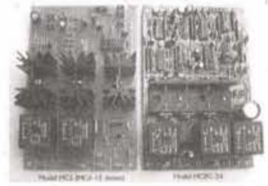

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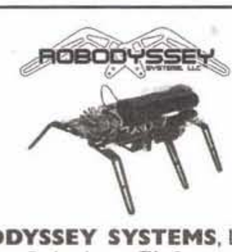

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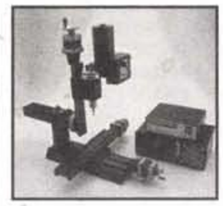

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Prepaid ads received by 5:00pm on the **closing date (5th of the month)** will appear in the following month's issue. Ads postmarked through the **5th**, but received after the closing date, will be placed in the next available issue. No cancellations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

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!

Don't forget to check out the new online electronics forums at the *Nuts & Volts* website. There are currently boards for discussing Robotics, Microcontrollers, Radio, Computers, CNC, and a General forum for discussing any electronic topic at all. We'll even add new dedicated boards for hot topics. Just let us know!

Want to get a jump on things before the magazine arrives? The Tech Forum questions are posted on our website on or before the first of each month. Unanswered questions from recent issues are there also.

Send all material to **Nuts & Volts Magazine**, 430 Princeland Court, Corona, CA 92879, OR fax to (909) 371-3052, OR E-Mail to **forum@nutsvolts.com**

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. Be sure to include your mailing address if responding by E-Mail or we can not send payment.
- Your name, city, and state, will be printed in the magazine, unless you notify us otherwise. If you want your email address printed also, indicate to that effect.
- The question number and a short summary of the original question will be 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

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, Phone Number, and email. Only your name, city, and state will be published with the question, but we may need to contact you.

QUESTIONS

Is it reasonably easy to convert an automotive alternator tester like the RadioShack handheld LED tester for use as a 36-volt golf cart gas gauge?

10011 **Bryan Mcphee**
via Internet

I have a two-board EPROM programmer manufactured by Supercomputer, Inc. It has an eight-bit ISA card with a 25-pin D connector and a daughter board with a 40-pin zif socket. Unfortunately, I do not know anything about it or where to get a driver.

10012 **Bryan Mcphee**
via Internet

I would like to find some information on position and angle sensing for a potential VR application. Accuracy (short-term) needs to be of the order of 6" linear and 0.5° angular. The system should ideally be self-contained (no external references other than an initial and/or periodic calibration).

I'm considering using some of the new solid-state angular rate sensors from Analog Devices (I have their app notes), and integrating to get position/angle information, but I've been unable to find any circuit examples or detailed design information, particularly with regard to the required processing (coordinate transformations, suggested DSPs, etc.).

Any ideas (books, comments, URLs, etc.) or possible alternative solutions (DTGs?) would be appreciated.

10013 **Larry Supremo**
Baltimore, MD

I have attempted to design a circuit to automatically reset a PC after a power failure. The PC requires one to reset the PC by pushing a reset button. After examination, the button shorts two pins on the motherboard which have an isolated +5V and GND.

I've attempted several circuits using a 555/556 to give a delay, but the only source of voltage at that point is the 5V at that pin. I want to be able to build a circuit which will not require cutting or jumpering the motherboard.

If the button is constantly depressed, the system 12/5V will come up for a few seconds, but will then power off. If the contacts are lowered to >= 2.4 volts for < a second, the system will reset. I have used a relay such that when the main 5V comes up it resets, but there is no time delay which I believe should be utilized. Any ideas would be appreciated.

10014 **Alex L.**
via Internet

I have recently obtained a new/unused Itronix T3500 handheld computer with a barcode wand made sometime around 1993.

I'm trying to find any documentation or manuals on this item. It seems to be similar to the popular T5000, but in a handheld vertical arrangement with (I'm guessing) a 64x128 LCD graphics display at the top. It was probably used for inventory tracking and control.

It does have a PCMCIA slot to accept the same memory card as the T5000. In fact, one of the instruction pamphlet/cards shows the T3500 and the T5000 side by side with instructions for both for the memory card. It didn't arrive with any charging devices or docs though the battery pack is 6 VDC, so I assume the wall plug jack is the same with a negative tip.

Itronix has no current records on this device and the info on the internet is scant. If you are curious, I have pictures of this device on my website at: **www.version5design.com/t3500**.

Thank you for a great magazine and column.

10015 **Kevin Hunt**
via Internet

I would like to build a circuit to control 40-50 LEDs. I'd like to control these LEDs with a numeric-touch pad. The way I would want it to work is if I wanted the LED in the number 3 position to go on, I would just press "03" on the touch pad. If I want the LED in the number 3 position to go off, I'd press "03" to extinguish the LED.

If this can be accomplished with a wireless circuit that would be ideal, but a ribbon cable connection is just as good.

Can someone draw me a diagram with required parts?

10016 **Salvatore Licata**
via Internet

I work in the telecommunications field and we work with a lot of ground start telephone lines (ground applied to tip before dial-tone is received).

Is there a way to simulate this using a normal loop start line for testing equipment and demonstration purposes, without buying expensive equipment?

10017 **Jay Perkins**
via Internet

Can someone show me how to rewire a PC plug to a MAC 15 pin plug so I can hook up my MAC SVGA monitor?

I know they have an adapter for a PC monitor to hook into MAC, but what I want is an adapter MAC montior to hook into a PC min tower or a wire diagram design.

10018 **Dennis Marques**
Chelmsford, MA

I just discovered a Heathkit GR-91 shortwave receiver that I built probably more than 25 years ago. It seems to work, but I really need a couple of things: antenna selection/hookup, any information on operation (a copy of the assembly/use manual) would be wonderful. Also information on obtaining tube replacements, if needed.

Of course, I will pay all copying/shipping costs.

10019 **Kevin Holbrook**
via Internet

I am looking for information on how to build a "routing or a switch type" device. It would have two inputs, both analog, low voltage (from a tape player and a radar detector or scanner), and one output (which would go to a headset).

One circuit would be open continuously, unless the other was activated, then the "switch" would allow input from the second source to pass through.

Once the second signal stopped, it would return to the original input. Power would come from a 12-volt DC source.

100110 **Chuck Bennett**
via Internet

I have not been able to find any schematics on the web for the Hitachi static RAM part #HM628128.

I am interfaced to a PIC16F877. It is a 32-pin DIP.

29 = We write enable.
24 = OE chip enable.
22 = CS1 (?)
30 = CS2 (?)

CS1 and CS2? Also, does someone know if the 512K static RAM would be similar?

100111 **Steve**
Fullerton, CA

I found a set of E.A.W. speaker cabinets with the 12" woofers missing. I want to use them as a small P.A. system.

I have a set of blown 12" J.B.L. E120s that I want to use in the cabinets. I am going to recone them with a 4-ohm voice coil rather than an 8-ohm coil, because the Carvin P.A. amp I am using puts out 250 watts per channel at 4 ohms, but only puts out 175 watts at 8 ohms.

What value cap can I add or replace to the low pass crossover to make it cut off at the original frequency with the new 4-ohm coil?
schematic

100112 **Jon Garee**
Newark, OH

I installed an array of 4 and 3" solar cells onto the wings of a styrofoam glider, with a Mibuki electric motor in the nose. I was ready to fly.

What I need is a simple timer to break the circuit to let my glider glide to earth. Use of a 555 timer would be an answer, but how? And an even better fix would be some sort of radio frequency control that would allow me to control the rudder (for turning) and elevators for up and down.

I don't have money to purchase servo's and remote controllers like radio-controlled airplanes use, so I need help in designing a remote control that will allow me to fly my glider, powered by the sun.

100113 **Jim Emrich**
Fremont, OH
junglejimie@aol.com
junglejimie@yahoo.com

ANSWERS

ANSWER TO #9011 - SEPT. 2001

I'm looking for schematics on a Toshiba PCX1100 cable modem or any source of information regarding the details of its operation, motherboard layout, etc. Apparently, these modems only work on a 10baseT ethernet. I want to modify the modem so it will work on both 10baseT and 100baseT.

Modification is impractical. It would require completely replacing the Ethernet portion of the cable modem. No simple solution exists, such as substituting drop-in replacement 100BaseTX components.

100BaseTX will not provide any better/faster performance than 10BaseT which has sufficient bandwidth for handling the data coming into the cable modem.

If it's an issue of connecting your cable modem into a 100BaseTX network, buy one of the inexpensive Ethernet six-eight port dual 10BaseT/100BaseTX switches (approximately $125.00). Individual ports run at the speed of the connected device. The switch translates between ports running 10BaseT and 100BaseTX.

These are very useful tools since most cable modem, DSL boxes, ISDN boxes, and network attached printers (except for recent units) support only 10BaseT.

Greg Werstiuk
via Internet

ANSWER TO #9012 - SEPT. 2001

I have an Allen Electric & Equipment Co. (formerly of Kalamazoo, MI), model E313 growler (motor armature tester) that I would first like to rewire, and then learn how to use it!

I need a schematic and operating instructions.

These web sites should provide all the information you need:

www.geocities.com/flywheels2001/Growler.html
www.uiitraining.com/b51a/200/25136_37_41growlersandtester6.htm
http://an.hitchcock.org/repairfaq/REPAIR/F_appfaqi.html#APPFAQI_003

Russell Kincaid
via Internet

ANSWERS TO #8017 - AUG. 2001

A young man whose father used to work with me came to me with a problem.

He overloaded the stereo with speakers and as soon as the power button is pressed, it shows protect, and 24 hours later when powered up, it goes through a display. I have used the buttons to clear the memory several times with no results.

Sharp says take it to a repair shop. They quote $50-$250, but this kid doesn't have that kind of money.

I wish someone would tell me how to correct this problem.

#1 Having repaired a few stereos in my time, what it sounds like – if I read you correct – by adding too many speakers to the system you have changed the impedance of the output and this can act like a heavy load or virtual short. Permanent damage may have already been done.

Resetting codes and playing around with the processor won't help if the finals are damaged or compromised.

The areas I would concentrate on are the impedance matching final resistors which your system may or may not incorporate. If you have these resistors, they will usually be a large "sand-type" resistor about one or two inches long. See if they are smoked, cracked, or they have a burnt smell. Also check to see if they have become un-soldered due to overheating.

Next, I would move along to see if you have a "final" transistor set-up such as the TO-220 or the TO-5 style and, if incorporated, test them for getting hot, see if they have become un-soldered due to overheating, check for "no current flow" because they are fried, or the usual array of transistor checks that are used in any standard circuit.

If you have this design, they will be located fairly close to the back section of the circuit board close to where the speaker wires connect to the back plate or jumpers. Check to see if there are "final" fuses installed in the same area because many manufacturers incorporate these into their design as a fail-safe system in case of a dead short. Some manufacturers replace the fuse with a circuit breaker instead of a one-time fuse.

Next, you may have the "Solid-State Module" type of stereo and again check for input VS output voltages and current. The module may be the complete type which is usually around two square inches in size, and it is always attached to a heatsink of the same size.

It also might be broken down into two or more smaller chip type amps (usually four) and so treat them the same and check each amp separately.

A set of head phones can be modified to check for pre-amp and amp damage or operation. The module or chip can be completely fried so check for overheating, running stone cold, smell, and any physical damage such as a cracked plastic housing or burnt plastic.

Other than this, you need to have good knowledge and experience in troubleshooting and audio circuits because it could be anything.

Depending on age, any one of these systems may be incorporated in your stereo and you need to determine which, if any, is your type.

Chris
Bieber, CA

#2 The protect usually indicates that there is a fault on the output. These circuits are used to detect excessive DC from the power amplifier. There is probably a relay that connects the amplifier section to the output terminals. Find the input side and check for DC. If it is above a few millivolts, then the power amplifier is probably shorted.

This type of failure can put quite a load on the power supply and affect other stages, as well. It is likely that this unit uses a hybrid power module of some kind so, it should be relatively easy to repair.

Please use care when poking around as there is a lot of energy available. Also use an isolation transformer if you have one available.

Al Sekeet
Grand Rapids, MI

#3 It's likely that the power output IC(s) are blown due to the overload. This is causing the power supply to go into protect mode so as not to smoke the unit. If you remove the power ICs and the unit then powers up, replace them. If it still does not power up, then you have a power supply problem which should be easy to trace, or you should send the unit to a repair shop.

Russell Kincaid
Milford, NH

ANSWERS TO #9013 - SEPT. 2001

I have an old (1977) Heathkit Digital Floor Clock/Chime (GC-1195).

I would like to replace the small main clock board with an all new current clock IC chip board (keeping the current display board), but found they are all the multiplex type and while the display (now LED) could be cut up and re-wired to separate/isolate the common ground leads into four groups, there would be additional issues with the seven control segment leads that also multiple to the clock chime board control inputs and the 1/4 hour chiming outputs

Is there an easy/practical way to convert a new clock board's seven-segment LED output and multiplexing leads into 24 non-mux leads (i.e., 24 optical isolators with capacitors to block the on/off mux sequencing of the segments or op-amp comparators across the new display segment LEDs, etc.)?

#1 This is not as difficult as it sounds.The multiplex system is used in modern clock chips to reduce the number of wires (and output pins) needed to drive all those LED segments. Two groups of signals are sent out, the segment lines (there are seven) and the digit lines (there are four in a clock).

When both the digit line and the segment line are "active," the specific segment in that specific digit lights up.

To de-multiplex a standard clock chip into 24 distinct segment signals, you simply use 24 two-input AND gates. You combine the segment and digit signals together with the AND gate, and each gate's output goes to one of the 24 segments.

First, determine whether you need a high (+5V) or low (0V) signal to drive your PNP transistor. Then determine if the new clock chip's segment and digit outputs are active high, active low, or one of each. Use inverter gates and perhaps NAND (inverted AND) gates to get all the signals to where they are supposed to be, and you're all set.

For example, if you need a low signal to turn on the segment transistor, the digit signal is active low, and the segment signal is active high, you should use a NAND gate with an inverter in the segment signal line.

When both inputs are "active," the gate's output goes low and turns on the segment.

Don Rotolo
via Internet

#2 This web site claims to have five clock ICs at $5.00 each. Used in Heath GC-1195 clock. **www.d8apro.com/heath4.htm**.

Russell Kincaid
via Internet

OP-AMP COOKBOOK

by Ray Marston

Part 4 • Instrumentation and Test Gear Circuits

Ray Marston looks at practical op-amp instrumentation and test-gear circuits in the final episode of this four-part survey of op-amp principles and applications.

The opening episode of this four-part 'op-amp' series described the basic operating principles of conventional voltage-differencing op-amps (typified by the 741 type) and showed some basic circuit configurations in which they can be used.

This month's concluding episode looks at practical ways of using such op-amps in various instrumentation and test-gear applications, including those of precision rectifiers, AC/DC converters, electronic analog meter drivers, and variable voltage-reference and DC power supply circuits.

When reading this episode, note that most practical circuits are shown designed around a standard 741, 3140 ,or LF351-type op-amp and operated from dual 9V supplies, but that these circuits will usually work (without modification) with most voltage-differencing op-amps, and from any DC supply within that op-amp's operating range. Also note that all 741-based circuits have a very limited frequency response, which can be greatly improved by using an alternative 'wide-band' op-amp type.

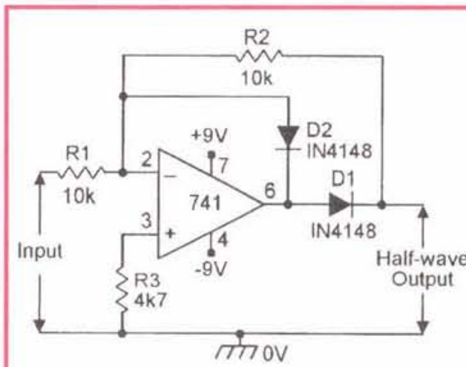


Figure 3. Precision half-wave rectifier.

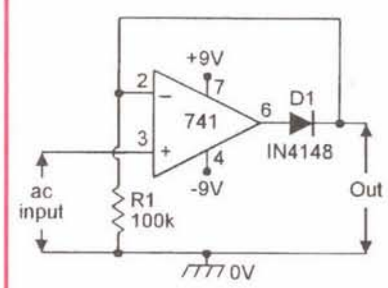


Figure 1. Simple half-wave rectifier circuit.

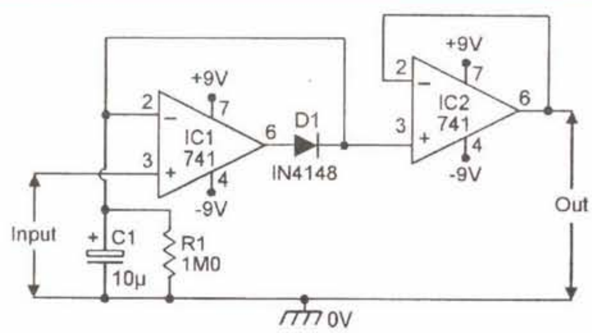


Figure 2. Peak detector with buffered output.

ELECTRONIC RECTIFIER CIRCUITS

Simple diodes are poor rectifiers of low-level AC signals, and do not start to conduct until the applied voltage exceeds a certain 'knee' value; silicon diodes have knee values of about 600mV, and thus give negligible rectification of signal voltages below this value. This weakness can be overcome by wiring the diode into the feedback loop of an op-amp, in such a way that the effective knee voltage is reduced by a factor equal to the op-amp's open-loop voltage gain; the combination then acts as a near-perfect rectifier that can respond to signal inputs as low as a fraction of a millivolt. *Figure 1* shows a simple half-wave rectifier of this type.

The *Figure 1* circuit is wired as a non-inverting amplifier with feedback applied via silicon diode D1, and with the circuit output taken from across load resistor R1. When positive input signals are applied to the circuit, the op-amp output also goes positive; an input of only a few microvolts is enough to drive the op-amp output to the 600mV 'knee' voltage of D1, at which point, D1 becomes forward biased. Negative feedback through D1 then forces the inverting input (and thus the circuit's output) to accurately follow all positive input signals greater than a few microvolts. The circuit thus acts as a voltage follower to positive input signals.

When the input signal is negative, the op-amp output swings negative and reverse biases D1. Under this condition, the reverse

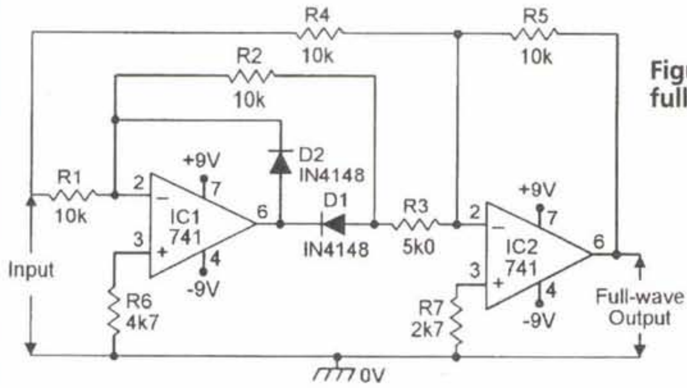
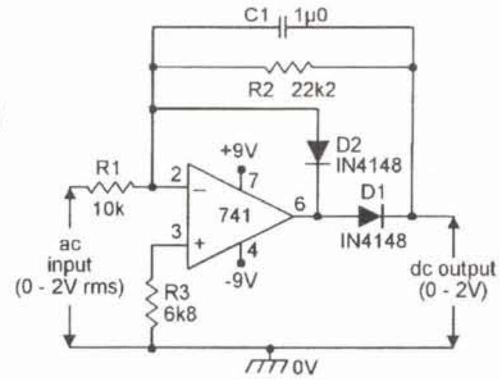


Figure 4. Precision full-wave rectifier.

Figure 5. Precision half-wave AC/DC converter.



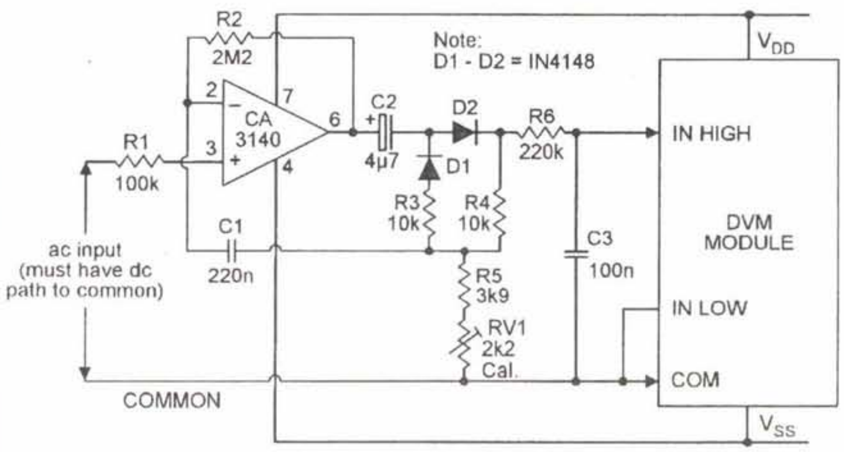


Figure 7. AC/DC converter for use with DVM module.

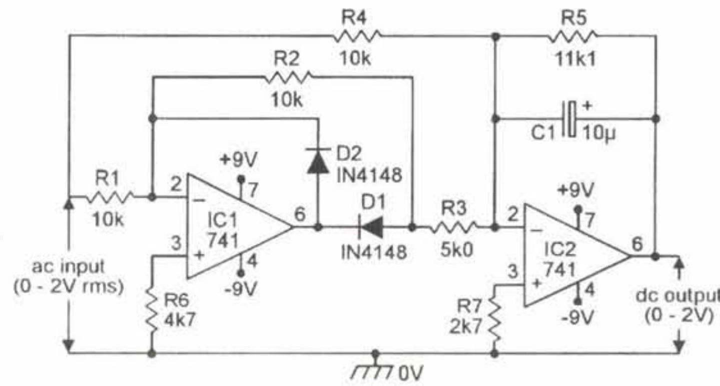


Figure 6. Precision full-wave AC/DC converter.

leakage resistance of D1 (typically hundreds of megohms) acts as a potential divider with R1 and determines the negative voltage gain of the circuit; typically, with the component values shown, the negative gain is roughly -60dB. The circuit thus 'follows' positive input signals but rejects negative ones, and hence acts like a near-perfect signal rectifier.

Figure 2 shows how the above circuit can be modified to act as a peak voltage detector by wiring C1 in parallel with R1. This capacitor charges rapidly, via D1, to the peak positive value of an input signal, but discharges slowly via R1 when the signal falls below the peak value. IC2 is used as a voltage-following buffer stage, to ensure that R1 is not shunted by external loading effects.

Note that the basic *Figure 1* and *2* circuits each have a very high input impedance. In most practical applications, the input signal should be AC-coupled and pin 3 of the op-amp should be tied to the common rail via a 100k resistor.

PRECISION RECTIFIER CIRCUITS

The *Figure 1* rectifier circuit has a rather limited frequency response, and may produce a slight negative output signal if D1 has poor reverse resistance characteristics. *Figure 3* shows an alternative type of half-wave rectifier circuit, which has a greatly improved rectifier performance at the expense of a greatly reduced input impedance.

In *Figure 3,* the op-amp is wired as an inverting amplifier with a 10k (= R1) input impedance. When the input signal is negative, the op-amp output swings positive, forward biasing D1 and developing an output across R2. Under this condition the voltage gain equals $(R2+R_D)/R1$, where R_D is the active resistance of this diode. Thus, when D1 is operating below its knee value its resistance is large and the circuit gives high gain, but when D1 is operating above the knee value its resistance is very low and the circuit gain equals R2/R1. The circuit thus acts as an inverting precision rectifier to negative input signals.

When the input signal goes positive, the op-amp output swings negative, but the negative swing is limited to -600mV via D2, and the output at the D1-R2 junction does not significantly shift from zero under this condition. This circuit thus produces a positive-going half-wave rectified output. The basic circuit can be made to give a negative-going half-wave rectified output by simply reversing the polarities of the two diodes.

Figure 4 shows how a negative-output version of the above circuit can be combined with an inverting 'adder' to make a precision full-wave rectifier. Here, IC2 inverts and gives x2 gain (via R3-R5) to the half-wave rectified signal of IC1, and inverts and gives unity gain (via R4-R5) to the original input signal (E_{in}). Thus, when negative input signals are applied, the output of IC1 is zero, so the output of IC2 equals $+E_{in}$. When positive input signals are applied, IC1 gives a negative output, so IC2 generates an output of $+2E_{in}$ via IC1 and $-E_{in}$ via the original input signal, thus giving an actual output of $+E_{in}$. The output of this circuit is thus positive, and always has a value equal to the absolute value of the input signal.

AC/DC CONVERTER CIRCUITS

The *Figure 3* and *4* circuits can be made to function as precision AC/DC converters by first providing them with voltage-gain values suitable for form-factor correction, and by then integrating their outputs to give the AC/DC conversion, as shown in *Figures 5* and *6*, respectively. Note that these circuits are intended for use with sinewave input signals only.

In the half-wave AC/DC converter in *Figure 5*, the circuit gives a voltage gain of x2.22 via R2/R1, to give form-factor correction, and integration is accomplished via C1-R2. Note that this circuit has a high output impedance, and the output must be buffered if it is to be fed to low-impedance loads.

In the full-wave AC/DC converter in *Figure 6*, the circuit has a voltage gain of x1.11 to give form-factor correction, and integration is accomplished via C1-R5. This circuit has a low-impedance output.

DVM CONVERTER CIRCUITS

Precision 3-1/2 digit Digital Voltmeter (DVM) modules are readily available at modest cost, and can easily be used as the basis of individually-built multi-range and multi-function meters. These modules are usually powered via a 9V battery, and have a basic full-scale measurement sensitivity of 200mV DC and a near-infinite input resistance. They can be made to act as multi-range DC voltmeters by simply feeding the test voltage to the module via a suitable 'multiplier' (resistive attenuator) network, or as multi-range DC current meters by feeding the test current to the module via a switched current shunt.

A DVM module can be used to measure AC voltages by connecting a suitable AC/DC converter to its input terminals, as shown in *Figure 7*. This particular converter has a near-infinite input impedance. The op-amp is used in the non-inverting mode, with DC feedback applied via R2 and AC feedback applied via C1-C2 and the diode-resistor network.

The converter gain is variable over a limited range (to give form-factor correction) via RV1, and the circuit's rectified output is integrated via R6-C3, to give DC conversion. The COMMON terminal of the DVM module is internally biased at about 2.8 volts below the V_{DD} (positive supply terminal) voltage, and the CA3140 op-amp uses the V_{DD}, COMMON, and V_{SS} terminals of the module as its supply rail points.

Figure 8 shows a simple frequency-compensated attenuator network used in conjunction with the above AC/DC converter to convert a standard DVM module into a five-range AC voltmeter, and *Figure 9* shows how a switched shunt network can be used to convert the module into a five-range AC current meter.

Figure 10 shows a circuit that can be used to convert a DVM module into a five-range ohmmeter. This circuit actually functions as a multi-range constant-current generator, in which the constant current feeds (from Q1 collector) into R_X, and the resulting R_X volt drop (which is directly proportional to the R_X value) is read by the DVM module.

Here, Q1 and the op-amp are wired as a compound voltage follower, in which Q1 emitter precisely follows the voltage set on RV1 slid-

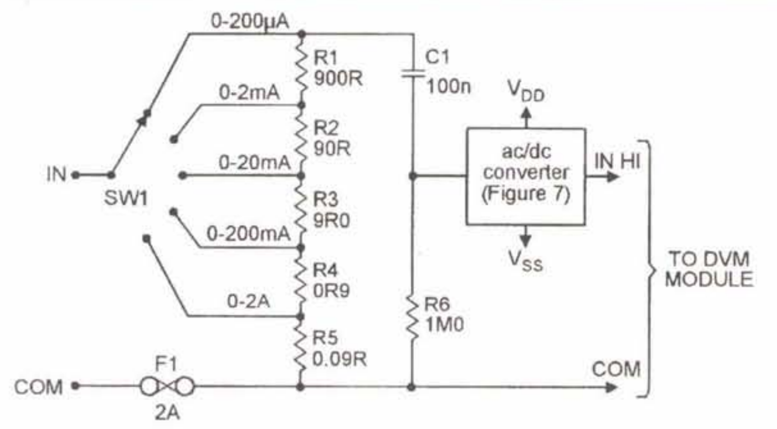


Figure 9. Five-range AC current-meter converter for use with DVM modules.

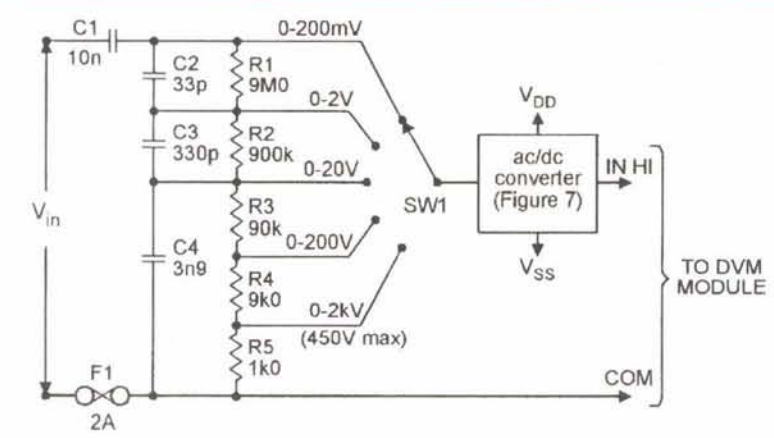
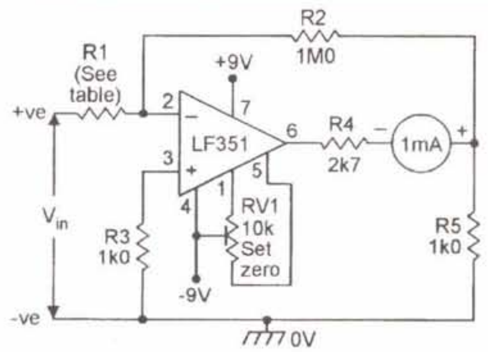
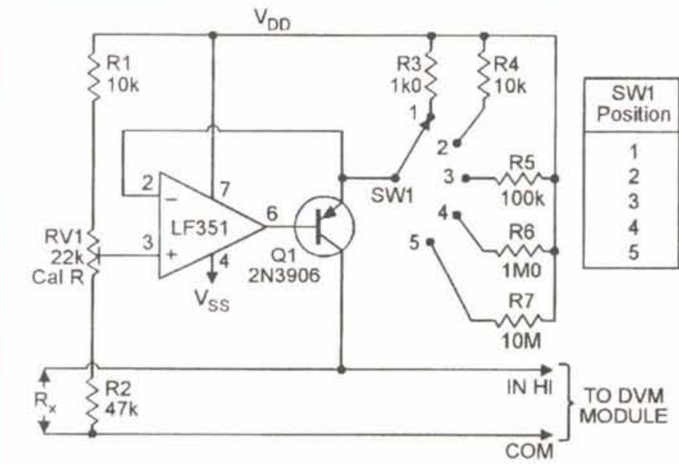


Figure 8. Five-range AC voltmeter converter for use with DVM modules.



V_{fsd}	R1
1V0	1M0
100mV	100k
10mV	10k
1mV	1k0

Figure 11. A DC millivoltmeter circuit.



SW1 Position	Range
1	0 - 200R
2	1 - 2k0
3	0 - 20k
4	0 - 200k
5	0 - 2M0

Figure 10. Five-range ohmmeter converter for use with DVM modules.

er. In practice, this voltage is set at exactly 1V0 below V_{DD}, and the emitter and collector (R_X) currents of Q1 thus equal 1V0 divided by the R3 to R7 range-resistor value, e.g., 1mA with R3 in circuit, etc. The actual DVM module reads full scale when the R_X voltage equals 200mV, and this reading is obtained when R_X has a value one-fifth of that of the range resistor, e.g., 200R on Range 1, or 2M0 on Range 5, etc.

ANALOG METER CIRCUITS

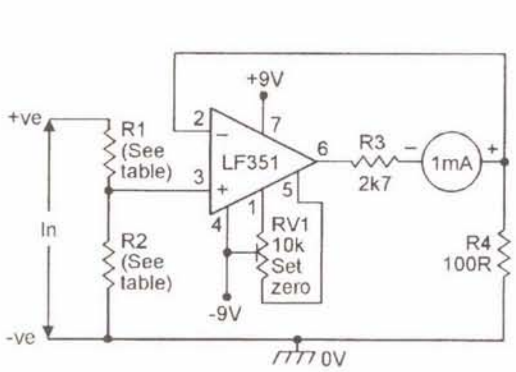
An op-amp can easily be used to convert a standard moving coil meter into a sensitive analog voltage, current, or resistance meter, as shown in the practical circuits of *Figures 11* to *16*. All six circuits operate from dual 9V supplies and are designed around the LF351 JFET op-amp, which has a very high input impedance and good drift characteristics. All circuits have an offset nulling facility, to enable the meter readings to be set to precisely zero with zero input, and are designed to operate with a moving coil meter with a basic sensitivity of 1mA fsd.

If desired, these circuits can be used in conjunction with the 1mA DC range of an existing multi-meter, in which case, these circuits function as 'range converters.' Note that each circuit has a 2k7 resistor wired in series with the output of its op-amp, to limit the available output current to a couple of milliamps and thus provide the meter with automatic overload protection.

Figure 11 shows a simple way of converting the 1mA meter into a fixed-range DC millivolt meter with a full-scale sensitivity of 1mV, 10mV, 100mV, or 1V0. The circuit has an input sensitivity of 1M0/volt, and the table shows the appropriate R1 value for different fsd sensitivities. To set the circuit up initially, short its input terminals together and adjust RV1 to give zero deflection on the meter. The circuit is then ready for use.

Figure 12 shows a circuit that can be used to convert a 1mA meter into either a fixed-range DC voltmeter with any full-scale sensitivity in the range 100mV to 1000V, or a fixed-range DC current meter with a full-scale sensitivity in the range 1μA to 1A. The table shows alternative R1 and R2 values for different ranges.

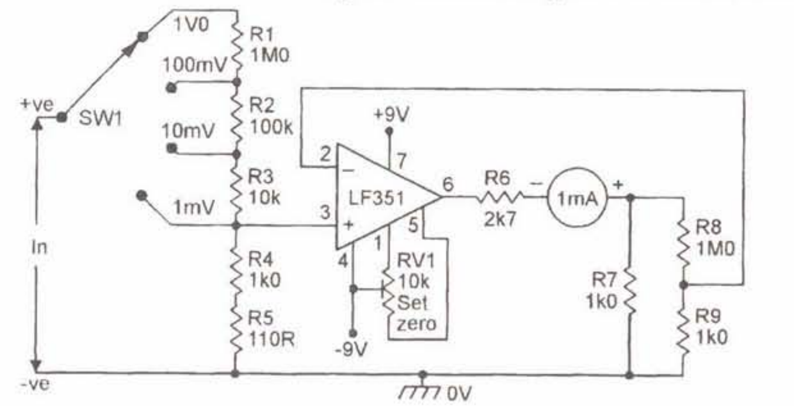
Figure 13 shows how the above circuit can be modified to make a four-range DC millivolt meter with fsd ranges of 1mV,



Voltmeter		
fsd	R1	R2
1000V	10M	1k0
100V	10M	10k
10V	10M	100k
1V	900k	100k
100mV	-	100k
Current meter		
1A	-	0R1
100mA	-	1R0
10mA	-	10R
1mA	-	100R
100µA	-	1k0
10µA	-	10k
1µA	-	100k

Figure 12. A DC voltage or current meter.

Figure 13. Four-range DC millivoltmeter.



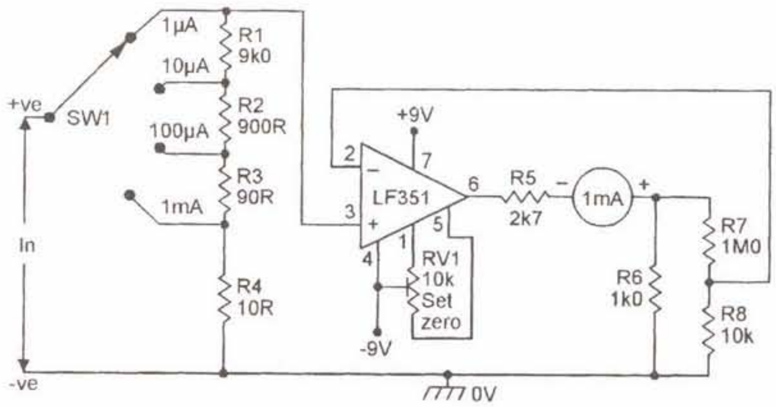


Figure 14. Four-range DC microammeter.

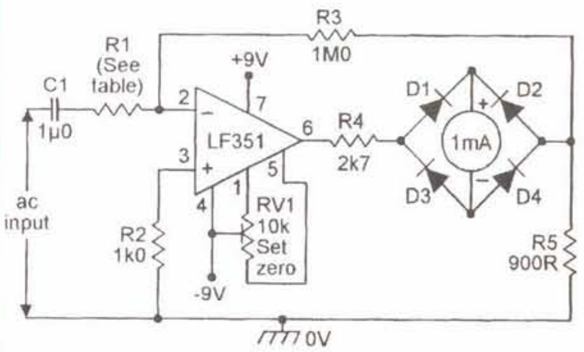
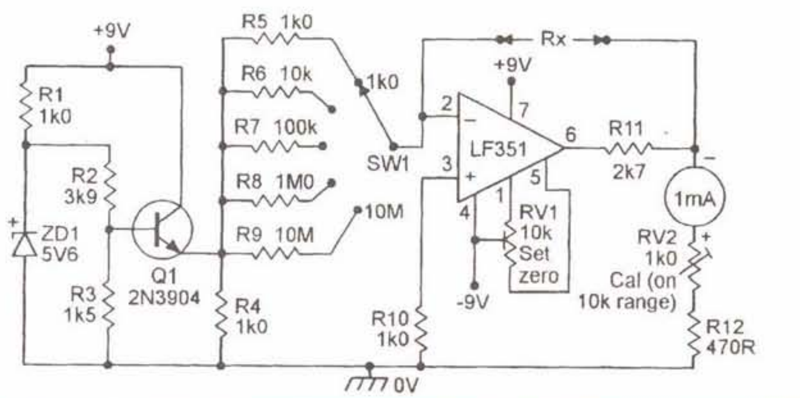


Figure 15. Four-range AC millivoltmeter.

V_{fsd}	R1
1V0	1M0
100mV	100k
10mV	10k
1mV	1k0

Note:- D1-D4 are germanium diodes.

Figure 16. Five-range linear-scale ohmmeter.



10mV, 100mV, and 1V0, and *Figure 14* shows how it can be modified to make a four-range DC microammeter with fsd ranges of 1µA, 10µA, 100µA, and 1mA. The range resistors used in these circuits should have precisions of 2% or better.

Figure 15 shows the circuit of a simple but very useful four-range AC millivoltmeter. The input impedance of the circuit is equal to R1, and varies from 1k0 in the 1mV fsd mode to 1M0 in the 1V fsd mode. The circuit gives a useful performance at frequencies up to about 100kHz when used in the 1mV to 100mV fsd modes. In the 1V fsd mode, the frequency response extends up to a few tens of kHz. This good frequency response is ensured by the LF351 op-amp, which has very good bandwidth characteristics.

Finally, *Figure 16* shows the circuit of a five-range linear-scale ohmmeter, which has full-scale sensitivities ranging from 1k0 to 10M. Range resistors R5 to R9 determine the measurement accuracy. Q1-ZD1 and the associated components simply apply a fixed 1V0 (nominal) to the 'common' side of the range-resistor network, and the gain of the op-amp circuit is determined by the ratios of the selected range-resistor and R_X and equals unity when these components have equal values. The meter reads full-scale under this condition, since it is calibrated to indicate full-scale when 1V0 (nominal) appears across the R_X terminals.

To initially set up the *Figure 16* circuit, set SW1 to the 10k position and short the R_X terminals together. Then adjust the RV1 'set zero' control to give zero deflection on the meter. Next, remove the short, connect an accurate 10k resistor in the R_X position, and adjust RV2 to give precisely full-scale deflection on the meter. The circuit is then ready for use, and should need no further adjustment for several months.

VOLTAGE REFERENCE CIRCUITS

An op-amp can be used as a fixed or variable voltage reference by wiring it as a voltage follower and applying a suitable reference to its input. An op-amp has a very high input impedance when used in the 'follower' mode and thus draws near-zero current from the input reference, but has a very low output impedance and can supply several milliamps of current to an external load. Variations in output loading cause little change in the output voltage value.

Figure 17 shows a practical positive voltage reference with an output fully variable from +0.2V to +12V via RV1. Zener diode ZD1 generates a stable 12V, which is applied to the non-inverting input of the op-amp via RV1. A CA3140 op-amp is used here because its input and output can track signals to within 200mV of the negative supply rail voltage. The complete circuit is powered from an unregulated single-ended 18V supply.

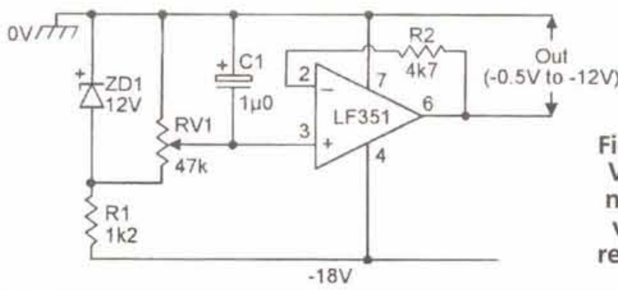


Figure 18. Variable negative voltage reference.

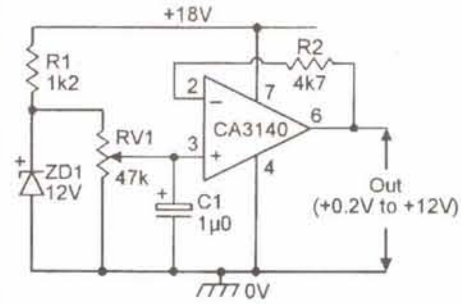


Figure 17. Variable positive voltage reference.

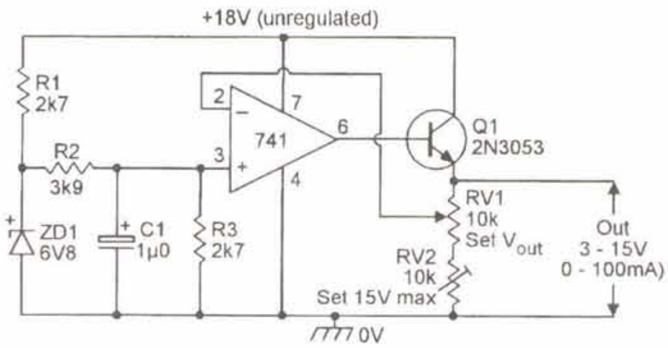


Figure 20. 3V to 15V, 0 to 100 mA stabilized PSU.

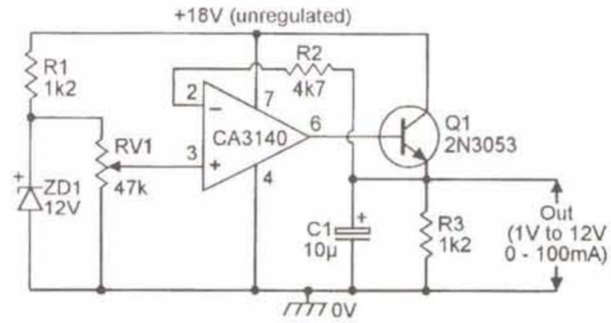


Figure 19. Simple variable-voltage regulated power supply.

Figure 18 shows a negative voltage reference that gives an output fully variable from -0.5V to -12V via RV1. An LF351 op-amp is used in this design, because its input and output can track signals to within about 0.5V of the positive supply rail value. Note that the op-amps used in these two regulator circuits are wide-band devices, and R2 is used to enhance their circuit stability.

VOLTAGE REGULATOR CIRCUITS

The basic circuits in *Figures 17* and *18* can be made to act as high-current regulated voltage (power) supply circuits by wiring current-boosting transistor networks into their outputs. *Figure 19* shows how the *Figure 17* circuit can be

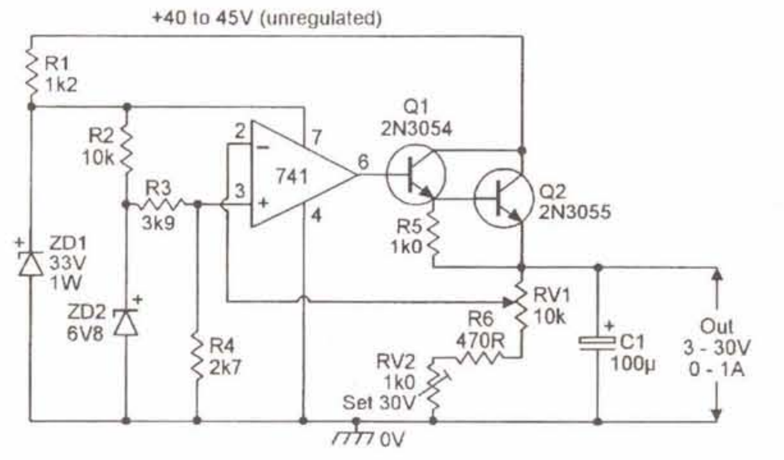


Figure 21. 3V to 30V, 0 to 1 amp stabilized PSU.

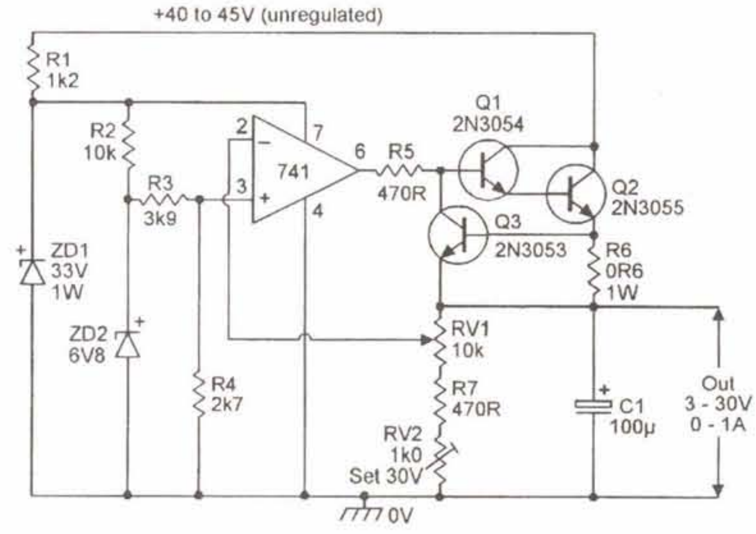


Figure 22. 3V to 30V stabilized PSU with overload protection.

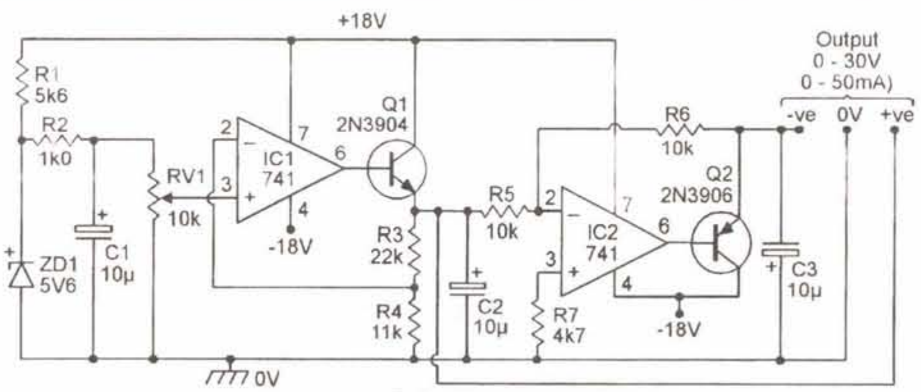


Figure 23. Simple center-tapped 0 to 30V PSU.

modified to act as a 1V to 12V variable power supply with an output current capability (limited by Q1's power rating) of about 100mA. Note that the base-emitter junction of Q1 is included in the circuit's negative feedback loop, to minimize offset effects. The circuit can be made to give an output that is variable all the way down to zero volts by connecting pin 4 of the op-amp to a supply that is at least 2V negative.

Figure 20 shows an alternative type of power supply circuit, in which the output is variable from 3V to 15V at currents up to 100mA.

In this case, a fixed 3V reference is applied to the non-inverting input terminal of the 741 op-amp via ZD1 and the R2-C1-R3 network, and the op-amp plus Q1 are wired as a non-inverting amplifier with gain variable via RV1.

When RV1 slider is set to the upper position, the circuit gives unity gain and gives an output of 3V; when RV1 slider is set to the lower position the circuit gives a gain of x5 and thus gives an output of 15V. The gain is fully variable between these two values. RV2 enables the maximum output voltage to be pre-set to precisely 15V.

Figure 21 shows how the above circuit can be modified to act as a 3V to 30V, 0 to 1A stabilized power supply unit (PSU). Here, the available output current is boosted by the Darlington-connected Q1-Q2 pair of transistors, the circuit gain is fully variable from unity to x10 via RV1, and the stability of the 3V reference input to the op-amp is enhanced by the ZD1 pre-regulator network.

Figure 22 shows how the above circuit can be further modified to incorporate automatic overload protection. Here, R6 senses the magnitude of the output current and when this exceeds 1A, the resulting volt drop starts to bias Q3 on, thereby shunting the base-drive current of Q1 and automatically limiting the circuits output current.

Finally, *Figure 23* shows the circuit of a simple center-tapped 0 to 30V PSU that can provide maximum output currents of about 50mA. The PSU has three output terminals, and can provide either 0 to +15V between the common and +ve terminals and 0 to -15V between the common and -ve terminals, or 0 to 30V between the -ve and +ve terminals. The circuit operates as follows: ZD1 and R2-RV1 provide a regulated 0 to 5V potential to the input of IC1. IC1 and Q1 are wired as a x3 non-inverting amplifier, and thus generate a fully variable 0 to 15V on the +ve terminal of the PSU.

This voltage is also applied to the input of the IC2-Q2 circuit, which is wired as a unity-gain inverting amplifier and thus generates an output voltage of identical magnitude, but opposite polarity on the -ve terminal of the PSU.

The output current capability of each terminal is limited to about 50mA by the power ratings of Q1 and Q2, but can easily be increased by replacing these components with Darlington (Super-Alpha) power transistors of appropriate polarity. **NV**

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219 California Dr.
Williamsville 14221
Tower Records/Video
105 Old Country Rd.
Carle Place 11514

350-370 Route 110
Huntington 11746

1961 Broadway
New York 10023

383 Lafayette St.
New York 10003

OHIO
Footsteps
4925 Jackman Rd. Store #58
Toledo 43613
Hosfelt Electronics, Inc.
2700 Sunset Blvd.
Steubenville 43952
Keyways, Inc.
204 S. 3rd St.
Miamisburg 45342

OKLAHOMA
Taylor News & Books
133 W. Main, Ste. 102
Oklahoma City 73102

OREGON
News & Smokes
1060 S.E. M St.
Grants Pass 97526
Norvac Electronics
7940 S.W. Nimbus Ave. Bldg. 8
Beaverton 97005

960 Conger
Eugene 97402

1545 N. Commercial N.E.
Salem 97303
Tower Books
1307 N.E. 102nd Ave.
Portland 97220

PENNSYLVANIA
Tower Books
425 South St.
Philadelphia 19147
Tower Records
340 W. Dekalb Pike
King of Prussia 19406
Tower Records
Land Title Bldg.
100 S. Broad St.
Philadelphia 19110

TENNESSEE
Tower Books
2404 W. End Ave.
Nashville 37203
Tower Records
504 Opry Mills Dr.
Nashville 37214

TEXAS
BDL News, Inc.
809 Pierce
Houston 77002
Electronic Parts Outlet
3753-B Fondren Rd.
Houston 77063
Mouser Electronics
958 N. Main St.
Mansfield 76063
Tanner Electronics
1301 W. Beltline #105
Carrollton 75006
Tower Records
2403 Guadalupe St.
Austin 78705

VIRGINIA
Tower Records/Video
6200 Little River Turnpike
Alexandria 22312

4110 W. Ox Rd. #12124
Fairfax 22033

1601 Willow Lawn Dr.
Richmond 23230

8389 E. Leesburg Pike
Vienna 22182

WASHINGTON
A-B-C Communications, Inc.
17541 15th Ave. N.E.
Seattle 98155
Supertronix
16550 W. Valley Hwy.
Seattle 98188
Tower Books
10635 N.E. 8th St.
Bellevue 98004

20 Mercer St.
Seattle 98109

WISCONSIN
Amateur Electronic Supply, Inc.
5710 W. Good Hope Rd.
Milwaukee 53223

WYOMING
Western Test Systems
2701 Westland Ct. #B
Cheyenne 82001

Laser Insight

by Stanley York

This month, we are going to take a closer look at fiberoptics, and see how they are made and used in a number of applications.

Making fibers

One of the most difficult parts of optical fiber manufacturing is finding the best materials to use for a given task. For instance, the fiber material must be very transparent at the wavelengths desired, so that maximum energy transfer is obtained. It must be able to be drawn into a thin filament, and it must be flexible.

Most glasses are silica-based, with additional materials to enhance some particular optical properties. These materials also raise the refractive index of the glass. During the fabrication process, some impurities remain in the glass, and these impurities raise the wavelength dependent attenuation factor of the finished fibers.

Figure 5-1 shows a schematic representation of how a glass preform as it is called, is drawn into a fiber. A polished glass core of high refractive index material is surrounded by a glass tube of lower index material (cladding). The lower index material is heated in a circular furnace and collapsed on to the core and the combination further heated to allow the two glasses to be drawn into a coaxial fiber. As the fiber is drawn away from the melt, it begins to solidify almost immediately, and the manufacturer must monitor the fiber carefully and continuously as it is being drawn.

Fibers made for delivering large amounts of laser power are made with thick cores of pure silica, and thin cladding layers. Large core silica fibers usually have higher attenuation losses than communication fibers, but typically, their attenuation is under 20dB/km.

Choice of material

One of the main uses for fiberoptics is in light transmission for illumination and imaging applications. Fiberoptics have been around for many years now and there have been many materials used for the fibers themselves.

Optical transmission relies on multiple reflections from the core/cladding interface to transfer the light energy down the length of the fiber. Choice of materials really depends on the application, wavelength, and power level of the light being transmitted.

For low power, non-imaging applications, there are many plastics in use for general illumination purposes. For spotlights working in tight areas, cheap plastic fiber bundles provide a simple, convenient way of bringing a lot of light to a small or confined area.

For general, short-range communications, these plastic fibers can be used successfully. Plastic fibers can only be used for low power transmission in the visible range because of absorption losses within the fiber. Attempting to transmit too much power would literally melt the fiber. For larger distances or high power transmission, only glass fibers can be used with any degree of reliability.

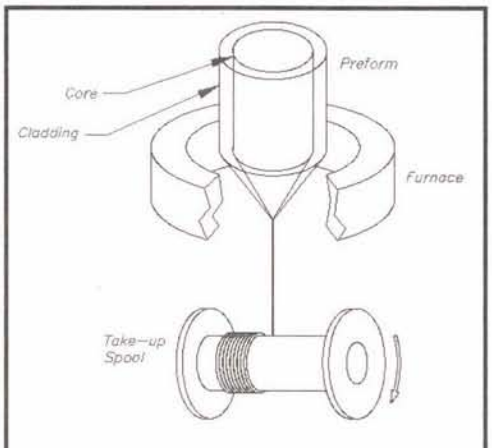


Figure 5-1 — Fiber manufacturing process.

For most applications, crown glass is used because of its low cost, and its ability to transmit a wide bandwidth. Borosilicate Crown Glass (BK7) can transmit between 400nM and 1900nM uniformly, with only minor variations in absorption throughout the wavelength range. Wavelengths outside this range are not usually sent down this type of fiber. If it is necessary to transmit UV light, then more expensive UV transmitting glasses must be used. Fused silica glass can transmit UV light from 200nM and extend well into the infrared.

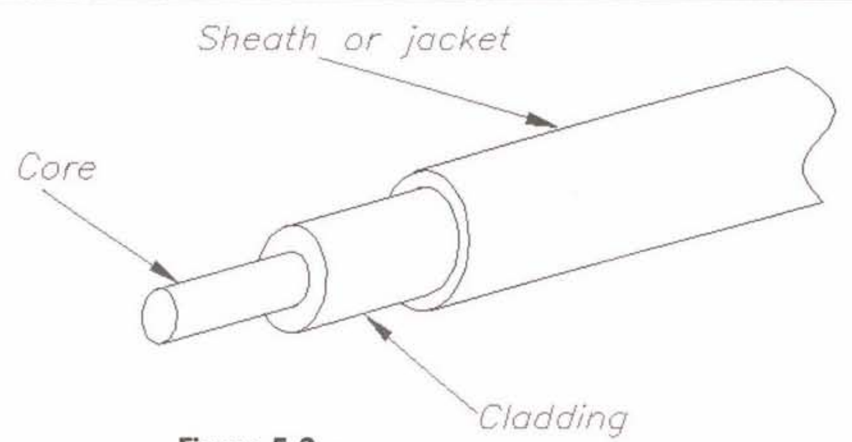


Figure 5-2 — Typical optical fiber construction.

With the exception of the bundled fibers mentioned above about optical fibers, most industrial and medical applications are usually made as a single strand of glass surrounded by a cladding and finally a reinforcing jacket as shown in Figure 5-2.

The choice of the core glass and the cladding material again depends on the application. Fibers buried underground (i.e., telecommunications fibers) would require a jacket material that would be impervious to moisture, and not likely to be damaged by insects or burrowing animals.

For industrial applications, fiberoptic cables are usually supplied with steel jackets around the fiber to strengthen the assembly, and to allow the user to mount the fiber robustly. The steel jacket also prevents damage from oil, water, and harsher chemicals, and protects the fiber bundle from abrasion and physical abuse. Figure 5-3 shows how a typical fiberoptic cable might terminate for an industrial application.

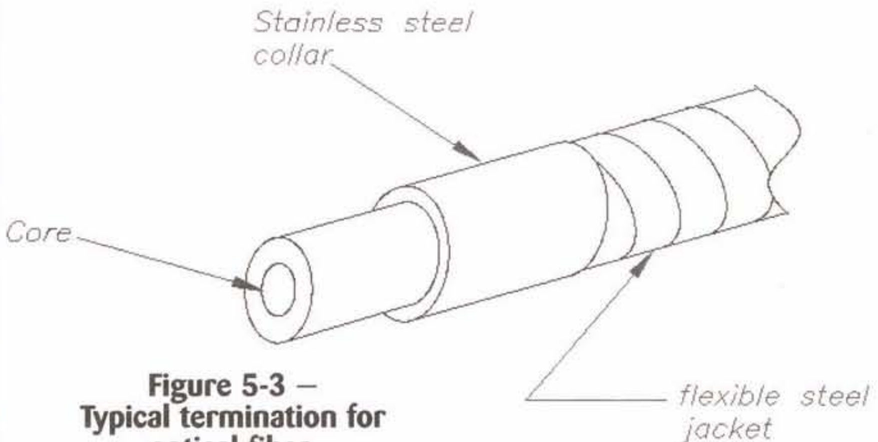


Figure 5-3 — Typical termination for optical fiber.

For working in high temperature environments, fiberoptics are usually made with a jacket of Teflon or some other fire resistant material. The choice of the outer jacket of the fiber is usually the dominating factor when considering bends in the fiber. Without a jacket, an unmounted fiberoptic may be bent in a radius as small as about 25 times the fiber diameter without damage or change in optical transmission properties.

Bending a fiber tighter than this may result in microscopic fractures in the fiber, allowing light losses to increase at the fracture site and ultimately leading to total failure of the fiber. With a jacket surrounding the fiber, the bend radius is usually governed by the jacket itself.

I have seen fibers as large as 0.5mm actually burning because of these microscopic fractures. This particular fiber was used in a medical device that was being tested at the time. Fortunately, I have never witnessed such a disaster during a medical procedure.

Edmund Scientific (Barrington, NJ) carries many types of fiberoptics and, if you want to experiment with them, a jacketed bundle of 64 fibers (each 1/4mm in diameter) is available off the shelf for less than $3.00 per foot (ES # L02-540). These fibers are made for the visible wavelengths. The attenuation factor is about 200-300dB/kilometer at 650nM, so they are not the best choice for long distance communications, but they are useful for short range work.

These fiber bundles can be made into a very pleasing static light display if part of the jacket is stripped and the exposed fibers are fanned out as indicated in Figure 5-6. A rotating colored plastic film is then placed between the tied end of a bundle and a white light source. In this display, a multi-colored disk of gel or plastic is made to rotate slowly between the light source and the tied end of the fiber bundle. The resulting display is very striking in a low light setting, and may comprise several hundred pinpoints of multi-colored light. A display such as this is easy to make and could be put together quickly and at a reasonably low cost.

In addition to the common optical fiber, there are light transmission devices that use the optical properties of liquids. These are called (appropriately enough) liquid light guides. In these guides, a flexible plastic tube is sealed at both ends with a high transmission window, and filled with a proprietary liquid medium. They are then usually covered with a spiral aluminum or steel wrap.

Liquid light guides offer several advantages over conventional fibers. For one, they are extremely flexible, and have better transmission properties in the UV range of the spectrum. The optical properties of the liquid determine the transmittable wavelengths, but liquid light guides generally have a higher throughput than glass fibers.

I have used these light guides myself to carry high energy pulses in a medical laser. During these experiments, peak laser power exceeded 50 megawatts! Unfortunately, the guide wall absorbed too much of the incident radiation and began to contaminate the liquid, bringing about an early demise. The one main disadvantage with these guides is they are not available in long lengths. About six feet seems to be the longest liquid guides commercially available.

Incidentally, did you know that the idea of light guides is really quite old? A search of the US patent records shows a patent application by William Wheeler (US Pat# 247,229 — 1881) for a method of illuminating "dwellings or other structures ..." using hollow reflective pipes connected to a single intense arc lamp housed in the basement.

It's not known at this time how far Mr. Wheeler got with his idea, but one can't help but wonder how individual room control was achieved, or how he extracted the heat given off by the lamp. Who knows, perhaps he was able to heat his house with it as well ... but, moving on.

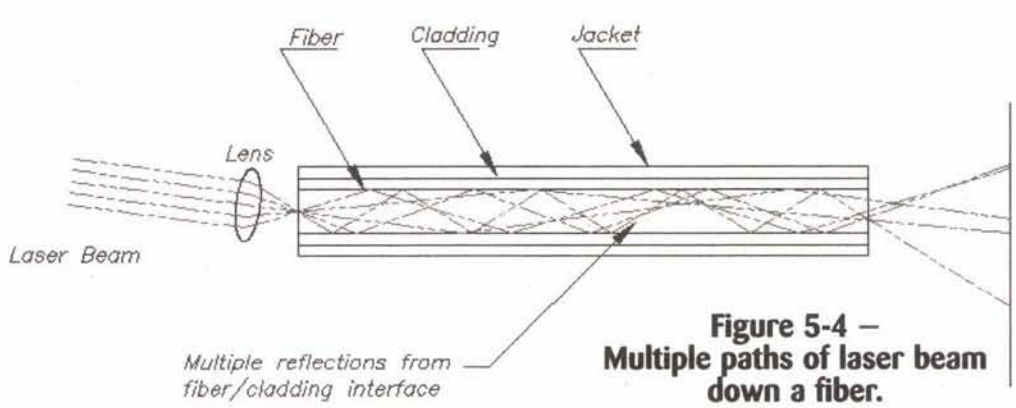


Figure 5-4 — Multiple paths of laser beam down a fiber.

Considerations when using fibers

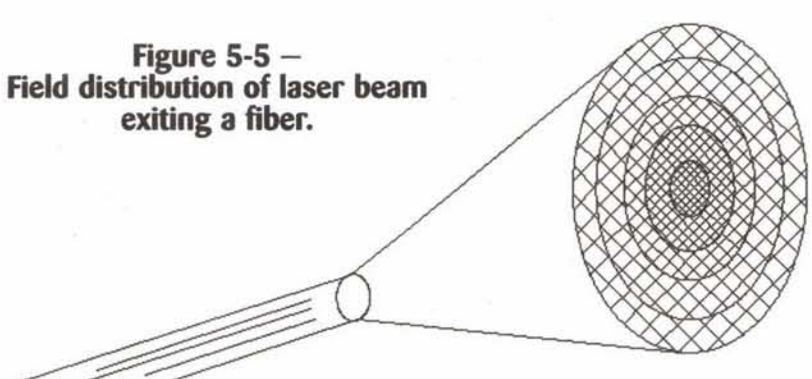
Remember a couple of issues back, we were talking about the mode structure of a laser beam, and how important the beam mode can be in some applications? Consider the drawing in Figure 5-4.

Here a laser beam is entering the fiber via a short focal length lens from the left of the page. We'll assume for now that the laser emits a pure, single mode (TEM00) beam. Let's also assume that the beam enters the end of the fiber at some slight angle to the entrance face of the fiber. Because of multiple reflections occurring at the core/cladding interface of the fiber, there is a homogenizing (or equalizing) effect in the laser beam before it emerges from the other end of the fiber. The beam leaving the fiber may appear to have a fairly symmetrical field intensity (Figure 5-5).

The field profile is not a Gaussian distribution though, and changing the angle of incidence on the input beam (or changing the distance from the lens to the fiber) changes the field distribution. The pattern is always circular simply because of the shape of the fiber, and the way the laser beam propagates down the length. The distribution of energy in the exiting beam usually takes on uniform intensity at equidistant points from the center of the field pattern, and is not a uniform field or Gaussian distribution anymore.

There are certain types of fiber (called single mode fibers) that do maintain a very close proximity to a single mode distribution in the exiting beam, and these are used in the most critical applications of fiberoptics. However, for most industrial applications, the exiting laser beam mode is not critical, and this homogenizing effect is of little consequence.

Figure 5-5 — Field distribution of laser beam exiting a fiber.



For practical reasons, the maximum laser beam diameter that can be transported down a fiber is about 90% of the fiber diameter. In other words, when the laser beam is focused on the end of the optical

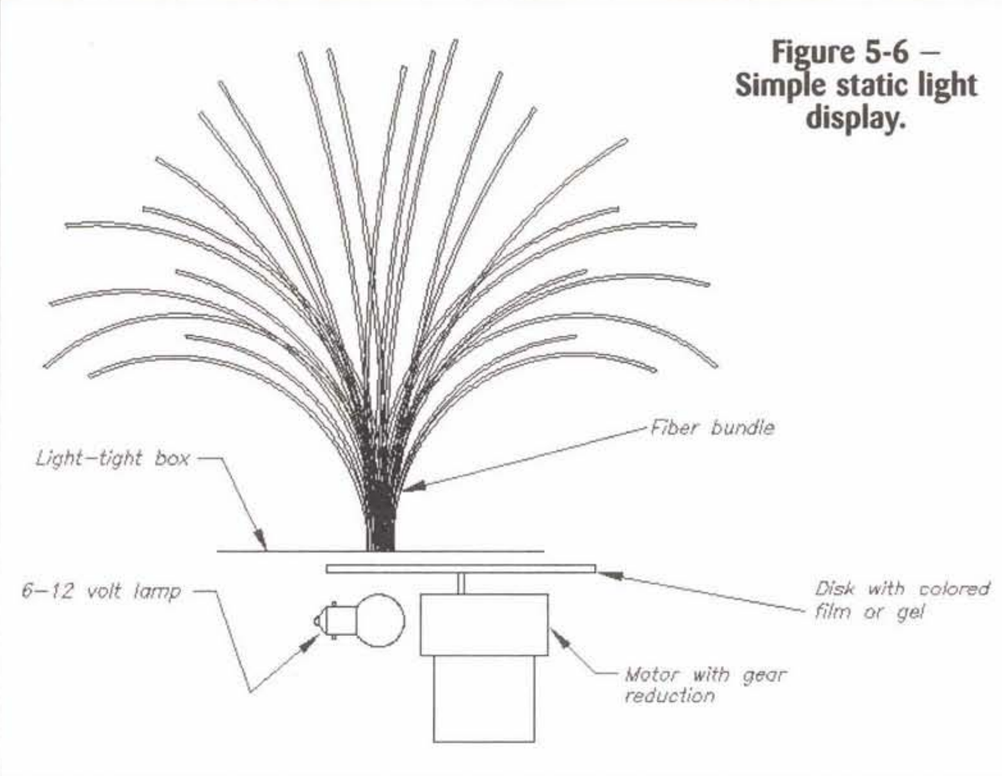


Figure 5-6 – Simple static light display.

fiber, it must fall in a window that is about 10% smaller than the fiber. This allows a little tolerance in the mechanical and optical components without compromising the fiber mount or the cladding surrounding the fiber.

A laser beam hitting the side of the mount or the cladding will do serious damage very quickly. When the beam exits the fiber of course, it fills the core entirely. Within certain limits, the exit angle of the laser beam leaving the end of the fiber is equal to the entrance angle. This is true as long as the entrance angle is not too steep, and the bend radius on the fiber is large compared to the fiber diameter (>300 times).

In the usual case, in order to process materials with a laser, a beam of high power density must impinge on the work piece surface. The beam exiting the end of the fiber diverges at a high rate, and in order to generate the high power density required for the proper surface interaction, an optical system is required to image or focus the end of the fiber on to the material. The focusing lens system must have a way of correcting the large divergence angle before allowing the beam to enter the final focusing lens, and a typical lens system is shown in Figure 5-7. Here the raw laser beam from the end of the fiber enters the first lens of the focusing system. The magnification of the lens system M is equal to dfocus/dfiber, where d = diameter.

Typical magnification ratios are between 0.5 and 2, depending on the application requirements. A fiber with a 0.5mm core for instance, will produce a focused spot size between 0.25 and 1mm. Besides determining the spot size, the magnification also determines the cone angle of the focused beam. A small focused spot gives a larger cone angle than a larger focused spot. It is also much closer to the focusing lens resulting in more working distance between the lens and the work piece. This makes it much easier to get parts in and out of the cutting path and clamping tools.

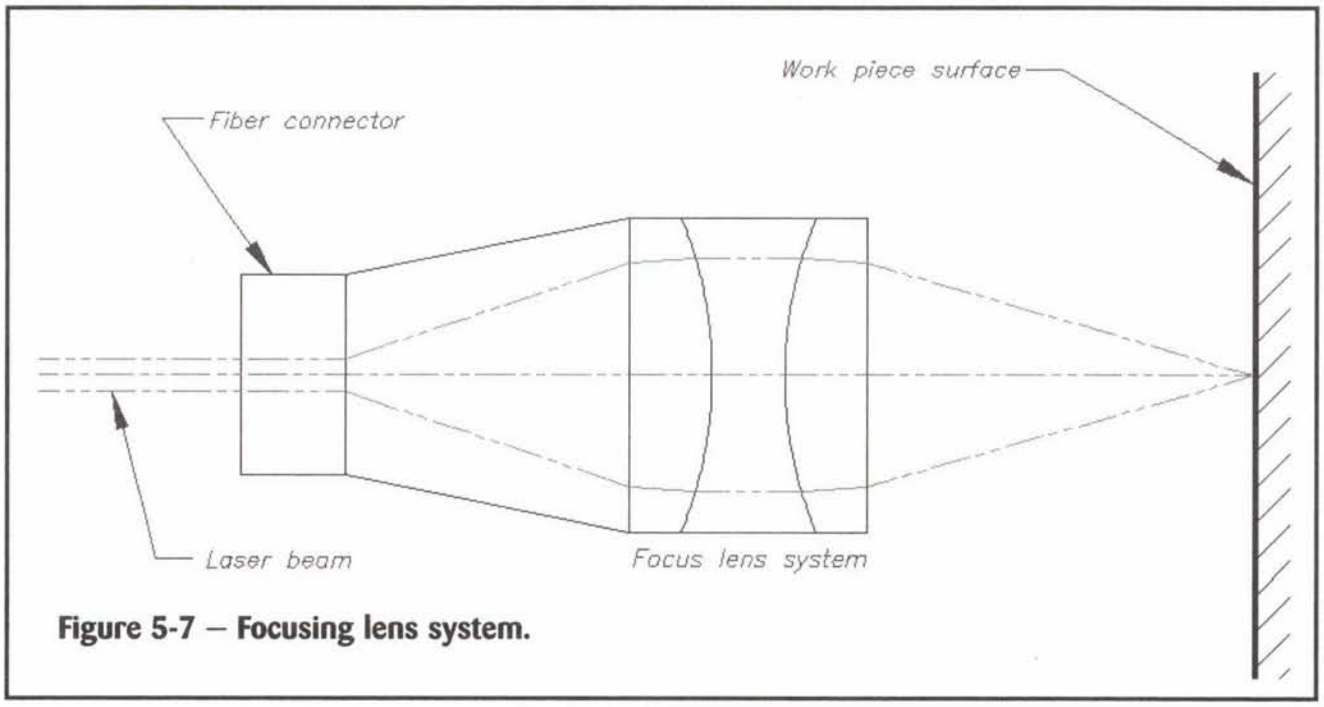


Figure 5-7 – Focusing lens system.

One thing to keep in mind though, is that the maximum depth of cut is limited by the laser beam's ability to melt material. As the cone angle gets larger, the spot diameter gets smaller, but the depth of focus of the beam also gets smaller. As a result, the power density of the beam on either side of the focal point quickly reduces to the point where it is too low for efficient melting of the material, and results in a poor quality cut or no cut at all.

The magnification, and therefore the resulting spot size really depends on the task the laser is used for. Cutting requires a small, tightly concentrated beam to raise the power density as much as possible at the focal point. This makes it easier for the assist gas to clear the molten metal (or other material) out of the cut path. Welding is usually done with a much larger spot size, except for cases such as microwelding, where very fine welds must be made.

Edmund Scientific also sells borescopes. In case you have never heard of them, a borescope is an optical device (that uses fiberoptics) that allows you to see in very small or confined areas. These are very interesting devices and worthy of a mention here.

In a borescope, many optical fibers are laid parallel and in a strictly defined sequence so that any spot of light on one end of the bundle produces a corresponding spot image on the other end of the bundle. The spot image is the same size and in the same place as it appears on the input side.

With enough fibers in the bundle and, if the fibers are small enough, then clearly-defined images can be transmitted down the bundle in a similar manner to the way a TV picture is built up.

These devices also have an illumination source built in so that even if the confined area is not well lit, a separate smaller bundle of fibers wrapped around the main bundle can carry light into the crevice you wish to peer into. Borescopes can be made rigid or flexible, depending on how the fiber bundle is manufactured.

Probably one of the biggest impact areas that fiberoptics have had over the last 10 to 15 years or so has been in the medical industry. I spent a couple of years with a company down in Florida that manufactures laser systems for use in internal surgery. The Nd:YAG laser (Yttrium-Aluminum-Garnet) put out about 100 watts or so, that was transmitted down a fiber and terminated in a sapphire cutting tip. In effect, it was a laser scalpel. The great advantage of laser surgery is the very small opening needed to insert the scalpel and, of course, this in itself helps with the healing and recovery time.

One of the people I worked with at this office had a simple procedure performed using a laser, and told me of a similar operation performed on his father some years earlier using conventional surgery. His father was in the hospital for several days, mostly for the healing and recovery process after surgery. My friend was in and out in a few hours on an outpatient basis.

An important consideration that applies not so much to optical fibers (except in a few rare instances) but more to the final focusing optics, is the avoidance of smoke or back spatter from the surface of the material getting on to the focusing lens.

Smoke particles will stick to the surface of the lens in a gradually increasing layer, and will begin to absorb laser power. The lens will heat up where deposits are heaviest and crack the lens due to uneven thermal expansion. Molten material is ejected at high speed back onto the focusing lens and will cause immediate surface melting on the lens at the site where the particles hit. The particles will thus be embedded in the surface where they will continue to absorb laser power, causing local cracking in the lens surface that will propagate from the hit area.

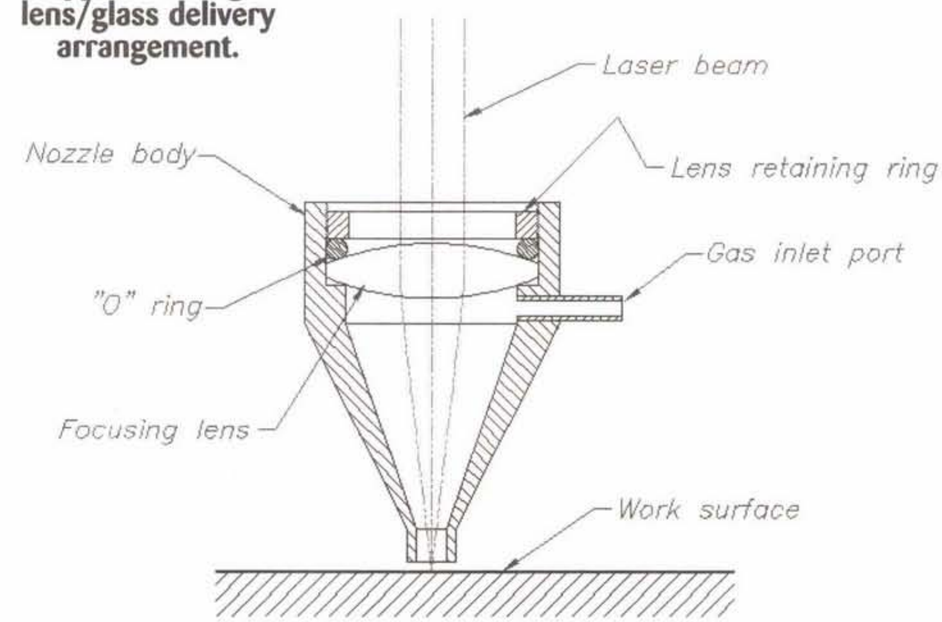
When cutting, it is usual to have an assist gas (compressed air, for instance) coaxially mounted with the lens (Figure 5-8). This then performs two important tasks: first, it produces a strong jet of air down into the cut area to clear out the molten material, and second, it creates a positive pressure under the focusing lens to prevent the ingress of smoke particles and spatter as mentioned above.

In a welding application, the gas chosen is usually an inert gas of fairly high purity. During the weld process, the metal undergoes tremendous heating. So much so that it melts and fuses together. When it leaves the weld pool, it quickly begins to solidify, even though it is still extremely hot.

The inert gas displaces oxygen in the weld pool area and prevents the molten metal from combining with the oxygen to form an oxidized film on the weld surface, or worse, a highly-oxidized weld. Oxidized welds are usually porous and weak, making them unacceptable in most applications.

Well, that's all I have space for this month. Next month, we'll be looking at a couple of industrial workhorses: the CO2 laser and the Nd:YAG laser. We'll look at how they work, and compare how they are used in industrial applications. **NV**

Figure 5-8 — Typical cutting lens/glass delivery arrangement.



This column welcomes your participation. If you have questions, comments, or perhaps an idea for a future project, please let me know. Any ideas or suggestions are welcome. You can write to me in care of *Nuts & Volts* or you can email me at stanley.york@att.net.

OOPS! In the Laser Insight column (Aug. '01 issue) on page 60, the first sentence in the first column should read "We shall see in a later column, how enormously high powers are generated using a laser."

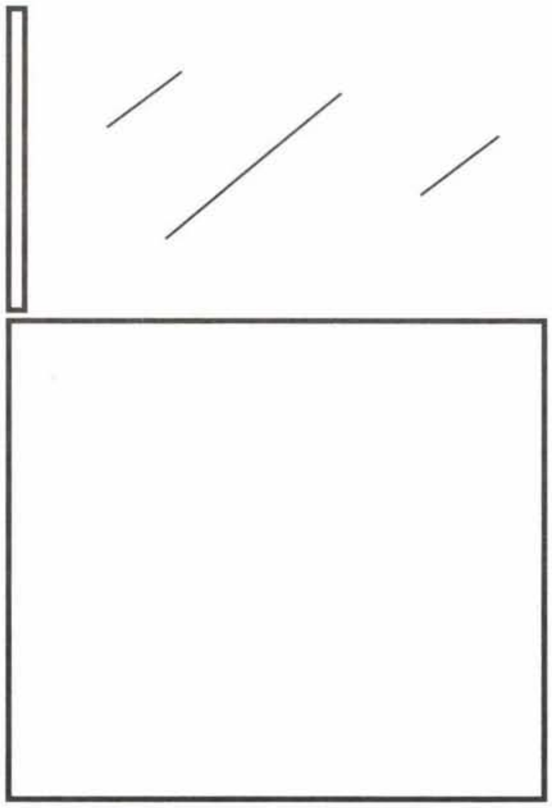
Here are some tables that should help everyone who had questions regarding the components used in last month's project.

In Figure 4-1

IC1	LM384
R1	22 ohm
VR1	10 kohm
C1	5uF
C2	0.1uF
C3	0.1uF
C4	500uF 25V
L1	Scanner coil 3-6 ohm (see text)

In Figure 4-2

T1	12VAC 2A
F1	1A slow blow
SW1	DPST 120VAC 5A
D1-4	Diode bridge 50V 5A
D5	Red LED
R1	1 kohm
C1	1000uF 25V
C2	0.1
PL1	Main power plug



BUILD A TALKING BOX

SIMPLE, LOW-COST RECORD/PLAYBACK DEVICE IS LOTS OF FUN FOR ALL

by Anthony J. Caristi

This project describes the use of a low-cost, versatile, recording/playback chip that is capable of storing up to 20 seconds of high-quality audio, using a non-volatile solid-state memory that retains messages without any power, whatsoever.

The total recording time may be broken up into as many separate and discrete messages as can be recorded without exceeding 20 seconds total time.

The messages are automatically played back one at a time, upon command, in the order of which they were recorded.

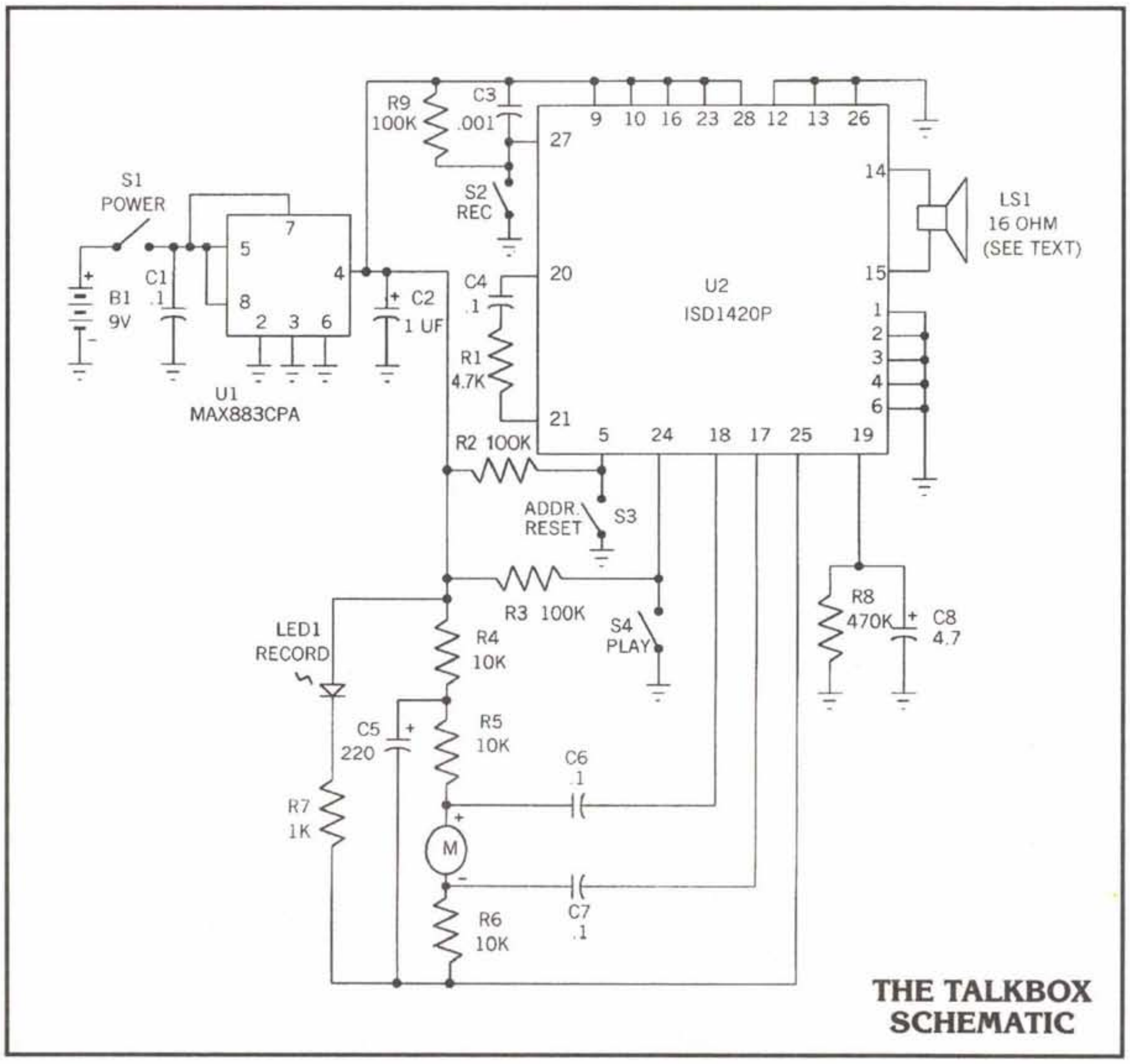
The record/playback chip, operating at five volts DC, is extremely frugal with power. At all times (except during playback), the total current draw of the chip is a scant 0.5 microamperes. This allows the unit to be continuously powered, if desired, ready to accept the playback command. Under such conditions, a fresh nine-volt alkaline battery could last a year or more.

The playback circuit contains a built-in audio amplifier which is capable of delivering a reasonable amount of power into a quality speaker. As with all portable audio equipment, the quality and intensity of the audio is a direct function of the speaker and enclosure.

You have probably seen (and heard) one or more toys or similar products that talk back to you in response to external stimuli. Using this circuit, you can build a similar device, and its use is limited only by your imagination. While this project is very educational, it also makes a unique gift for a child in your life.

ABOUT THE CIRCUIT

The heart of the Talkbox is an Information Storage Devices (ISD) integrated circuit — ISD1420P — which constitutes a solid-state high-quality single chip recording/playback system that uses a minimum of external components. The IC contains an on chip clock oscillator, microphone amplifier, automatic gain control circuit, and power amplifier. The total capacity of this system is 20 seconds of recording/playback time which can contain as many discrete messages as desired.



THE TALKBOX SCHEMATIC

Voice recordings are stored in non-volatile memory cells, which allows memory retention up to 100 years without input power. High-quality audio processing provides natural sounding voice reproduction. The memory cells can be rerecorded whenever desired, up to 100,000 times.

Refer to the schematic diagram. The circuit is powered by a common nine-volt transistor radio battery that drives a fixed five-volt linear regulator chip, U1. Under stand-by conditions, current draw of the regulator circuit is less than 15 microamperes. This permits battery life of about a year, depending upon how often the circuit is required to deliver audio power to the speaker. A power switch is included so that the battery may be disconnected entirely from the circuit, if desired. The recorded messages are always retained, even with no battery connected to the circuit.

The record/playback chip, U2, has three control inputs. Pin 27 is the record/playback control that is activated by S2. When this switch is pressed and held, the chip is placed in record mode and LED1 is illuminated. During this time, the chip will record any voice signals detected by the microphone. When S2 is released, the LED is extinguished and the message is stored at address #1 in the chip.

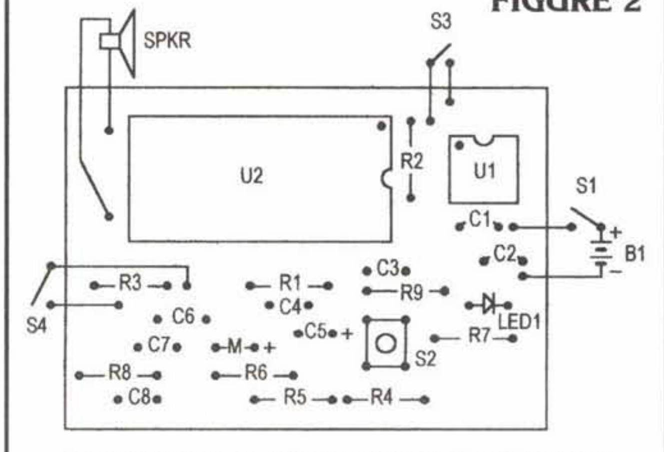
Additional messages may be recorded by pressing and holding S2 down for the duration of the message. Each individual message is placed in sequence in U2's memory. It is not necessary to use up the entire 20 seconds of available recording time.

Pin 24 of U2 — controlled by S3 — is the playback input. When S3 is momentarily pressed, the first message in the queue is played. Each subsequent activation of S3 will cause the next message to be played.

The address reset push button, S4, may be pressed at any time to reset the address counter so that the first message will play with the next activation of S3.

U2 contains an audio power amplifier that is capable of driving a 16-ohm speaker. This provides sufficient audio reproduction of the recorded messages.

FIGURE 2



Parts placement shown from component side of the board. Note polarization of microphone, LED1, and C5.

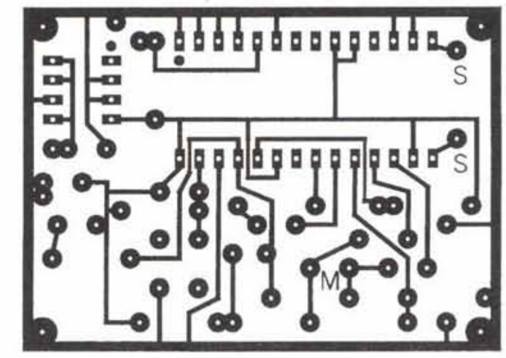


FIGURE 1

Printed layout shown full size as seen from the copper side of the board.

CONSTRUCTION

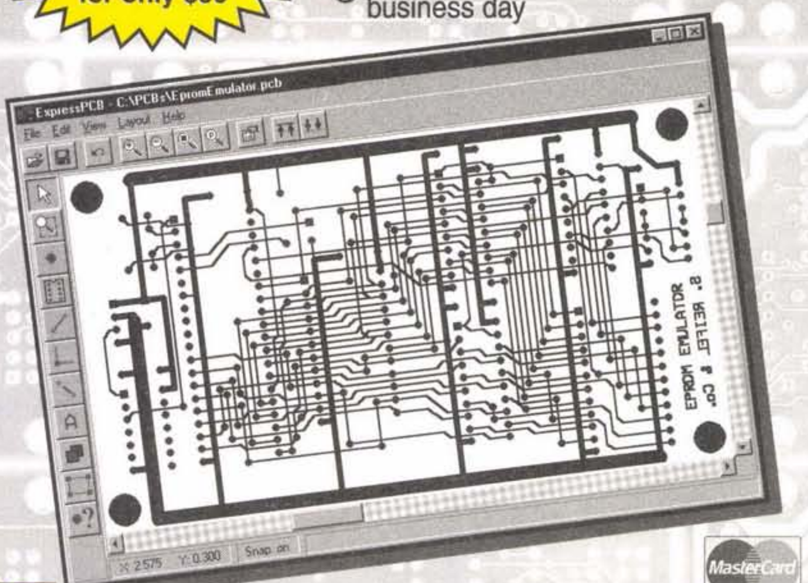
The Talkbox consists of a printed circuit assembly which can be conveniently mounted into a small enclosure that includes the operating switches, loudspeaker, and battery.

A full size layout of the printed circuit board is illustrated in Figure 1. The circuit is not critical and may be hard wired on a perfboard using good construction techniques. If you do not wish to etch and drill your own board, one may be obtained from the source specified in the Parts List.

Refer to Figure 2, which illustrates the parts placement as seen from the top or component side. When placing polarized components such as the microphone, solid-state devices, and electrolytic capacitors into the board, be sure they are properly oriented as shown. Just one part placed backwards into the board will render the circuit inoperative, and may cause damage to one or more components.

Sockets may be used for the integrated circuits, to allow ease of service should it ever be necessary. It is difficult to remove a multi-pin IC from a board for servicing once it has been soldered in place. Do not insert the ICs into the board until instructed to do so later during the checkout procedure.

The Record switch, S2, is a four-terminal SPST normally open momentary push-button



switch that is designed to be mounted directly into the printed circuit board. If desired, the builder has the option of using any type of momentary switch that can be remotely mounted from the board and connected to it with flexible wires.

Use a connector — available from electronics supply houses — for the nine-volt battery. If desired, one may be fabricated by taking apart an old battery and recovering the connector. Solder a red (+) and black (-) flexible wire to the terminals and be sure to observe correct polarity, noting that it will be opposite to that of a battery. When finished, snap on a fresh battery and use a DC voltmeter to verify that the polarity of the wires is correct. Do not connect the battery to the circuit at this time.

The loudspeaker used with this circuit must have an impedance of 16 ohms or greater. If an eight-ohm speaker is to be used, it is necessary that a 10-ohm, 1/4 watt carbon resistor be placed in series with one of the loudspeaker connections. Note that a 16-ohm loudspeaker will provide the best performance for this circuit.

MICROPHONE

This circuit makes use of a common electrolet microphone which is very low in cost and available at any electronics parts suppliers. This type of microphone is polarized. If it is not specifically marked for polarity, examine the terminals. One of these will be connected to the body of the microphone. This is the negative terminal. Refer to Figure 2 for the proper orientation of this part.

When the printed circuit board is completed, it is imperative that you examine it very carefully for proper parts placement, opens, short circuits, and bad solder connections which may appear as dull blobs of solder. Any solder joint which is suspect should be redone by removing the old solder with desoldering braid, cleaning the joint, and carefully applying new solder. It is far easier to correct problems at this stage rather than later on if you discover that your Talkbox does not work. Do not attempt the checkout procedure unless you are satisfied that the assembly and wiring are 100% correct.

SPEAKER

The recording chip is designed to operate into a 16-ohm speaker for best performance. If a 32-ohm speaker is chosen, power demand of the battery is reduced by half, with a resulting 3 dB loss in audio intensity. Eight-ohm speakers may also be used; however, it is necessary to connect a 10-ohm, 1/4 watt resistor in series with the speaker connection to achieve an 18-ohm load to the chip. This will also cause a 3 dB loss in audio level.

ENCLOSURE

The enclosure for the speaker will have a large effect on the quality of the audio. Before deciding upon a speaker and enclosure, it is recommended that a high-quality speaker with a reasonably sized enclosure be used to test the performance of the circuit. In this way,

SOURCES OF SUPPLY

Mouser Electronics
1-800-346-6873;
www.mouser.com

Digi-Key
1-800-344-4539;
www.digikey.com

Note: The following parts are available from A. Caristi, 69 White Pond Road, Waldwick, NJ 07463

Etched and drilled PC board @ $12.95
U1 @ $5.75
U2 @ $11.75

Please add $6.00 postage/handling

you will be able to hear the performance of which the recording/playback chip is capable.

Once an enclosure has been selected, determine the location of the desired speaker. A "grille" may be simulated by drilling a series of 1/8-inch holes in a square pattern that approximates the size of the selected speaker.

FINAL WIRING

Use a battery holder for the nine-volt battery, and mount the control switches at any convenient location. When wiring the switches, loudspeaker, and battery to the circuit board, use flexible #20, #22, or #24 wire to make the connections. Use several colors, if possible, to help avoid mistakes. Do not use solid wire — it will break.

When the Talkbox has been fully assembled, examine the wiring very carefully for proper connections. Do not attempt the checkout procedure unless you are satisfied that the assembly and wiring are 100% correct.

CHECKOUT

Checkout of the circuit will require the use of a DVM or VOM. Before inserting the ICs into the board or applying power, measure the resistance between the positive side of C2 to circuit common to be sure there is no short circuit. Normal indication is essentially open circuit. If you measure zero or low resistance, troubleshoot the circuit and correct the fault before proceeding. Check C2 and all other polarized components.

Insert U1 into the board and then snap a fresh nine-volt battery on to the connector being very careful to observe polarity. Turn power on and measure the voltage to circuit common at pin 4 of U1. Normal indication is +4.75 to +5.25 volts DC.

If you do not obtain the correct voltage, verify that the battery is delivering at least +7 volts under load to pins 5 and 8 of the regulator, U1. Check the orientation of C2 and U1. Correct the fault before proceeding.

Remove power and insert U2 into the board, observing proper orientation as indicated in Figure 2. Be sure all terminals are seated properly, with none inadvertently bent under the body of the chip.

Apply power. Press and hold S1. Note that LED 1 is illuminated, and speak into the microphone for a few seconds. Release S1. The LED should be extinguished.

Press S2 momentarily. The voice recording should be reproduced in the loudspeaker. The message will remain stored in U2 even though power is removed from the circuit. Press S3 momentarily, and then press S2 again. The message should be repeated.

If you do not obtain these results disconnect power and very carefully check the wiring and assembly of the unit using Figure 2 and the schematic diagram as a guide. Any assembly and wiring errors can usually be found by visual inspection such as this.

If necessary, refer to the following hints to troubleshoot the circuit:

If the LED does not illuminate when S1 is pressed, check its orientation. Check R7 and try a new LED. If U2 does not record or play back, check its orientation and all components associated with it. Check the loudspeaker wiring. Verify that the speaker resistance — measured across its terminals — is about 16 ohms.

Check the operation of S2, S3, and S4, verifying that the respective terminal of U2 is at +5 volts when the switch is off, and zero volts when the switch is on.

RECORDING SEQUENCE

To make a series of recorded messages, use the following procedure:

1. Upon power-up, the circuit is automatically set for recording address #1. Additionally, S4 may be operated at any time to reset the circuit to address #1.

2. Press and hold the record push button. The LED will illuminate. Speak clearly into the microphone, and when the message is completed, release the push button. This completes recording message #1 which is stored at address #1.

3. To record message #2, press and hold the record push button while speaking into the microphone. When the record push button is released, message #2 will be stored at address #2.

4. Repeat as desired to record as many messages as necessary. The only limitation is the maximum recording time for all messages may not exceed 20 seconds.

5. If it is desired to change any of the messages without disturbing those that are to be retained, simply use the play push button as many times as required to play the desired messages. Do not play the message that is to be deleted. Then use the record push button to make a new recording at the address of the message that is to be replaced.

6. If it is desired to make a whole new series of messages, simply follow the procedure above, starting with step #1.

PLAYBACK

Playback is accomplished by momentarily pressing S4 to set the address to location #1. Note: Upon powerup, the playback address is automatically set to address #1.

When S3 is momentarily actuated, message #1 will be heard. Each repeated actuation of S3 will cause the next message in the queue to be heard. When the last message is played, press S4 to reset the address back to address #1.

S4 may be actuated at any time to reset the address back to address #1 so that message #1 will be ready to play again upon actuation of S3.

Should the audio quality diminish noticeably, replace the battery with a fresh alkaline type. **NV**

PARTS LIST

B1 — 9-volt alkaline battery
C1, C4, C6, C7 — 0.1 uFd 50-volt ceramic disc capacitor
C2 — 1 uFd 50-volt radial electrolytic capacitor
C3 — 1,000 pF 50-volt ceramic disc capacitor
C5 — 220 uFd 10-volt radial electrolytic capacitor
C8 — 4.7 uFd 10-volt radial electrolytic capacitor
LED1 — Red light emitting diode, general purpose
Microphone — Electrolet, Mouser 252LM049 or similar
R1 — 1K 1/4 watt carbon resistor
R2, R3, R9 — 100K 1/4 watt carbon resistor
R4, R5, R6 — 10K 1/4 watt carbon resistor
R7 — 1K 1/4 watt carbon resistor
R8 — 470K 1/4 watt carbon resistor
S1 — SPST toggle or slide switch, general purpose
S2 — SPST push-button switch, Mouser 612-TL1105A or similar
S3, S4 — SPST push-button switch, general purpose
Speaker — 16-ohm coil (see text)
U1 — 5-volt linear regulator, MAX883CPA
U2 — Record/playback IC, ISD1420P

Misc: — Enclosure, hook-up wire

News Bytes

Continued from Page 13

machine. While you are away from your desk, it will keep the detailed call log and can send email or SMS notification any time someone leaves you a message.

Anyone who has a computer and a modem will benefit from the new Call Corder. While voice modem or TAPI compatible device is necessary for voice recording, many other functions, such as Caller ID, advanced call logging, and email notification will work on practically any modem. Competitively priced (US $29.00), Call Corder is a must-have tool for any home or office.

Call Corder is available for Windows 95, 98, ME, NT4, and Windows 2000 platforms, and is compatible with MS newest operating system, Windows XP.

The fully functional 30-day trial version of Call Corder is available from http://www.callcorder.com/. It can be purchased securely on-line from the same URL.

Contact Misha D'yachkov, Pingram Marketing, 302-4464 West 10th Ave., Vancouver B.C., V6R 2H9 Canada. Office: (604) 222-7429, Fax: (604) 692-5673, or info@voicecallcentral.com.

MANNETRON ROBOTS GET SMARTER WITH SMARTMOTOR™

Mannetron, one of the leading entertainment robot manufacturers has created a new generation of "anthrobots" (anthropomorphic robots) by incorporating Animatics' SmartMotor™.

Mannetron is installing 10 of the SmartMotors into International Robotics' latest version of the SICO eight roll-around entertainment robot. The SmartMotor was chosen because of it's stand-alone, brushless feature.

According to Mannetron's chief engineer, Peter Jungen, the SmartMotor handled the need to design around where to put the servo amp, DSP card and positioning sensor wiring. "All of these are packaged inside the SmartMotor servo which solved our problem of limited space within the robot cavity," said Jungen.

Mannetron also developed a real-time Windows driver and wireless transmitter. This software enables the robot to be controlled remotely by a keypad in the operator's pocket, which is used to transmit a single command or a macro to the SmartMotors. Jungen said, "Because of the amount of processing power in the SmartMotor's built-in DSP which handles all the low-level, real-time calculations, we are able to use the power of the central processor entirely for the coordination of fluid and complex gestures."

Mannetron plans to use the SmartMotor in their next generation of the Maximillion anthropomorphic robot, which has 45 motions. With their development of the real-time software, wireless transmitter and the SmartMotor, they feel they have one of the most advanced entertainment robots to date.

For more information on Mannetron, visit their website at Mannetron.com and SmartMotor.com.

Animatics Corporation, 3050 Tasman Drive, Santa Clara, CA 95054. **NV**

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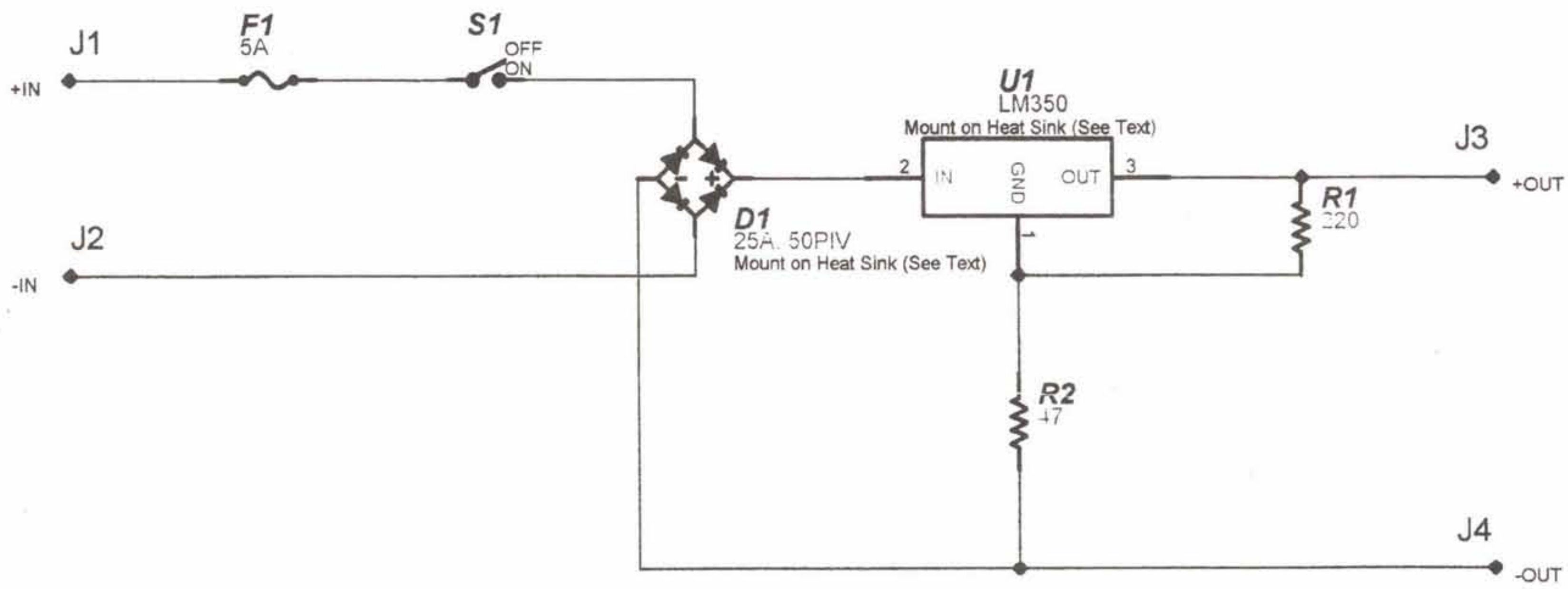
MODEL ENGINE IGNITOR

by Dennis Eichenberg



For many, many years the No. 6 ignition dry cell was the standard power source for starting model airplane engines, model car engines, model boat engines, and the like. Unfortunately, the No. 6 ignition dry cell is no longer available. There are other dry cells that can be used for this application, but they do not possess the capacity of the No. 6 cell, and do not last as long. An alternative was desired. The circuit shown was devised to fill this need, and has worked splendidly.

A typical model engine 1.5-volt ignitor — or glow plug — draws about 1.5 amps steady state, although the inrush current is much higher. A six-volt or 12-volt lead-acid automotive battery is ideal for engine starting in that they have a great capacity, can be recharged many times, and are very forgiving.

Deep discharge marine batteries have even greater capacity. Motorcycle and lawn batteries are excellent candidates, as well. The circuit shown here reduces the higher voltage to the 1.5 volts required for the glow plug.

Voltage regulator U1 is the primary component of the circuit. U1 is an LM350T three terminal, adjustable, positive regulator and has many qualities that make it ideal for the application. It requires a minimum of components to adjust the output to 1.5 volts as desired. It operates with as little as 4.5 volts at the input, and up to 36.5 volts. It is capable of supplying in excess of three amps.

It offers full overload protection, including current limit, thermal overload protection, and safe operating area protection. The output is short-circuit protected.

In this circuit, U1 is adjusted to 1.5 volts through resistors R1 and R2, where $V_{out} = 1.25V(1+R2/R1)$.

The LM350T has a TO-220 package in which the case is the output. U1 should be mounted to a heatsink with a mica insulator and the correct mounting hardware, as well as thermal grease, to assure proper heat transfer from U1 to the heatsink.

Bridge rectifier D1 was provided for reverse-polarity protection, as well as for reducing the voltage that is applied to U1, which reduces heating of U1. D1 is isolated from its case, so insulation is not required. It is recommended that D1 be mounted to a piece of metal, such as the enclosure with thermal grease for good heat transfer.

Fuse F1 is provided primarily for protection of the battery, as well as the wires, which run to the unit. Eighteen gauge conductors should be used throughout the circuit, except for R1 and R2, as the currents are relatively high, and voltage drop should be minimized to provide the greatest power to the glow plug. Switch S1 is provided to save battery power when the circuit is not being used, although the quiescent current of the circuit is only five milliamps.

The circuit can be built in a small enclosure rugged enough for this application. Jacks J1 through J4 are multiple binding posts to accept banana plugs, spades, phone tips, or bared wires. The circuit has been designed so that input polarity, as well as output polarity, is not critical.

Engine starting will be much easier on the nerves with the use of this circuit. It will provide adequate ignition energy for the time required getting the engine started. Then the battery can simply be recharged for the next outing. Gentlemen (and everyone else) — start your engines! **NV**

Model Engine Ignitor Parts List

No.	Description
U1	Voltage Regulator, 3 amp, 3 terminal, adjustable, TO-220, National Semiconductor No. LM350T, RadioShack No. RSU 11481397, Heatsink, RadioShack No. 276-1368, TO-220 Mounting Hardware RadioShack No. 276-1373, Heatsink grease, RadioShack No. 276-1372.
D1	Rectifier, Bridge, 25A, 50 PIV, RadioShack No. 276-1185.
R1	Resistor, 220 ohms, 1/2 watt, RadioShack No. 271-1111.
R2	Resistor, 47 ohms, 1/2 watt RadioShack No. 271-1105.
F1	Fuse, 5A, RadioShack No. 270-1011. Fuse Holder, RadioShack No. 270-739.
S1	Switch, SPST, 6 amp, RadioShack No. 275-651.
J1-4	Jack, multipurpose, RadioShack No. 274-661 (set of four, two red, two black)

by Robert Nansel

Amateur Robotics

Last month, I began presenting the design for the heart of the Heavy Iron project: the Power Driver Module (PDM) which contains the power supply and the three-axis chopper drive. I gave a preview drawing, schematic, and parts list so the impatient among you could order parts ahead, and I talked about the design considerations. It is a preliminary design, so I still want to test it a bit more before giving final details on wiring and checkout.

I am satisfied with the mechanical details of machining the PDM chassis, so this month, I'll give details on how to get professional results using only a few hand tools and a power drill. It takes about 15 or 16 hours of careful work, say a month's worth of weekend evenings.

With two very active toddlers to keep track of here at the Robot Ranch, 16 hours is about all the time I have a month to work on robotics. Many of you are in similar situations, so getting the project plans in monthly increments is not a hardship. Beginners with more time on their hands than us sleep-deprived parents will just have to be patient a while longer until all the plans are in place.

More advanced builders may choose to work ahead using the schematics and plans from this and previous columns. You could wire up the power supply portion of the PDM and maybe also get a head start on building the Camtronics chopper board. The Camtronics instructions are a bit challenging in places, though, so beginners should wait until I cover building the chopper in depth. You will at least need the bare chopper board and its DB-25 connector to make some of the measurements required for machining the chassis.

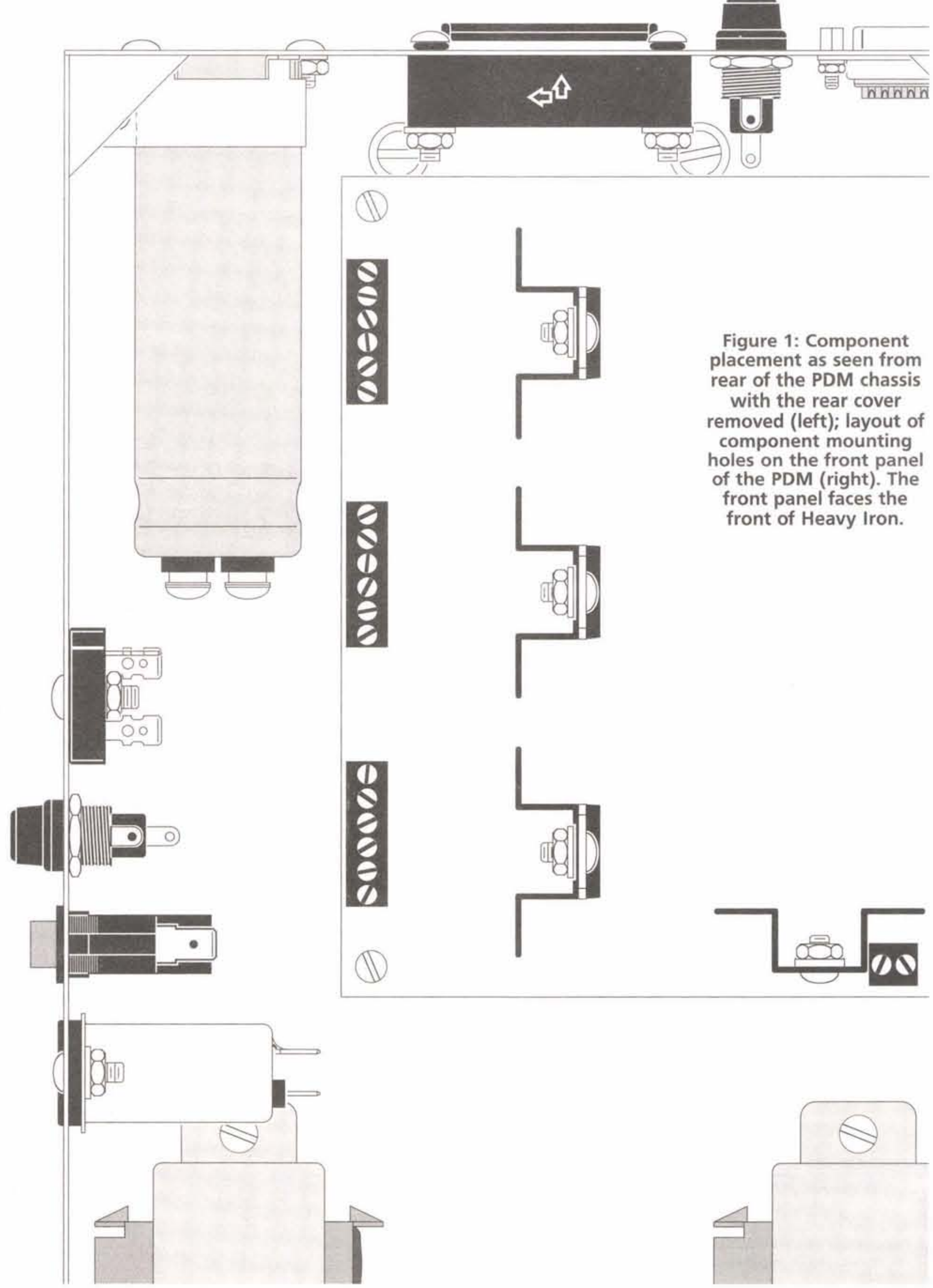


Figure 1: Component placement as seen from rear of the PDM chassis with the rear cover removed (left); layout of component mounting holes on the front panel of the PDM (right). The front panel faces the front of Heavy Iron.

The Fancy Tools

My 8" bench drill press is too small to drill all of the holes required for this project — in particular, the holes for the top and bottom panels. The Mouser #537-8123 chassis is several inches too tall for my drill press, but I could have drilled the rest of the holes for the front and side panels with it. I decided instead to drill everything with a 3/8" power hand drill. Not everyone will have a drill press, and I want to demonstrate the precision you can achieve with simple hand tools.

If you do have a larger drill press, by all means, use it; you can make a quicker, neater job of some tasks. Likewise, chassis punches will also simplify the job. Mouser Electronics sells a variety of chassis punches that produce perfect round, square, or even D-sub con-

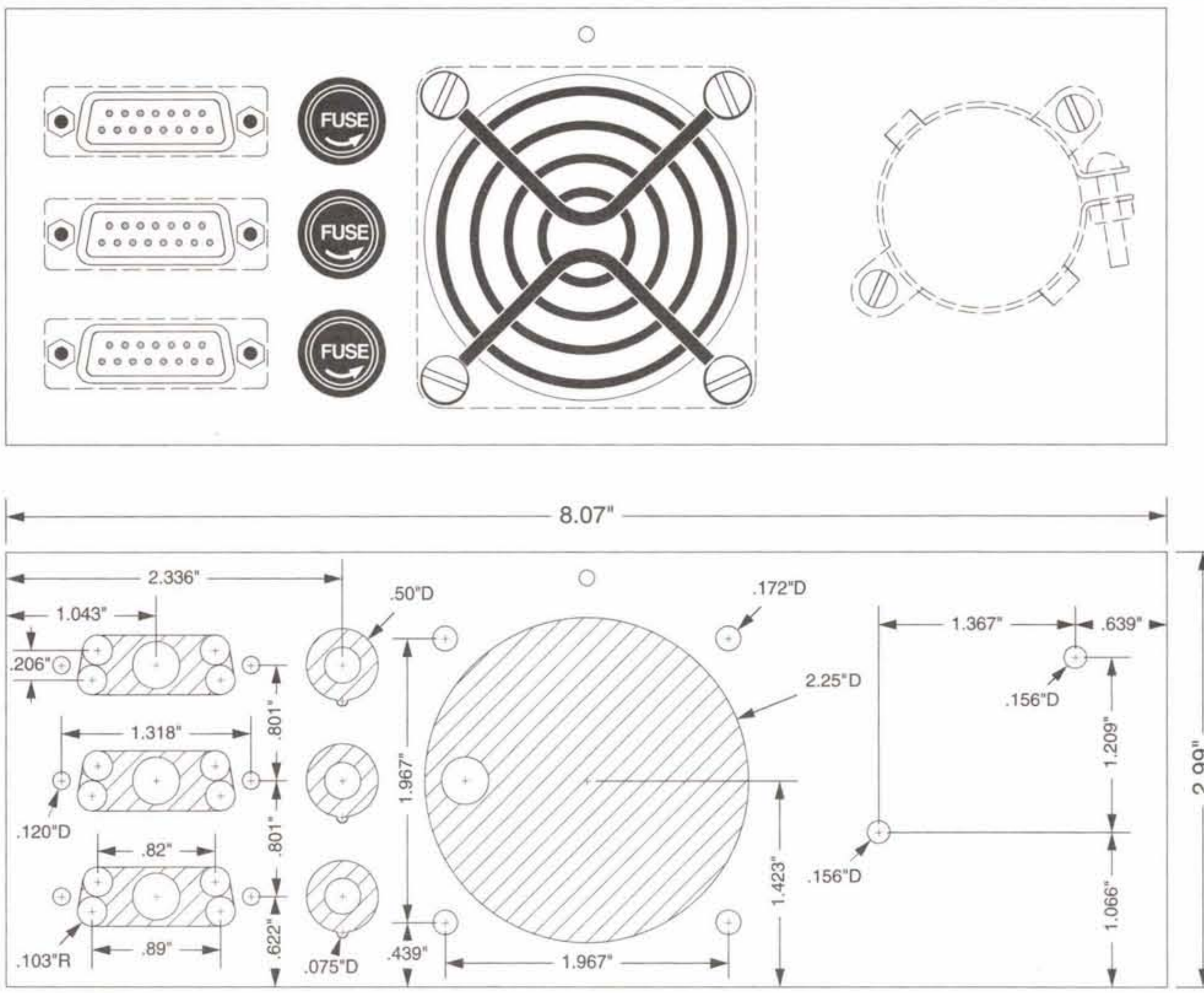


Figure 2: Top panel component placement (upper); layout of mounting and fuse holes and connector and exhaust fan cutouts (lower).

nector holes through thin aluminum or mild steel, all with little finish work required.

Round punches aren't expensive in the smaller sizes; if you punch more than a few holes in sheet metal, they are a good buy. The PDM requires four 1/2" holes for the fuse holders, so if you have an extra bit of cash you might consider buying Mouser's #586-3801 Greenlee-brand round punch for $23.92.

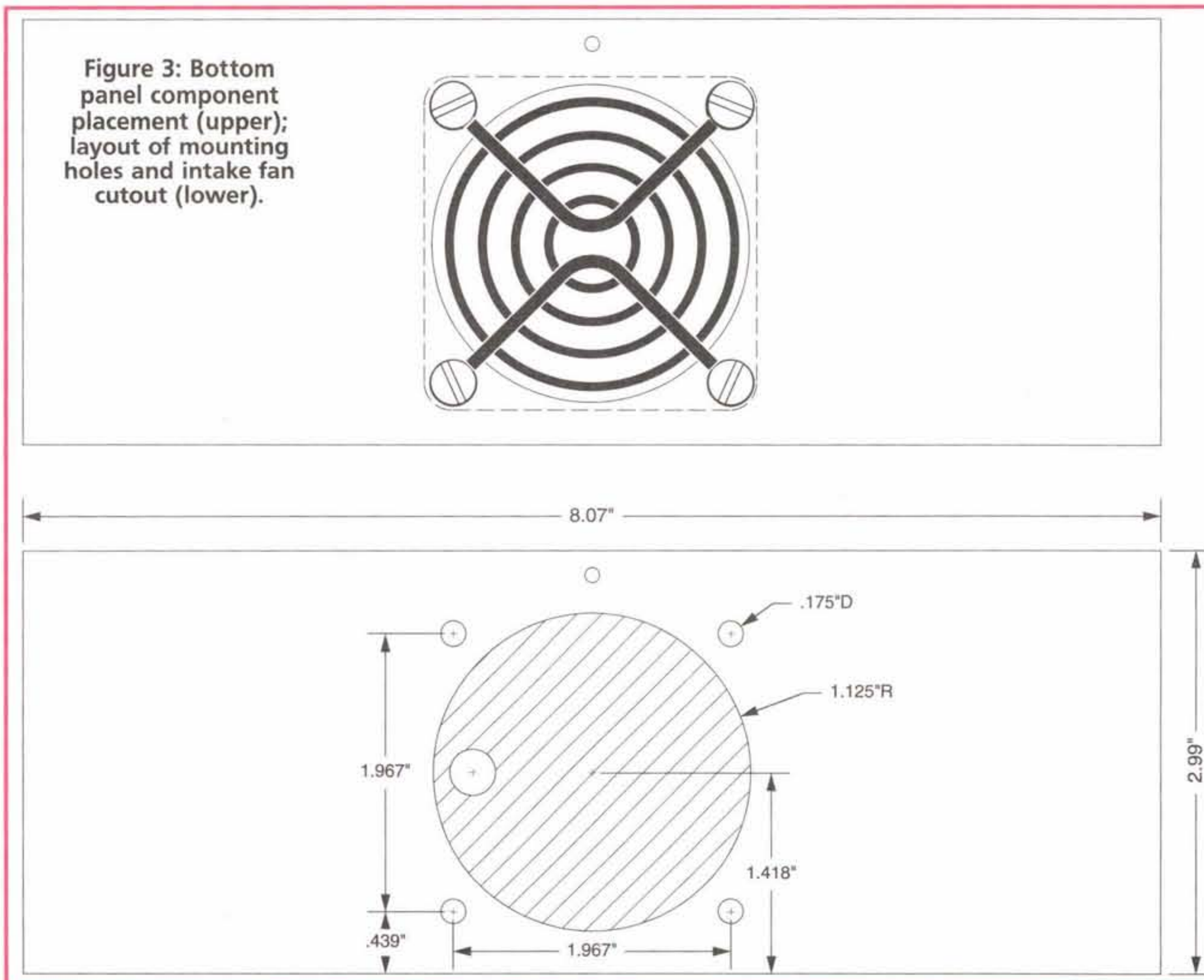


Figure 3: Bottom panel component placement (upper); layout of mounting holes and intake fan cutout (lower).

It is difficult for most hobbyists to justify the outlay required for larger punches, though. A 2.25" Greenlee round punch (Mouser #586-3823) to make the fan openings in the top and bottom panels goes for $93.60, and punches for 15- and 25-pin D-sub connectors cost even more: $392.00 apiece! Unless you plan a small commercial production run, these prices are ruinous.

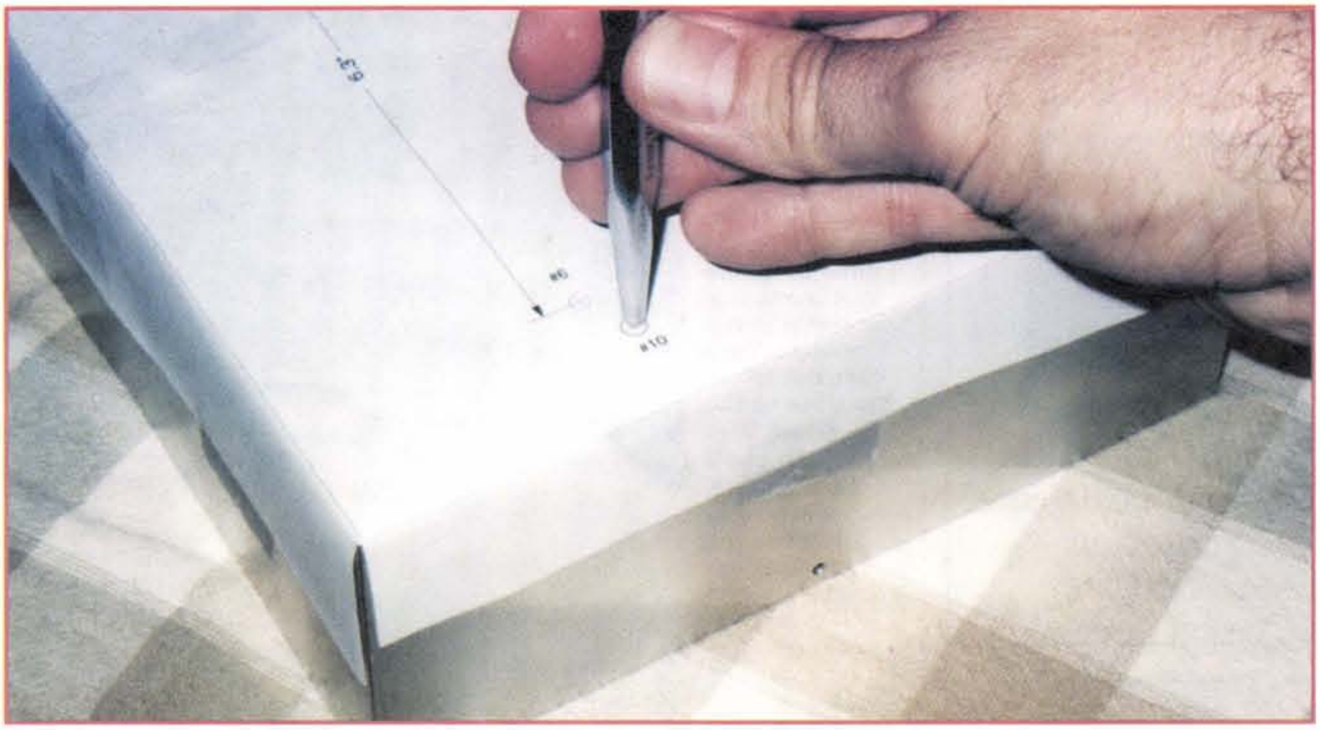


Photo 1: Taping a full-size printout of the front panel plans to the chassis speeds hole location and center punching. Be sure to check the accuracy of the dimensions on the printout, though. Most laser printers and photocopiers don't print exactly at the same scale for both length and width, and the resulting drawing may be slightly stretched or squeezed in one direction or both.

Simple Tools

I will assume you don't have any fancy punches and will do all your work with hand tools and a variable-speed power drill. Further, I'll suppose that you will use no drill bit larger than 3/8" diameter.

Besides drill and bits, you will also need:

- A center punch
- An 8-oz. ball pein hammer to tap the center punch
- A 6" machinist divider or compass
- A 1/2" T-handle tapered reamer
- An 8" bastard-cut mill, round, half round, and triangle files
- A Swiss pattern needle file set
- A 12" straight-edge or machinist rule
- A Vernier caliper
- A sharp steel scriber
- A nibbling tool
- A machinist square set: 2", 4", and 6"
- Assorted 4" hand scrapers

With the exception of the last three items, all of these tools can be found in most any hardware or tool store. RadioShack carries the nibbler tool (RadioShack #64-823, $9.99), and similar nibblers are also available from Digi-Key (www.digikey.com) and Mouser Electronics (www.mouser.com).

I bought my machinist squares from Enco (www.use-enco.com), a Brown & Sharpe set (Enco #990-1026, $47.89 on sale). This may seem an extravagance, but I've found machinist squares to be indispensable for precision layout and measurement work in robotics. The 2" and 4" sizes fit in tight places, and the 6" size gives the reach needed to scribe lines across the front panel of the PDM chassis.

Enco also carries hand scrapers in triangle, flat, and half round styles (Enco #380-0030, #380-0020, and #380-0025, respectively); they cost only $1.65 each, so it's worth it to get a couple of each. If you are really strapped for cash, get the triangular style; that's the scraper I use the most for deburring and general scraping.

RadioShack used to carry T-handle reamers. Mine was dull, so I found a replacement at a local hardware store for about $10.00.

Using these tools and the hints that follow, you will get results as professional as you have the patience and perseverance to apply.

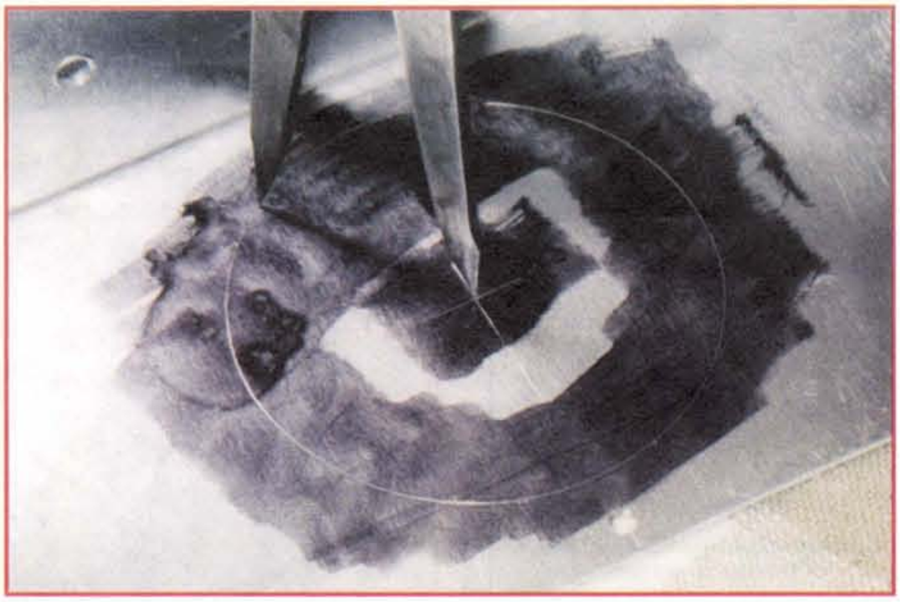


Photo 2: It's easier to do most of the nibbling required from the outside of the chassis, and this means you need to scribe some layout lines on the inside surfaces of the panels. Here I've used a permanent ink marker as a cheap substitute for layout dye to make my scribed line show up clearly.

Drilling Small Round Holes

It surprises beginners that standard twist drills don't make round holes; rather they tend to make rounded triangular holes. If you don't believe this, try it yourself with a piece of scrap aluminum. The effect is pronounced with hole sizes a quarter inch and larger, especially when drilling with a hand-held drill.

You can minimize the effect several ways. The most familiar is step drilling, where you drill an undersized hole, then use one or more larger drills to increase the

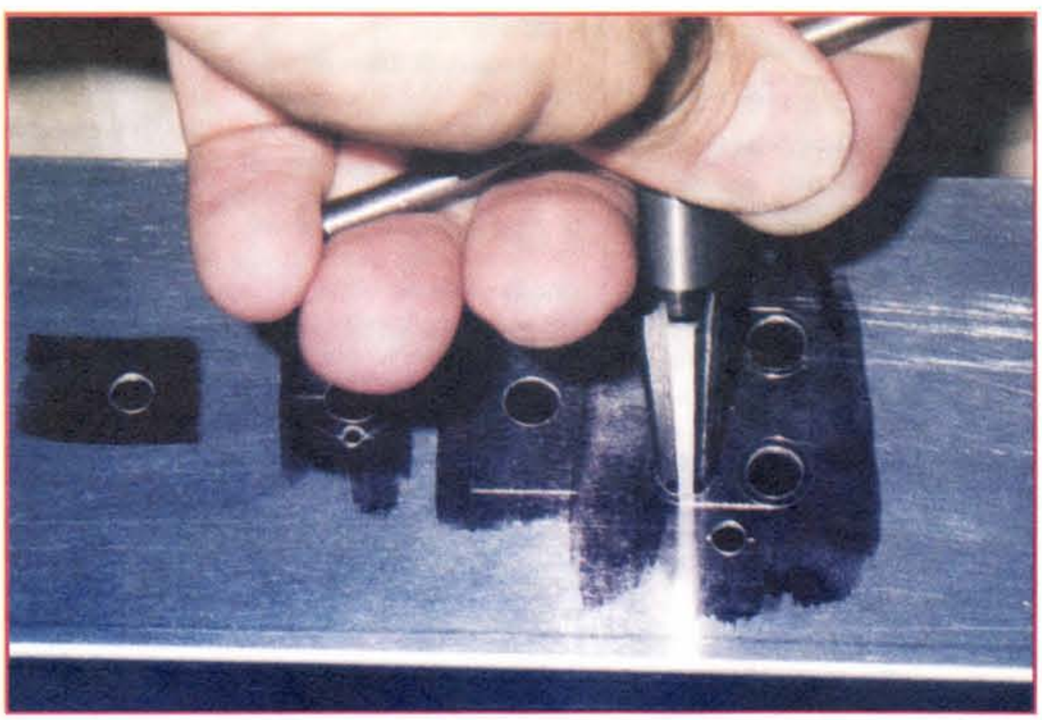


Photo 3: Using a T-handle reamer to ream radius holes. To get precise, round holes in sheet aluminum, it's best to drill undersize then ream to final dimension. Use a triangular hand scraper to make corrections to keep the reamed hole concentric with the scribed circles.

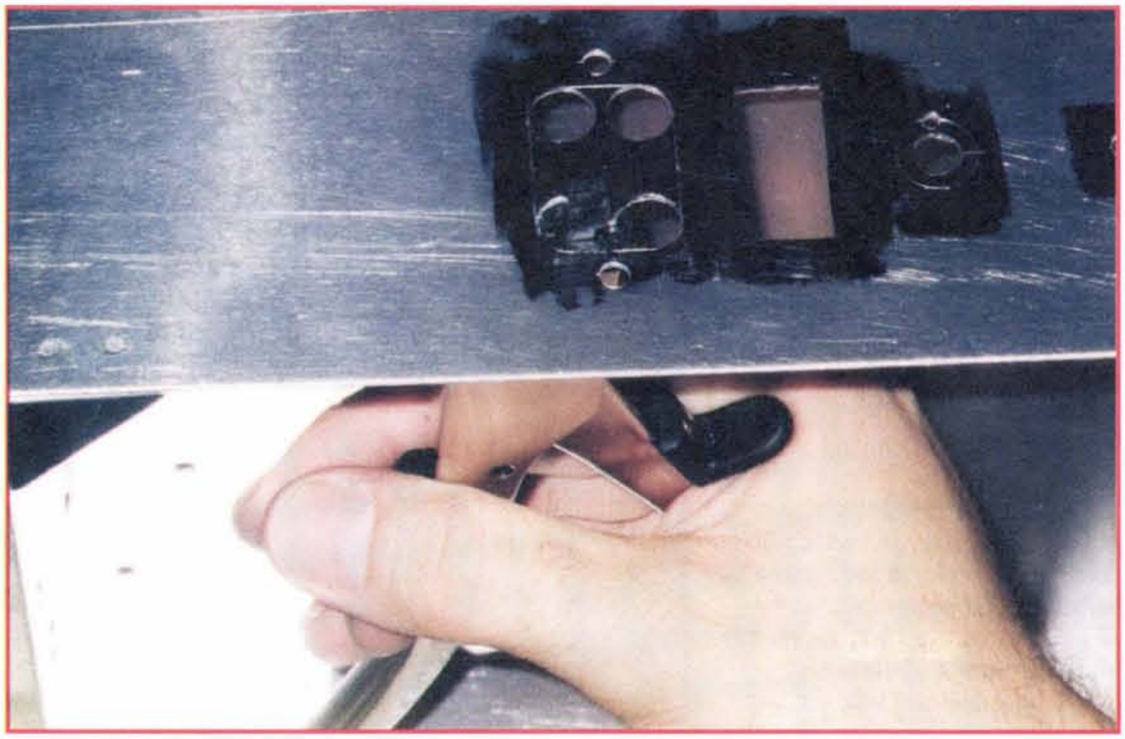


Photo 4: Once you ream and scrape the corner radius circles to the proper size, it's time to nibble out the waste metal in the middle. Take care not to cut too close to the scribe lines so you'll have enough material to remove the rough edges by file and scraper.

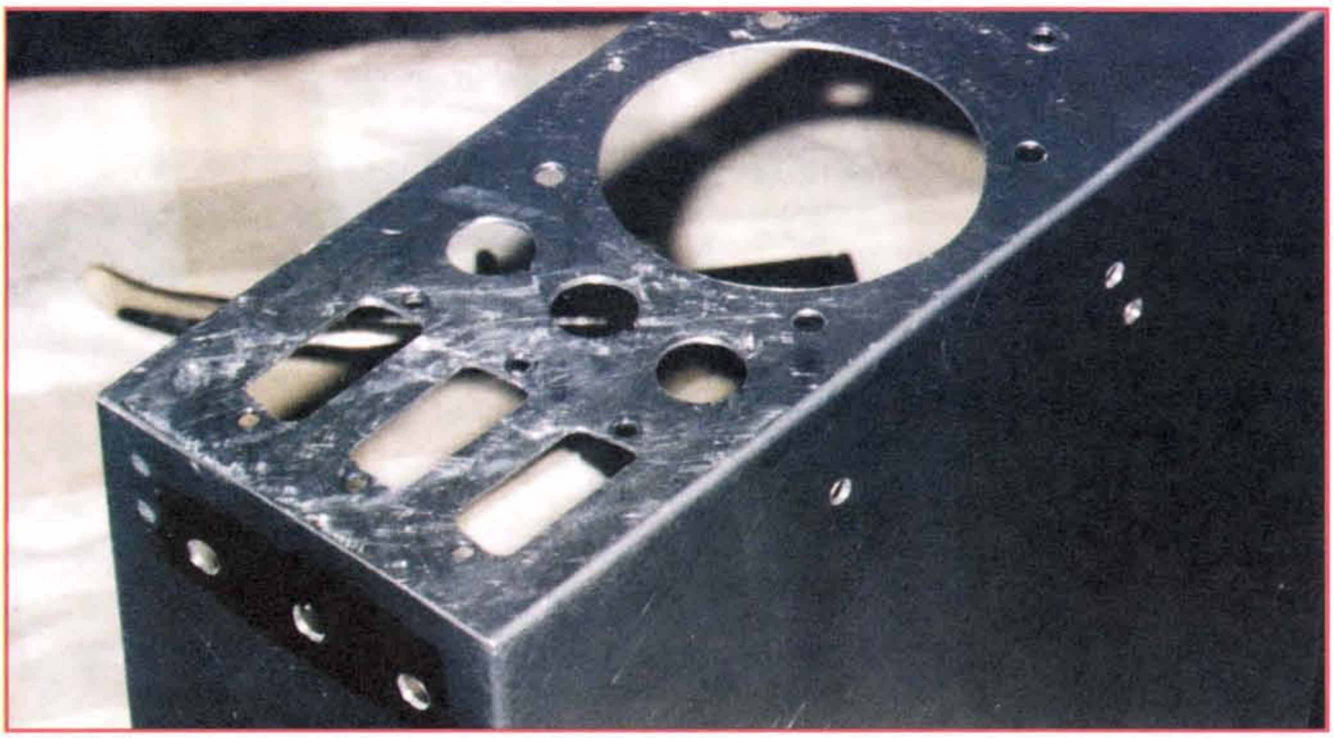


Photo 5: The top panel with finished openings for the DB-15 connectors, fuse holders, and ventilation fan. The edges have been filed smooth and the metal burrs removed with a hand scraper. Hand machining soft aluminum with these methods scuffs up the metal quite a bit, but most of the scratches come out in the wet/dry sanding preparatory to priming and painting.

size of the hole. This works well for small hole sizes.

Another problem with a standard twist drill is it wanders. Because of the way it is ground, the very center of the bit does not cut; instead, it acts as a blunt wedge, pushing metal out of the way. Center-punching, then drilling a pilot hole to guide the larger bit helps, but any changes in the density or hardness of the surrounding metal still tends to deflect the bit toward softer material. This is why you can't accurately drill overlapping holes with a standard drill bit.

Several kinds of drill bits make rounder holes, wander less, or both. For wood, there are Forstner bits and brad-point bits; both types cut from the outside edge; once they start, they track true. A brad-point bit works fairly well in soft aluminum, but you still need to drill a pilot hole to accommodate the sharp spike at the bit's center. Drill bits specifically designed for metal, though, work the best.

One type is the split-point bit, a bit with a special double-ground tip that will cut at the center; these bits wander less and can even start without a center punch indentation to guide them. They still drill triangular holes, though, because the rest of the drill is the same as a regular twist drill.

I prefer bullet-point bits. This type is a hybrid between brad-point and split-point bits. The central third of the tip — the "bullet" — is a split-point extension that acts as a built-in pilot drill. The rest of the tip is ground with a negative angle between the two cutting edges so the outermost portion of each edge cuts ahead of the innermost portion. The resulting holes are rounder and truer.

Bullet-point bits are commonly available in sets that include the fractional bits sizes from 1/16" to 1/4". The smallest size with a true bullet point will be the 1/8" bit; the 1/16" through 7/64" sizes will usually be standard twist drills, though

If you have suggestions, questions, or comments about amateur robotics topics, you can now reach me at:

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Email: **bnansel@nauticom.net**

some kits have split-point bits instead for those sizes.

If you can't afford bullet-point bits, you can use standard twist drills. Start with accurate pilot holes, drill the main holes undersize, then ream the holes to final size with a hand reamer.

Making Larger Holes

I don't advise attempting to drill holes much larger than, say, 3/8" through thin aluminum with a hand drill and standard drill bits. Even with the work securely clamped and using the step drilling technique, it's difficult to get smooth, round holes. The larger bit sizes tend to grab on breakthrough, especially when a softer material, such as wood, is used as the back-up material.

For holes smaller than 1/2" you'll get better results if you drill the holes undersize, then ream to nearly final dimension. For this to be most effective, you should scribe a circle of the desired location and radius directly on the metal before doing any drilling. Follow this by step drilling or drilling with a bullet-point bit more than 1/2 but less than 7/8ths of the final diameter desired so you'll have enough metal left to determine if the hole to be reamed is concentric with the scribed circle. You may need to deburr the undersized hole, either with a triangular scraper (as shown in Photo 7) or with a chamfering bit or countersink.

If the hole and the scribed circle aren't concentric, use a triangular scraper to shave metal away from the wider side to re-center the hole. Make a few turns with the hand reamer, then check for concentricity again, shave the wide side, and repeat as necessary.

Once the hole is concentric, ream until the burr raised by the

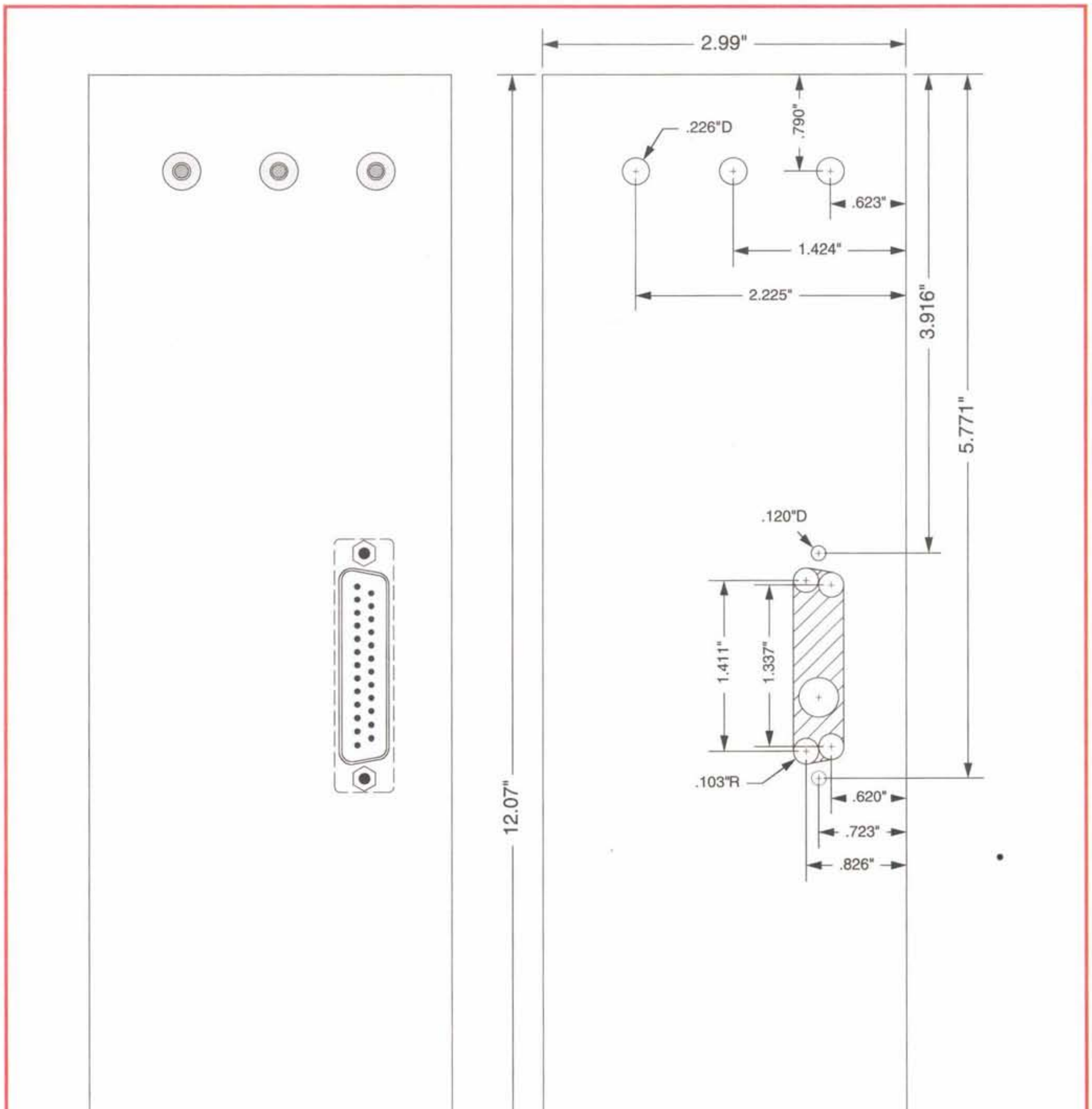


Figure 4: Left panel component placement (left); layout of LED indicator mounting holes and DB-25 connector cutout (right).

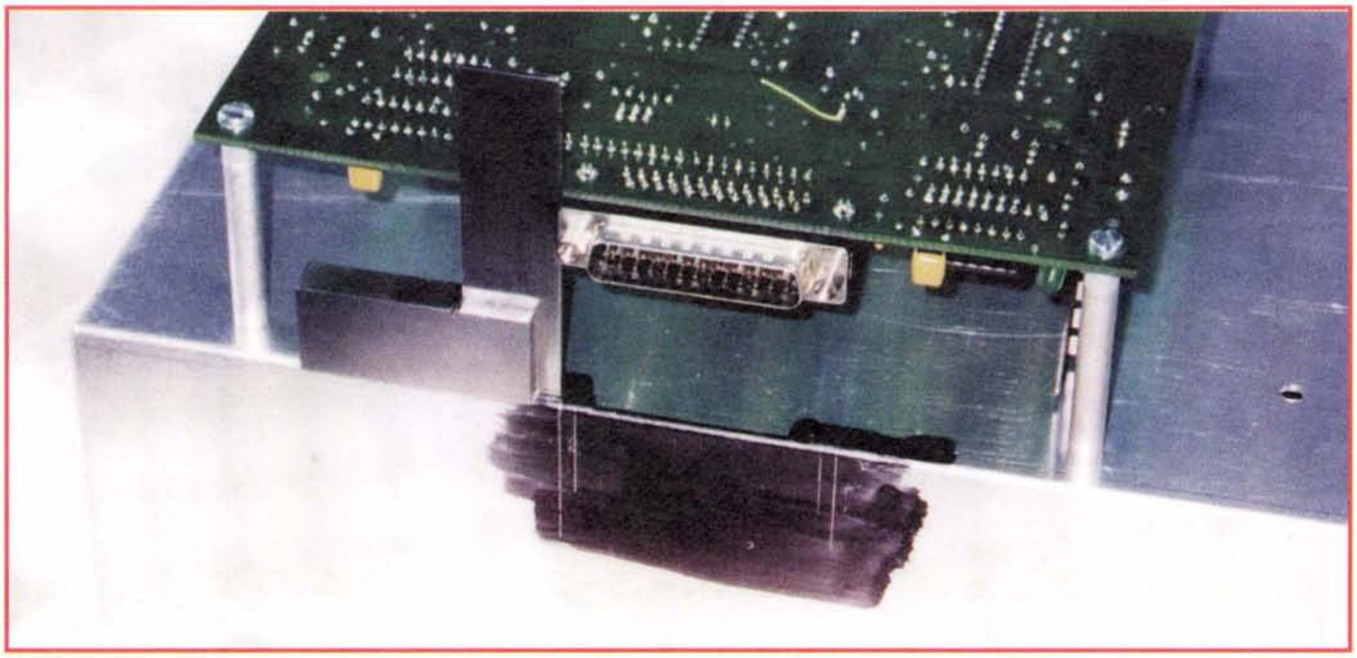


Photo 6: Using a small machinist square to transfer the precise location of the DB-25 connector to the chassis. The chopper/step motor driver board is shown temporarily mounted inverted on spacers on the outside front of the chassis. This ensures the DB-25 connector will be the same distance relative to the top corner of the case as when the board is mounted permanently inside the chassis.

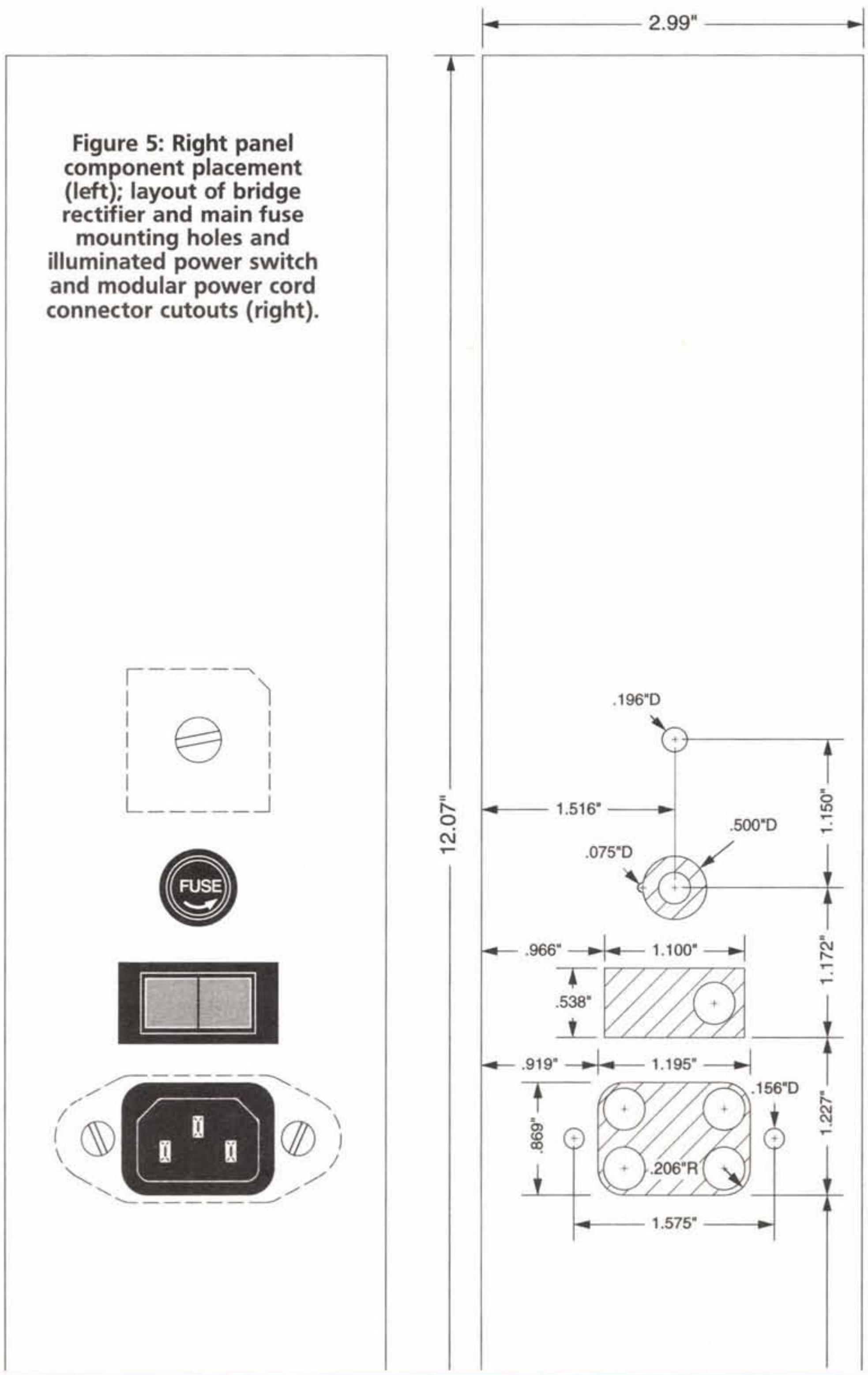


Figure 5: Right panel component placement (left); layout of bridge rectifier and main fuse mounting holes and illuminated power switch and modular power cord connector cutouts (right).

reamer is nearly to the circle, then shave away the burr and the last few thousandths of an inch with a triangular scraper. If practical, do frequent test fittings of the item to be mounted to ensure a good fit.

Irregular holes and holes larger than 1/2" will be done with a nibbling tool (I'll talk about this later).

Front Panel

The front panel of the PDM chassis — so called because it faces the front of Heavy Iron — is the easiest to machine. Figure 1 shows the holes you'll need to drill. Lay out the locations of all the holes using a straightedge, machinist square, and calipers, or do what I did — use a full-size printout as a template for center-punching (Photo 1). This latter technique isn't as precise as the former because most printers don't print width or length exactly to dimension. Check the actual distances on the paper template against the dimensions called for in Figure 1, in particular those of the four .156" mounting holes of the Camtronics chopper board. These holes need to be precise because they locate the DB-25 connector cutout to be machined later. You may want to drill the mounting holes slightly oversized so the chopper board will have a little wiggle room.

Top and Bottom Panels

The top panel is the most demanding part of the chassis to machine (Figure 2); the bottom panel (Figure 3) is easier, but the layout of its fan opening and mounting holes is identical to the top's, so I include it here. The hatched areas in the figures represent metal to be removed, and the white circles within those hatched areas are holes to be drilled, the first step of that process.

Coat the metal with layout dye (Enco #825-8640, $3.25) or use a black permanent ink marker to make the scribe lines show up better, then lay out the locations of each hole and scribe the cutout outlines. The 2.25" circles should be scribed on the inside of the chassis so you can work with the nibbling tool outside the chassis (Photo 2).

Next, center-punch the location of each hole to be drilled, including the registration notches for the three fuse holders. Give particular attention to precisely locating the centers of the .103" radius circles for the three DB-15 cutouts. The connector layouts also have 3/8" holes on their centerlines. These are holes for the head of the nibbling tool, so their exact locations aren't critical so long as they fall within the scribed outlines.

Drill the radius circles of the D-sub connector with a 3/16" bit; this will leave the holes undersized enough that the close spacing of adjacent holes won't cause the bit to wander off center. Ream and scrape to final radius, so they are tangent with the straight line segments of the outline.

The DB-15 connector cutouts are the most difficult cutouts to nibble on the chassis. Unless you are more dextrous than I am, you'll have difficulty scribing all the connector cutout lines inside the chassis. It's too tight to work the nibbler inside the chassis, so you must nibble from the outside even though your guidelines will thus be hidden. Take very small bites; checking between each bite so you don't go outside the lines. Plan on doing a bit more filing to smooth rough edges on these cutouts.

The fuse holder cutouts each have a round registration notch on their perimeters. First, drill a 1/4" starter hole at the center of each 1/2" scribed circle, then drill 5/64" holes for the registration notches.

Ream and scrape the 1/4" holes to their final dimension. The reamer will tend to pull toward the registration notch hole once the reamed hole is that big; use a scraper to force the reamer to stay concentric with the scribed circle.

Now it's time to nibble the fan openings, but this is much easier than the DB-15 cutouts, though tedious. Proceed clockwise around the circles. Be sure to let each tiny bite of metal clear the nibbling tool before taking the next bite so the tool won't jam. Don't cut closer than 1/64", say, from the line. (Photo 5 shows the finished top panel.)

Left and Right Panels

In contrast to the DB-15 cutouts, machining the DB-25 cutout of the left panel is a breeze. Just follow the clockwise rule while nibbling and leave some metal to clean up with file and scraper. It's getting the layout of the connector cutout aligned with the chopper board mounting holes that's the trick.

First, mount the chopper board upside down, outside on the front panel. You'll need four 1.75" aluminum spacers so the heatsinks clear, assuming you've already built the board. Otherwise, you can get by with 1" spacers, but you will still need to snap the DB-25 connector in place in the correct orientation.

Using a small machinist square, transfer the location of the edges of the DB-25 connector shell to the chassis (Photo 6). Find the midpoint between these two lines, then lay out the rest of the cutout as shown in Figure 4. The chopper board is shown temporarily mounted inverted on spacers on the outside front of the chassis. This ensures the DB-25 connector will be the same distance relative to the bottom corner of the chassis as when the board is mounted permanently inside the chassis.

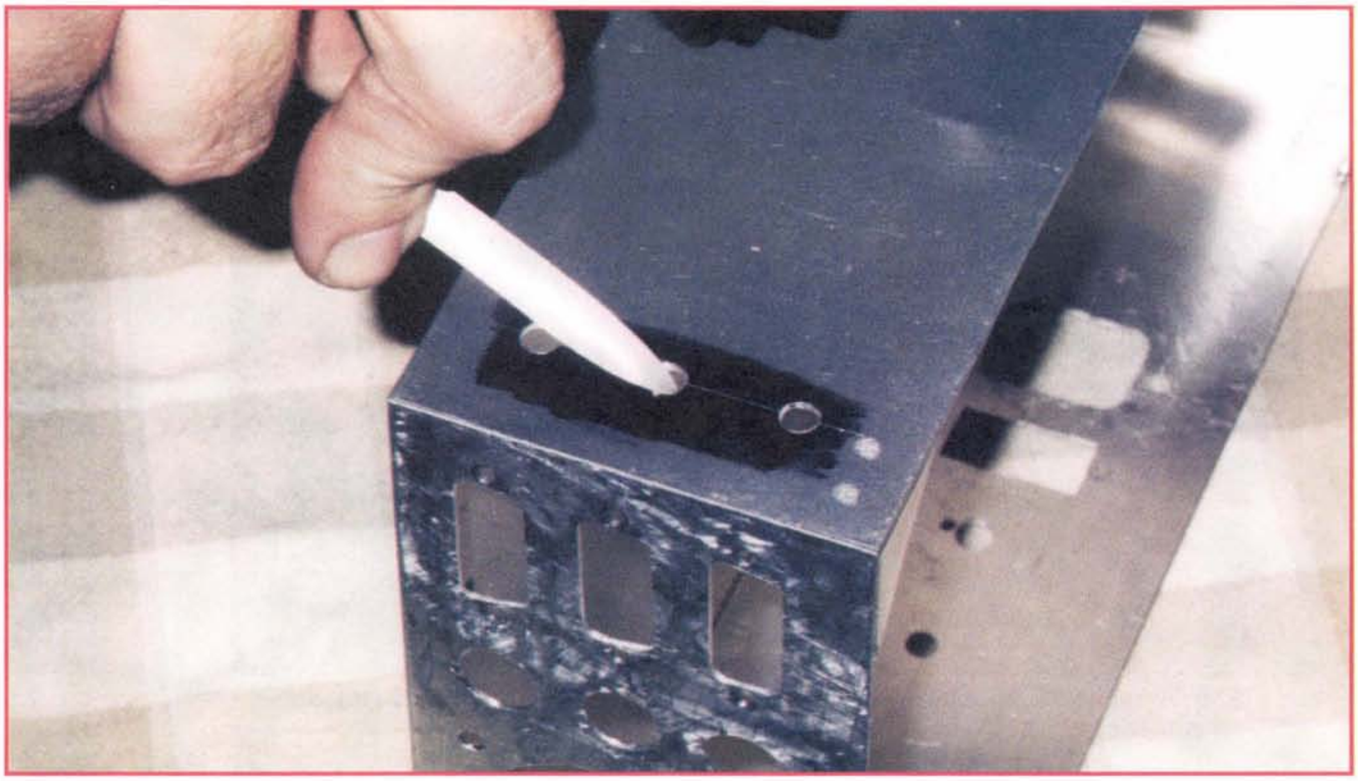


Photo 7: Using a triangular hand scraper to remove the metal burr made by drilling and reaming.

Please note the vertical distances shown in Figure 4 for the DB-25 mounting holes are relative to the top of the chassis and thus should be considered as reference dimensions. Recall that the chopper board mounting holes drilled in the front panel were measured from the bottom edge of the chassis, and since the tolerances for the overall chassis dimensions are a bit loose, there would likely be a mismatch between the reference dimensions shown and the actual dimensions.

One solution is to make all your vertical measurements for the DB-25 cutout from the bottom panel (i.e., subtract the given dimensions from 12.07"). The other solution — the one I used — is to measure relative to the midpoint between the two edges of the connector.

(It's perfectly okay to measure the vertical offset of the LED indicator holes relative to the top edge because that's an independent measurement.)

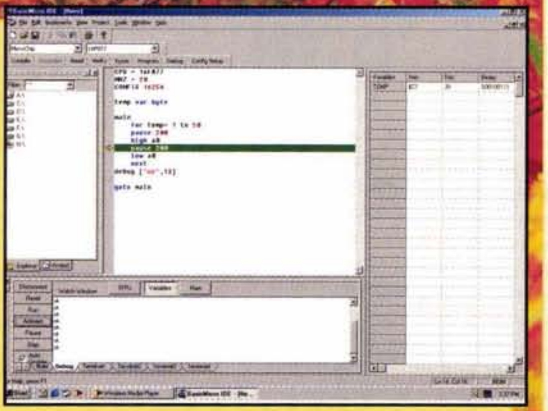
Finally, lay out and machine the right panel using the techniques outlined above. Figure 5 gives the dimensions, and Photos 3 and 4 show the general procedure. This panel requires some patient filing and test fitting, but it's pretty straightforward.

A Wrap

Next time, I'll delve into building the Camtronics board and wiring up the PDM. Don't cut any of your fingers off while machining the chassis (you'll need them to do the wiring). **NV**

New Product News

THE PICMICRO BASIC COMPILER



Programming PICmicros with Basic Micro has never been easier. Basic Micro software developers have released a new version of their compiler that gives the end-user a way to test their code on the fly using the new ICD (In Circuit Debug) feature.

"We have introduced a compiler that has been long overdue, our goal from day one was to become a strong developer in the microcontroller industry, with PICMicro Basic and Pro, Programming PICmicro's is no longer a complicated undertaking" says Dale Kubin, President of Basic Micro, Inc. "The ability to debug code in Basic without knowledge of Assembly makes our compiler one of the most versatile programming software packages available."

With the added flexibility of being able to customize menu options, built-in task reporting and multiple document support, it is no wonder the PICMicro Basic Standard and Pro Compiler are ahead of their time.

Shawn Cummins, Operations Manager at Basic Micro wrote, "At Basic Micro, Inc., we listened to what people wanted in a compiler. What they wanted was clear. Give them a true ICD, create an easy way to compile and program using one software application, and most important, a windows interface that was easy to use and straightforward." With all this information, Basic Micro's programmers and tech support set to work on what would be the end-users compiler, fully documented, detailed in layout and instruction. Shawn concludes by saying "When you look at the market in a whole, you see the vast potential of microcontrollers in our lives, from medical to exploration, engineering to the environment. There will always be a need for computers and microcontrollers to perform accurately and without mistake every time."

Hobbyists and professionals alike will enjoy the features and commands this compiler has to offer. Starting at just $99.95 for the standard compiler, with the ability to upgrade to the professional version at any time, Basic Micro unparalleled themselves with new innovations in software for the PICmicro market.

For more information, contact:

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34391 PLYMOUTH RD., DEPT. NV
LIVONIA, MI 48152
734-425-1744 FAX: 734-425-1722
EMAIL: info@basicmicro.com
WEB: www.basicmicro.com

NEW LOW LATENCY ZEUS TRANSCEIVER

RF Neulink announces the new low latency Zeus transceiver (ZLRT2100).

This new unit is fast and reliable with a new time of 5.8 milliseconds per hop period making it the fastest low latency on the market.

With features such as forward error correction, full duplex handshaking and addressability, it is a wise choice for point-to-point, point-to-multi point, and broadcast systems.

This transceiver should be used wherever the need for reliable low-cost license-free operation is needed or desired.

The ease of use, simple installation makes it the choice for those new to wireless data transceivers or the old pro who wants to plug and play.

Operating at speeds up to 19,200 kbs, it is perfect for SCADA systems or control of non-real time needs such as pumps or motors in oil, gas, water, and waste water plants.

For more information, contact:

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7610 MIRAMAR RD., DEPT. NV
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M-50-8 MULTICOUPLER

RF Science & Technology announces the availability of the new RF Tech M-50-8 Antenna Multicoupler.

The multicoupler permits simultaneous operation of up to eight receivers from a common antenna.

In commercial applications, it allows the expansion of a radio plant where space does not permit the addition of additional antennas.

In an amateur radio application, it permits up to eight receivers to be connected to a single antenna without complicated switching or messy cabling.

All outputs are internally terminated, thus unused outputs do not require termination.

Multicouplers can also be connected in series or parallel for expanded applications

Specifications: 10 kHz to 300 MHz nominal frequency range; isolation >23 dB port - port; noise figure 2.0 dB 50-ohm terminated; 2nd & 3rd order intercepts 45 dB and 42 dB; typical gain +1 dB; 50-ohm BNC input protected; eight isolated BNC outputs; housed in a rugged steel cabinet for stability and shielding; EMI/RFI shielding 50 dB @ 300 MHz; and 115V AC 60 Hz input.

Options include: 220V 50 Hz transformer; 75-ohm impedance with type F connectors for cablevision/TV signal distribution; and standard 19" rack chassis to mount two multicouplers side by side.

The M-50-8 antenna multicoupler sells for $225.00 Canadian (approximately $150.00 US). Quantity discounts are available for dealers.

Manufactured exclusively for RF Science & Technology, the M-50-8 includes a one-year warranty against manufacturer's defects.

For more information, contact:

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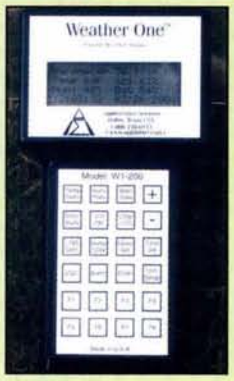
WEATHER ONE™ PORTABLE WEATHER STATION



Applied Data Sciences introduces the Weather One™ portable weather station. It is designed for anyone who wants to keep an eye on the weather.

It has professional features like a 16-bit processor, but is priced so that amateurs can afford it, too (~$150.00).

The Weather One portable weather station includes:

1. Barometer, Thermometer, Hygrometer, Solometer, a real-time clock (time and date), and a battery fuel gauge.

2. A 32K EEPROM for datalogging which will hold up 2,730 samples of all the sensors. Also has a user settable sample delay between one minute and two hours.

3. Instant pressure drop detector for detecting events with a rapid pressure drop such as tornados.

4. Instant Stats buttons for all the sensors.

5. Includes a RS232 interface, cable, and terminal software for Windows™, 95, 98, NT, 2000, and ME operating systems. The terminal software has three modes: Real-time instrument panel, real-time graphing readout, and data logger graphing readout for analyzing data logged by the unit.

6. Raw data is formatted so that it is readable as raw data, including carriage return and line feeds. Users can program their own terminal interface in whatever language they choose. Or they can just look at the logged data using a terminal program like Procomm™ or Hyperterminal™.

7. Comes with a one-year warranty with upgrade options for when the product evolves.

8. Includes external power supply, or can be ran on a nine-volt battery.

9. Also includes detailed instruction manual.

Some of the uses for the Weather One portable weather station are monitoring the greenhouse, storm watching, and tuning race cars.

For more information, contact:

APPLIED DATA SCIENCES, INC.
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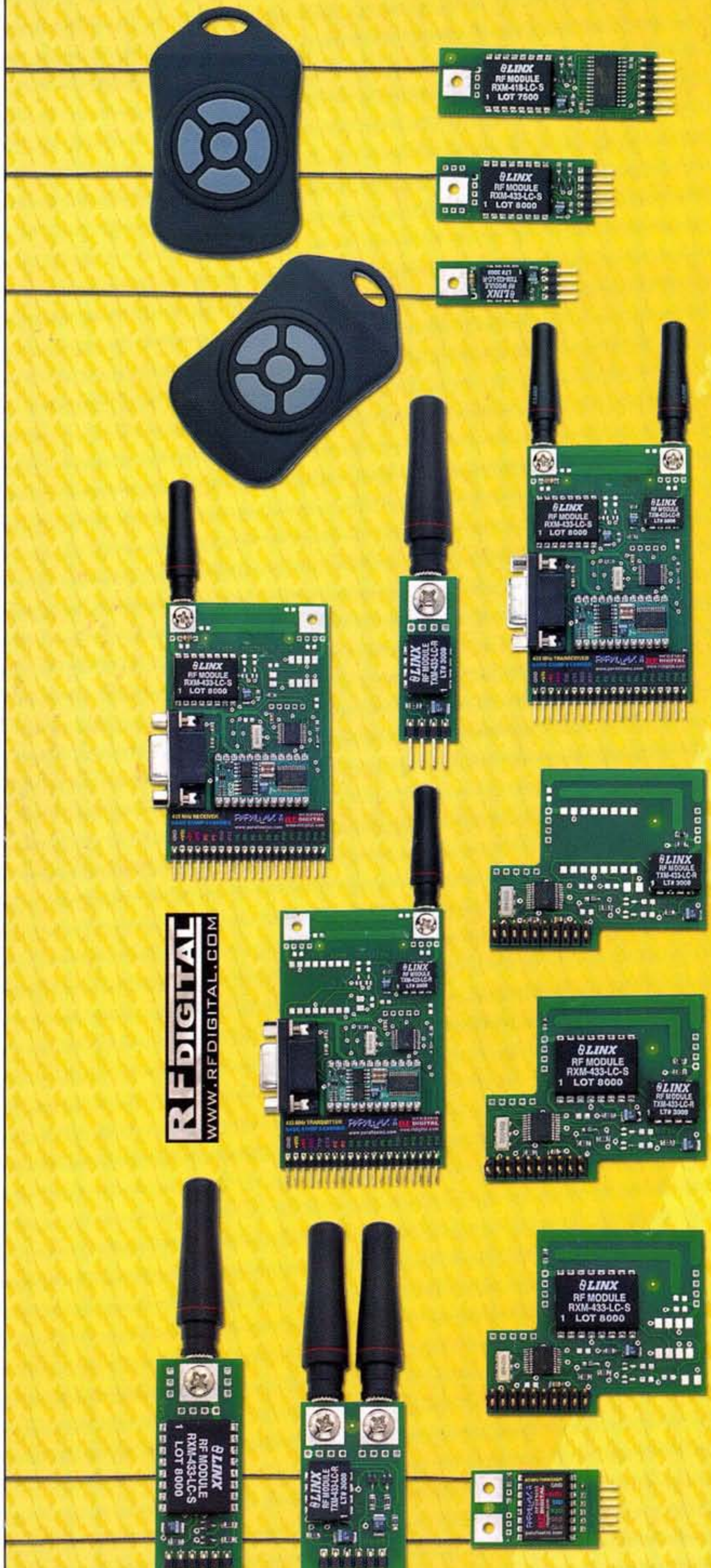

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